Integrating Mapping with Immunization Registries

Overview

Immunization registries offer the opportunity for epidemiologists, immunization coordinators, assessment specialists, and immunization coalitions to address all aspects of communicable disease prevention. Registries that are population-based become valuable resources for the health professional. In an era of tight budgets, increasing public health demands and over worked staff, management level tools that can capitalize on the information within an immunization registry are necessary.

Tools such as statistical packages, report generators, and database query builders can be used for "mining" of information from registries. However, these tools do not easily support combining of related information resources. For example, they can be used to display graphics, tables, charts, and projections of the data in the immunization registry. They cannot easily be used to link this information to reportable communicable diseases, birth rates, or characteristics of the population base within a geographic study area.

The tool that does allow this is a Geographic Information System (GIS). A GIS allows a user to combine sets of information such as patient immunizations, birth rates, population demographics, and geographic boundaries into visual displays that are then integrated with underlying data sets. GIS however, is not a universal tool that is easy to use. This paper illustrates by example of how a GIS can be used to support proactive immunization efforts.

Overview of GIS Products

GIS systems are not prevalent in public health. There are pockets of GIS developers and users. These are generally isolated in other program areas such as in health statistics. Rarely is there sharing of basic data sets between programs and most GIS workstations operate in a stand-alone environment. Enterprise-wide GIS using shared data within agencies is rare and if it exists does not lend itself to an easy to use operation.

The fact that GIS users historically have been geographers, programmers, land use planners, and environmental engineers has not facilitated the evolution of this technology into public health. Furthermore, it has only been in the last few years that GIS software has migrated to the desktop and now some Web applications. In the desktop area, products such as ArcView, Autodesk World, EpiMap, and MapInfo provide the majority of software sales in this area. A product like MapInfo generally has been a little easier to use but a product such as ArcView offers greater functionality and is significantly more popular with the GIS professionals. In the Web area, ArcIMS (ESRI) and MapGuide (Autodesk) are the two GIS toolsets being marketed. ArcIMS dominates the Web GIS marketplace, has the greatest functionality and does not require a download plug-in to view Web maps. . MapGuide currently requires a download plug-in to view Web maps.

In all cases GIS developers will utilize these types of products to develop customer interfaces to GIS in both the Web and desktop environments. ***STC's*** two products in this area are MapDesigner and QuickMap.

Case Examples

Arizona

The first use of GIS with the Arizona registry was demonstrated in 1995 through a pilot project that evaluated the potential of comparing under immunized patients and a pertussis outbreak along the Arizona - California border. Three recent examples of how this GIS have been used with the Arizona immunization registries are presented in the following paragraphs.

