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Mapping Health Information

Jessica Wardlaw, University College London
Dr Muki Haklay, University College London
Scott Parker, Dr Foster Intelligence

Abstract

Dr Foster Intelligence (DFI) is a public-private partnership in the health informatics sector that delivers independent health and social care information to providers of care such as hospitals, so that they can improve performance. DFI has produced a range of innovative web-based data analysis tools which gives health managers in the National Health Service (NHS) access to the Hospital Episodes Statistics (HES) database, that records admitted patient care data from 1989 onwards and outpatient attendance data from 2003 onwards.

Although DFI has significant expertise delivering health statistics in tabular and chart form, only recently have they begun to investigate the application of mapping techniques. This is principally due to the technical challenges associated with linking live to a database, which is updated with approximately 6.3 million records a month. A map component has now been built into the data analysis tools so that the spatial patterns of the HES data can be visualised. Examples include the flow of patients from primary to secondary care and hospital admission rates.

In the NHS, mapping datasets such as the Hospital Episodes Statistics, geodemographic and public health data can expose inequalities in health service provision and inform the commissioning of services. Many managers responsible for health service provision may not be familiar with public health and epidemiology, yet they need to manage and commission health intervention programmes on a regional basis. The use of proper cartographic representation is therefore critical in ensuring commissioning decisions, based on maps created from the relevant data, are reasonable.

This paper presents not only the use of maps in practical information products, but the results of a survey of Public Health, Performance and Information analysts, carried out by DFI and University College London, which revealed fascinating insights into the impact of map design on interpretation of data by these users.

The need for information in the NHS

The health sector in England is controlled by the Department of Health, which is in overall charge of the National Health Service (NHS), with a cabinet minister reporting as secretary of state for health to the prime minister. The NHS organises and provides health services like hospitals, doctors, dentists and chemists.

The NHS in England comprises of ten Strategic Health Authorities (SHAs), which are in charge of all NHS Trusts and oversee all NHS activities. SHAs monitor performance and standards; making sure health services in their area are running well and make improvement plans. They are the key link between the NHS and the Department of Health, ensuring that policy is implemented.

NHS Trusts include Mental Health Trusts, Ambulance Trusts and Acute Hospital Trusts. Primary care services are managed by Primary Care Trusts; these are the services provided by the people you normally see when you first have a health problem (e.g. a doctor or dentist, to an optician for an eye test, or a trip to a pharmacist to buy cough medicine). NHS Walk-in Centres and the NHS Direct telephone service are considered primary care services. There are 152 Primary Care Trusts in England, each one covering a separate local area.

PCTs are responsible for 80% of the NHS budget. As local organisations, PCTs decide what health services a local community needs, and they are responsible for providing them. They must ensure that there are enough primary care services for people within their local area, and that the services are accessible. Additionally, PCTs make decisions about the type of services that hospitals provide and are responsible for making sure that the quality of service is high enough. They ensure NHS organisations work effectively with local authorities, and other agencies that provide local health and social care services, so that the local community's treatment needs are met.

Alongside PCTs and GPs, decision making and commissioning have been devolved to Foundation Trusts (with accountability to the local community, rather than central government), which are required to produce information for the purposes of quality assessment and local and national accountability. All of these groups need timely access to accurate and relevant information. In order to commission services effectively, PCTs require access to up-to-date and reliable hospital records, so that they can retrieve information relating to diagnoses and procedures carried out. This paper describes how many commissioners currently access these data and how mapping and GIS can be used to help them to their work.

The paper is based on work being carried out through a Knowledge Transfer Partnership between University College London and Dr Foster Intelligence (DFI). The aim of the research is to introduce GIS techniques into the analysis and visualisation tools used to process healthcare statistics in the National Health Service (NHS). This paper presents the use of maps and GIS technology in practical information products that are used by many healthcare professionals in the NHS by first discussing why this technology is needed in the NHS, what specific tasks the technology is used for and then the results of a questionnaire amongst users to find out how the maps could be designed to make them easy to interpret.

