A virtual aged care system: When health informatics and spatial science intersect

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Abstract. Healthcare systems are increasingly adapting to address the issues associated with population ageing. The shift to chronic diseases and a rise in neuroepidemiological conditions, associated with rising life expectancies, means that continued change and accommodation will be required of our health and social support systems. Current social policy environments developed out of early approaches to state-supported health and welfare service provision, most now a century or more old. A feature of these systems has often been a formal separation between them, into silos, that does not and cannot effectively address the issues raised by a growing population of older people. This is especially true in the context of community-based care where the majority of older people currently live and where governments hope to keep more elderly people living into the future. This objective will require a far more sophisticated and responsive approach to the health information environment than is currently the case. One strategy for improving this scenario is the development of augmented and virtual environments that collect and analyse real-time data on which health professionals and support staff can act in a timely manner. In this paper we explore some aspects of a virtualised aged care system and provide some examples of how this would enhance our current strategies for aged care.

Keywords. Ageing, informatics, spatial, virtual, visualisation

Introduction

Population ageing is progressing globally at a phenomenal pace [1]. In a parallel process, health informatics is also globalising as health systems adapt to changing demographics and associated social and environmental changes. Consequently the volumes of information in health systems are rising rapidly and this data is proving complicated to track, analyse and act upon. Already, there is a shortage of health informatics specialists and this situation can only grow in importance as those systems attempt to adapt to their changing environments [2]. A key issue for the future of convergence in population ageing and health informatics will be the issue of large, highly dynamic data volumes that provide useful, real-time information that health professionals, planners and others can act on to control, modify and improve health service delivery.
1. Aim

In this paper we combine demographic, epidemiological, health and social support infrastructure data to create a virtual aged care system environment. We do this to: (a) illustrate how a broader evidence-based modelling approach can better support aged-care policy and service initiatives; (b) to show how a spatial approach is central to improving systemic responses and; (c) to explore how this approach supports an enhanced policy development and implementation. Lastly, we consider how an enhanced visual environment supports a wide variety of engaged users in exploring the potential consequences of policy responses and outcomes.

2. Methods

The methods utilised in this virtual approach are several:
- firstly, we geocoded a wide variety of direct and indirect health service providers including hospitals, pharmacies and residential aged care facilities but also adding in a variety of emergency service providers who have or are likely to have significant contact with older people including police stations and State Emergency Service (SES) bases;
- secondly we included these in a geographic information system (GIS) software package that permits us to analyse these infrastructure locations against population data such as Census information so that a variety of policy issue and response scenarios could be developed;
- thirdly, we exported a number of these scenarios in the form of KML files, that is the Google Earth™ format, so that outputs could be visualised and explored by a users without the need for a GIS system and the skills and experience generally required of GIS users.

The result is a developmental and extensible virtual information system for inquiring on current and future ageing scenarios. The point of this exercise is twofold: firstly we illustrate the value of extending health informatics and health information issues into the spatial domain which makes anew range of tools, techniques and approaches available to health informatics issues and problems; and secondly, we explore the potential of virtual environments more generally for the health sciences and health policy development through the lens of ageing.

2.1. Health Informatics and ‘Big Data’

One of the major concerns in the wider information science community relates to the development of ever-increasing numbers of complex information systems, sometimes referred to as a ‘data glut’[3]. The digitisation of previously analogue data systems is creating a massive increase in the quantity, quality and scale of information types being collected by current computational systems. While storage is not the issue it once was, the analysis and practical application of this ‘big data’ paradigm is of growing concern. This is also the case in health informatics where, for example, the developmental of digital radiography is adding to the timeliness of clinical test information but additionally compounding the need for data storage as well as methods and skills to maximise the utility of newly digitised information sources [4]. Many types of data
associated with clinical care, such as clinical notes or patient and family feedback, are still rarely used or analysed for deeper insights and this too is changing in the context of rapid computer-based analysis of textual data such as textual data mining [5].

