



# GIS and General Practice

*where are we going and  
when will we get there ...?*

A report from the 2007  
APHCRI / Robert Graham Center  
Visiting Fellowship

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# **APHCRI Stream Eight report**

## ***APHCRI / Robert Graham Center Visiting Fellowship***

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January 2008

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*The Australian Primary Health Care Research Institute is supported by a grant  
from the Australian Government Department of Health and Ageing.*

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## ***Executive summary***

### **Introduction**

The report, auspiced by the Australian Primary Health Care Research Institute (APHCRI) Visiting Fellowship Program, focuses on a visit by an APHCRI Fellow to the American Academy of Family Physicians' Robert Graham Center for Policy Studies in the latter part of 2007.

The purposed of the visit, and this report, is to help summarise the current state of Geographic Information Systems (GIS) in health, compare the primary care/general practice workforces of the two countries and focus on a new web-GIS tool, HealthLandscape, developed by the Robert Graham Center.

Thus report will also provide some reflections, from the visit, on future areas of collaboration between APHCRI and the Robert Graham Center.

### **GIS**

GIS, the use of spatial mapping to investigate data, is having increasingly greater impact on the analysis of primary care in both the US and Australia. GIS can link diverse health care, social and environmental parameters to the relationships between these social determinants of health, allowing easier identification and interpretation of these links

Australia's general practice sector though, has not embraced this technology to the same extent at the US, and has been utilising GIS in a more haphazard (and therefore, less efficient) manner.

### **Workforce**

Whilst the application of GIS within primary care can span multiple policy and research areas, this report focuses more so on its application to informing primary care workforce policy.

The general practice/family physician workforces in both countries have significant parallels in both the structure of the training environment and the form and distributional qualities of the workforces. Both counties share similar recent history of apparent oversupply, then maldistribution and now general undersupply. Both countries have also looked at regionalising their respective workforce training programs in the hope this regionalisation equates to better distribution in the longer term. GIS is ideally suited to allowing thorough analysis of these policies. However, at this time Australia lacks the comprehensive, albeit imperfect, physician workforce dataset that U.S. planners and researchers enjoy in the American Medical Association Masterfile\*.

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\* <http://www.ama-assn.org/ama/pub/category/2673.html>

## **HealthLandscape**

HealthLandscape is an interactive web-based mapping tool developed by the Robert Graham Center to look at health and population data including primary care (workforce, service centre and population health data) in visual (maps) or tabular formats. It came about through the integration of two independent pilot projects and funding streams – one looking at physician workforce shortages, physician training program footprints, and community health centre service areas, and the second focusing on mapping population health data.

The end result is a publicly-available, web-based tool that allows the end-user to produce customisable maps of the area of interest from multiple datasets held by the Center. The tool is divided into four modules, each allowing the user to analyse and address differing aspects of primary care.

HealthLandscape's market is as varied as that of primary care. From national policy personnel and planners, academics, and health services, to individual clinicians and the general public, HealthLandscape is a tool that is utilised by a wide range of consumers. The advantages of having HealthLandscape based on the web include accessibility and customisability.

HealthLandscape took three years and almost half a million US dollars to develop using limited but dedicated staffing and contract coding/programming (US\$125,000). It combines the capacity to upload and geocode spatial data (though *US Streetmap*, part of the *ArcView* software) with the ability to create maps and conduct analyses using thematic and point data. The latter data is obtained from assorted sources, including the US AMA Masterfile, the US Census, national health surveys, proprietary or modified files, plus data from specific community health services sources such as primary care clinics. Perhaps most importantly, it permits a novice GIS user to upload, geocode and integrate their own data into the mapmaking or analytic process.

## **GIS in Australian General Practice**

GIS has been used in Australian general practice, albeit in fragmented and diverse manners. There have been a few research and pilot projects using GIS within primary care, in addition to some (primarily in-house) usage by some organisations such as the Australian Government's medical Workforce division. This usage has been both fragmented and wasteful in terms of duplicated effort and resources.

Australian general practice already has significant infrastructure in place to permit more universal use of GIS, such as electronic health records, publically available census data, widespread internet access and use. Despite this, there are barriers to the uptake of GIS that would need to be addressed and overcome. These include improving the type and access to the available data.

Concerns about privacy are real, but are surmountable with appropriate systems in place. Australia lacks reliable morbidity data, in addition to significant data at the local level, although the efforts of the Public Health Information Development Unit has begun addressing these issues.

Another issue that would need to be addressed is that of ownership of proprietary data and 'ownership' of a possible collaborative GIS tool (such as HealthLandscape) within Australia. Inter-organisation and political barriers need to be overcome to allow the benefits of the creation of new datasets, 'awakening' previously dormant data, and allowing for combining of data currently used for independent purposes.

### **Future APHCRI/Robert Graham Center collaborative opportunities**

Both organisations involved in this Visiting Fellowship have core missions and domains that are well aligned. The organisations are structured differently but have the opportunity to learn from each other, especially in the areas of GIS, mental health, the 'medical home', primary care workforce, preventative health, electronic health and primary care teams.

## **Introduction**

He had brought a large map representing the sea,  
Without the least vestige of land;  
And the crew were much pleased when they found it to be  
A map they could all understand.  
- Lewis Carroll, The Hunting of the Snark<sup>1</sup>

Negotiating the Australian and US health systems can feel a bit like being lost out at sea. Whilst there are many similarities between the two countries, the differences can seem overwhelming. Whether one is trying to interpret the subtleties, or attempting to explain the 'big picture', one often finds oneself wishing for a navigational aid; a map.

The author, an Australian general practice registrar, funded by the Australian Primary Health Care Research Institute (APHCRI) Visiting Fellowship Program, spent six weeks with the American Academy of Family Physicians' Robert Graham Center for Policy Studies (the Robert Graham Center) in the latter part of 2007. During this immersion experience, the Fellow investigated U.S. primary care workforce studies and their dissemination, and specifically the use of Geographic Information Systems (GIS) to inform workforce dialogue.

APHCRI is an initiative of the Australian Government, established in 2003 as part of the Primary Health Care Research, Evaluation and Development (PHC RED) strategy. The mission of APHCRI is to *"Provide national leadership in improving the quality and effectiveness of primary health care through the conduct of high quality priority-driven research and the support and promotion of best practice. It focuses on important sectoral questions relating to the organisation, financing, delivery and performance of primary health care, including its interaction with public health and the secondary and tertiary health care sectors."*<sup>2</sup>

The Robert Graham Center was established by the American Academy of Family Physicians ten years ago, to improve individual and population health by enhancing the delivery of primary care. The Center *"aims to achieve this mission through the generation or synthesis of evidence that brings a family medicine and primary care perspective to health policy deliberations from the local to international levels"*.<sup>3</sup>

This report will summarise the current state of GIS in health, compare the primary care/general practice workforces of the two countries and focus on a new tool, HealthLandscape, which may assist us in navigating the health systems in which we live, so that we can understand and therefore plan them in an enhanced manner. While this report will touch on other areas of health in which GIS can be utilised (such as public health, health access etc), the primary focus for the examples given will be concerning medical workforce

issues. In addition to reporting on HealthLandscape and GIS, this report will conclude by outlining ideas and project topics that are aligned between APHCRI and the Robert Graham Center, with a view to possible future collaborations between these two primary care research organisations.

## **Geographic Information Systems**

*“A geographic information system (GIS) is an automated system for the capture, storage, retrieval, analysis, and display of spatial data.”<sup>4</sup>*

In layman's terms, GIS is a system to place information (data) on a map (spatial referencing), so that it can be usefully interpreted.

GIS has had a smaller impact within the health sector than many other sectors, such as the environmental, managerial, urban planning, cartographic, criminology, history, and marketing sectors, despite first being documented in the epidemiological/public health work of John Snow in 1854<sup>5</sup>.

The advent of high speed computing and software advances has enabled GIS to become more accessible to a greater number of users, and has also lead to an increase in the methods of use, leading to a resurgence in the uptake of GIS.

## **GIS in Health**

Other than its initial uses for spatial epidemiology, when John Snow famously traced the 1854 London cholera epidemic to the Broad Street pump, the health sector has been slow to uptake GIS systems<sup>6</sup>. This is despite advances in technology facilitating its use over recent decades, leading to the manner of this uptake being described as uncoordinated and unplanned<sup>7</sup>. In a review of GIS in Health<sup>8</sup>, McLafferty describes multiple functions of GIS within the health sector environment. These include organising the spatial environment of health care, analysing relationships to health outcomes and relationships to health access and delivery.

GIS can link diverse health care, social and environmental parameters to the relationships between these social determinants of health, allowing easier identification and interpretation of these links<sup>9</sup>. Maps and other spatial presentation of data can emphasise the geographical dimensions of health, such as identifying vulnerable populations due to location relative to existing health services. GIS has also been used in disaster management (natural and human disasters)<sup>8</sup>; an essential public health topic in today's geopolitical environment.