Data dissemination

Many data analysts in the NHS currently carry out their work using internet-based data analysis tools developed by a company called Dr Foster Intelligence (DFI). DFI started out as Dr Foster Ltd in 2001. It was launched with the publication of the Good Hospital Guide in the Sunday Times, which rated hospitals according a number of indicators, including hospital standardised mortality ratios (HSMRs). Dr Foster Ltd has since joined forces with the Information Centre (a special health authority of the NHS) to create the public-private partnership Dr Foster Intelligence. Launched in February 2006, the company aims to improve the quality and efficiency of health and social care through better use of information. DFI provides access to health and social care information for professionals and the public through a range of products and services. At the time the Information Centre was created the Department of Health, recognised that it lacked expertise in publishing, marketing and in producing relevant information products and services that would encourage strategic level and senior NHS staff to make more intelligent use of information. As a result of this unique partnership, DFI are market leaders in the dissemination of independent health and social care information.

The aim of the partnership is to improve access to and use of health and social care information, thereby improving the quality and efficiency of health and social care. The company provides products and services to NHS Trusts, using the Hospital Episode Statistics (HES) database. The HES database contains details of every hospital visit in England since 1996. DFI develops internet-based technology that allows managers at the Primary Care Trusts to access the data. This empowers them to monitor hospital admissions and how much money the admissions are costing them. A team from Imperial College London, based at DFI, add value to the data in the form of Healthcare Resource Group codes (standard groupings of clinically similar treatments which use common levels of healthcare resource), socio-economic deprivation measures, Experian's MOSAIC geodemographic classification, and several flags (e.g. emergency readmission within 28 days, patient safety indicators) designed to add functionality to the data. This allows them to perform tasks which help in commissioning, performance assessment and case management tasks.

The data analysis tools allow the following tasks to be carried out:

Case management
- GP Practices can control their own budget (in line with Practice Based Commissioning)
- GP Practices can assess the 18 week referral to treatment target
- Decide where and how to influence referrals and configure secondary healthcare provision for the future
- Identify patterns in GP Practice referrals and understand the share of this activity in relation to all other acute hospital trusts in England

Performance assessment
- Near to real-time information on patient outcomes such as mortality, length of stay, day case rates and emergency readmissions, for all inpatient and outpatient activity
- Analyse performance against expected and national rates
- Monitor progress by comparing historical data with current information
- The identification of potential clinical issues, such as changes in patient outcomes or issues with coding quality, as soon as they occur
- Comparison of health outcomes between trusts across England
- Highlight gaps in current provision compared with potential activity and how this relates to revenue

Commissioning tasks
- Local health profiling e.g. which admissions are costing the PCT the most money, admissions ratios for different diagnoses
- Evaluation of commissioning decisions
- Monitoring inequalities in service and treatment provision
- Estimate patients' health needs by linking hospital admissions with local population-based geodemographic data such as Experian's MOSAIC classification
- Scenario planning e.g. if a trust wishes to reduce alcohol-related admissions by 10%, how many admissions does this translate to for the largest five GP practices?
- Evidence on which to base and design public health interventions
- Reporting on key targets such as National Service Frameworks (NSFs) and Joint Strategic Needs Assessments (JSNAs).
    - NSFs are long term strategies for improving specific areas of care
    - The Local Government and Public Involvement in Health Act 2007 requires PCTs and local authorities to produce a Joint JSNA of the health and wellbeing of its local community

The current data provision tools are based on Department of Health policies, such as Practice Based Commissioning. Since the 2004 publication of the white paper Choosing Health: Making healthy choices easier, public health issues have been high on the policy agenda. Public health data is now being integrated into the data provision tools.

Adding mapping to the mix
Data is currently delivered in tabular and chart form. Mapping functionality is being developed to allow users to extend the basic analysis to:
- Produce maps alongside a range of other outputs including charts, graphs and models to support public health interventions
- View and map information in an easily accessible format on the basis of diagnosis and procedure, by geography, from SHA level right down to GP practice level
- Identify spatial health inequities

Maps are unrivalled in their power to create knowledge and understanding of geographical data. While in some areas of the health sector, such as epidemiology or population health, the use of

maps for spatial representation of data is common and has a long tradition (from John Snow's map of cholera outbreaks in London in the 1850s to contemporary atlases such as the Atlas of US Mortality and the Dartmouth Atlas of Health Care), in many other domains of medical research the use of maps is far less common.

In the NHS, mapping datasets such as the Hospital Episodes Statistics, geodemographic and public health data can expose inequalities in health service provision and inform the commissioning of services. Maps can expose spatial patterns that are not apparent from a simple table or chart. They allow commissioners to target services in precisely the right location and make a real difference to the quality and efficiency of health services on the ground.