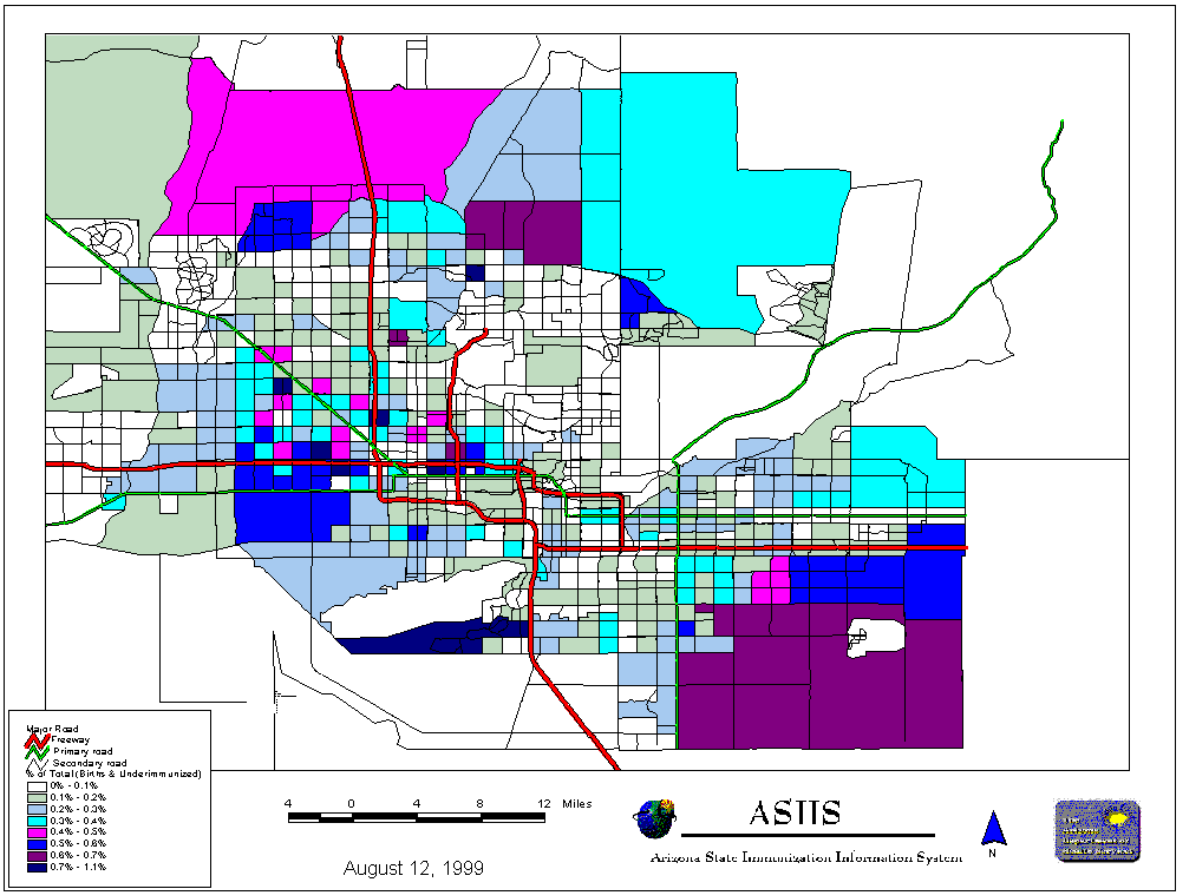
Example 1 - Targeting a Parent Education Campaign

The Arizona Partnership for Infant Immunization (TAPII), a statewide user coalition, secured a grant to establish a billboard based education campaign. With limited resources and the mandate to support immunization efforts statewide, the question posed to the immunization registry team was: Can the immunization registry be used to identify locations where there were large numbers of under immunized children? The issue was to not only identify these locations but to establish appropriate geographic boundaries around these pockets of need. The end goal was to advertise childhood immunizations on a series of strategically placed billboards such that, the message would be visible to the highest risk population.

GIS was used to access the statewide registry and retrieve those children under the age of 36 months, who were not fully immunized according to the CDC recommended 4:3:1:1 immunization schedule. The location of each child as retained in the registry, was displayed on a state map. At the time it was estimated that 76% of the children who are under the age of two have been added to the registry, the distribution of providers statewide provides a good cross section of the population and hence the data that is in the registry is representative of the whole.

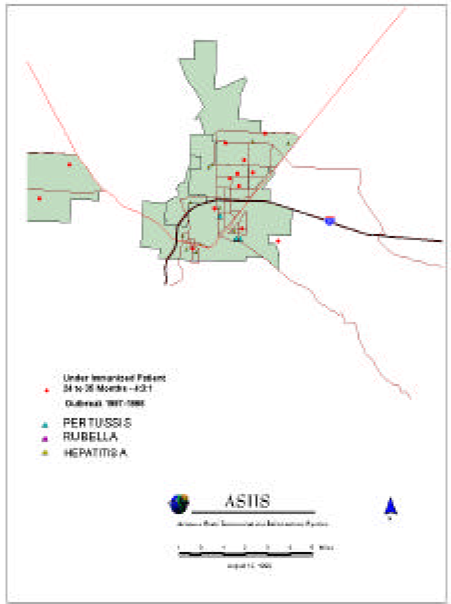
Viewing this data on a statewide scale allowed the immunization program user to access areas where the greatest need appeared. It was then possible to zoom to these areas using the capabilities of the GIS. As the user reviewed pockets of need, the GIS was used to redisplay the map by illustrating a statistical distribution of the under immunized for each census tract. The distribution was determined by dividing the number of under immunized by the census tract population. The following figure illustrates one of the maps. The darker colors are those geographic areas with the highest percentage of under immunized. From these visual displays, it was possible to identify the target areas for the billboard campaign.