GIS is also a useful tool for illustrating and understanding health workforce issues, including workforce distribution, location of workforce training and the impact of workforce on population health measures. Its use can even inform workforce policy.



## **GIS in US Primary Health Care**

Within the US primary health care environment, GIS has a more prominent role in a variety of spheres. Primary care epidemiology research dominated early, due to its long history. Uses of spatial analysis to organise US primary care delivery and enable Community Oriented Primary Care by visionaries such as Curtis Hames and Eugene Farley occurred in the 1970s<sup>10, 11</sup>, but it was not until the mid 1990s that GIS-related studies looking at health service spatial accessibility began to emerge<sup>6</sup>.

GIS studies of workforce policy, planning interventions and health care access and utilisation began to emerge in significant numbers in the early part of this decade<sup>12,13</sup>.

In the past few years, the Robert Graham Center, the policy and research division of the American Academy of Family Physician (AAFP), has used GIS to focus on areas such as workforce distribution, health care access, training 'footprints' and health inequalities. Initially, GIS tools were developed that were desktop-based, requiring individualised input and analysis of data, for each research question from a variety of consumers. Targets in their initial mapping efforts included AAFP members and advocates at the local level as well as at the national level as well as policymakers. The Center found that its maps opened doors with policy-makers, who found them visually compelling conversation synopses of difficult issues. They responded to these comments by expanding their spatial analyses and map collections<sup>†</sup>. Additionally, there was a need for increased user customisability and further development, which led to a web-based GIS tool, HealthLandscape (refer page 11, 'HealthLandscape – a new GIS tool used for US primary care').

## **GIS in Australian General Practice research**

Compared to other developed countries such as the UK and USA<sup>6</sup>, Australia's uptake of GIS for the General Practice sector has lagged behind. A look at the current literature which studies GIS within the Australian health care environment revealed the majority of the work to have occurred within the public health sphere<sup>7</sup>, with only a handful of studies in the area of general practice. This is in stark contrast to the volume of information studies in the UK's general practice sector<sup>14</sup>. Australian general practice GIS research projects documented in the literature has been limited<sup>‡</sup>. There are four published studies, which have examined GP workforce distribution and accessibility in a single city (Perth)<sup>15</sup> and rural South Australia<sup>16</sup>, workforce shortage in remote and rural Western Australia<sup>17</sup> and national distribution and access to chronic heart failure facilities<sup>18</sup>. Governmental workforce agencies, such as Australian Medical Workforce Advisory Committee (AMWAC) and the Australian Bureau of Statistics (ABS) have documented geographic

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<sup>†</sup> <http://www.graham-center.org/maps.xml>

<sup>‡</sup> Searching Pubmed and Medline using the search string "GIS OR geographic information system" AND ("general pract\*" OR GP) AND Australia, as at Sept 2007

distribution of the Australia general practice workforce, but the areas that have been studied have remained large, missing potentially richer understanding from using smaller areal units (eg postcodes) or potentially rich data within smaller areal units (ie geo-coded data) <sup>17</sup>.

Aside from published research literature, there have also been some other GIS projects in the Australian general practice setting. In 1997, a pilot project involving two divisions of general practice looked at the issues involved with implementing a GIS tool for use by the general practice workforce <sup>6, 7, 19</sup>. A research thesis focused on mapping of general practitioners in Toowoomba, Queensland has also looked at this area <sup>20</sup>. Most recently, a project using GIS technology has been introduced for individual GP practices within a single division of general practice <sup>21</sup>. Informal communication with the Australian Government's Workforce Distribution Branch of the Department of Health and Ageing have also revealed "use of GIS technology to spatially analyse a wide range of health issues including the location of a range of medical and allied health professionals for the purposes of ascertaining areas of workforce shortage". This analysis has not been disseminated and has remained 'in-house', relatively inaccessible to the public or other stakeholder organisations.

This limited and fragmented approach to GIS within the general practice centre equates to issues of duplication of effort and cost, without any benefit of integration of data to allow for customisable data analysis. It has been a worthwhile exploratory effort that is ripe to expand for general use.

General practice/primary care workforce is an area that has taken parallel courses in both Australia and the US, and is an area where GIS analysis of workforce data can be particularly useful for workforce planners in both countries. In both countries, there has been a recent realisation that medical workforce is an important determinant for the health of communities.

## **Workforce**

### **Australian General Practice Training Workforce**

The Australian General Practice Training Program has changed significantly over the past 5 years in both structure and administration. Namely, the administration of the national training program, which was once the responsibility of the Royal Australia College of General Practitioners (RACGP), is now controlled by General Practice Education & Training (GPET), a company responsible directly to the federal government.

Part of this change has been the regionalisation of the training program, departing from a single centralised administration, to twenty-one (twenty-two prior to 2006) regional training providers (RTPs). These RTPs are self-governing bodies with direct reporting and funding responsibilities to/from GPET. Thus, within the individual budgets, distinct RTPs can generate unique training curricula and delivery methods to accommodate regional variations in need. For example, RTPs to the north of Australia will be more likely to incorporate tropical medicine than the southern regions. There is a recognised shortage of GPs in rural and remote Australia<sup>22</sup>. One of the main reasons for this regionalisation (of administration and content) was to help ensure an active general practice workforce in Australia's rural and regional communities. One area that has not been presently well documented is the success or failure in these changes in retaining young GPs in the regional areas in which they trained.

### **US primary care workforce – comparison with Australia**

Australia and the USA share many similarities in both their physical geography and the geography of their workforce.

In both the US and Australia, there has been a sustained maldistribution of family physicians/general practitioners<sup>23</sup>. In both countries, the 'workforce gap' is greatest in areas of increased rurality<sup>24</sup>. Whilst there are differences between the two nations' health and medical education systems, there are similarities between the Australian General Practice Training program and the US Family Physician residency program, including the structure, gender balance and the recent decline in graduate popularity<sup>25</sup>.

Workforce policy makers in both countries have been working to develop systems to address the workforce maldistribution. In Australia this has recently taken place with the establishment of GPET's regionalised training program. The geographical locations of qualified GPs and GP registrars in Australia have been well described, but little is known about whether the new regionalised training system will equate to a better distribution of the GP workforce, especially in rural areas. The creation of family practice residencies in the US in the 1970s halted the decline of the number of rural GPs, but rural workforce shortages have remained<sup>24</sup>.

### ***HealthLandscape – a new GIS tool used for US primary care***

HealthLandscape<sup>§</sup> is an interactive web-based atlas that has been designed to look at health and population data including primary care (workforce, service centre and population health data) in visual (maps) or tabular formats. It was launched in April 2007 and took 3 years to develop. It came about through the integration of two independent projects – one looking at physician workforce shortages, physician training program footprints, and community health centre service areas, and the second focusing on mapping population health data.

The Robert Graham Center initially produced static maps exploring primary care clinical data in community health centers, as well as depicting the value of the primary care workforce in its training pipeline. These maps were produced for both physician-members and policy makers in all states and territories. The demand soon outpaced the available resources and a decision was made to construct a platform that could be interactively used by the consumer in real-time. Advances in web-based GIS and two visionary funders (the American Academy of Family Physicians and the Health Foundation of Greater Cincinnati) offered a solution.

The end result is a publicly available, web-based tool that allows the end-user to produce customisable maps of the area of interest from multiple datasets held by the Center. HealthLandscape is divided into four main modules: 'Community HealthView', 'Primary Care Atlas', 'My HealthLandscape' and 'Health Center Mapping Tool'. The latter feature remains in pilot testing and is available to a small amount of primary care clinics.

### **Who uses HealthLandscape, and how?**

Since its launch in April 2007, HealthLandscape has registered over 600 new users<sup>\*\*</sup>. As is evident from the brief descriptions of each of the HealthLandscape modules (below, taken from [www.healthlandscape.org](http://www.healthlandscape.org)), there is a wide range of current and potential end-users, or consumers. From the macro (national policy makers) to micro (individual clinicians within a practice), HealthLandscape is currently catering for a wide variety of consumers within the health sector. The Community HealthView module also caters for the general public interested in discovering and analysing their own communities demographic and health data.

One of the benefits of a tool such as HealthLandscape, is that many different consumers (eg academic researchers, health professionals, policy personnel, planners) can generate customisable maps of variable data that reduces duplication of effort and takes advantage of economy of scale.

