

## Geographic Information Systems and Health in North Carolina

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A geographic information system (GIS) is a powerful tool in shaping North Carolina health policy and research. A geographic information system is more than a mapping tool; it is defined as a database that is tied to locations in space. However, the true power of a GIS comes from the ability to view many types of data together and to query or ask questions of the data.

There are some challenges in using health data with GIS. First, you must be able to geocode the data or assign a location to it in some fashion. Sometimes this could be simply presenting data that are already aggregated at the city or county level such as rates for a particular cause of death. (See Figure 1.) However, patient- or provider-level data must become geo-enabled. This type of point-level data could be geocoded by either gathering data in the field with a global positioning system (GPS) or through address matching.

A global positioning system captures location coordinates that are easily imported into a GIS to display locations. A global positioning system provides very accurate data; however, time must be spent in the field traveling to each location to ascertain specific coordinates. Geocoding at the address level involves matching an address against source data such as a road network that is attributed with existing address ranges. The geographic information system interpolates the position along the road where the address falls and captures the coordinates to display location. Numerous problems can occur with address matching. Mistakes can be made when the address is entered into a data system. In addition, problems can occur with the interpolation, or the source data that the address is compared to could have mistakes. Sometimes a person's current address is newer than the source data's creation date, or the address given simply does not exist and therefore cannot be

located. Also, collection of patient data is often done for billing purposes. Many patients report a post office box for billing purposes, thus the patient's physical residence is not locatable.

The State Center for Health Statistics (SCHS) has been using GIS since 1989 to assist health programs with evaluations, to establish or modify health policy, and to facilitate research. A simple choropleth (shaded) map can provide valuable information obtained by visualizing where in space a health event or problem is occurring. A choropleth, or thematic map, is based on statistical data that have been aggregated to an aerial unit. The maps are

*“...a valuable tool for emergency response, program evaluation, and health research. The geographic information system has proved to be an essential tool to help allocate limited public health resources.”*

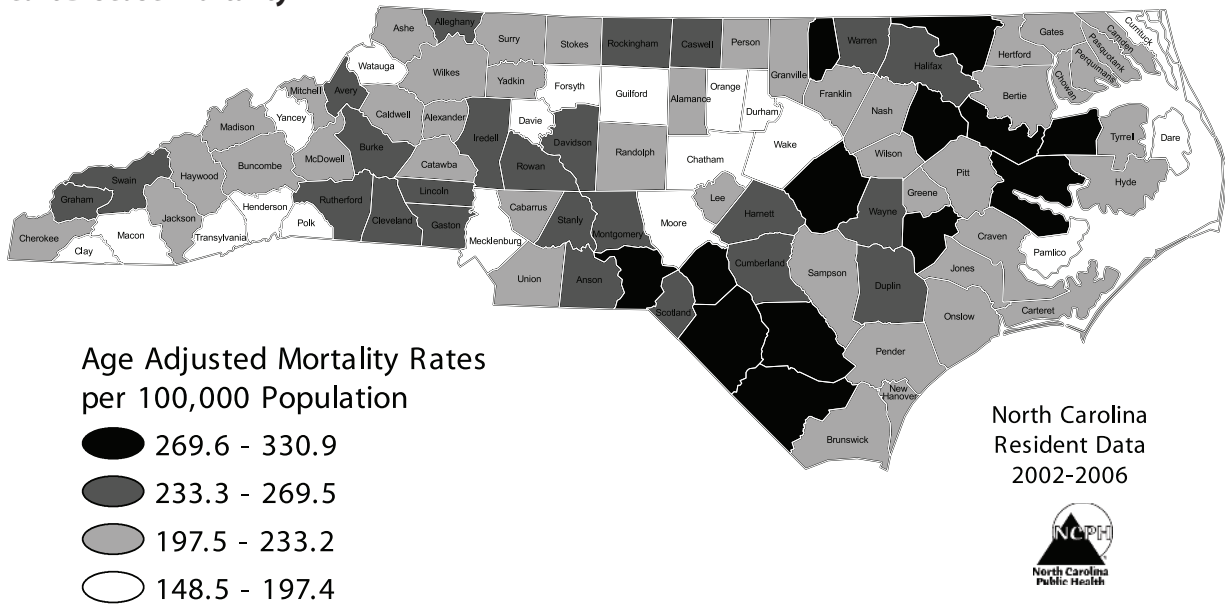
then shaded using different degrees of the same color, traditionally displaying the highest values as the darkest shade. (See Figure 1.)

