INTRODUCTION

In many areas of Europe patterns of drug use are changing. The mechanisms of diffusion are diverse: introduction of new practices by new users, tourism and migration, cross-border contact, drug transportation, and increasing opportunities for economic and international contact. The 1997 EMCDDA annual report notes that:

there is a geographical diffusion of drug use from cities to towns and rural areas, which has implications for needs assessment, service provision and training. Differences in patterns of diffusion may also improve our understanding of the distribution of drug behaviours at European, local and regional levels.

A Geographic Information System (GIS) offers a dynamic and flexible approach to visualising the diffusion of drug use in Europe. The potential use of GIS models in drug misuse research has been described by the authors in an earlier EMCDDA project: Study of options to develop dynamic models of drug use (CT.96.EP.05)-[Frischer and Heatlie, 1997]. The development of a European drug misuse GIS would be a logical progression in view of improvements in drug misuse surveillance in Europe.

This report aims to show how a geographical information system can be used to develop a model of geographical spread of drug misuse in the European Union.

In March 1998, the tender for project CT.98.EP.04 was awarded to the Department of Medicines Management, Keele University, UK.

The objectives and timetable for the project are:
1. To create a pilot GIS mapping package and database for drug misuse covering the EMCDDA area.
2. To produce detailed spatio-temporal maps of diffusion of drug use in Scotland.
3. To produce illustrative maps for selected European regions (London and Italy).
### TIME | WORK
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September | 1. Reviewing use of GIS in epidemiological and social research.  
2. Obtain European GIS digital maps and databases for three regions.

October-December | 1. Mission to EMCDDA to access drug misuse data.  
2. Create a pilot GIS database for drug use in the three regions.  

January | 1. Run GIS using existing data from three European regions.  
2. Integrate results from Drug Incidence & Prevalence Estimation Program (DIPEP) into a detailed GIS analysis.

February | 1. Complete analysis and write report.

Following the award from DGXII/TSER to the EMCDDA on the topic European Network to develop policy relevant models and socio-economic analysis of drug use, consequences and intervention it was decided to use project CT.98.EP.04 as the basis for creating this network. Consequently a meeting was arranged at the EMCDDA in Lisbon to review the work done on this project with the aid of experts in this field (see section 5). A further objective agreed between Keele and the EMCDDA was to use the mapping software to illustrate local and national prevalence estimates in Europe.

### STRUCTURE OF REPORT

1. GIS and its capabilities.  
4. Mapping European aggregate data.  

### SECTION 1: GEOGRAPHICAL INFORMATION SYSTEMS CAPABILITIES
Various disciplines (e.g. ecology and environmental health) are increasingly using Geographical Information Systems (GIS) to study associations between location, environment and behaviour. Advances in computing and graphical technology enable spatially referenced data to be linked to relational databases and epidemiological functions. GIS thus provide a powerful tool for analysing the spread of phenomena over time and space and GIS models have been used to predict disease spread from infected to susceptible populations (Haggett 1994).

1.1 What is a Geographical Information System (GIS)?

Although there are many types of Geographical Information Systems, they are all capable of capturing, analysing and displaying spatially referenced data. GIS development has been facilitated by the availability of digital map data which provides a spatial framework on which to attach attribute data (figure 1). The main characteristic of a GIS is the ability to link spatially referenced data to a relational database that contains relevant information (e.g. population data, transport routes or other socio-economic data). These features, together with more powerful spatial analysis tools, distinguish GIS from early mapping programmes that simply displayed information.

![Figure 1. GIS linking attribute data to the spatial framework](image)

A GIS stores both spatial map data and associated attribute data. Attribute data is stored in a relational database management system contained within the GIS and accessed by a spreadsheet.
or query driven user interface. The GIS can accomplish everything that a traditional database system can, querying, selecting and manipulating data.

1.2 Software and Hardware

ARC INFO (7.1.1) and Arc View (v3.0a) were used to manipulate, analyse and display the data used in this report. The software is run on a Sun Ultra 10 SPARC processor.

1.3 Digital Spatial Data

The framework used for spatial referencing was the Bartholomews 1996 digital data. These data are available for three spatial areas at three levels of detail. The largest scale digital data is available at a scale of 1:250,000 but is available only for the United Kingdom and was therefore not used for this report. The largest scale digital data used during this project was the 1:1,000,000 database. This is available for the whole of the European area (from -29W 27N degrees to 70E 82N degrees [excluding Greenland and North Africa]). This data was used for country specific maps in section 2 (Forecasting drug diffusion) and section 3 (Mapping existing individual data). A sample of this data set is shown below (figure 2). The European Bartholomews database is split into grids 5°'s East West and 4°'s North South. Each grid contain layers of information detailed below (see appendix 1).

General European maps, shown in section 4 (Mapping European aggregate data) used the Bartholomews 1:20,000,000 world database, a sample of this data is displayed below (figure 3). These data are available as a single world-wide coverage and contains information detailed below (see appendix 1).
Figure 2. Sample data showing topographical and road networks from the 1:1,000,000 coverage.

Figure 3. Sample European data showing towns and administrative regions from 1:20,000,000 coverage.