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<sup>§</sup> [www.healthlandscape.org](http://www.healthlandscape.org)

<sup>\*\*</sup> As of December 2007



## Primary Care Atlas

*The Primary Care Atlas maps Health Professional Shortage Areas (HPSAs<sup>††</sup>), Medicare Physician Scarcity Areas (PSAs), the impact of residency program graduates on regions, the distribution of physicians by specialty (primary care and other), and populations. It is designed for physicians and administrators in primary care clinics, state academies of family physicians, family medicine residency program directors and state primary care associations.*

**Physicians and administrators in primary care clinics** use the Primary Care Atlas to answer questions such as the following:

- Is my clinic located in a Health Professional Shortage Area (HPSA) or Physician Scarcity Area that may be eligible for Medicare bonus payments?

**State academies of family physicians** use the Primary Care Atlas to answer questions such as the following:

- How many counties in my state have no radiologists (or other specialty of interest)?
- What is the ratio of population per [radiologist, other specialty] by [state, county, census area]?
- What regions in my state would become Health Professional Shortage Areas if the existing supply of family physicians were withdrawn? (Refer to Appendix 1 – Comparison of US Health Professional Shortage areas (HPSA): with and without family physicians. page 33 for map).

**Family medicine residency program directors** use the Residency Footprint mapmaker within the Primary Care Atlas to answer questions such as the following:

- What is the distribution of my program's graduates by individual practitioner? (refer to Appendix 2 – George Washington University Family Medicine residency footprint map, page 34 for maps)
- What is the distribution of my program's graduates by state or county?
- How do my program's graduates overlay with existing HPSAs or low-income areas?
- What counties would be HPSAs without my program's graduates?
- In whose political boundaries do these counties lie?

**State Primary Care Associations** use the Primary Care Atlas to answer questions such as the following (refer to Appendix 3 – community health center , page 35 for maps):

- What counties (or other geography) in my area have the highest percentage of Hispanic population?
- Which of these counties are Health Professional Shortage Areas?
- Which have a community health center?
- Where should we place the next community health center?

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<sup>††</sup> HPSA = Health Professional Shortage Area: a US measure of workforce shortage, leading to physician bonus payments – similar to Australian Medicare's outer metropolitan and rural bulk-billing incentive item numbers?

## Community HealthView

*Community HealthView provides the ability to create custom maps and tables of health in communities - depicting populations at risk, health outcomes, and the distribution of health interventions. It is designed for local public health officials and agencies, State health department officials, clinicians and administrators.*

**Local Public Health Officials and Agencies** use Community HealthView to answer questions such as the following:

- As I prepare to embark on a drug use prevention campaign, which neighborhoods should I target?
- In which electorates are the highest rates of low birth weight found?

**State Health Department Officials** use Community HealthView to answer questions such as the following:

- Which counties have the highest infant mortality rate?
- Which of these counties are Health Professional Shortage Areas (HPSA)

**Clinicians and Administrators** use Community HealthView to answer questions such as the following:

- What is the percentage of uninsured patients by census tract in the community served by my clinic?
- How prevalent is drug use in the community served by my clinic?

## My HealthLandscape

*My HealthLandscape is a secure environment for users to upload and geocode their own health-relevant data, display that information with key population, demographic, and economic indicators, and collaborate with others in their organization to create a myriad of informative visual displays. It is designed for any organisation that wishes to utilise HealthLandscape's analysing and mapping tools to look specifically at their local data. The data uploaded into this module is only available to user, via password, and so can include more sensitive data that is inappropriate for public viewing. Data may also be nominated for public use, continually building a useful data repository, and using geography as a common theme for data that might not otherwise be used together to produce understanding.*

## Health Center Mapping Tool

*The Health Center Mapping Tool focuses on Community Health Center or clinic's data about the patients they serve, the core neighborhoods that comprise their service area, and areas with the densest concentrations of patients. There is also the ability to map U.S. Census data to find populations of interest. It is designed for physicians and administrators in Community Health Centers and other clinics, state primary care associations, academic researchers interested in health center populations.*

**Physicians and administrators in Community Health Centers and other clinics** can upload their patient data securely to use the Health Center Mapping Tool to answer questions from their own data such as the following:

- What is my clinic's core service area or penetration rate?
- In whose congressional districts does my service area lie?
- Is my clinic located in a HPSA or Physician Scarcity Area that would make me eligible for (US) Medicare bonus payments?
- Which Census tracts in my service area are most densely populated with African-American women older than 40, so that I can direct my outreach campaign more efficiently?
- Where are my patients with poorly controlled diabetes?
- Am I serving poor neighborhoods in my community and where are there opportunities to let such communities know about our clinic?

## **Structure of HealthLandscape**

### **Software**

HealthLandscape's software platform was developed by the Robert Graham Centre, utilising the ESRI ArcView software program and customized web-interfaces built by a web GIS consultant. The web design was produced in-house, at the Robert Graham Center in conjunction with the American Academy of Family Physician's (AAFP) On-Line Content Division. (Refer Figure 1, page 16)

### **Hardware**

The data is stored on two secured servers, with the second server containing the potentially sensitive data utilised in the My HealthLandscape module (see above), existing behind the primary server. Refer Figure 1, page 16)

### **Funding**

The HealthLandscape project has been jointly funded by the American Academy of Family Physicians and the Health Foundation of Greater Cincinnati, with collaboration from the University of Cincinnati. The estimated total cost of establishing this tool is in the order of US\$300,000-400,000, including personnel, software, design support, data purchasing. The project was directly funded for half of this amount through the two main funding bodies (above) and the Robert Graham Center contributed the remaining personnel costs through its normal services.

### **Personnel**

The HealthLandscape tool is supported by a small number of staff at the Robert Graham Center. Namely, the Center's Assistant Director, Dr Andrew Bazemore with the assistance of the Center's health geographer/biostatistician, a health economist, a senior health policy researcher/sociologist and an off-site website manager.

### **Spatial Data sources**

The source of information about geography (ie administrative boundaries, roads, addresses, etc) comes from 'US Streetmap' module that integrates into the ArcView software. There is an Australian equivalent currently available, *StreetMap Australia*, which is available at significant cost (AUD \$13,000 +GST, at time of writing). Refer to Appendix , page for examples of datasets currently including in HealthLandscape.

### **Thematic Data sources**

The majority of the health workforce dataset comes from the US American Medical Association (AMA) Physician Masterfile<sup>††</sup>. This is data collated from various sources, such as AMA membership information, State and specialty medical board databases (plus other sources), and portrays to account for

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<sup>††</sup> <http://www.ama-assn.org/ama/pub/category/2673.html>

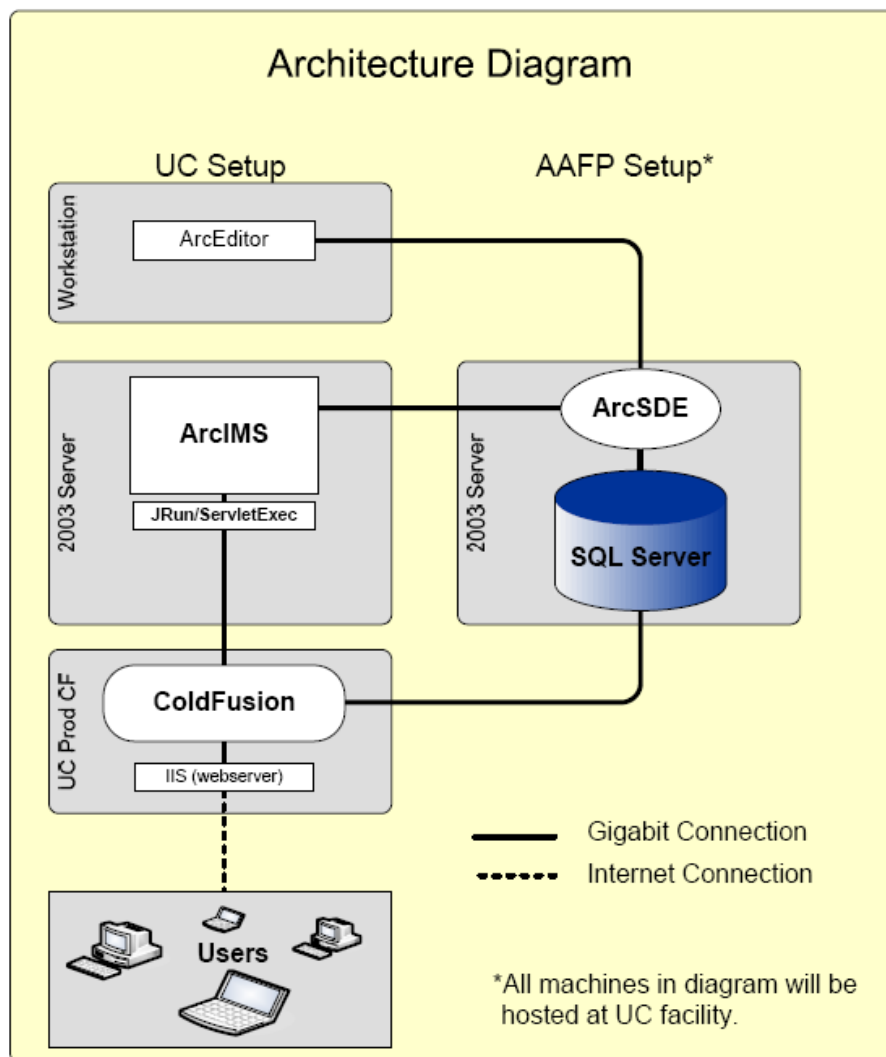


every practising physician in the United States. While it is the most complete physician workforce dataset available, it has been found to be less up-to-date than some local workforce databases.