2.2. Augmentation and Virtualisation

The idea of augmentation is not new in that almost any form of technology designed to clarify, magnify or collect difficult-to-access information in a way that exceeds normal human capacities can be seen as a form of augmentation. A variety of sensor systems in medicine and elsewhere (e.g. cardiac sensors for runners) have already developed this basic concept and it represents a highly dynamic field linking engineering, design and software technology. Many augmentation systems target the visual sensory system because we rely on sight, even when supplemented by other senses, to such an enormous degree. In addition, the use of the visual domain to summarise large amounts of information has a deep historical and cultural history with which most of us as human beings are intimately familiar. The map is a good example of this – it summarises often complex natural and manmade phenomena in ways that as individuals we find difficult. Out of this process and rapid developments in fields such as the gaming industry, has emerged the concept of ‘virtual’ realities that often produce digital spatial environments that mimic or replicate external ones.

2.3. The Geographic Dimension of the Aged Care System

One of the key issues for consideration in this paper is the size, complexity and extensive geographic spread of the ‘aged care system’. There are many elements to the thing we refer to as the aged care system and numerous observers have pointed to the many disconnections that tend to characterise this system. In the context of population ageing, geography can only grow in importance because to a considerable extent where you age affects how you age. The components of the aged care system include not just GPs and acute care hospitals, and not just RACFs and respite service providers. The whole spectrum of medical specialists and allied health professionals as well as pharmacists, dentists and others are part of the mix. Most of these services become more readily accessible the closer one is to larger urban centres. The distribution of the population is uneven over space and so too is the health workforce and key healthcare facilities. This can be problematic in smaller countries but in very large ones, like Australia, these issues take on an additional spatial dimension that complicates access to and receipt of a variety of services for older people. Where access is problematic epidemiological, clinical and treatment outcome factors are also likely to vary. Many current e-health projects are a direct consequence of acknowledging these issues.

2.4. Spatialising Health Informatics

To function usefully and accurately in a virtual earth environment, health informatics data will increasingly need to be indexed using spatial, as well as conventional, information methods. Varying levels of precision are obviously possible in the way information (patient, clinical, administrative) is georeferenced but it needs to go well beyond the present common defaults of Post Code or Local Government Authority (LGA). Address records are readily geocoded in modern database environments and even spreadsheet files with address data can now be geocoded to map information
directly without having to utilise a relatively complex geographic information system (GIS).

The following examples show how components of the aged care system can be integrated into a single computational environment. In the first example, we show an analytical example combining infrastructure and population data. This illustrates how key demographic information, such as age-specific population cohorts, can be linked to the existing distribution of health and residential aged care facility locations. These data can then be used to target opportunities for providers or, equally relevant, gaps in service provision for advocacy and community organisations.

In the second (Figure 2), we illustrate the visualisation and scaling potential of a virtual system. This image is taken from a model in Google Earth TM which shows how the details for a variety of different types of health and health-related service providers can be incorporated into the same modelling environment. These include hospitals, residential aged care providers, meals-on-wheels providers, state emergency service locations and police stations. These are fully indexed for New South Wales including an overlay of Statistical Local Areas (SLAs). Then, the user can zoom in or out on that information to individual service providers as well as visualise the overarching pattern to service providers. Every service provider has a database entry including not only latitude and longitude coordinates but an extensible list of details such as address, telephone number and so on. As with the map in Figure 1 above, other information, such as population data, can be added in to explore current and future scenarios.
Figure 2. Location of Residential Aged Care Facilities on the Central Coast and Their Catchment Area

Figure 3. Multiple New South Wales Service Providers in Google Earth™
3. Conclusion

The complexity of ageing and our aged care systems can only grow over time because of population ageing and the complexity of responding to this process effectively. In Australia, population ageing is not expected to peak until the middle of this century. Concerns about the cost of aged care, access to services and older people ageing safely in their local community settings can only become more pronounced. We have identified a number of reasons why and methods for developing a virtual approach to aged care planning and development. Taking advantage of significant developments across a number of other industry sectors is already a key aspect of systemic developments in aged care service design. A virtual aged care system adds value to coping with these complex issues because there are currently few other options for incorporating often complex and disparate health information from multiple providers and sub-systems and modeling that with the key population and infrastructure issues that impact on care in the real world. This case study expands on both the theoretical development of health informatics in the ageing societies and explores some specific practical applications of a virtual and spatially enabled health informatics paradigm.

