

CREATING AN ONLINE ATLAS OF SALMONELLA SEROTYPES IN EUROPE

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Introduction

Salmonellosis is a frequently occurring disease in Europe. Through their national surveillance systems, the European Union (EU) Member States collect a substantial amount of information on cases of salmonellosis, which may be used to gain new insights into the epidemiological characteristics of the many different *Salmonella* serotypes. One simple approach to this is by visualising the spatial distribution of the cases on maps.

Geographic information systems (GIS) are computer tools that help to map and analyse the spatial distribution of cases. This may help to identify associations that are not otherwise easily noticed.

In the project described here, we used GIS to depict the spatial distribution of the most important *Salmonella* serotypes in Europe.

Methods

Data used in the project were national surveillance data of laboratory-confirmed *Salmonella* infections. The source of data was Enter-net (http://www.hpa.org.uk/hpa/inter/enter-net_menu.htm), the EU dedicated surveillance network for the enteric infections *Salmonella* and verocytotoxin-producing *Escherichia coli* (VTEC) O157, which has been collecting case-based data from participating countries since 1994. These data are interesting in a GIS context because they include a geographical variable indicating – within each country – the region of residence of the patient or the region where the diagnosis was made. In October 2007, the coordination of Enter-net was transferred to the European Centre for Disease Prevention and Control (ECDC).

The project was put forward at the annual Enter-net workshop in 2005. Subsequently, the data were cleaned and geo-coded in cooperation with the Enter-net representatives of the countries that were interested in taking part in the project. In addition to the Enter-net data, several countries supplied data directly to the project. These were Greece, Poland, Sweden, the Netherlands and Germany (the latter via the SurvStat@RKI system). In total there were 1.6 million cases in the dataset used.

The geographical information in the data was recoded according to the Nomenclature of Territorial Units for Statistics classification (NUTS, http://ec.europa.eu/comm/eurostat/ramon/nuts/home_regions_en.html), which is the official EU geographical division system. This system is based on the existing geographical administrative divisions used in the EU Member States. The maps were made using Arc-GIS software [ESRI®] and a website (<http://www.epigis.dk>) was set up.

Results

As a result of this project, maps were created showing the annual incidence (number of cases per 100,000 inhabitants) of laboratory-confirmed cases of the 10 most common *Salmonella* serotypes (Enteritidis, Typhimurium, Virchow, Hadar, Infantis, Newport, Derby, Agona, Saintpaul and Heidelberg) listed in the Enter-net database. The maps cover all countries in Europe for which data were available and which agreed to participate in the project. In all, 30 countries were represented with data for at least one year within the period 1994-2006.

Three different annual series of maps were made. The first simply show the annual incidence per country (Figure 1). The second series illustrate the incidence at the district (sub-country) level (Figure 2). This geographic level differs between countries; for example, in case of Germany the states (Länder) are represented, in France they are departments and in Denmark counties. The third series show the serotype data per district, giving percentage (rather than an incidence rate) relative to the total number of annual reported *Salmonella* cases per district (Figure 3).

All maps are available at the *Salmonella* Atlas website (<http://www.epigis.dk>), where more information about the project may also be found.

Discussion

The maps we have created give an overview of the geographical distribution of the cases of salmonellosis and allow for comparisons between countries, thus making it easier to use the otherwise complex data of the Enter-net *Salmonella* database. Furthermore, the maps are presented in an easily accessible format on the Internet.

While the maps highlight areas with high or low incidences of a given serotype, it is important to bear in mind that significant variations between countries may be partly related to the large differences between surveillance systems in European countries. As a result, it is often not possible to compare incidence rates of salmonellosis between countries directly, and in some instances it is even not possible to make comparisons between various districts of a single country. Therefore some background knowledge about the surveillance systems in place in Europe is needed when interpreting the maps. For this reason, a note is added to each map, stating that the maps should be interpreted with caution due to the existing differences in surveillance and reporting.

