Special Article

GIS and Epidemiology

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Understanding the spatial patterns of infectious diseases can provide insight as to their causes and controls. Geographic information systems (GIS) and related technologies like remote sensing are increasingly used to analyze geographical distribution of diseases as well as relationships between pathogenic factors (causative agents, patients, vectors and hosts) and their geographic environments. Basic and analytical applications of GIS in epidemiology can help in visualizing and analyzing geographic distribution of diseases through time, thus revealing spatio-temporal trends, patterns, and relationships that would be more difficult or obscure to discover in tabular or other formats. GIS can provide a means to meet the demands of outbreak investigation and response, where understanding the spatial spread and dynamics of an outbreak is central to the design of prevention and control strategies.

Epidemiologists try to understand the spread of a disease as they study outbreaks of the disease through space and time. In many cases, incidence of a disease can be identified by their locations. By mapping the locations of affected people, as well as the disease vectors, and looking at the presence of the disease over time, it may be easier to identify the source of the disease and how it spreads. Knowing these factors can help health practitioners create a plan to deal with the disease. Geographic information systems (GIS) and related technologies like remote sensing are increasingly used to analyze geographical distribution of diseases as well as relationships between pathogenic factors (causative agents, patients, vectors and hosts) and their geographic environments.

GIS are powerful automated systems for the capture, storage, retrieval, analysis and display of spatial data[1]. In other words, a GIS is an information system with a geographical variable which enable users to process, visualize and analyze data spatially[2]. Each piece of information is related in the system through specific geographical locations (e.g. latitude and longitude) to a geographical context, which can be a hospital, a village, a district or a country. Georeferenced data sets are now readily available, facilitating analyses by researchers[3].

Understanding the spatial patterns of infectious diseases can provide insight as to their causes and controls[3,4]. The recent development in GIS, as well as data gathering and remote sensing, has greatly improved the ability to measure and assess these patterns. Moreover, GIS allows policy makers to easily visualize problems in relation to existing health and social services and the natural environment and so more effectively target resources[5].

Applications of GIS in epidemiology can be as simple as means of visualizing and analyzing geographic distribution of diseases through time, thus revealing spatio-temporal trends and patterns that would be more difficult or obscure to discover in tabular or other formats. Analytical functions in GIS can also help answer specific questions by performing spatial statistical tasks, such as overlaying of different layers of information to determine dependencies and relationships between outbreaks and environmental factors.

For example, the maps shown below depict geographic distribution of annual number of human deaths by rabies in Thailand, from 1994 to 2003 (Fig. 1). Overall, the national death toll seemed to be decreasing during the decade. Additional spatio-temporal patterns

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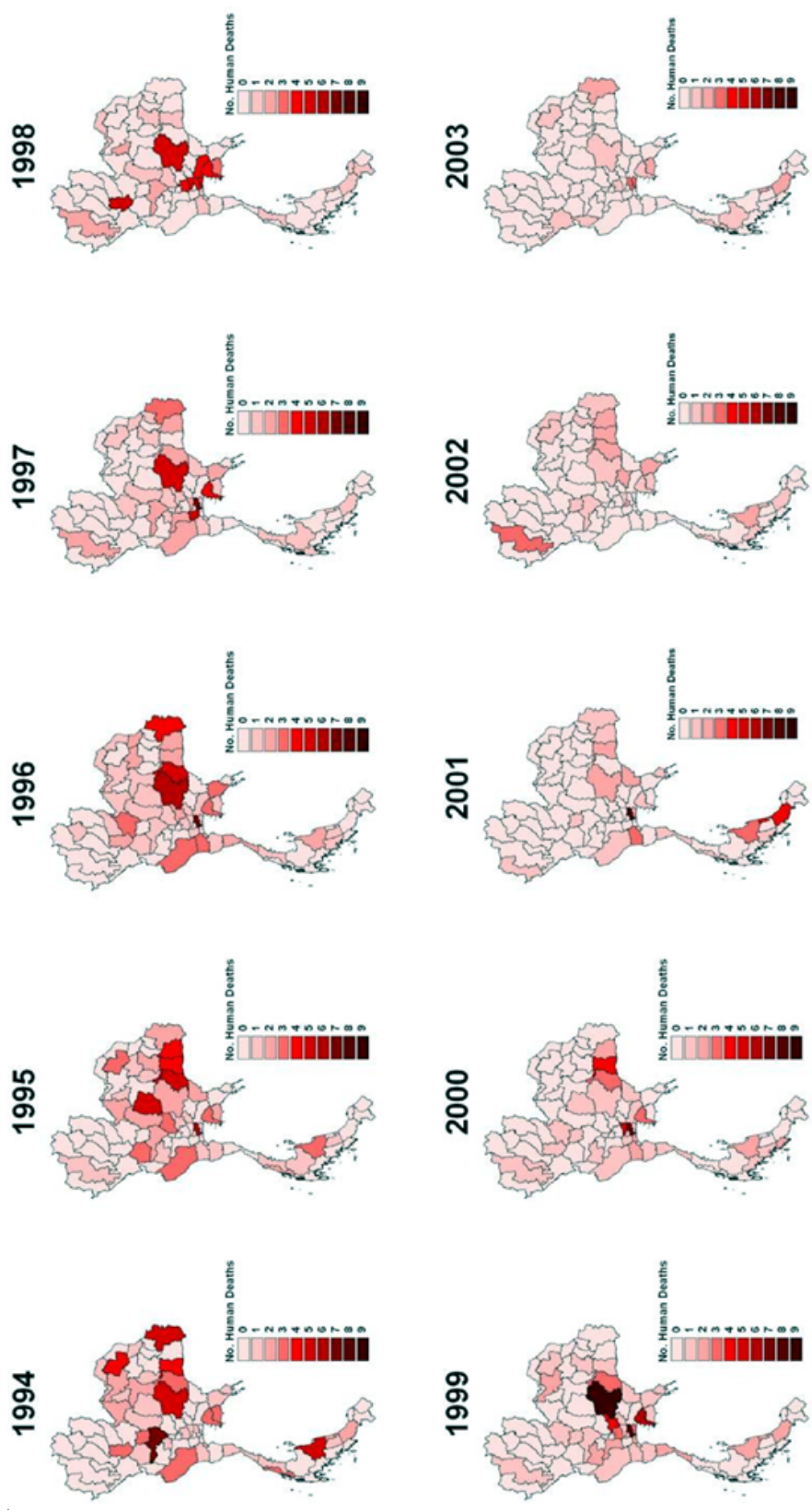
Fig. 1 Number of human deaths by rabies from 1994 to 2003. Data from Thailand's Department of Disease Control, Ministry of Public Health