Population data is sourced from the US Census Bureau, national health surveys and shared community data. Community or health service specific datasets are uploaded by the relevant communities or services.

Since the launch of HealthLandscape early in 2007, this utilisation by communities and subsequent data uploading of previously inaccessible datasets has lead to HealthLandscape being described as a 'data magnet'.

**Figure 1 - GIS software and hardware setup for HealthLandscape**



## ***Discussion - A GIS future in Australian General Practice?***

It is clear the Australian general practice, as a sector of the health system, currently is using and will continue to use GIS into the future. One of the main drawbacks of the current GIS usage is its haphazard uptake, without collaboration between stakeholders. Systems that would facilitate a more accessible and universally used tool, such as electronic health records, publically available census data, widespread internet access and use, are already in place. So what's stopping us?

### **Potential limitations to the development and use of a GIS tool in Australia**

In this section, I outline foreseeable obstacles to developing a similarly-based GIS mapping tool like HealthLandscape, for Australian general practice. I also look to discuss possible methods to overcome some of these limitations.

#### **Current Data limitations**

Concerns about confidentiality and privacy of information and valid and important to address. There needs to be a balance between utilising more detailed, "richer" information<sup>7,6</sup>, and maintaining adequate privacy provisions to ensure compliance with Australian privacy laws. Whilst the US Health Insurance Portability and Accountability Act (HIPAA) legislation<sup>ss</sup> differs in part from Australia's Privacy Act, lessons can be learnt from the US about methods of ensuring privacy concerns are allayed. Namely, HealthLandscape has multiple levels of data security. From a hardware point of view the data is stored across two onsite servers. Both servers are secured, but a key feature is that the software accesses data from a second server that is not directly accessible otherwise. Web access is password-dependant, data transfer/access is via https 128-bit encryption, and new users are registered through the Robert Graham Center allowing for different levels of access, depending on the needs and position of the user. In addition, the language used within the HealthLandscape website requires users to acknowledge their legal and privacy responsibilities. Patient data have a separate off-line agreement process that must be followed to preserve patient confidentiality and make users/uploaders aware of their legal obligations.

In Australia, in contrast to the U. K. and the U.S., there is an unfortunate lack of reliable morbidity data<sup>19</sup>, and availability of data at the local level<sup>6</sup> (which has been described as the biggest gap in Australian health GIS data). Whilst this sort of data is currently gathered in a 'piecemeal' arrangement, coordinated public health datasets are beginning to emerge. The federal Public Health Information Development Unit is currently trailing GIS to map various public health parameters to census data<sup>26</sup>.

The uneven adoption of GIS in health services research is partly a result of structural barriers. Health services research requires spatial data on health

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<sup>ss</sup> <http://www.hhs.gov/ocr/hipaa/>

resources, population, utilization, treatments, and outcomes, and data are often unavailable or provided at different temporal and spatial scales<sup>8</sup>. There are difficulties of integrating geospatial data sets with different boundaries<sup>6</sup>. Whilst there are GIS techniques that try to overcome these barriers (such as averaging or using projection models to fill 'the gaps'), a universally utilized GIS tool, such as HealthLandscape, provides pragmatic incentives to align data collection and data coding to a contrast standard, such as postcodes, census boundaries, or similar well defined scales.

Data on health care utilization and treatments are often proprietary, controlled by health insurers and provider organizations<sup>8</sup>. HealthLandscape has currently worked around this problem by negotiating with such organizations to be able to display the mapped proprietary data, without providing access to the datasets themselves. By allowing 'closed shop' or in-house data to become available to the wider community, US organizations are starting to realize the potential of access to multiple datasets (which allow for greater analyses), improved learning by other sectors such as research organizations, industry bodies, governmental departments and community organisations. Sensitive data which cannot be shared is blocked from this public portal, maintaining the privacy regulations over this data.

Even for public data, there may be problems with compatibility and sharing of information among agencies<sup>8</sup>. The Robert Graham Center has avoided getting mixed up in this sort of organisational politics, but sees a role in allowing HealthLandscape to facilitate discussions between organisations. In some cases, HealthLandscape helps resolve compatibility for some data by using geography as the common element when there are no other linking or common elements between data sets. This reduces duplication, connects the organisations to multiple data sets, and provides them with better access to data, which allows for more efficient dissemination of findings which informs policy.

### **Mapping / GIS limitations**

The variety of geographic classifications that have been used for health data over the last decade including numerous versions of geographic classifications used by national and state authorities<sup>19</sup>. Area-based measures like these have well-known limitations: they work with predefined area units, often political units, and the choice of units strongly affects the results<sup>8</sup>. Like many areas of data and statistics, the quality of the output (ie a map) relies on the quality of the input data. Further information about mapping limitations can be read in the book 'How to Lie with Maps'<sup>27</sup>.

When looking at aspects such as access to service, most area measures do not take into account cross-area travel, an important factor when the area units are small; nor do they assess differences in access within areas, an important factor when the units are large. One of the advantages of GIS is that it can combine spatial information on roads, transportation, and population to

create more accurate measures of geo-graphical separation<sup>8</sup>. This is an analytic process that is currently not available in HealthLandscape; however data can be prepared off-line using traditional GIS desktop software and then loaded into HealthLandscape to display these features. There will always be a role for off-line data preparation to extract more meaning from existing data.

The health systems that are in practice are likely to continue to evolve. For example, the rapid growth of managed care, ambulatory services, telemedicine, and provider networks is fundamentally altering health care delivery with concomitant effects on the spatial organization of health services. Traditional GIS models that describe the spatial behaviors of health care consumers and providers were thought to be unlikely to translate well in the new “digital” health care landscape<sup>8</sup>. For example, when analysing access to health services, traditional mapping may not accurately convey access to telemedicine, although it is not hard to envisage methodologies that would facilitate analysis of these sorts of issues. These connections could be mapped just like phone or power companies map connectivity and grids. In this way, GIS could actually inform how to connect clinics and health centres by telemedicine most efficiently - there are entire companies built on this concept, specifically for mapping internet connections and data flow. This area of technology is known as telegeography, and is beyond the scope of this paper.

### **Utilisation limitations**

As was noted in the Divisions pilot GIS program<sup>7</sup>, “individual activity substantially affects the utilisation of a computer-based system and that organisational stability with respect to personnel is likely to have considerable impact on the uptake of a system across an organization”. Constraints on time to learn about the tool can be a hindrance to the use of desktop GIS (due to a loss in skill confidence, for example) and periodic changes of work priorities can result in staff being distracted from exploring GIS. This ‘vicious cycle’ can work in reverse though, provided that web-based platform is designed to make the process as easy as possible for the beginning user. With further use, confidence may grow leading to increased utilisation. The US experience suggests that a pragmatic demonstration can allay many fears and actually encourage non-users to integrate their own datasets and begin the process of maximizing the benefits of HealthLandscape. The web-based tool also has a much easier learning curve than desktop software, due the flexibility of designing the software’s user interface.

### **Cost**

A HealthLandscape-type mapping tool has been estimated to cost around AUD\$500,000 to develop from ‘scratch’, plus ongoing software licensing and software development fees. However, with the benefit of a US pilot and many lessons learned in its development, it is highly likely that development of a new tool would achieve many efficiencies. A tremendous cost saving could occur through modification of the existing US HealthLandscape platform, for



Australia is estimated, (though estimating the actual cost is beyond the scope of this document). This cost outlay is likely to be prohibitive for most organizations, but collaboration amongst the major stakeholders would make this possible, as occurred in the US.

HealthLandscape is not currently used as a revenue stream for AAFP or the Health Foundation of Greater Cincinnati. Whilst there are certain charges for certain types of use, this revenue is used to fund the maintenance of the tool and is not currently a profit-making business enterprise.

