Abstract

It is now universally accepted that an effective primary health care system plays a crucial role in managing the rapidly increasing demand pressures on the acute and residential sectors of the health system, as well as improving the general well-being of individuals and communities. Furthermore there is considerable evidence that partnerships and collaborative action are very important in the planning, coordination and delivery of primary health services and facilities.

The Victorian Government, Australia has adopted better primary health care as an important priority and adopted a Primary Care Partnership Strategy to develop this cooperative and collaborative approach. There are 31 Primary Care Partnerships across Victoria in which more than 800 service providers have established voluntary alliances called Primary Care Partnerships (PCPs). The Lower Hume PCP brings together four hospitals, two community health services, two local government authorities, two family care services, a mental health agency, and a range of local community service providers. Its geographic area is within the shires of Mitchell and Murrindindi, rural areas totalling 6,735 sq kms and a population of 45,000 across two municipalities.

The development of efficient SDI and GIS aims to enable ready and effective access and use of the large number of health and community services data sets and technology assets of the collaborating agencies and the general community. SDI/GIS was seen as offering a strategic means of developing and strengthening the complex partnership to encourage effective collaboration on a range of important health projects, and it also presented an opportunity to derive substantial additional clinical, economic and community benefits from large under-used data sources.

Keywords: Primary Health Care, Spatial Data Infrastructure, Geographical Information Systems
1. INTRODUCTION

Health organisations in Australia are under increasing pressure to rationalise resources, predict health problems and to improve their ability to “know” how to act and where to target scarce resources. In particular they require the ability to evaluate accessibility of health services and barriers to healthcare delivery; to be able to model the demand for services and to investigate the distribution of health care facilities, services and providers. Each of these functions is related to location and involves using the spatial dimension of the data for analysis. This research builds on the concept of Spatial Data Infrastructures (SDI) which is widely recognised as a framework for governing the data, people and technologies and can potentially be used to design the processes of spatial data access and management of spatial information (Williamson et al., 2002). This is now a priority of the health sector, particularly in Victoria and at the national level.

The improvement in spatial technologies have developed significantly over recent years with applications such as Google Earth, Virtual Earth and in car navigation systems all providing ready access to spatial information (SISL., 2008). However despite best efforts, application of spatial information in the health sector in Victoria has been ad hoc and uncoordinated. Without an effective management framework silo-based departments and agencies have been hampered in their attempts to harmonise datasets and fully utilise the latest technological advances.

The solution proposed within this research project involves the development of a SDI and GIS platform to facilitate data harmonization between health and government agencies in the Mitchell and Murrindindi Shires. A number of agencies in the region have data which can potentially be spatially enabled and integrated to improve health service planning in the region. The project is being monitored by the Victorian Government as it may provide a model for effective area planning of health services by the large number of health and community services within a particular area.

The paper is organised into the following three main sections. Section 1 provides a background and motivation for the research. Section 2 outlines the approach and provides two examples where the research could be applied to improve the efficiency of health services in the region. Section 3 provides the future directions in the form of a Spatial Data Road map, which sets out the guidelines for the spatial enablement of consistent, up-to-date and effectively managed health data.

1.1 Background

Australia, like most countries around the world, is facing very alarming increases in the cost of maintaining, let alone improving, the population’s health. In Australia, for example, expenditure on health, including residential aged care, currently accounts for about 9.4% of GDP and this is expected to increase to 12.4% in less than 20 years (Goss 2008). In other words, it is anticipated that one in every eight dollars spent in Australia will be directed to health.

This disturbing trend is largely a result of an ageing population, the increase of chronic disease (mostly lifestyle caused and significantly preventable), and skilled health workforce shortages. The Australian Government has recognised that, without significant change to our health system, Australians will all spend more and achieve less. It has therefore initiated a sweeping review of the entire health system and an interim report has just been released (National Health & Hospitals Reform Commission 2008).

The report makes a number of important observations and recommendations. First, it clearly confirms the now universally accepted position that an effective primary health care system plays a crucial role in managing the rapidly increasing demand pressures on the acute and residential sectors of the health system - as well as improving the general well-
being of individuals and communities. This is the principle of building a fence at the top of the cliff rather than providing a fleet of ambulances at the base of the cliff.

The report also provides considerable evidence that partnerships and collaborative action are very important in the planning, coordination and delivery of health services and facilities. Scarce health resources are best used when they are shared and used in a coordinated manner.

These conclusions support the approach of the State Government of Victoria which seven years ago had adopted better primary health care as an important priority and implemented a Primary Care Partnership Strategy to develop this cooperative and collaborative approach. There are now 31 Primary Care Partnerships across Victoria in which more than 800 service providers have established voluntary alliances called Primary Care Partnerships (PCPs). The Lower Hume PCP brings together four hospitals, two community health services, two local government authorities, two family care services, a mental health agency, and a range of local community service providers. Its geographic area is within the shires of Mitchell and Murrindindi, rural areas totalling 6,735 sq kms with a population of 45,000 across two municipalities.