Using the data from the immunization registry, it took less than half a day to create these maps and identify the target area for the campaign. These maps were based upon actual records. Past efforts similar to this would have been based on assumptions of need.



Example 2 - Communicable Disease Reporting

The first example utilized data directly from a single source, the immunization registry. Example 2, combines two data sets. Under immunized records with data from the CDC communicable disease reporting system. This map illustrates communicable disease reports in a specific county. Under immunized children for the 4:3:1 series is presented along with the outbreak information.



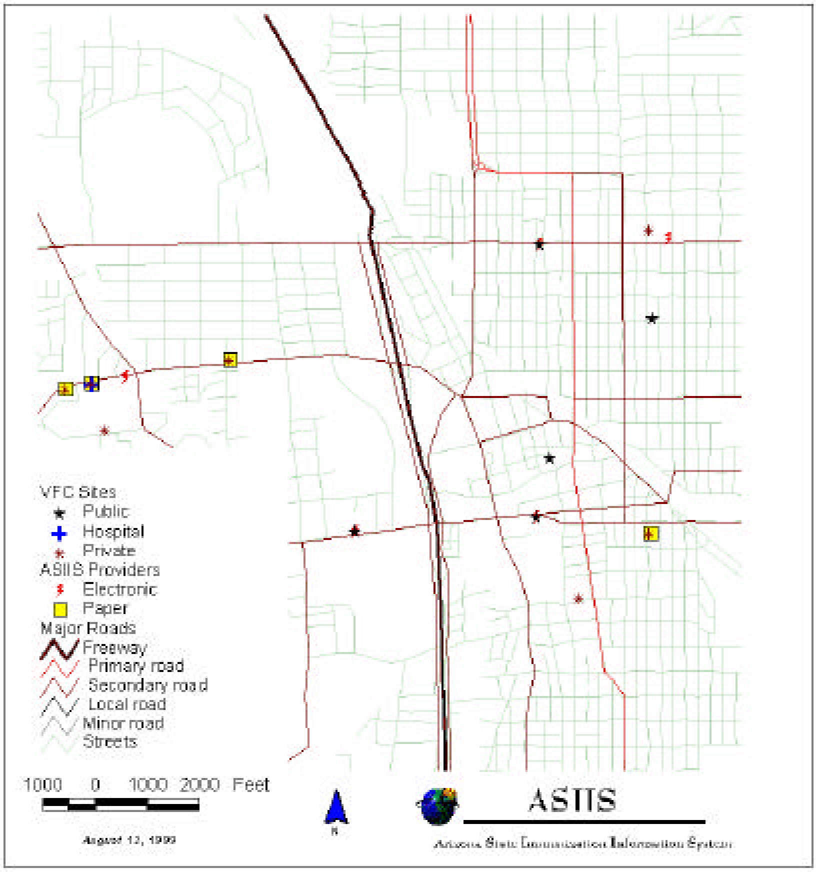
Example 3 - Provider Recruitment

As can be seen from the first two examples, the possibilities of using the GIS are limited only by the user's need. Displaying patient immunization data and disease data over a variety of geographic attributes is fairly obvious. However, there are many more uses for this type of tool.