References

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Preface

Around the world the healthcare industry is embracing information technology (IT). Historically the use of IT was administrative, financial, or statistical. Now it is transforming the way healthcare does business from the bedside, into primary care and patient and carer information management. As a part of this exciting change the Health Informatics Society of Australia, with the active support and involvement of the Australasian College of Health Informatics, is excited and proud to be active contributors to extending knowledge and understanding of these changes and the opportunities associated with them. The Australian National Health Informatics Conference (HIC) series of meetings is the largest national event of this type in Australia, with a dedicated scientific stream on health informatics. HIC provides a valued platform for academic and research contributions and interchange as well as industry updates and innovations.

The HIC 2014 theme of ‘Investing in e-health: People, knowledge and technology for a healthy future’ emphasises the journey being made in healthcare. As healthcare organisations and government projects look to information technology to capitalise and enhance healthcare the need for investment is clear, but where to invest, how to define success and understand opportunities and risks in this time of change are key issues. These investments extend past the technology required to provide infrastructure for the future. Investment is also required to enable the building of people, skills, careers, and professions to support and develop this infrastructure in a cost effective and clinically safe manner and lead change management. This e-health enabled healthcare environment offers faster and more wide reaching knowledge acquisition and best practice improvement, as well as improved healthcare.

Decisions made about investment in e-health need to consider what the successful outcomes would look like, rather than just considering a single project in isolation. Success can be seen as delivering

1. future focused infrastructure, scalable and adaptable to changing needs
2. capacity and capability building amongst our healthcare workforce, to enable them to meet the challenges of this information centric world and certainly doing no harm (preferably making care, or the care system better). It is also vital that systems enable secondary use of clinical data for biomedical research, public health and health policy. This necessitates a more active role from individuals in maintaining their health, facilitated by innovative technologies.

Questions arise such as: What investments will give the best short and long term outcomes, what activities could be undertaken, what works and what does not are all considered by papers in this volume. Papers represent experiences in Australia and New Zealand and further afield. As always, it is the strength of HIC that a wide diversity of work is presented and that a set of papers has been collected here that ranges from deeply theoretical to intensely practical. The careful reader will be rewarded with exposure to much diversity, and many elements of contemporary health informatics research endeavours.
The double blind peer review process established for HIC 2011 in a previous volume has been continued and augmented. All papers were reviewed by 3 experts in the field of health informatics, selected as prominent academics and industry specialists. The assistance of the Australasian College of Health Informatics in supporting this process through the voluntary efforts of a number of their Fellows is gratefully acknowledged, as is the similar contribution made by many senior members of the Health Informatics Society of Australia. This phase of reviewing resulted in the provisional acceptance of 28 from a much expanded submission field of 42. The Scientific Program Committee then undertook a validation process for all such papers that were resubmitted in amended form, to ensure that reviewers’ recommendations were appropriately addressed or rebutted.

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Contents

Preface v
Heather Grain, Fernando Martin-Sanchez and Louise K. Schaper

Acknowledgements vii

Optimising Computerised Alerts Within Electronic Medication Management Systems: A Synthesis of Four Years of Research 1
Melissa T. Baysari, Johanna I. Westbrook, Katrina Richardson and Richard O. Day

Gerontechnology: The Importance of User Participation in ICT Development for Older Adults 7
Heidi Bjering, Joanne Curry and Anthony Maeder

Methods for Assessing the Quality of Data in Public Health Information Systems: A Critical Review 13
Hong Chen, Ping Yu, David Hailey and Ning Wang

Shared Responsibility for Electronic Records: Governance in Perinatal Data Entry 19
Alison Craswell, Lorna Moxham and Marc Broadbent