There were several key reasons why the proposal to introduce SDI and GIS to the PCP operations was developed. First, voluntary partnerships involving a large number of disparate organisations are difficult to develop and maintain. The PCP partners have different objectives, structures, financial arrangements, and operating procedures. Some, like the hospitals, are relatively large publicly funded organisations while others, like a local mental health support group, may be quite small and independent. An important key to effective collaboration is to ensure that all participating agencies shared their data and information in a trusting and cooperative manner.

Secondly, the PCPs are being encouraged to undertake more area planning of health services within their region. This focus on geography meant that uniform spatial data was necessary and accessible in a form that could be used by all partner agencies.

A third incentive for introducing SDI/GIS was the perceived need to empower the local community to better understand health issues and to take more responsibility for the maintenance of their own health and well-being. The Australian Government’s health review report stated:

*We encourage all relevant groups (including health services, health professionals, non-government organisations, media, private health insurers and governments) to provide access to evidence-based, consumer-friendly information that supports people in making healthy choices and in better understanding and making decisions about their use of health services* (National Health & Hospitals Reform Commission (2008). *A healthier future for all Australians*)

This meant that it was necessary to be able to present a great deal of data and information to the general community in a form that meant sense to them and, most important, related to their own specific location.

### 1.2 The opportunity

The health sector overall is data rich with extensive data (including spatial data) collected and submitted by the agencies. However, the large number of private and public agencies involved has few common data systems and, even within some agencies, the data systems are fragmented and differently formatted. This lack of coordination of data sets and protocols for the sharing of data sets means that the agencies do not have a systematic knowledge of all partners’ resources and services - and certainly the general public do not have this knowledge.
Furthermore, it is increasingly recognised that a person’s well-being (health) is determined by the environment in which he/she lives. Matters such as good housing, safe and accessible transport, decent employment, pleasant open space, good education, freedom from persecution, good air quality, and so on are the factors that really determine one’s health – not just the availability of a hospital nearby. This implies the need for data on a very wide range of issues and from many non-health organisations and timely and efficient access to such data by both the health services providers and the general community.

Although a great deal of valuable spatial information is available within health agencies, very little use is made of it. Certainly there are valid concerns with such issues as privacy, but in general there are clearly significant opportunities to make capitalise on this data for the benefit of all concerned.

In summary SDI was identified as a strategic framework for developing and strengthening the complex partnership to permit effective collaboration on a range of important health projects, it also presented an opportunity to derive substantial additional clinical, economic and community benefits from a large under-used data source.

1.2 The solution

The proposed solution for the harmonisation of data integration and reporting is a well developed Health Spatial Data Infrastructure (SDI). The vision for the Health SDI is to provide a highly accessible framework for linking users (community) with health service providers. The Health-SDI comprises the people, policies and technologies to enable the use of spatially referenced data through health agencies, hospitals, local government, the private sector, non-profit organisations, academia and ultimately the community.

The Health SDI architecture is to deploy interoperable services that assist users to produce and publish, find and access, and eventually, analyse, use and understand geographic information over the internet across the LHPCP region. The aim is to ensure that agencies have a good understanding and appreciation of the power and effectiveness of SDI and GIS technology. Once the people, policies and technology are in place the system should be readily accessed for a range of practical and cost-effective purposes. The following section outlines the approach taken in the development of the system.

2. APPROACH

The approach engaged in this project involves two components: the first is the management phase in which stakeholders from the region were invited to learn, exchange and share data as well as to articulate projects for which spatial data could be used. The second is to develop a technical solution for combining public health, hospital, census and geographic data of the two shires Mitchell and Murrindindi. By under-taking these two components in unison the project aimed to provide both a framework for ongoing collaboration as well as a platform for visualising service availability, population location and characteristics. The following section outlines the tasks undertaken.

2.1 Development Stages

The approach involves the development of a spatial platform delivered using GIS technology and governed by SDI principles. Error! Reference source not found. illustrates the development stages.
1. **Project Preparation**
   To begin, the team reviewed current literature on health applications which utilise spatial data. Investigations were also conducted to identify relevant project partners and data custodians. This information was then used as the basis of the initial consultation seminar.

2. **Consultation seminar**
   The introductory seminar was held for members of the LHPCP, Department of Human Services (DHS), University of Melbourne Department of Rural Health, and Mitchell and Murrindindi Shire Councils. The aim of the seminar was to provide information on spatial information and SDIs, the requirements for their development and the potential applications for which they can be used.

3. **Concept design, Data Collection and Integration.**
   This phase was conducted jointly between the Centre and the LHPCP. Through this process numerous datasets were collected, formatted and integrated into the platform. Because of limited resources and policy issues, it was not possible to collect all the datasets identified at the outset of the project. Figure 2 is a conceptual model of the integration of data within the
spatial platform for health. The databases represent data custodians who routinely collect spatial data. For example hospitals routinely collect data on patient addresses, symptoms and treatments. The Australian Bureau of Statistics (ABS) collects data on the age and incomes of the general community. Integrating these data sets and visualising them spatially can provide greater understanding on the distribution of health characteristics across the study area. This information is of particular value for planning services and resources across the region.

