Chapter V

The New Kid on the Block: A Look at How Geographic Information Systems Are Changing the Face of Cancer Research

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In the last 20 years, Geographic Information Systems (GISs) have had an ever-increasing impact on the course of research and planning in many diverse fields, including geography, geology, environmental studies, business and criminal justice. Relatively recently, health care research, including cancer research, has entered this domain. The rapidly increasing use of GIS in health-care research over the past few years is witnessed by the fact that 63% of papers in literature review for this chapter were written in the last five years, and 35% within the last three years.

Epidemiology, the study of disease patterns in human populations according to person, place and time, has been the traditional means of approaching cancer etiology. Combining its tools with those of GIS has enabled researchers to look at the distribution of cancer in new ways and uncover relationships not previously seen with traditional epidemiological methods alone. Through its data integration function, GIS has enabled the use of existing data collected
for other purposes to be applied to cancer research. GIS techniques can enhance the visualization of spatial patterns of cancer, examine the contribution of various risk factors for cancer in new ways and allow hypotheses about cancer etiology to be tested in a spatial framework.

The purpose of this chapter is to examine the impact of GIS on the direction of cancer research. In doing so, it will consider the application of GIS techniques to research in cancer etiology and compare them to traditional epidemiological methods. Rather than an exhaustive compilation of all the studies in this category, selective examples will be chosen from the literature to illustrate particular applications.

GIS AND ITS SUITABILITY TO CANCER RESEARCH

A Geographic Information System is a set of hardware and software for inputting, storing, managing, displaying and analyzing geographic or spatial data or any information that can be linked to geographic location such as events, people or environmental characteristics. Some of the most common sources of geographic data for a GIS are: printed maps such as those from the U.S. Geological Survey (USGS), aerial and satellite images, global positioning systems and U.S. Census TIGER line files, which allow the determination of geographic location (e.g., and y coordinates on a map) from street address. The more widely available sources of non-geographic data for a GIS include worldwide census population tables, satellite remote sensing information and geologic surveys such as those from the USGS. However, any information that can be associated with geographic coordinates, or a geographic identifier such as a street address or geographic region (city, state, county, police precinct, etc.), can be incorporated into a GIS.

The capacity of GIS to integrate data on the three epidemiological components of person, place and time make it particularly suitable as a tool for cancer epidemiological research. With respect to person, it is well established that many cancers are related to demographic factors such as race or sex. Using GIS, the location of cancer cases can be overlaid on maps of population data to visualize relationships between demographic factors and patterns of cancer.

With respect to place, epidemiologists have traditionally examined geographic variation in cancer incidence using maps. Continuing interest in this application is demonstrated by the existence of cancer mortality and morbidity atlases in many countries (Atlas of Cancer Mortality in Central Europe, 1996; Atlas of Cancer Mortality in the European Economic Community, 1992; Buser, Wolf & Robra, 1984; Cislaghi, Decarli, La Vecchia, Mezzanotte & Smans, 1989; Errezola,
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