The Arizona registry also contains a separate database of all providers who are reporting patient records. Providers can send data electronically or by paper. There are both public health and private physicians participating.

With over 700 providers, the user support team requires a number of management tools to allow them to monitor frequency of record submittal, numbers of patients and records, as well as the process. The objective is to move the high volume providers to electronic submittal. One recent question addressed by the registry support team involved management reports containing the following: (1) the number of private providers reporting, (2) those reporting by paper versus electronic, (3) the location of these providers within the state, and (4) of these providers those that were enrolled in the Vaccine for Children (VFC) Program. Certainly this type of data can be printed in tabular form, although the distribution of providers in the state is not easily represented. It was not until the GIS was used to capture this data, that the full scope became visible.

The following figure illustrates one of the maps created to address the above four questions. The area represented is Pima County in southern Arizona. The locations of private and public providers that are VFC enrolled are shown. A star indicates a public provider and an astrix a private physician. If they are currently submitting data to the immunization registry, an icon is used to represent the method. A lightening bolt represents electronic submittals and paper reporting is shown by a square.

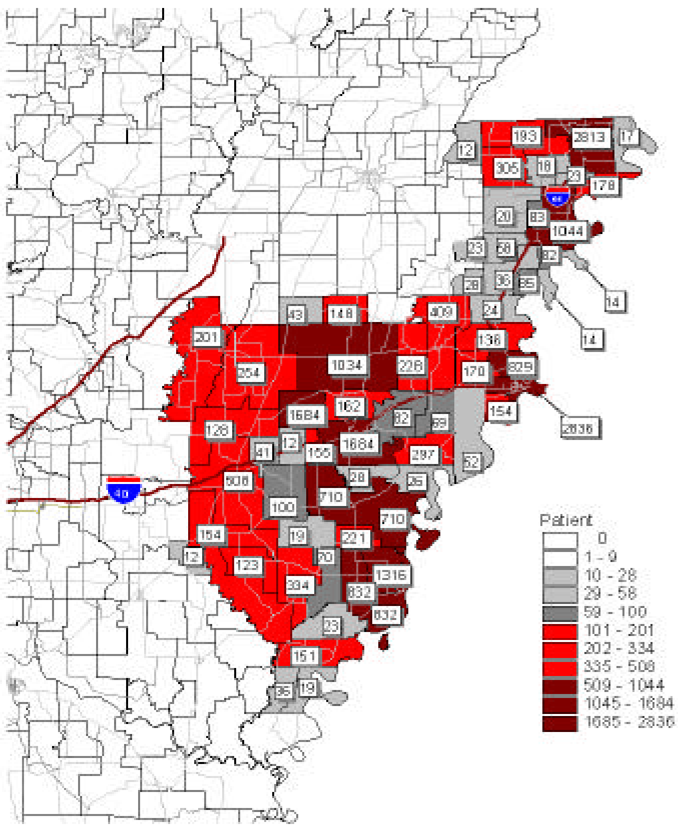


Given this data, the user support team simply needs to point to an exact location on this map and the detailed information associated with the site can be recalled. This data includes provider name and phone number, method of reporting, and average number of records reported. Higher volume providers who are still sending data by paper are candidates for contact by the user support team to migrate to electronic.

Although not illustrated herein, other data overlaid upon these types of maps included birth records. The density of area births could be quickly compared to the number of VFC providers and those that were reporting. Adding immunization characteristics gives the state's immunization action coordinators data on which to educate providers, target outreach, etc.