Furthermore, we attempted to adjust for the overall differences of the *Salmonella* surveillance systems in each region by making a

FIGURE 1

Incidence of *Salmonella* Enteritidis, by country, 2004

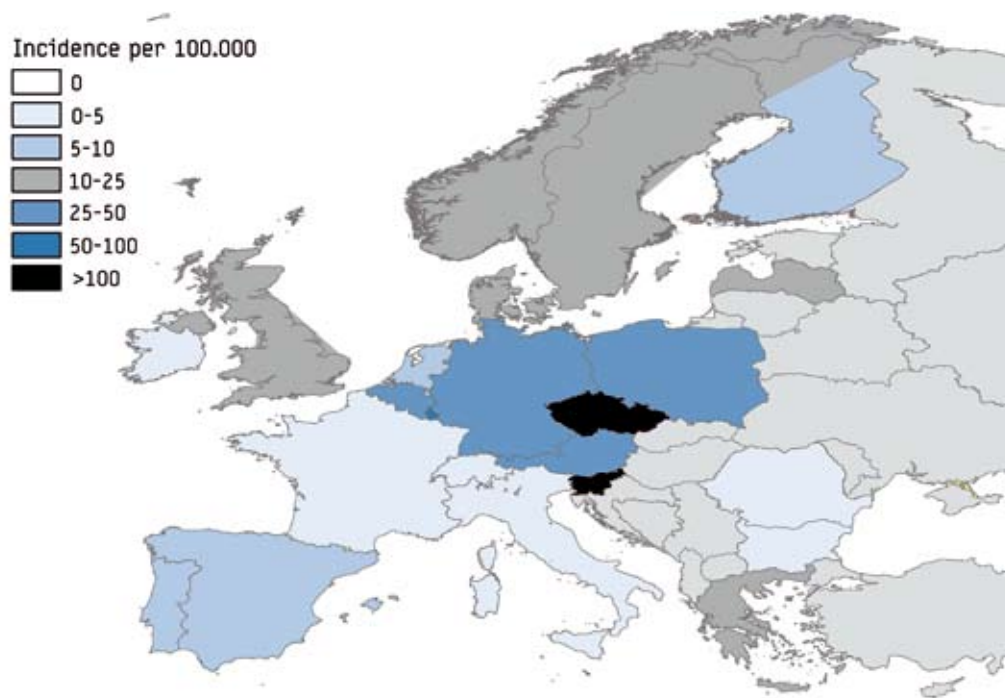


FIGURE 2

Incidence of *Salmonella* Enteritidis, by district, 2004

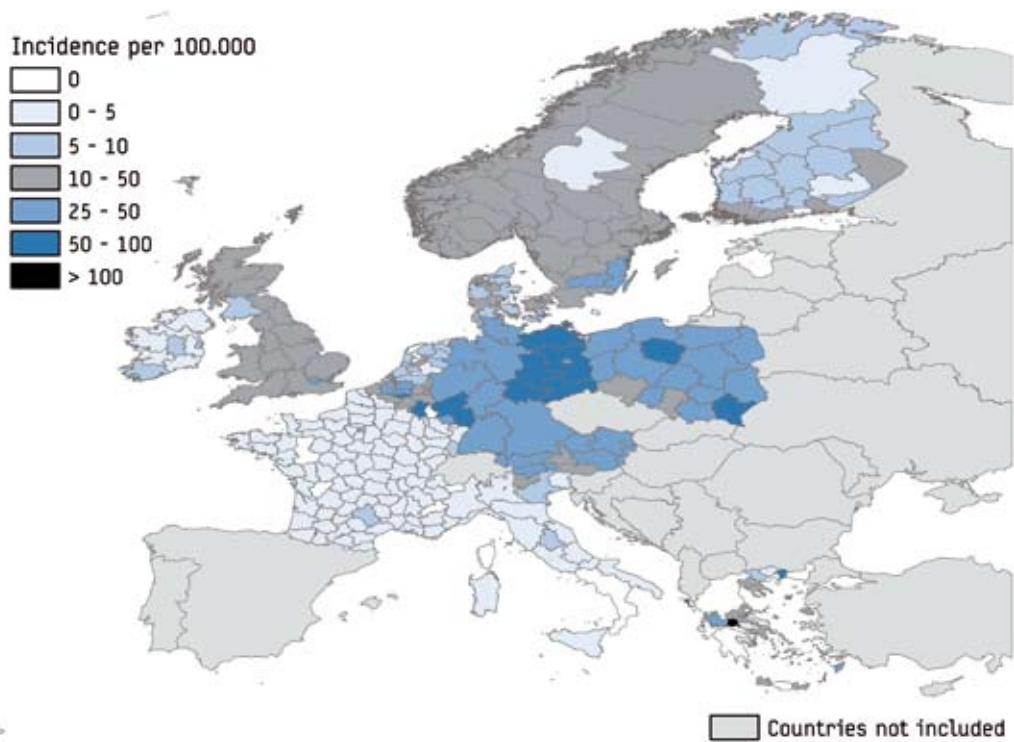
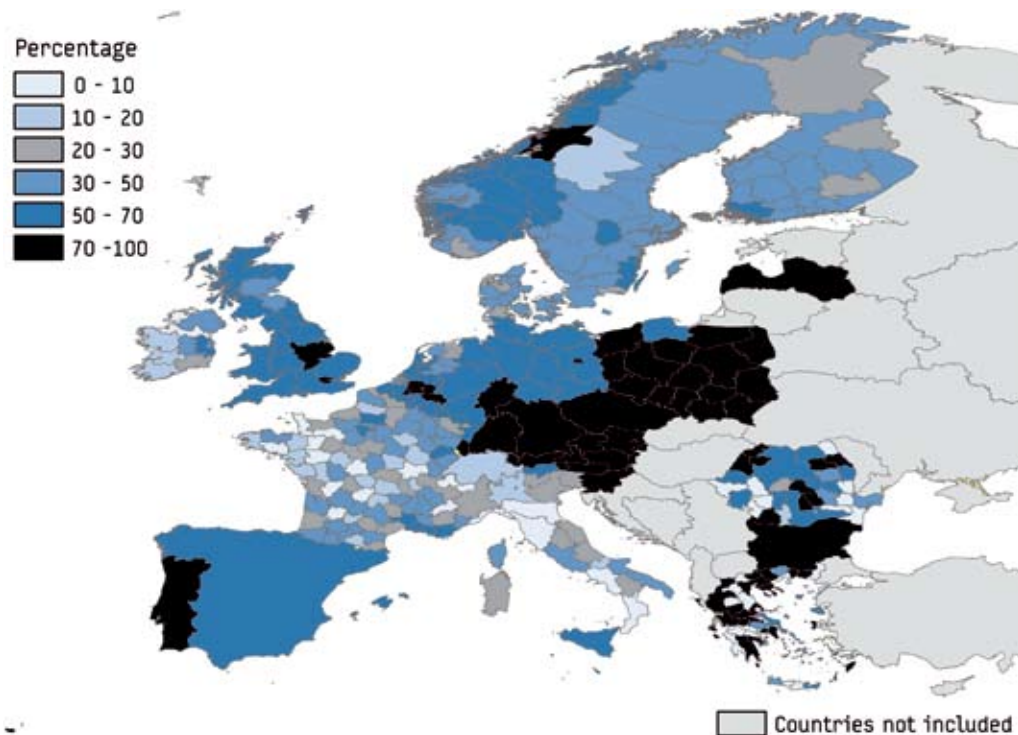


FIGURE 3

Incidence of *Salmonella* Enteritidis, as a percentage of the total number of *Salmonella* cases, 2004



series of maps that show the number of cases of a given serotype in relation to the total number of diagnosed *Salmonella* cases. These maps provide a picture of how important a given serotype is in the different countries and districts.

Although GIS can be a very powerful tool in descriptive epidemiology, geographical location data are often not routinely collected as part of disease surveillance. Few European disease datasets exist that (like the *Salmonella* dataset) are both fairly large and contain information about where within a country the incident took place. We think it is useful to ask for location variables when collecting data at regional, national or international institutions. Such location data should refer to well-defined geographical areas; for example, in case of the EU follow the NUTS system of classification.

We hope that these maps will be useful for epidemiologists when making trend analyses and investigating outbreaks. In their current form the maps may not be sufficiently flexible to fulfil all these goals, but we are continuing to develop this project and plan in the near future to construct a dynamic web-based mapping-tool that will allow users to set a number of parameters and be presented with a map drawn from an underlying database. In this way, it will be possible to create maps which present much more data, including depictions of the full list of serotypes, different age groups, phage types and other information such as whether or not the infections were travel-related.

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