Geographic information system techniques are also used for more sophisticated public health analyses. For example, the SCHS uses the power of GIS to assist in making decisions for nutrition services programs. The Health & Spatial Analysis Unit of the SCHS has been working with the Women's & Children's Health Section (Nutrition Services Branch, North Carolina Division of Public Health) to support decisions about the Child and Adult Care Food Program. The program funds meal reimbursements to family day care homes. The reimbursement for meals served in day care homes is based upon eligibility for tier I

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**Figure 1.**  
**Heart Disease Mortality**

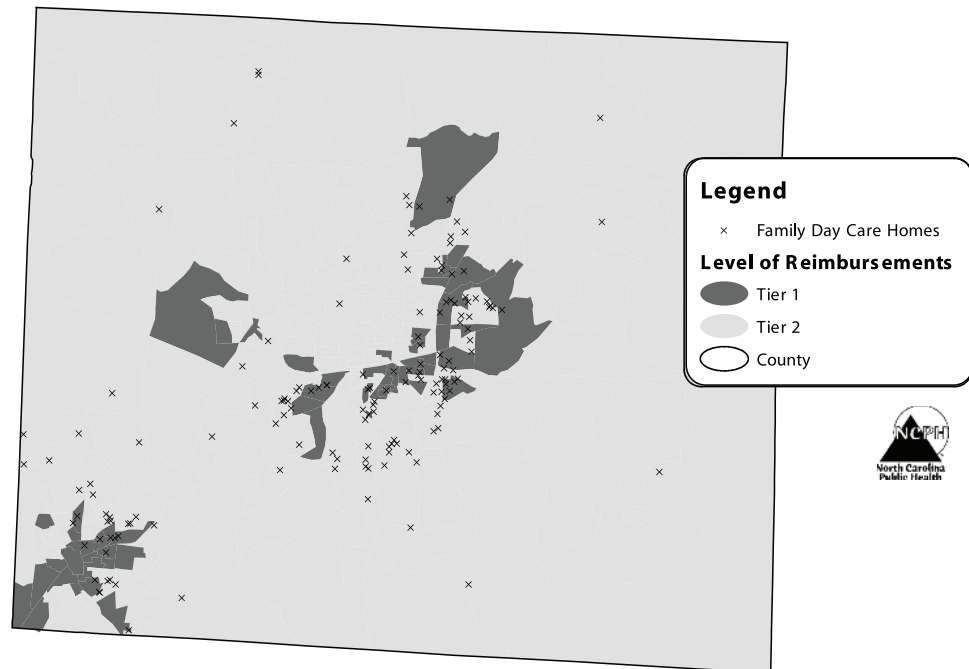


SOURCE: NC State Center for Health Statistics

rates (which targets higher levels of reimbursement to low-income areas, providers, or children) or lower tier II rates.<sup>a</sup> After the Nutrition Services Branch approves an application, the family day care homes are located using GIS and then overlaid on a special run of census data. The census data show the percentage of children in poverty to determine the amount of reimbursement the family day care home may receive. (See Figure 2.) Using a different population age, the same type of analysis is applied to the Summer Adult Food Program. These analyses help target where limited funding dollars are truly needed.

Another ongoing project the North Carolina Division

**Figure 2.**  
**Family Daycare Home Reimbursements**



SOURCE: NC State Center for Health Statistics

of Public Health has been working on for several years is syphilis elimination. New syphilis cases are geocoded and

mapped on a quarterly basis in the 6 counties with the highest rates in the state. Each quarter is assigned a different color so

a Child & Adult Care Food Program. Food and Nutrition Service. United States Department of Agriculture Web site. <http://www.fns.usda.gov/cnd/Care/CACFP/aboutcacfp.htm> Accessed January 3, 2008.

the new cases identified throughout the year are easily traced. The staff of the HIV/STD Prevention & Care Branch (Epidemiology Section, North Carolina Division of Public Health) and local health departments use these maps to help reduce outbreaks. Again, by using a GIS to pinpoint where new syphilis cases occur, testing, education, and prevention methods are targeted directly to the neighborhoods where they are needed the most.