Initially, Scalar Vector Graphics (SVG) technology was used for the maps but there were cross-browser compatibility and technical support issues. DFI has now integrated AspMap as the technology to deliver maps to end users. AspMap is a Web mapping component for embedding spatial data access, display and analysis functionality in Web applications. Performance issues are generally related to the filtering of the millions of hospital records with a live link to the database server.
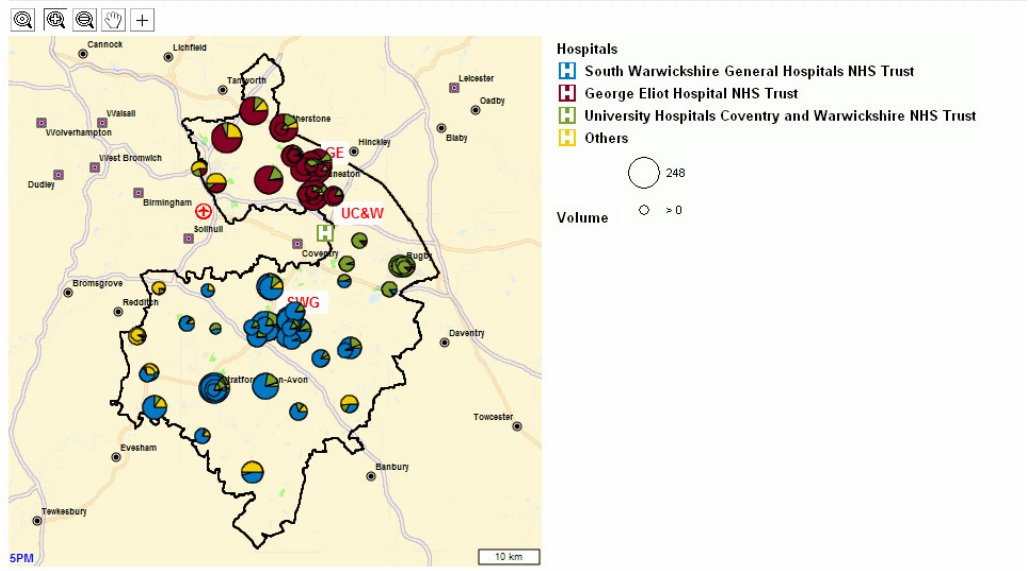

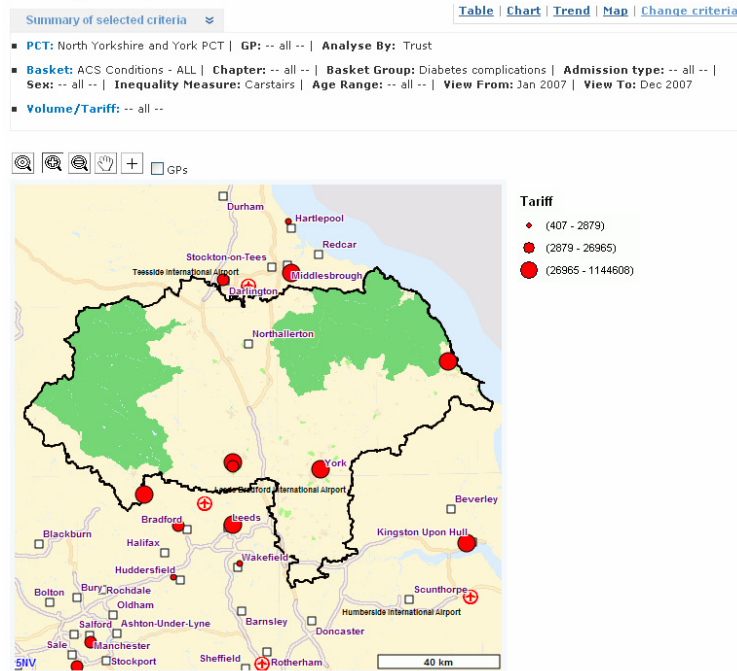**Figure 1: Patient flow. A pie-chart map showing where patients are being referred to from GP Practices in Warwickshire PCT**