### **Ownership**

The issue of ownership of such a GIS tool is a difficult barrier to overcome within the existing Australian general practice geopolitical landscape. Data ownership remains with the organisation that collects the information, but they would need to agree for the data to be used by HealthLandscape's users. However, data use agreements may be sufficient to overcome such issues. HealthLandscape currently uses a number of datasets under such agreements. Ownership of the actual GIS tool is a more difficult issue. In the US, HealthLandscape is a resource established and maintained by the Robert Graham Center, the policy and research division of the AAFP and the Health Foundation of Greater Cincinnati. HealthLandscape is designed to focus on US primary care - an ideal strongly aligned with the Robert Graham Center's mission. In Australia, no similar organisation yet exists, although one could argue that organisations such as the RACGP, APHCRI and/or the AGPN all have significant and legitimate roles to play in the future of Australian general practice GIS. Such organisations would need to have the collective or individual will, financing, and wherewithal to lend to such an endeavour, and might benefit from shared development and administration of such a tool.

### **Potential Australian GP Data sources**

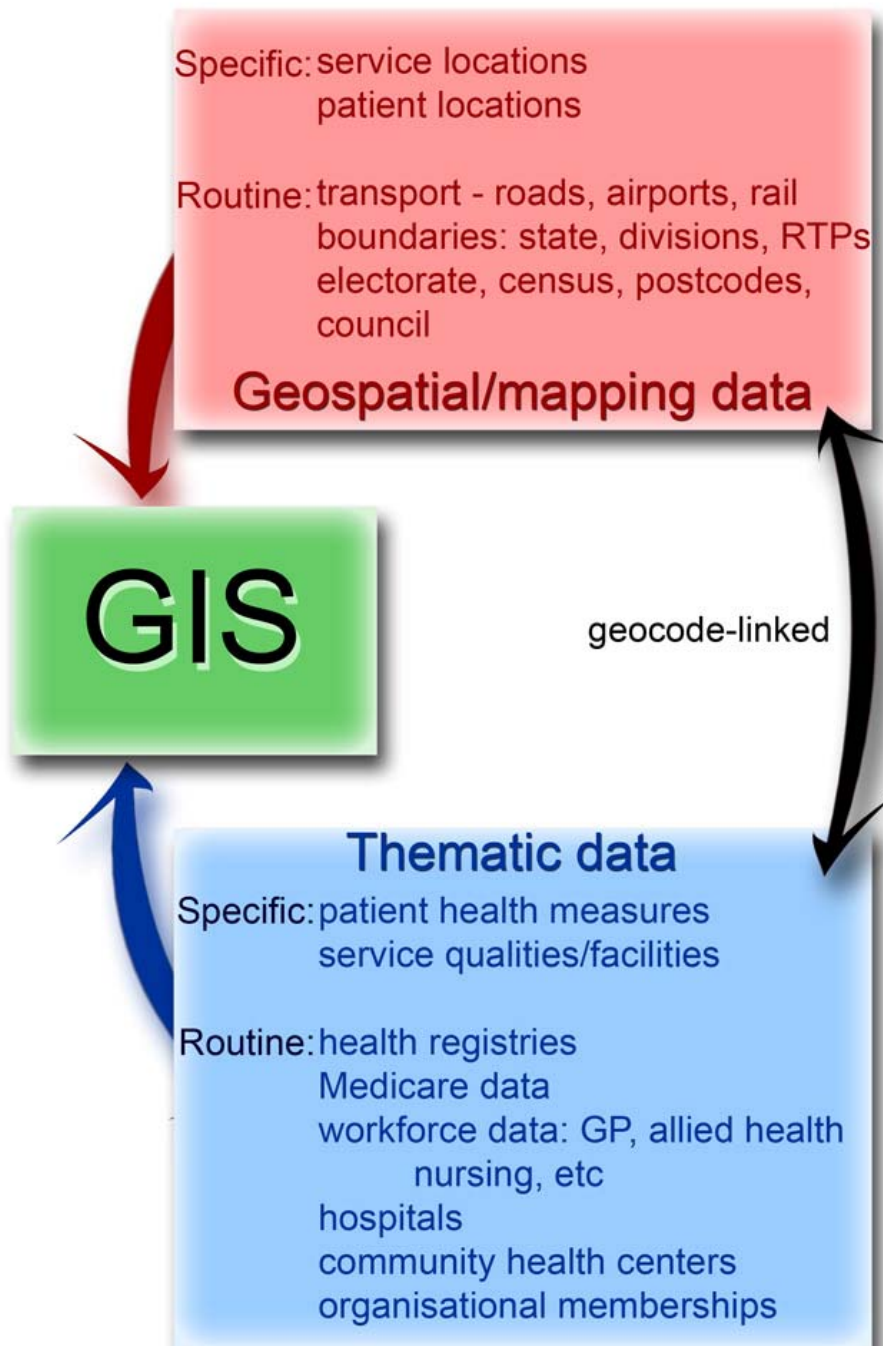
**One indirect benefit of instituting an Australian version of HealthLandscape, is that it may drive the creation of new datasets. It will also attract data that are currently unknown or at least not used together. HealthLandscape's current growing recognition within the US as a 'data magnet' suggests that a well designed inter-organisational GIS tool will facilitate the creation of new datasets, 'awaken' previously dormant data, and allow for combining of data currently used for independent purposes.** Table 1 (on page 21) refers to current sources of Australian general practice-related data, and the types of data currently gathered by these sources. Australia, in contrast to the US, does not currently have a regular national 'household survey' measuring the health status of the Australia population. It does have various content-specific surveys (such as the 2004 National Drug Strategy Household Survey), but lacks a broad content-based survey. Thus, many population health parameters are extrapolated from smaller samples.

Figure 2 (page 22) demonstrated the relationships these datasets would have with each other.

**Table 1 = current sources of Australian GP data**

<b>Organisation</b>	<b>Type of data collected</b>
<i>State-based rural workforce agencies</i>	<ul style="list-style-type: none"> <li>• Workforce</li> </ul>
<i>GPET</i>	<ul style="list-style-type: none"> <li>• Training workforce</li> <li>• Registrar workforce</li> </ul>
<i>Medicare/HIC</i>	<ul style="list-style-type: none"> <li>• Population</li> <li>• Health services (Medicare billable)</li> </ul>
<i>State medical boards</i>	<ul style="list-style-type: none"> <li>• Workforce</li> </ul>
<i>University</i>	<ul style="list-style-type: none"> <li>• Medical students</li> </ul>
<i>General Practice Networks</i>	<ul style="list-style-type: none"> <li>• Aggregate patient data</li> <li>• Clinic data</li> </ul>
<i>Divisions of General Practice</i>	<ul style="list-style-type: none"> <li>• Membership workforce</li> </ul>
<i>National Census</i>	<ul style="list-style-type: none"> <li>• Population demographics</li> <li>• Workforce</li> </ul>
<i>Community practices</i>	<ul style="list-style-type: none"> <li>• Individual clinic datasets</li> </ul>
<i>DoHA</i>	<ul style="list-style-type: none"> <li>• Workforce – medical and other (eg allied health)</li> </ul>
<i>Medical Colleges</i>	<ul style="list-style-type: none"> <li>• membership</li> </ul>

**Figure 2 - structure of possible Australian GP GIS**



### Potential users of an Australian General Practice GIS tool

A well integrated, universal and customisable GIS tool, such as that of HealthLandscape in the US, would have application across a wide market. Table 2 (below) Table 2 refers to some examples of potential users and the types of use that would be expected to be accessed through such a tool.

**Table 2 - Examples of use of a GIS tool within Australian GP**

User	Example of use	Data Inputs	Output
<b>Individual GPs</b>	What is the distribution of [diabetes, elderly, HCC holders] in my [practice catchment, division, state]?	Medicare data Census data Disease registries	Thematic map of requested area showing distribution
	Where are the Medicare-registered psychologists in my area?	Medicare workforce data	Point map of target service providers
<b>General Practice clinics / Practice managers</b>	Is this practice in an area of workforce shortage / particular RRMA zone?	RRMA / Outer Metro boundaries DoHA	Yes/no Distribution map
	Of the area/s within our catchment area that have poor childhood immunisation rates (adjusted for age), what % of these areas have low English literacy rates?	Practice patient demographic data Immunisation registry Census data Literacy surveys	Thematic map with overlays demonstrating areas of poor immunisation penetration / sub-threshold literacy rates
<b>RACGP / ACRRM</b>	What is the proportion of practicing GP obstetricians in each (state, division, electorate, postcode)?	Medicare/College workforce data	Thematic map of specific area
	In which divisions do our members not have access to a local CPD/CME provider for topic ....., that we should cater for?	College education program provider data	Thematic and point maps of various educational programs and their distribution
<b>Rural workforce agencies</b>	Which divisions in my state have a higher proportion of requests for locum services?	RWA/divisional data Locum service provider databases	Thematic map
<b>Academic researchers</b>	Where are the non-English speaking female patients 18-70 years old who attend a Community Health Center but have not had a pap test in 5+	Pap registry Census data CHC patient registries	Thematic map (point data would only be available after ethics approval permitted that

