Paul Grinzi
MBBS, BMedSci, DipDerm(Cardiff), is Honorary Lecturer and Masters student, Department of General Practice, University of Melbourne, Victoria. pgrinzi@unimelb.edu.au

Andrew Bazemore
MD, MPH, is Assistant Director, The Robert Graham Center: Policy Studies in Family Medicine and Primary Care, Washington DC, USA.

Robert L Phillips Jr
MD, MSPH, is Director, The Robert Graham Center: Policy Studies in Family Medicine and Primary Care, Washington DC, USA.

Navigating general practice

The use of geographic information systems

Geographic information systems (GIS) are powerful tools for managing, analysing and mapping geographical and associated data. In the health care setting, GIS can be used to map and graph health care provider and social and environmental data. This article uses two hypothetical cases to explore applications of GIS in general practice.

In 1854, John Snow traced the London cholera epidemic to the Broad Street pump. Since this time, western health systems have employed the power of mapped data to inform health decision making.

Modern computing advances have increased our capacity to interact with data since Snow's day. Current spatial analytic capacity using geographic information systems far exceeds its uptake; the health care sector in particular lags behind its peers. Australia's primary care sector shows minimal adoption of this valuable technology.[1]

How GIS works

A geographic information system (GIS) is a software system for managing, analysing and mapping geographical and associated data. In the health care setting, GIS can be used to locate health care, social and environmental parameters relative to each other, allowing easier identification and interpretation of these links. Source information is of two types: geospatial (mapping) and thematic data (*Figure 1*). Geocoding allows thematic data to be displayed on a map (dot mapped) or summed by geographic unit (eg. postcode, census areas, division of general practice region). Results are shown on a map and a histogram.[2]

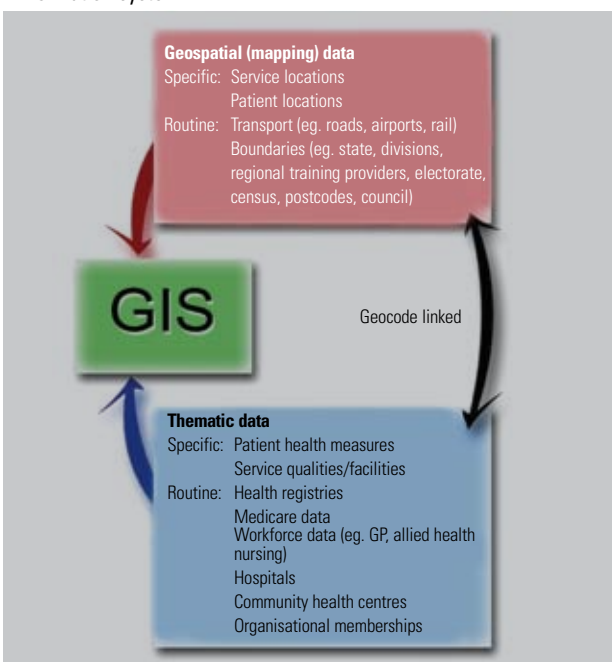
GIS in general practice

Australia is continually developing GIS systems for universal usage. The current literature on GIS in Australian health care chiefly relates to public health applications,[2] with only a handful of studies examining GIS in general practice.[3–5] However, some important resources are already available for practice and individual use.

The role of GIS in general practice includes:

- investigating clinic-population relationships such as defining a practice's 'true community'
- mapping and analysing patterns of disease and population demographics
- identifying and analysing the location of various aspects of the workforce.

Figure 1. Geospatial and thematic data for entry into a geographic information system



When designing patient education and intervention programs in particular, it would be useful for general practices to have a geographic understanding of the residential and sociodemographic patterns of their patients. This would help practices to characterise their community, prioritise problems, and design and monitor interventions.

Case study 1

Dr X has arranged for Mrs A to return for a review appointment at Northsouth Eastwest medical centre. At Mrs A's last visit, Dr X noted that Mrs A's diabetes care was poor, despite referrals to a podiatrist, an optometrist, and a visiting diabetes educator. Dr X suspects she has not attended all of these appointments. He now also wants to arrange physiotherapy for her painful shoulder and a visit to the local clinical psychologist after a recent worsening of her longstanding obsessive compulsive disorder.

Dr X is new to the area. He wonders where he will find providers willing to see Mrs A, and whether Mrs A would be more inclined to keep her appointments if the providers were located closer to her home. He wants to avoid time spent fumbling around in front of his patient, telephone book in hand, looking for a suitable allied health provider. There has to be a better way.

How GIS helped

Dr X in *Case study 1* asked his colleagues to help him trim the local general practice division's list of providers to a few key names. He asked about their referral preferences, and prioritised each provider according to reputation and likelihood of taking his patient. However, being new to the area, he still had no idea where they were located.

