USING GIS TO ANALYSE SPACE TIME PATTERNS IN WATER BORNE INFECTIOUS DISEASES

I R Lake

School of Environmental Sciences, University of East Anglia, UK

Poor quality drinking water causes around 5 million deaths p/a from infectious diseases and many of these contaminants originate in the environment but are transferred to humans through public water supplies. In spite of their obvious importance little consideration has been given on how to investigate these environment and health links. This paper presents the design of such a study using Crypsporidiosis as a case study.

Cryptosporidiosis is a significant cause of gastro-enteritis and is caused by the protozoa Cryptosporidium. This is commonly excreted by livestock, has strong survival capabilities in the environment, and is resistant to simple water treatment. Many studies have linked cryptosporidiosis outbreaks to periods of high rainfall and river flows. These two suggest an environmental pathway of transmission through public water supplies. The main environmental reservoir of infection (livestock) and factors affecting transmission (water treatment, weather etc.) vary in space and time.

In this study we use a GIS to link the geography of the health outcome data (laboratory catchments) through the drinking water supply system to the catchments from which the water is abstracted. The analysis is subdivided into testing a number of geographical, seasonal and temporal hypotheses. These will determine whether cryptosporidiosis is varying in space and time in a manner consistent with a drinking water pathway.

The first stage of the analysis is geographical, and uses cluster analysis techniques to identify laboratory catchments with different densities of Cryptosporidium sources and types of water treatment. Once these have been defined the standardised attack rates per year between different laboratory catchments will be compared. As an example we would expect cryptosporidiosis to be higher in areas with poor water treatment and water catchments containing many Cryptosporidium sources.

The second stage looks at broad seasonal patterns. Time series statistics will be created for each cluster and compared between clusters. This will identify, as an example, whether areas of the country with different agricultural patterns are producing statistically different temporal patterns of cryptosporidiosis in their associated laboratory catchments.

The final phase looks at temporal fluctuations in cryptosporidiosis attack rates to determine if any relationships exist with runoff events and other weather conditions which may affect the transport of Cryptosporidium in the environment. However, these relationships may vary at different times of the year or be different in areas with different levels of water treatment. Therefore, the analysis is undertaken using multi-level modelling to permit the relationships between cryptosporidiosis and weather to vary according to the water source, time of year, level of water treatment, sources of Cryptosporidium deposition, soil hydrology, and river versus groundwater sources.