	years?		level of access)
	Which divisions of general practice have lowered smoking rates in adults by >4 % since the introduction of the SNAP program, and how does this reflect on the incidence of childhood (<14 years) asthma?	Disease registries National Census data	Thematic maps of smoking rates / population, overlayed with asthma disease distribution, over time.
<b>Health policy planners</b>	Where are the 20 electorates most in need of a community health center as determined by Access Deprivation?	Census Variable predictive of access deprivation Electoral boundaries	Thematic Map, by selected total population, combining most access deprived areas
	Which electorates have <80% bulkbilling rates and <50% private insurance coverage?	Insurance data Medicare data	Thematic map showing targeted regions
<b>GPET</b>	Which areas do registrars make up a higher than average proportion of the GP workforce?	GPET data Medicare data	Thematic map of regions of interest
	What proportion of IMG registrars within 2 hours of a RRMA 1-2 city, or regional airport/transport hub?	GPET workforce data RRMA boundaries Basic GIS map layers	Thematic map demonstrating proportion in addition to type of transportation?
<b>Medical schools</b>	Which geographic regions do most of our rural students come from? And do they return to their region of origin?	Medical school data linked with workforce agency/medical board data	Point and thematic map for various areas/regions
	What is the geographic distribution (footprint) of our school's graduates?	Medical board workforce data	Point map of graduate locations
<b>Regional GP training providers</b>	Which subregions in my area have capacity to increase their student/registrar teaching?	RTP practice data Practice surveys	Thematic / Point map of practices with target criteria
	Do the graduates of this training provider stay in the region? If not, where do they migrate to?	GPET workforce linked with medical board data	Point map of graduates



## **Potential areas for future collaboration between APHCRI and the Robert Graham Center**

This report has been the focus of the inaugural APHCRI/Robert Graham Center Visiting Fellowship. The two organisations share many common ideals and would benefit from ongoing collaboration and 'exchanges' into the future. The following section will aim to explore potential ideas and projects that may be undertaken that would be of benefit to both countries/organisations.

### **APHCRI mission/structure**

APHCRI is part of the Australian Government's Primary Health Care Research Evaluation and Development (PHCRED) strategy. Whilst its administration is run through the Australian National University in Canberra, the members of APHCRI was dispersed across Australia, through the various research organisations that APHCRI has supported. Thus, it could be described as a 'virtual organisation'. Its aims focus on three areas<sup>2</sup>:

1. To strengthen the knowledge base of primary health care by conducting and supporting research;
2. To facilitate the uptake of research evidence in primary health care policy and practice;
3. To enhance research capacity in primary health care through strategic partnerships with other relevant national and international groups.

### **APHCRI current projects**

APHCRI's funding has been divided into various 'streams', focusing on an assortment of domains. These themes are all focussed at system level - around innovation in the organisation, financing and performance of primary health care. There are some systems-based domains that align themselves with the Robert Graham Center areas of research interest (asterixed):

- |   |   |
|---|---|
| • Aboriginal and Torres Strait Islander Primary Health Care | • Primary Health Care Performance*      |
| • Adolescent/child health                                   | • Practice nursing                      |
| • Chronic disease management                                | • Preventative Medicine                 |
| • e-Health*   | • Rural and Remote Primary Health Care* |
| • Mental Health   | • Self-help organisations               |
| • Multidisciplinary teams*                                  | • and, Workforce*                       |
| • Primary Health Care models/delivery*                      |   |

### **Robert Graham Center mission/structure**

The Robert Graham Center exists to improve individual and population health by enhancing the delivery of primary care. The Center aims to achieve this mission through the generation or synthesis of evidence that brings a family medicine and primary care perspective to health policy deliberations from the local to international levels.

From its inception, it was decided that the Center's activity would be a blend of research to support the Academy's policy development and advocacy

efforts and Center-initiated studies. While funded in large part through the AAFP, the Center was established with a "degree of intellectual autonomy and independence". Like APHCRI, the Robert Graham Center is based in the national capital, Washington, DC, in close proximity to the Academy's Washington Office to facilitate interaction of staff and ease of interaction with other policy and advocacy organisations.

In contrast to its Australian counterpart, the Center is staffed by a defined number of professionals with specific skill-sets. Namely, the Center is managed by two family physicians, in conjunction with a health geographer/biostatistician, a health economist, a senior health policy researcher/sociologist, an off-site website manager, along with a few part-time research fellows/assistants. A listing of current staff descriptions can be found on the Center's website<sup>\*\*\*</sup>.

The themes guiding the work of the Graham Center are:

- The Value of Primary Care
- Health Access and Equity
- Delivery and Scope of the Medical Home
- Healthcare Quality and Safety

### **Robert Graham Center current projects**

The Robert Graham Center currently has focused its research effort on a defined number of areas that it sees as important to the betterment of US primary care. These include the links between primary care and geography, mental health, economics, workforce and the concept of the 'medical home'. A lot of the work produced by the Robert Graham Center has been along the theme of health inequalities amongst subpopulations of the American communities, especially the uninsured populations.

### **Important differences**

It is important to realise that the two organisations, whilst they have many common aims, are structured and funded quite differently. Therefore, they are likely to react to primary care issues, and address these issues, in differing manners.

APHCRI, though the PHCRED Strategy, has the Australian Government's Department of Health and Ageing as its sole source of funding. While it has some independence regarding how these funds are spend, it needs to ensure its primary care research efforts are aligned with current important issues –

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\*\*\* <http://www.graham-center.org/x433.xml>

important in both the professional as well as political worlds. APHCRI's contract is based on a limited timeframe and is renewable at the Government's discretion.

The Robert Graham Center is funded differently, directly from the AAFP. The costs of its core tasks are covered by this core funding, and thus, the organisation does not need to constantly source external funding/grants. Any external funding is thus 'cream on the top', allowing for side projects to occur. The Robert Graham Center also has been given editorial independence in a similar manner a peer-reviewed medical journal (like JAMA, AFP or MJA) has independence of content from its auspicing organisation. The Robert Graham Center's research focuses are therefore more at an arm's length from the politics of health. They are able to influence, with less risk of being influenced by, the politics of the day.

### **Possible aligned themes for linkages**

As can be seen in the listing of APHCRI's key domains of research interest, there are a number of aligned topics between the two organisations focusing on primary care systems and quality, as well as primary care workforce.

The concept of 'the medical home, (ie a clinic/doctor whom the patient considers provides potentially lifelong continuity of care) is a current topic of interest in the US primary care sector. This concept is far better established within Australia, so much so, that the term (or similar) doesn't exist, as it is assumed most Australians would be able to identify a particular clinic or GP as 'their GP'. The assumption may be false, and there is potential in collaborative work between APHCRI and the Robert Graham Center exploring this concept further.

As has already been stated in this report, primary care workforce issues have led somewhat parallel courses in both countries, over very similar timeframes. The similarities in both workforce constitution and policy may lead to comparative studies between the two systems.

One area of primary care that Australia seems to have greater developed, is that of chronic disease and preventative care management. Both countries rely on a fee-for-service model of funding, but Australia recent has incorporated blended payments and new fee-for-service items to encourage the improved uptake of chronic disease and preventative health management. There is considerable interest in the US regarding how they can similarly shift the focus away from reactive acute medicine to proactive preventative medical models.

Mental Health in Australia has been a focus of research and policy change in the recent decade in Australia. General Practice is seen as a vital cog in the delivery of mental health services to the community. The situation within the

US is different, with the funding of services (through the various health insurance models) differentiated from 'physical health' services. Thus, the gap between mental and other health parameters is greater in the US than Australia. Again, lessons can be learnt from both sides of the Pacific with collaboration in this area.

The Graham Center has ongoing work related to the ecologic impact of primary care, as well as large project attempting to combine ecologic and individual predictors of poor access to health care into a model that any community can use to understand their own distribution of access deprivation. A example of a mapped output of this index is included in Appendix 4 – Example of Health Deprivation Index output map – page 36.

The area of electronic health (e-health) has burgeoned in both countries in the past decade. Whilst the US family physicians are struggling with making electronic health records more widely utilised, the practice has become almost universal in Australia. Both APHCRI and the Robert Graham Center have similar interests in the utilisation of e-health within primary care.

Finally, the concept of primary care teams is another area where future collaboration may lie. Australia is currently in the middle of significant micro-organisational change, with increasing use of practice nurse (and occasionally other ancillary health providers) within the General Practice setting. The US has a much longer tradition of non-physicians providing care for patients in primary care, including the use of Physician Assistants.

## **Conclusions**

### **Ideal world recommendations**

As has been mentioned earlier this decade<sup>7</sup>, Australia's health care sector needs the flow of information between government departments, research centres and practitioners to be improved. A strategic approach has much to offer, especially to the general practice sector, which is now ideally placed to take up these opportunities.