Dr X manually entered the contact details into an online mapping service (*Table 1*). This allowed him to generate a customised map, with symbols colour coded from his priority list. He used this map to inform shared decision making with Mrs A, choosing providers that were more accessible to Mrs A (assuming distance had originally been a barrier for her) but still desirable to Dr X (according to the opinions of his colleagues) (*Figure 2*).

Figure 2. Use of an online mapping service to find most suitable diabetes care provider (Case study 1)

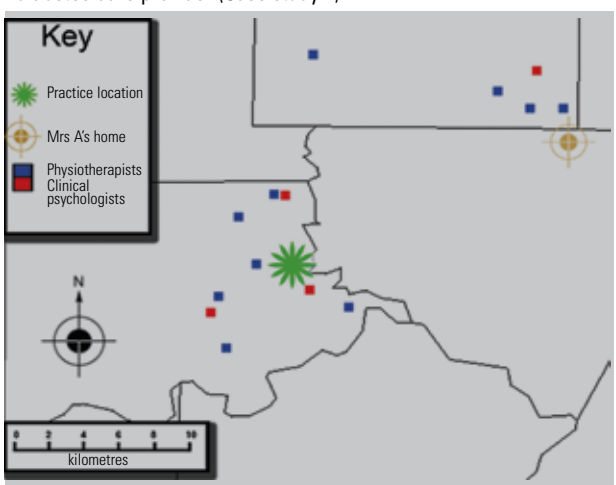
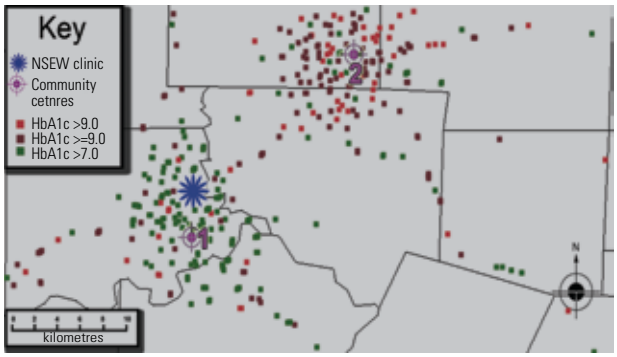


Figure 3. Use of mapping software and electronic records to show 'poorly controlled' diabetic patients in relation to health care resources (Case study 1)



Dr X's experience with Mrs A led him to consider other factors which might influence the care of his diabetic patients. He approached his colleagues about this experience with Mrs A. His senior colleagues showed him a recent practice audit which showed that diabetic control in their patient population had been slowly worsening. At the weekly practice meeting, partners noted that community wide survey data about their patients was unavailable and data gathering could not be undertaken given the practice's finances.

Dr X remembered the lessons of Dr John Snow. He asked his partners to send him to a course in the use of a simple mapping software tool. He then used the practice's electronic record database to create a map of all of their patients, showing where the diabetic patients, the 'poorly controlled' diabetic patients (patients with glycated haemoglobin [HbA1c] >9.0) and local health care resources were located (*Figure 3*). These and other maps showed that most of the poorly controlled diabetic patients were from poorer neighbourhoods with limited options for healthy food purchases, and distant from the referral resources they required.

Practice partners decided to 'go to the masses' and provide a community presentation about diabetes and lifestyle preventive measures. They used a map of the practice's catchment zone to determine where to hold the presentations. The clinic arranged the community presentation at 'community centre 2', as this was located where the diabetes problem was greatest. Better coordinating team care arrangements and additional outreach and education programs were delivered to patients in these areas.

A year later, the practice witnessed clinically significant improvements in their patients' diabetic control, with average HbA1c levels dropping by over 1%. Partners used this technology to learn about other issues with health implications for their patient community, which they used to direct additional outreach efforts, population studies, and evaluations of current community care measures.

