

## LETTING MAPS TELL THE FULL STORY: TEMPERO-SPATIAL VISUALISATION OF DISEASE OUTBREAK DYNAMICS USING A GIS

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*Les systèmes d'information géographique permettent l'établissement des cartes des maladies avec facilité, et offrent la possibilité d'incorporer les aspects spatialisés de l'incidence des maladies dans l'analyse de leur épidémiologie. Des techniques pour l'analyse des évolutions temporelles des maladies sont connues depuis longtemps des épidémiologistes. Cependant, l'examen simultané des aspects temporels et spatiaux de la distribution des maladies a souvent été négligé. Bien que les techniques statistiques existent, elles sont généralement complexes. Le présent poster décrit un logiciel simple qui permet la visualisation de la distribution spatio-temporelle des maladies. Une «animation» des données issues d'un foyer épizootique dans un village du nord de la Thaïlande est utilisé pour présenter le programme informatique. Les données montrent que même sans analyses statistiques complexes, une simple visualisation révèle beaucoup plus d'informations à propos de l'épidémiologie de la maladie que l'analyse temporelle ou spatiale seule ne peut donner. De tels outils ont un important rôle à jouer dans l'exploration des données et la génération d'hypothèses.*

One of the roles of epidemiology is the identification of patterns in the distribution of disease. Such patterns may lead to a better understanding of the mechanisms of disease, and offer insights into potential control options. The distribution of diseases may be examined in many ways — distributions with respect to sex, age, diet, genetic makeup, space, time, etc. When a pattern is detected, control options can be developed. Once the data is collected, the first step is to examine it for patterns. A geographic information system (GIS) offers, through the production of disease maps, the ability to examine the spatial distribution of disease and find meaningful patterns. An armoury of statistical techniques exist for the analysis of such patterns. Similarly, graphical and analytical techniques exist for analysis of the temporal distribution of disease (time series techniques). However, the simultaneous examination of the spatial and temporal distribution of disease is more complex. If we observe on a map that many cases appear to occur in the same area, are they occurring simultaneously? If we look at a graph of disease incidence over time and notice a peak, are these cases occurring in the same place? Statistical techniques exist to analyse the space-time "distance" between disease events, but little is available for the identification of these patterns in the first place.

Using a pilot GIS in three provinces in northern Thailand, a tool for exploratory data analysis was developed, that allowed simultaneous display of the temporal and spatial distribution of a disease. Data from a diagnostic laboratory submissions database, containing disease diagnosis, the origin of the submission and submission date was analysed. This provided the three necessary components for analysis: the "what", "where" and "when". The program was developed using the ArcView programming language, Avenue. The user creates a map of all disease events in a certain period. The program then "animates" the map by passing through the chosen period one day at a time, displaying new disease events (for an arbitrary period chosen by the user) and then erasing them. Using this simple technique, it is easy to see the wave of progression of an epidemic, or the random scatter of a sporadic disease. The program was used to examine several diseases in the study area, and revealed new patterns, suggesting new hypotheses. For example, while two serotypes of one disease were known to occur in all parts of the study area, and follow an annual cycle, it was not realised that mixed outbreaks do not occur — only one serotype occurred in an area at a particular time. A natural divide down the centre of the study area separated the two types, which tended to appear alternately on one side of the divide and then the other, from year to year. This observation led to new hypotheses as to the immunity of the population, and the source of the pathogen.

The program can be used to examine any disease information that has a location and a date associated with it. It provides no analytical or statistical support, but is a simple yet powerful data visualisation tool.

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