The *GIS for GPs* project<sup>7</sup> demonstrated the need for adequate planning and budgeting for GIS education, training and ongoing support.

One vital piece to the Australia's GP GIS puzzle is the development of strategic information partnerships between key stakeholders. The HealthLandscape project has demonstrated that the creation of a 'data magnet' provides individual stakeholders to have access to previously inaccessible datasets to be combined in previously unexplored combinations, using geography as a core universal linking element. Australian general practice representative organisations need to overcome some of the political and inter-organisation barriers that have occurred over recent times, to facilitate greater collaborative efforts, for the benefit of the community at large.

A web-based GIS tool should be useful for a range of consumers, from national policy planners, stakeholders such as Divisions of GP, the Colleges, GPET, etc, to research academics, to individual GPs and their clinics.

This range of users would:

- ensure that duplication is minimised; both in terms of establishing a GIS tool for each organisation and also in terms of duplication of output (ie maps and tables);
- facilitate collaboration between diverse organisations;
- provide an increase in perceived 'value' of the GIS tool, to facilitate coordination of funding and ongoing maintenance.

The creation of an on-line mapping tool overcomes the financial and technical barriers of each clinician or other consumer doing it on their own. It also maximizes the return on investment for Australia's data managers. It would be potentially utilised in different manners to how it is being used in the US, mainly due to differing health systems and the questions these systems raise, but the core need of such a tool remains.

In the end, Australian general practice is well placed to embrace GIS technology more completely than is presented occurring. It's not a matter of whether such tools would be useful, but more a matter of overcoming current barriers to design the best tool possible for the GP sector.

“That’s why they always put two blank pages at the back of the atlas. They’re for new countries. You’re meant to fill them in yourself.”

- *Roald Dahl*, THE BFG<sup>1</sup>



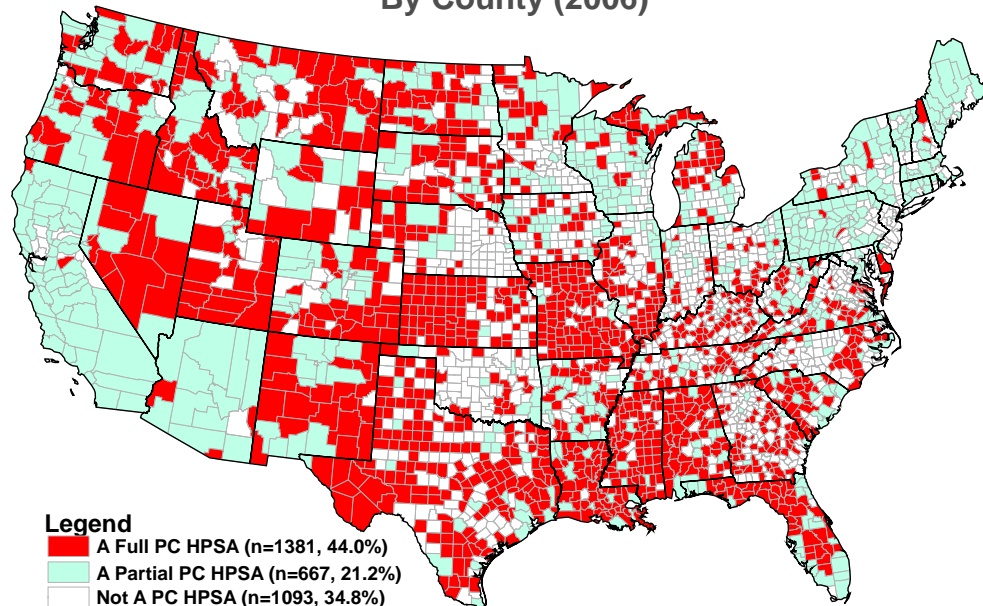




## Appendices

### Appendix 1 – Comparison of US Health Professional Shortage areas (HPSA): with and without family physicians.

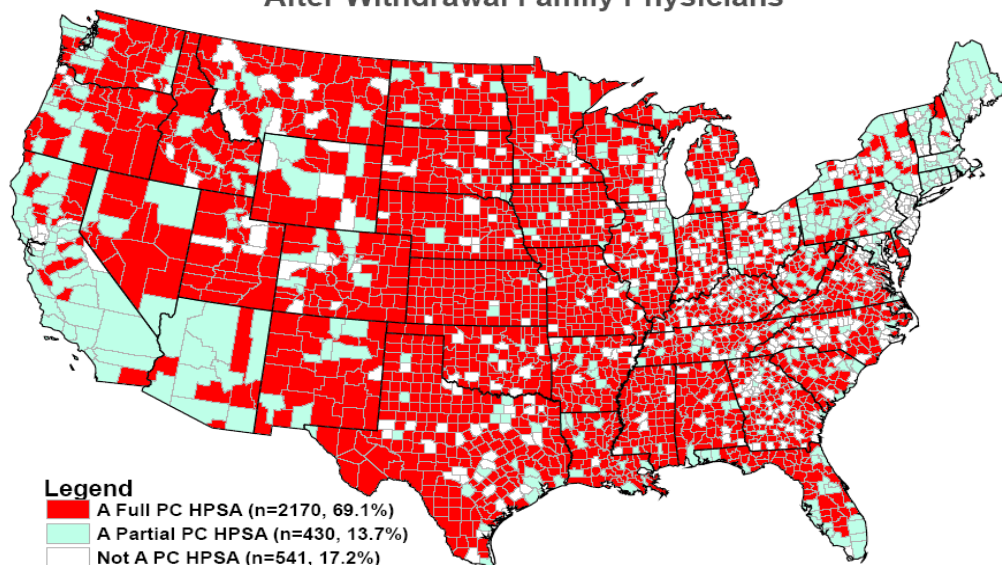
US Primary Care Health Professional Shortage Areas  
By County (2006)



Data Source: HRSA (08/03/2006)

Prepared by The Robert Graham Center

US Primary Care Health Professional Shortage Areas By County (2006)  
After Withdrawal Family Physicians



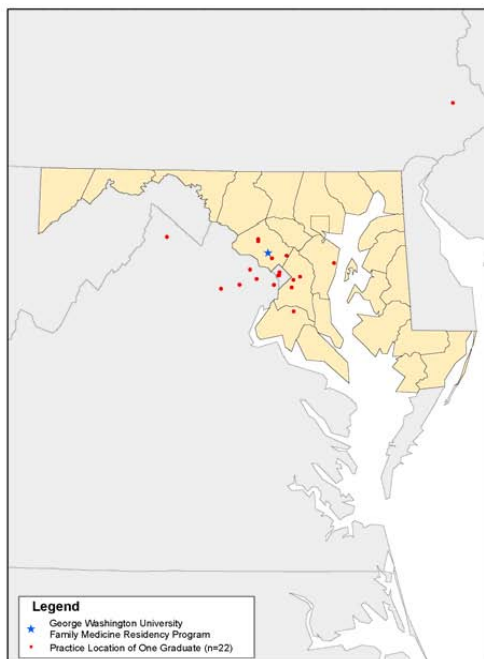
Data Source: HRSA (08/03/2006)

Prepared by The Robert Graham Center

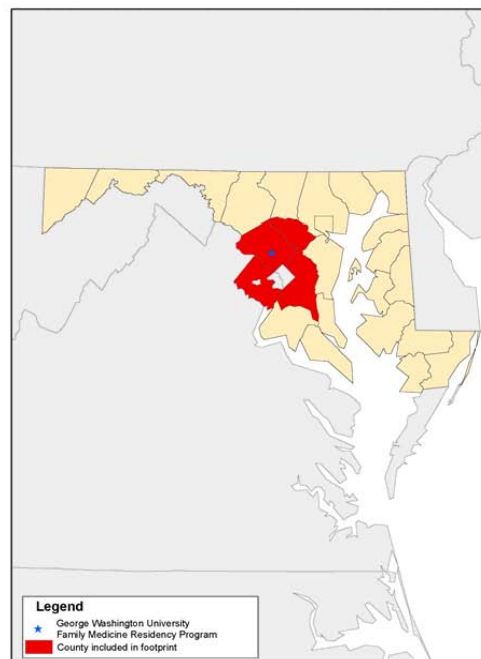
## Appendix 2 – George Washington University Family Medicine residency footprint map