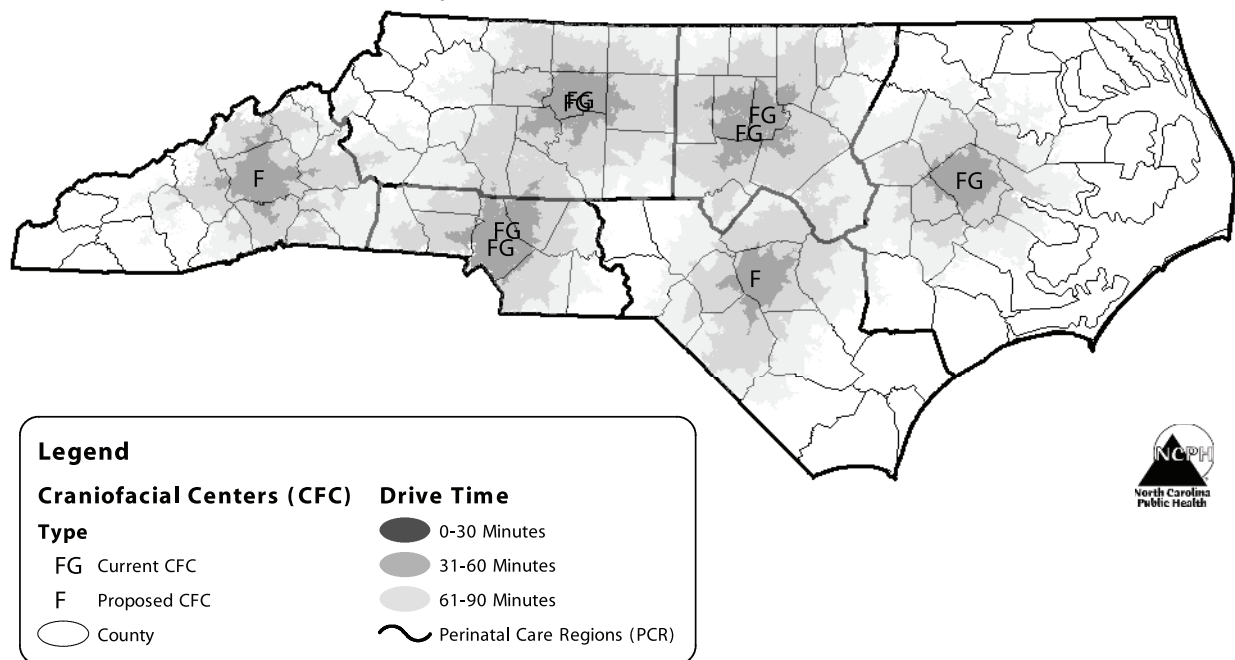
Geographic information systems are also becoming a widely used tool in emergency responses throughout the state. Many law officers and paramedics are equipped with GIS and GPS, which allows for real time vehicle routing for personnel to find locations quickly and for dispatchers to manage personnel and equipment. The North Carolina Office of Public Health Preparedness and Response (Epidemiology Section, North Carolina Division of Public Health) is also using this technology to better serve North Carolina residents. The North Carolina Office of Public Health Preparedness and Response is charged with responding to public health emergencies and has developed methods for gathering information from the field using GIS. It is vital to gather information very quickly in a public health emergency or following a natural disaster. Interviewers in the field are equipped with handheld computers that include a GPS. This equipment allows the staff in the field to navigate to interview locales as well as capture the coordinate location of where the interview occurs. Interviewers can use questionnaire forms on the handheld devices to gather required information from the population affected by the emergency or event. The information gathered is associated with the collected location coordinates. All of this information is then uploaded to a central

database where it can be analyzed. Reports are shared with multiple authorities to assist in determining needs and allocating resources.

A geographic information system also was used in a recent study of the time spent traveling to health care providers for families with a child having an orofacial cleft. It is important for infants born with an orofacial cleft to receive coordinated treatment from craniofacial centers or teams in the first 2 years of life. For the study, residential addresses of children with orofacial clefts were mapped, and the craniofacial centers were located. Using "closest facility methodology" the most efficient route from the residence to the closest care provider was calculated. By using this analysis method the actual distance and time spent traveling to the closest craniofacial center was estimated (although patients may not always travel to the closest facility or care provider) and is more accurate than using a straight line distance. This analysis was performed again after 2 new proposed locations for craniofacial centers were included where there were previously none. The analysis demonstrated that the addition of 2 new centers would result in an average decrease in orofacial cleft client travel time of 16 minutes. (See Figure 3.) A geographic information system is a useful tool for evaluating the role that travel distance may play as a potential barrier to accessing health care among children with orofacial cleft and/or other types of birth defects.

The North Carolina Division of Public Health uses GIS for a variety of projects and purposes. It is a valuable tool for emergency response, program evaluation, and health research. The geographic information system has proved to be an essential tool to help allocate limited public health resources. **NCMJ**

**Figure 3.**  
**Orofacial Clefts and Drive Time to Current and Proposed**  
**North Carolina Craniofacial Centers, 1995 - 2002**



SOURCE: NC State Center for Health Statistics