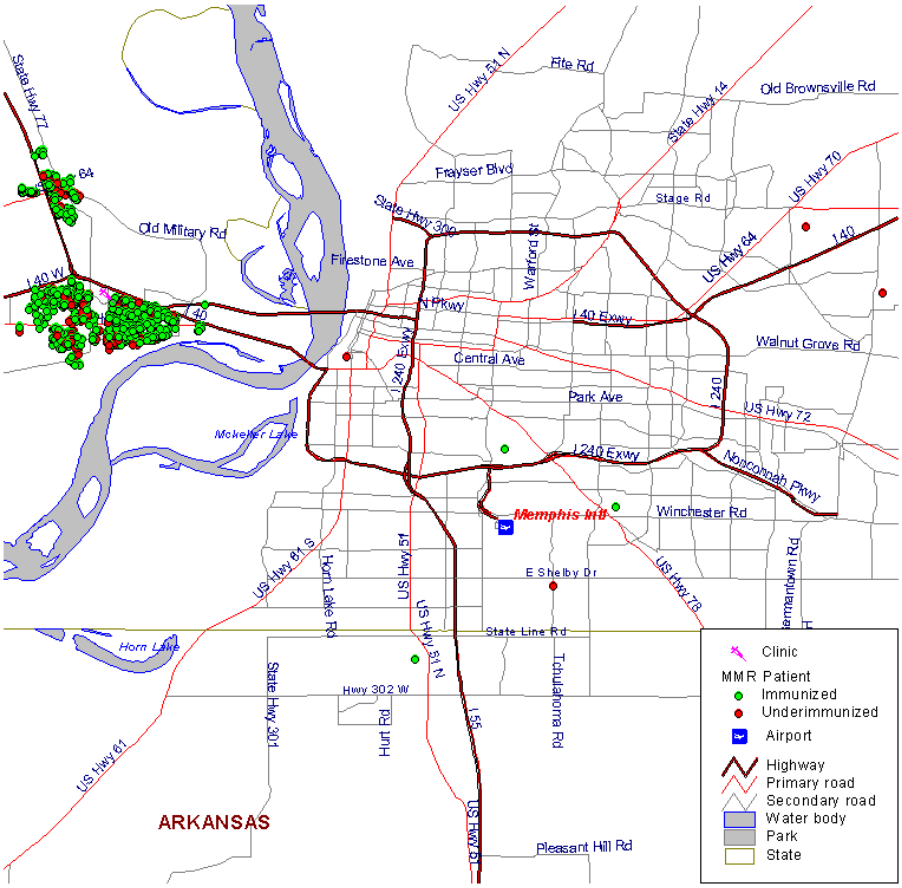
Arkansas Case Examples

The Arkansas GIS system was recently installed and is designed to work with the immunization registry. The system was recently used to visualize data in two areas of the state. These maps are included in the following two figures.
The first figure is a population density map from Region 9 in the state. This map shows where patients live by zip code. The darker colors represent the higher concentration of patients in the database. A number is printed on the map, which is an actual count. The next step would be to



overlay under immunized patients in these zip codes and determine coverage rates. From this an outreach plan could be developed and implemented. Over time these same maps could be regenerated to determine the effectiveness of the activities.

The second figure is in the Memphis, Tennessee area showing the location of patients that receive their immunizations in Arkansas. This map includes underimmunized patients. It is interesting to note that there are a number of patients that live in Tennessee but receive their immunizations in Arkansas. This data is reported to the Arkansas registry. This GIS map is linked to the database such that it is possible to select a specific patient location and view the demographics and immunization histories through a map interface.