Joanne Curry, Anneke Fitzgerald, Ante Prodan, Ann Dadich and Terry Sloan

Battling the Challenges of Training Nurses to Use Information Systems Through Theory-Based Training Material Design 32
Malatsi Galani, Ping Yu, Fred Paas and Paul Chandler

Application Areas of Multi-User Virtual Environments in the Healthcare Context 38
Reza Ghanbarzadeh, Amir Hossein Ghapanchi and Michael Blumenstein

Pre-Implementation Investigation of the Readiness of Allied Health Professionals to Adopt Electronic Health Records 47
David Hailey, Ping Yu and Esther Manyisia

Mid-Term NEAT Review: Analysing the Improvements in Hospital ED Performance 54
Sankalp Khanna, Justin Boyle, Norm Good and James Lind
“I Can Do It”: Does Confidence and Perceived Ability in Learning New ICT Skills Predict Pre-Service Health Professionals’ Attitude Towards Engaging in e-Healthcare?  
Mary K. Lam, Melanie Nguyen, Robyn Lowe, Srivalli V. Nagarajan and Michelle Lincoln

iPad Use During Ward Rounds: An Observational Study  

What Is the Effect of Electronic Pathology Ordering on Test Re-Ordering Patterns for Paediatric Patients?  
Ling Li, Andrew Georgiou, Elia Vecellio, Alex Eigenstetter, George Toudi, Roger Wilson and Johanna I. Westbrook

A Conceptual Model for Analysing Informal Learning in Online Social Networks for Health Professionals  
Xin Li, Kathleen Gray, Shanton Chang, Kristine Elliott and Stephen Barnett

Interpreting International Governance Standards for Health IT Use Within General Medical Practice  
Rachel J. Mahncke and Patricia A.H. Williams

Recognition of Health Informatics in Australian Standard Classifications for Research, Occupation and Education  
Fernando Martin-Sanchez and Kathleen Gray

Mobile Learning: A Workforce Development Strategy for Nurse Supervisors  
Carey Mather and Elizabeth Cummings

Usability of a Virtual Community of Practice for Workforce Development of Clinical Supervisors  
Carey Mather and Elizabeth Cummings

Expert Insights on the Design and Implementation of Interactive Patient Websites for People with Chronic Pain  
Mark Merolli, Kathleen Gray, Fernando Martin-Sanchez and Peter Schulz

A Case Study on Parsing Chemotherapy Related Free-Text Data  
Ante Prodan and Joanne Curry

Description and Analysis of Design and Intended Use for Epidemiologic Dynamic Data Collection Platform in China  
Xiaopeng Qi, Nilva Egana, Yujie Meng, Qianqian Chen, Zhiyong Peng and Jiaqi Ma

Fitting Clinical Workflow: The Case for Wound Care in a Residential Aged Care Home  
Siyu Qian and Ping Yu

A Virtual Aged Care System: When Health Informatics and Spatial Science Intersect  
Hamish Robertson, Nick Nicholas, Tuly Rosenfeld, Andrew Georgiou, Julie Johnson and Joanne Travaglia
Preliminary Results from a Study of the Impact of Digital Activity Trackers on Health Risk Status
  *Dinah Rowe-Roberts, Robert Cercos and Florian ‘Floyd’ Mueller*

Does CPOE Support Nurse-Physician Communication in the Medication Order Process? A Nursing Perspective
  *Basema Saddik and Shaha Al-Mansour*

Coping with Information Silos: An Examination of the Medication Management Process in Residential Aged Care Facilities (RACFs)
  *Amina Tariq, Andrew Georgiou and Johanna Westbrook*

Analysis of Operating Theatre Utilisation to Drive Efficiency and Productivity Improvements
  *Hamish Thorburn, Sankalp Khanna, Justin Boyle, Norm Good and Michael Steyn*

Cluster Analysis of Medication Adherence in Pacific Patients with High Cardiovascular Risk
  *Jim Warren, Yulong Gu and John Kennelly*

Patients’ Adoption of the e-Appointment Scheduling Service: A Case Study in Primary Healthcare
  *Xiaojun Zhang, Ping Yu and Jun Yan*

Subject Index

Author Index