### GEORGE WASHINGTON UNIVERSITY FAMILY MEDICINE FACT SHEET

Practice Locations



Footprint

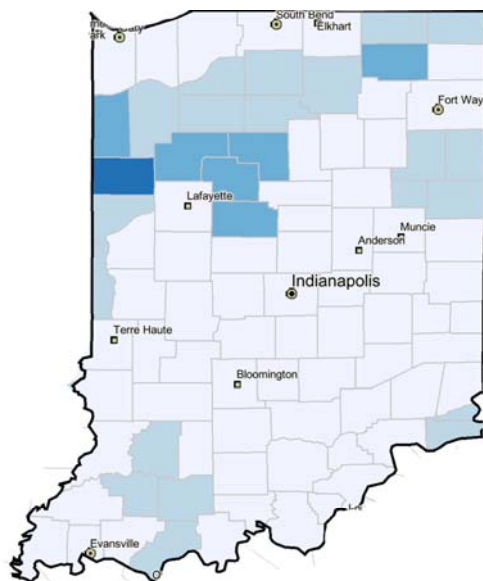


[www.graham-center.org](http://www.graham-center.org)

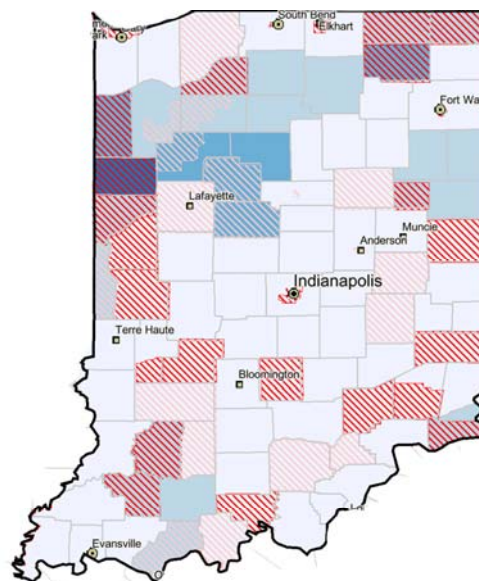
Graduate Practice Characteristics: 22 Graduates

	Number Practicing in District of Columbia	Percent Practicing in District of Columbia	Number Practicing in Rural Areas	Percent Practicing in Rural Areas	Number Practicing in *HPSAs	Percent Practicing in *HPSA
Program Graduates	11	50%	0	0%	14	64%

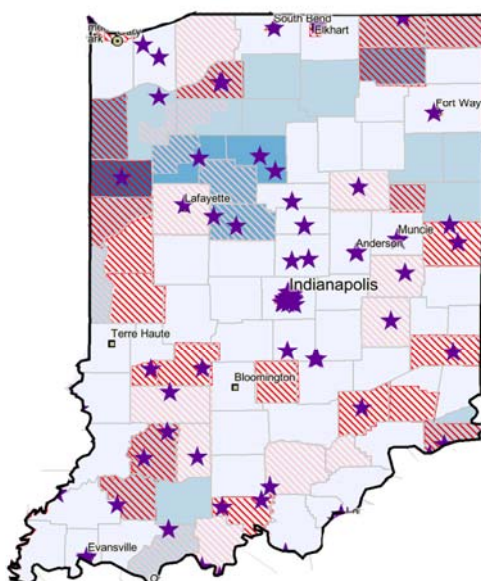
### Appendix 3 –community health center planning<sup>†††</sup>



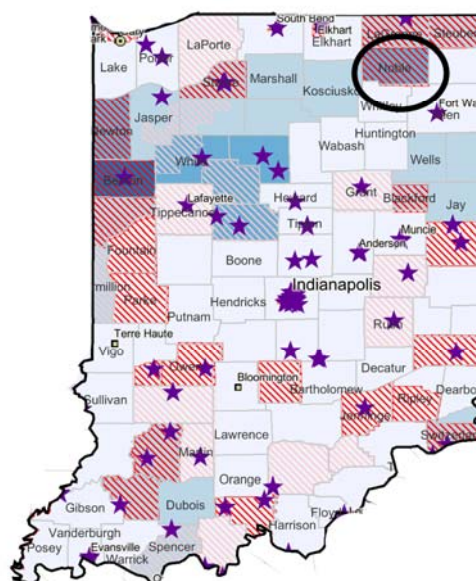
Map 1 - Indiana counties with % Hispanic



Map 2 - % Hispanic and HPSA counties

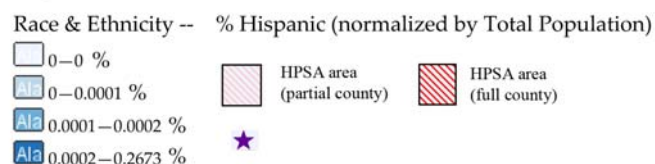


Map 3 - Location of community health centers



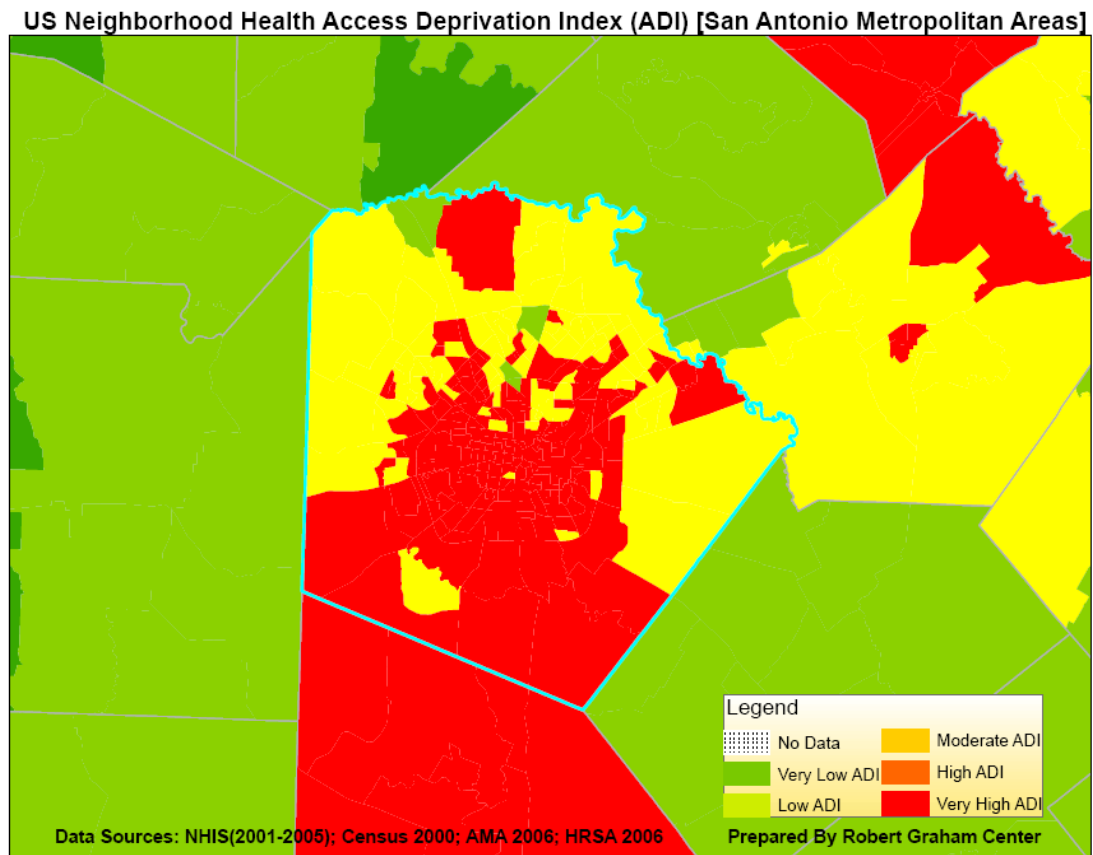
Map 4 - Target county = "Nobel Country, Indiana"

#### Legend:



<sup>†††</sup> assuming the community health centre planners were basing their decision on wanting to build a new CHC in a higher Hispanic population density county, which was also designated HPSA county.

## Appendix 4 – Example of Health Deprivation Index output map



## ***Acknowledgements***

I would like to acknowledge the incredible support, encouragement and friendship the staff of the Robert Graham Center provided me before, during and after my brief visit. The strength of the links that have been forged over this period will ensure many future opportunities for ongoing collaboration.

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I also wish to state my gratitude to the Australian Primary Health Care Research Institute, who supported and funded the Visiting Fellowship. It has become a wonderful learning opportunity for me professionally as well and personally.

*The research reported in this paper is a project of the Australian Primary Health Care Research Institute, which is supported by a grant from the Australian Government Department of Health and Ageing, under the Primary Health Care Research, Evaluation and Development Strategy. The information and opinions contained in it do not necessarily reflect the views or policy of the Australian Primary Health Care Research Institute or the Australian Government Department of Health and Ageing.*

Finally I wish to acknowledge my wife, Sarah, who allowed me the opportunity to undertake this project away from home, and was unwavering in her support and confidence that the visit would be a success.

Dr Paul Grinzi, January 2008



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Image (front cover):  
"That's progress"; Rock Creek Parkway, Washington DC 23<sup>rd</sup> Sept 2007. © P Grinzi



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