State Hwy 77
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Old Military Rd
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Stage Rd
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I 40
Firestone Ave
Warford St
N Pkwy
I 40 Exwy
Walnut Grove Rd
Central Ave
I 240 Exwy
Park Ave
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US Hwy 72
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Memphis Intl
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Horn Lake Rd
US Hwy 51
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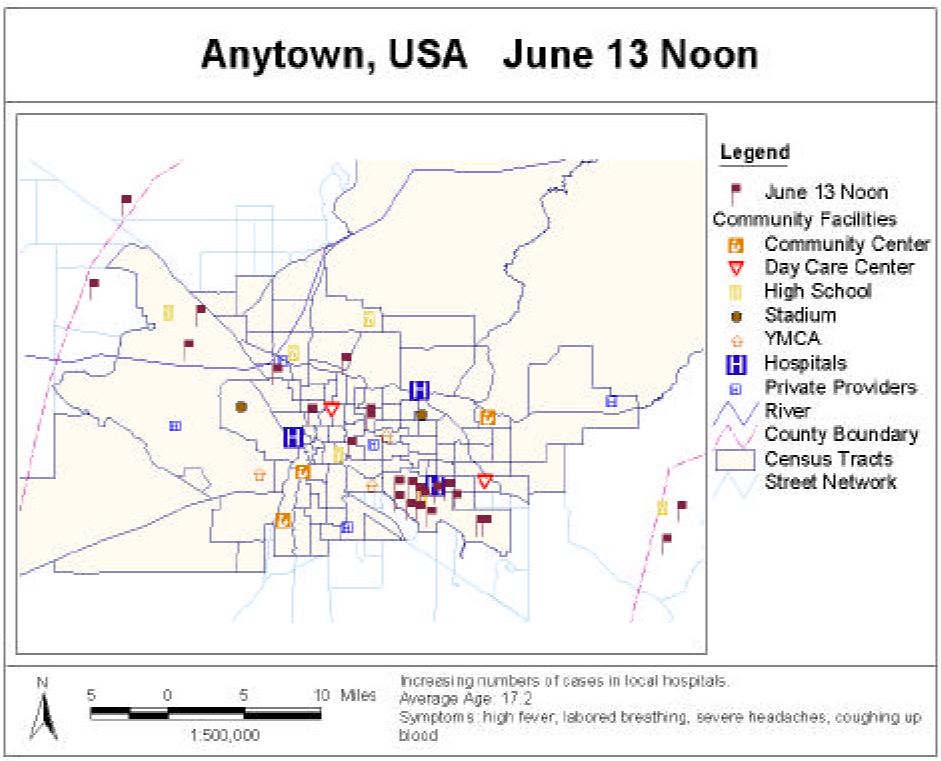
US Hwy 78
US Hwy 51 N
State Line Rd
Horn Lake
State Hwy 301
Hwy 302 W
Hurt Rd
I 55
Tchulahoma Rd
US Hwy 61
ARKANSAS
US Hwy 51
Pleasant Hill Rd
Clinic
MMR Patient
Immunized
Underimmunized
Airport
Highway
Primary road
Secondary road
Water body
Park
State

The Future of GIS and Registries

The power of GIS and registries is yet to be exploited. However, with the advent of the Web and the ability to create and publish GIS maps to this media and to make these maps interactive, will empower users of data to be more creative. Web based GIS maps that integrate data sets with census demographics and geographic relationships will soon be supporting communicable disease and surveillance systems, Bioterrorism, and public health initiatives**.**

STC's recent CDC Small Business Innovative Research Grant was funded to explore development and implementation of these tools in the public health environment. This project created a web based mapping tools set built using both the ESRI and AutoDesk products. An easy to use interface was integrated which gave to any web user the capability to visually display data, as they deemed necessary. These maps were interactive so that information could be included or excluded from the display at the touch of a button. Users have the ability to zoom to greater levels of detail and to view actual patient records through the Web. The following figure is an example map generated through a Web based GIS in support of CDC's Bioterrorism initiative. This map depicts in real time a communicable disease event that has occurred but not yet identified. Various community facilities are displayed as the user of this system attempts to determine if there is a visual relationship between the occurrences of a specific set of symptom to these facilities. This information is presented through the Internet in real time as more and more data is collected. The user can review and assesses the activities in real time.



Summary

GIS is becoming a practical tool for use in information systems. The value of visualizing data as it relates to geography, demographics, and events will prove invaluable in public health planning and assessment. The skill sets to utilize integrated GIS components are on par with the skill sets to utilize statistical reporting packages. The use of Web based papers creates and even more dynamic environment that is only limited by the imagination of the user.

Related Papers

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