Figure 2: Area analysis. A graduated point symbol map of diabetes admissions at Acute Hospital Trusts in North Yorkshire and York PCT in 2007
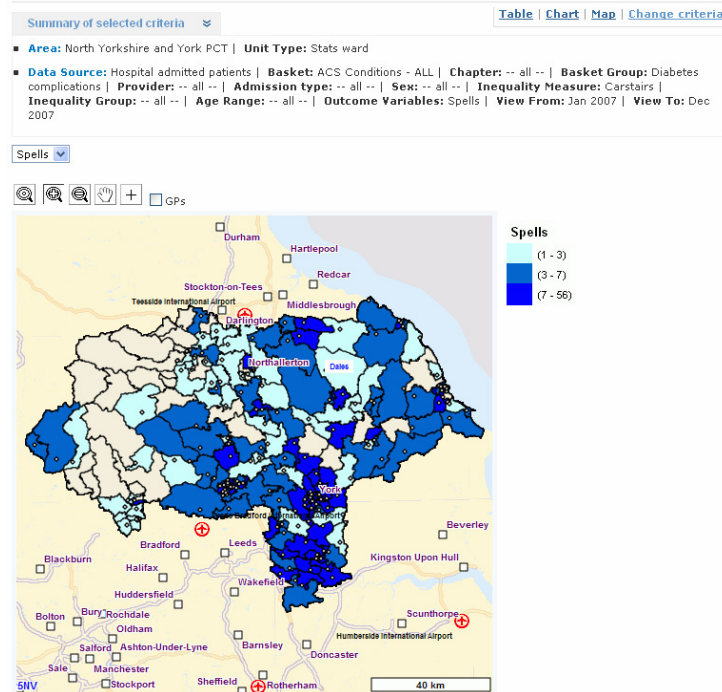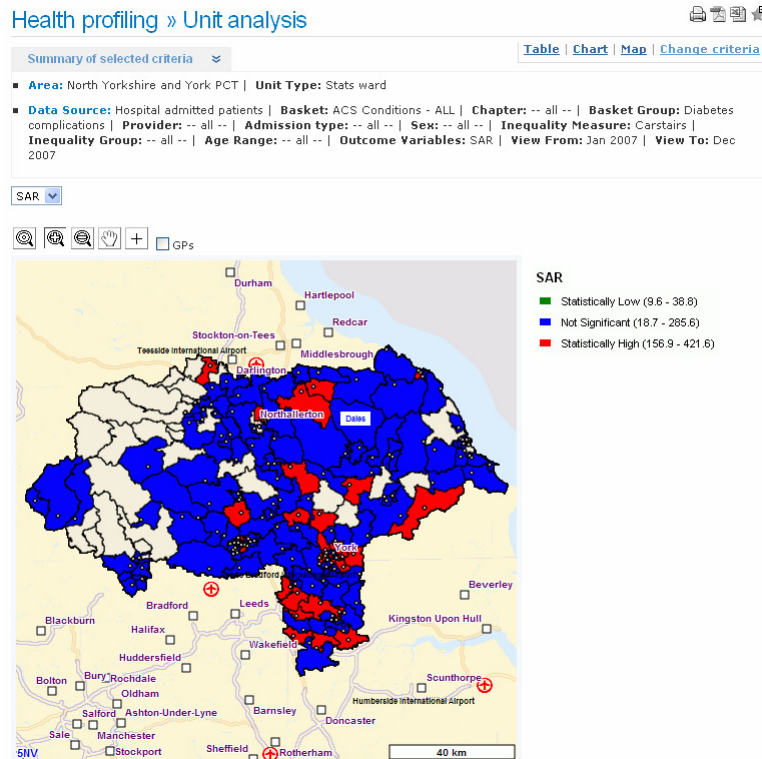

Figure 3: Area analysis. A map of diabetes admissions in North Yorkshire and York PCT by Stats ward in 2007

Figure 4: Standardised admissions ratios for diabetes admissions in North Yorkshire and York PCT by Stats ward in 2007. (N.B. This ratio compares admissions levels to the national average.)

Cartography for commissioners

Many managers responsible for health service provision may not be familiar with public health and epidemiology, yet they need to manage and commission health intervention on a regional basis. The use of proper cartographic representation is therefore critical in ensuring that commissioning decisions, based on maps created from the relevant data, are reasonable. The challenge is to maintain cartographic integrity, whilst providing commissioners with a visualisation of the data that they are able to interpret.