can also be revealed from the time-series, such as recurring incidence in several of the provinces. Overlaying with other georeferenced information, such as railroads, suggests a relationship between areas with a high frequency of rabies and transportation routes (Fig. 2).
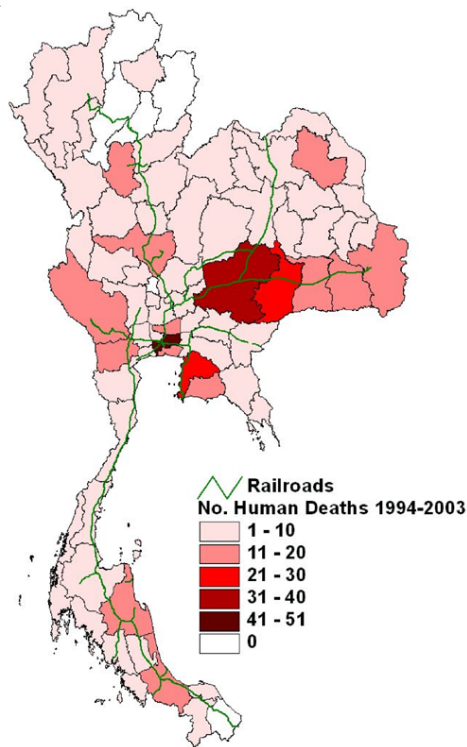

Fig. 2 Geographic distribution of accumulated human deaths by rabies, 1994-2003. Data from Thailand's Department of Disease Control, Ministry of Public Health

GIS provide epidemiologists and health practitioners with capabilities that are ideally suited for use in infectious disease surveillance and control. A GIS can provide a means of collecting, updating and managing epidemiological surveillance and related data, such as environmental and socioeconomic information. They are also highly relevant to meet the demands of outbreak investigation and response, where understanding the spatial spread and dynamics of an outbreak is central to the design of prevention and control strategies

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ระบบสารสนเทศทางภูมิศาสตร์กับระบาดวิทยา

นิพาดา เรือนแก้ว

รูปแบบการกระจายตัวของการระบาดของโรคติดต่อเป็นปัจจัยสำคัญต่อการเข้าใจถึงสาเหตุของโรค และการวางแผนควบคุมโรค ปัจจุบันได้มีการนำระบบสารสนเทศทางภูมิศาสตร์ (Geographic information system หรือ GIS) และเทคโนโลยีอื่นที่เกี่ยวข้อง เช่น remote sensing มาใช้ในการวิเคราะห์การกระจายทางภูมิศาสตร์ ของโรคต่าง ๆ รวมทั้งความสัมพันธ์ระหว่างปัจจัยที่เกี่ยวกับโรค เช่น เชื้อโรค ผู้ป่วย พาหะและแหล่งรังโรค กับสิ่งแวดล้อมต่าง ๆ ของโรคนั้น การประยุกต์ใช้ระบบสารสนเทศทางภูมิศาสตร์สามารถช่วยในการมองและวิเคราะห์การกระจายของโรค ดังนั้นจึงสามารถค้นพบรูปแบบการกระจายเชิงพื้นที่และเวลา รวมทั้งความสัมพันธ์ระหว่างปัจจัยต่าง ๆ ที่อาจค้นพบได้ยากหากวิเคราะห์ข้อมูลในรูปตัวเลขหรือตาราง ระบบสารสนเทศทางภูมิศาสตร์จึงสามารถช่วยในการตรวจสอบและตอบสนองต่อการระบาดของโรคติดต่อ รวมทั้งการวางแผนป้องกันและควบคุมโรค