In this project the datasets collected were formatted into shape file (.shp) format. These layers have been entered into ArcGIS for visualisation, analysis and interrogation of the data. The data can also be exported into MapInfo (mid/mif), the platform used by the two local government councils (Mitchell and Murrindindi). However due to the prohibitive cost of ESRI and MapInfo software for the community and health sectors, open source software systems have been investigated as alternatives (please refer to the website http://opensourcegis.org/ for a full list of open source GIS software). A number of these systems use the same data formats and will enable data integration and analysis without the barriers associated with cost. It is important to note that some of the open source software options have been developed specifically for the analysis of health data.

5. System testing and implementation

System testing has taken place as an iterative process. As the spatial data layers are added into the system and analysed they have been presented in reports and presentations. System implementation is currently in progress and the process for integrating the data layers into existing GIS systems being used by the local councils is underway. Additionally as the research phase is being distributed the benefits are being recognised and funding from relevant agencies is being sought.

2.3 Limitations
For the system to reach its fully potential mechanisms are required to ensure security and confidentiality of health data. In the first instance this will involve the de-identification of records, in the second the process relates to thoroughly testing the advantages and disadvantages of the mapping techniques such as the aggregation of data into larger spatial units, appropriate scale mapping and the use of techniques for randomisation or applying ‘geographical masks’ (Gutmann and Stern 2007).

3. FUTURE DIRECTIONS

This initial stage of the project has achieved satisfactory technical results. The further development of the system will proceed according to a work program that is under preparation. Figure 3 outlines the main areas of work involved in developing the program.

Figure 3. SDI Model

3.1 Technical

Due to the needs for data access and data integration, technical components and associated non-technical issues will be considered together. The overall components in the health SDI environment would be: system for data discovery and access, metadata repository through data catalogue or as part of data clearinghouse system (in this case, the metadata and data will be accessed through spatial databases). In addition, the data from different data providers will be integrated using agreed standards and specifications and also data interoperability among different databases and systems needs to be examined. With this in mind, the characteristics of the design of an effective SDI should include:

- The system needs to be easy to use and access,
- Security controls such as passwords need to be in place.
• The system must facilitate the integration of data from a variety of data custodians.
• The system needs to be flexible so that additional datasets and analysis functionality can be added in as they become available.

3.2 Institutional

Organisational requirements for agencies which collect health data include:
• An assessment of datasets which have the potential to be geographically referenced and included in the platform.
• Once datasets are identified the metadata needs to be documented. This will describe the procedure for accessing the data, updating the data, primary purpose of data collection and the data privacy requirements.
• The SDI development provides an opportunity to assess efficiency and effectiveness of the current data management practices of participating agencies.
• Develop a training program to improve awareness and to facilitate the uptake of new technology.
• Agencies need to be supported with training in the use of spatial information and provided with access to the system.

3.3 Legal

There are situations where legislation impacts on data access and policies will be developed regarding the data cost, security and confidentiality. Methods for protecting confidentiality include: de-identification of records, display scale, data aggregation and randomisation.

3.4 Social

SDI is about sharing and cooperation between different people within and across different disciplines in spatial data communities. It is important that there is a clear and positive vision to encourage participation in, and uptake of the system. The system must be supported at senior levels within the LHPCP and by other agencies and by government. This implies an enthusiastic project team and project manager who will motivate and assist agencies, and particularly the smaller organisations, to be appropriately involved. It is fair to say that there was unfortunately not a high level of participation in the initial stage of this project.

It is important to note that the development of the SDI should not occur in isolation. In Victoria we are fortunate that the state government has developed the Victorian Spatial Information Strategy (VSIS) 2008-2010 (Victorian Spatial Council 2008). The VSIS could be used to guide the development of policies covering a range of issues described above (ie. governance, custodianship, data quality, metadata, awareness, access pricing, and licensing, privacy; and strategic development).
4. CONCLUSION

To date the development is very promising. Good progress has been made in respect of the technical aspects of the project, and the major challenges ahead relate to the institutional and social development of the system. Issues like facilitating different data formats and data models, dealing with new institutional settings, reconciling different privacy requirements, collaborating on different pricing regimes, coordinating health SDI with wider government spatial policies and strategies, and so on will be researched in later stages of the research.

While the geographic area of the project is quite large, the population of the region is relatively small and scattered and resources to develop and manage the project are not substantial. Furthermore, senior officers of the partnership need more exposure to the operational and economic benefits of the system so that they have more confidence in using it and taking more initiative in working with it. Similarly, the advantages of sharing data sets also needs to be experienced so that a higher level of collaboration is developed.

The data access protocols and procedures in participating agencies will be a major focus for the next phase of the project. This has been a significant constraint and will need to be given high priority now.

The administration of the project will be reviewed to achieve a higher level of “local ownership” and a local project manager will be appointed to drive the project and especially establish and maintain the relationships necessary to ensure the success of the initiative.

REFERENCES