A recent survey of Public Health, Performance and Information analysts, carried out by Dr Foster Intelligence and University College London, revealed that map backgrounds should be very simple to facilitate interpretation of the data. The survey also revealed fascinating insights into how data visualisation methods can impact the interpretation of data.

Colour is often used on maps to portray differences in percentages, rates and other intensity measures (for example, the prevalence of Type 2 diabetes). The survey found that red shades were popular amongst NHS data analysts and single-colour gradients were preferable for displaying intensity. This is unsurprising since gradients with two or even three colours offer no logical ordering from low to high intensity.

For mapping of count data (for example, the incidence of Type 2 diabetes) it might be more appropriate to use graduated point symbols; this would also avoid the problem of large areas being disproportionately dominant on maps. For GP practice and hospital data, the survey found that scaling the points by size and colour assisted the interpreter to identify priority areas. In order to maintain cartographic integrity it has been recommended that when percentages or rates are plotted then the points should be shaded by colour and when counts are plotted then the size

of the points should be proportional to the value. As a Public Health Research Specialist indicated, "Using two forms of incremental display to represent a single indicator is confusing."

Data classification can also influence interpretation. Look at Figures 5 and 6 and notice how data is grouped or "classified" differently. Both maps give a different picture of the data. Figure 1 would assist in assessing overall performance, but if the map was created to assess the local area, then Figure 6 may be more useful. Classification depends not only on the data distribution but the question that the map is created to answer, as well as providing an appropriate level of detail. It was clear from responses that a classification based on national, regional and local averages would be useful for a variety of tasks, including performance assessment. A health economist said, "I absolutely must have some kind of benchmark when looking at performance data. Without this, we cannot know whether we are good or bad. Performance data is meaningless without context."
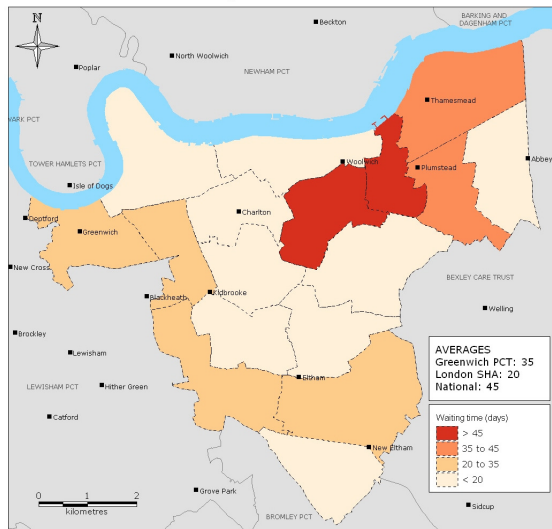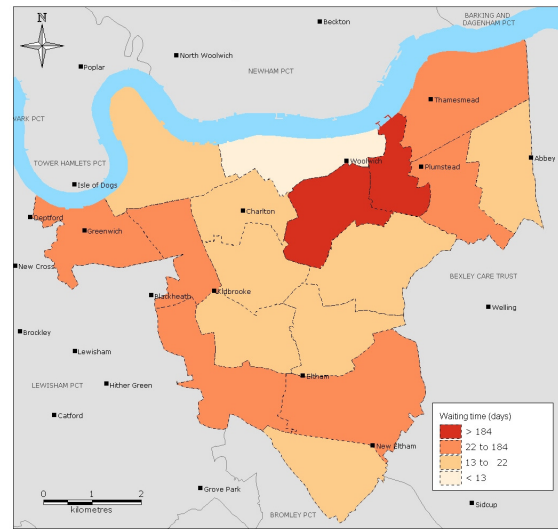

Figure 5

Figure 6

Conclusions

PCTs and GPs in the NHS routinely access patient information for commissioning decisions, quality assessment and local and national accountability. Dr Foster Intelligence has developed a suite of products that allow commissioners to access the Hospital Episodes Statistics (HES) database through the internet. The tools currently allow users to tabulate and chart the data, but functionality has now been added which allows the user to map the data.

This paper goes some way to illustrating the usefulness of maps in the health care industry. The contribution maps can make to commissioning decisions for the NHS is irrefutable, since they provide a visually powerful representation of local health needs. In this research a variety of mapping techniques were used to present the same data. A survey of the relevant health professionals enabled the identification of those representations that would be most useful for commissioning decision making above and beyond what is currently used. The results of this research are directly influencing the development of practical information products used to deliver data in the NHS.