Table 1. Characteristics of selected data sources and online mapping services

Resources	Cost	Ease of use	Pros	Cons	Notes
Conventional sources (eg. word of mouth, telephone book)	Free	NA	Immediate access, adds qualitative information	Not always available/ complete/reliable	Current practice for most GPs
Practice audit	Tools included in medical software Personnel (ie. costs related to audit)	Software and expertise dependant	Specific to practice population	Time, data entry dependant	
Division/practice generated contact list	Free/membership	Simple to use	Accessible, locally specific, often vetted for 'quality providers'	May be out of date, dependant on data entry	
Workforce agency data	Free	Depends on data and format	Specific advice	Limited to workforce data (often rural only)	www.rhwa.org.au
Census data	Free	Time required to extract relevant data	Accurate population specific data	Up to 5–6 years old, hard to access local data	www.abs.gov.au
Australian Institute of Health and Welfare	Free	Time required to extract relevant data	Accurate health specific data	Not locally specific	www.aihw.gov.au
Public Health Information Development Unit	Free	Time required to extract relevant data	Some mapping available, locally specific	Limited to public health related data	www.publichealth.gov.au
Internet mapping sites	Free (registration required)	Minimal internet experience required, simple user interfaces	Provides visual map, easy to add point entries to map, private or public	Not suitable for large datasets, some time required to upload local data	Wherels (whereis.com.au), Google Maps (maps.google.com), Yahoo! Maps (maps.yahoo.com), Microsoft Live Search Maps (maps.live.com), MapQuest (www.mapquest.com)
Internet geocaching application	$20 ('plus'), $400 ('pro') (see notes)	Some learning required (can be 'self taught')	Allows larger datasets to be uploaded (compared with mapping sites)	Small to medium cost, some expertise required	GoogleEarth Plus and GoogleEarth Pro (earth.google.com)
Desktop GIS software	Variable ($100s–10 000s)	Requires training	Customisable, data analysis, richness of detail, suitable for universal interorganisational use	Cost, time, expertise	Examples include ArcGIS, Maptitude
Next steps: web based GIS applications specific to primary care and health	Ideally developed for large scale use at low cost to providers	Friendly web interface minimises training requirements	Customisability, easy access, stores user data and maps for ready recall	Just beginning to be imagined and developed	Examples include HealthLandscape (www.healthlandscape.org), which is currently being tested for use in the USA

Case study 2

Dr Y is starting to prepare for her first general practice position as part of her registrar training. She has developed a strong interest in obesity management and paediatric care in her hospital years and is excited about the prospect of seeing her own patients in a community setting. The next step is working out where to apply for her basic term job.

To get the most out of her training, Dr Y wants to find a practice in a location with a high prevalence of young families and obese patients. She has a 'gut feeling' about where these populations might live, but doesn't know for certain.

How GIS might help

Until recently, doctors didn't have any reliable resources with which to make career planning decisions. The Australian census data doesn't include population health data, and there has never been a universal health related household survey. Options for Dr Y include asking the target practices about their patient bases, although different practices audit their populations differently, if at all. Local councils and shires could provide information about local age distribution, but wouldn't have data on health parameters such as body mass index.

Using obesity prevalence data from the government's public health website, it is possible to map this information with a GIS desktop application to produce a map (*Figure 4*) that would make Dr Y's decision much easier. Such a map shows that 'practice 1' fits Dr Y's criteria better than the other two options.

Conclusion

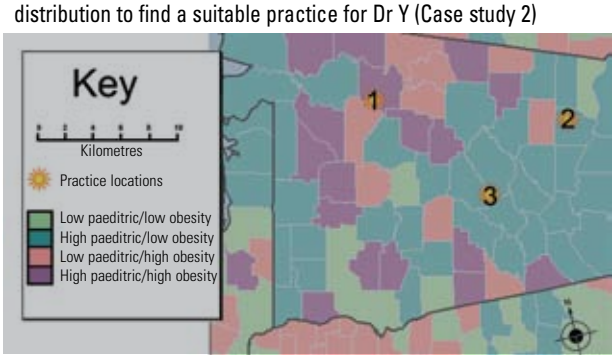
We are just beginning to tap into the power of GIS to help primary care providers improve care delivery and better understand patients and the community. A geographic information system is a tool that allows us to 'see' our communities differently. The hypothetical case studies show how GIS can help inform decisions at individual and population levels, as well as assisting with workforce planning. Geographic information systems have already been utilised in targeting breast cancer screening in the USA,[6] much as Dr X's clinic in *Case study 1* used GIS to target their diabetes interventions.

Geographic information systems, like any tool used to analyse data, have their limitations. Applying GIS to community based practices is a relatively new phenomenon, and the effectiveness and cost-benefit of investment has not yet been explored. However, there are inexpensive alternatives currently available in Australia (*Table 1*).

The quality of the output from GIS software depends on the quality and nature of the geocoded data. For a practice to use its electronic medical records to identify target patients (*Case study 1*), the data must exist, be entered correctly, and must be extracted efficiently. The power of GIS may provide practices with an incentive to ensure their data entry and coding practices become more efficient.

Experiments abroad such as HealthMap (www.healthmap.org) and HealthLandscape (www.healthlandscape.org) are revealing the potential of web based GIS. Customising and integrating these resources into health information technology in primary care practice offers great potential for Australian GPs.

Figure 4. Use of obesity prevalence data and council/shire age distribution to find a suitable practice for Dr Y (Case study 2)



Implications for general practice

- Geographic information systems and assembly of relevant geographically identified datasets offer the capacity to identify and depict areas of need and to inform decision making.
- There are a number of free, online resources that can facilitate georeferencing data. They require minimum time and effort. To use these resources, users need access to relevant data and some expertise in using the programs.
- Geographic information systems are expanding globally in the area of health care delivery and we can expect to see significant developments in this area in the near future.
- Centralisation, geographical identification and dissemination of workforce and population health data within a customised platform will help transform Australian general practice information resources.

Conflict of interest: none declared.

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AFP CORRESPONDENCE afp@racgp.org.au