e-Health – For Continuity of Care
C. Lovis et al. (Eds.)

doi:10.3233/978-1-61499-432-9-1168

Globalising Health Informatics: The Role of GIScience

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Abstract. Health systems globally are undergoing significant changes. New systems are emerging in developing countries where there were previously limited healthcare options, existing systems in emerging and developed economies are under significant resource pressures and population dynamics are creating significant pressures for change. As health systems expand and intensify, information quality and timeliness will be central to their sustainability and continuity. Information collection and transfer across diverse systems and international borders already presents a significant challenge for health system operations and logistics. Geographic information science (giscience) has the potential to support and enhance health informatics in the coming decades as health information transfers become increasingly important. In this article we propose a spatially enabled approach to support and increasingly globalised health informatics environment. In a world where populations are ageing and urbanising and health systems are linked to economic and social policy shifts, knowing where patients, diseases, health care workers and facilities are located becomes central to those systems operational capacities. In this globalising environment, health informatics needs to be spatially enabled informatics.

Keywords. Gobal, ageing, modelling, giscience, spatial, visualisation

Introduction

The developing economies of Asia, South America and, to a lesser extent, Africa are all seeing significant changes to their established health care systems. These changes include the emergence of rapidly expanding public and private healthcare systems, medical insurance schemes, long term care systems and a massive expansion in aged care as well as skilled migration internally and internationally. Population ageing is driving major changes in the healthcare systems of the developed world and in many emerging economies because it is increasingly a global demographic trend [1]. This means that health information systems are in a phase of expansion, diversification and interconnection [2]. The globalisation of health information systems has important implications for the quality, safety and effectiveness of health services in this dynamic and rapidly changing environment.

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In this paper we briefly explore how the integration of spatial concepts, methods and technologies has the capacity to enhance and support a globalising health informatics paradigm. The broad interdisciplinary field of the spatial sciences is highly information focused. A major issue for those sciences over the past few decades has been the issue of revising and integrating their information paradigms as the context of their theories and practices became increasingly interconnected and internationalised. This form of globalisation has had a significant impact on the way in which important information management concepts and practices have developed. Firstly, data collection is increasingly collected with geospatial indexing attached (georeferencing) which contextualises that data at both a local (collection site) and a global level (e.g. latitude, longitude and altitude). Secondly, significant metadata issues have undergone a process of inquiry, revision and restructuring in order to ensure that data interchange practices facilitate this local to global transformation and to support the complex research issues we are dealing with at a local-global level (e.g. climate change phenomena). Thirdly, the type and variety of user interfaces has expanded enormously and in ways that increasingly permit non-expert use and application of georeferenced data (e.g. Google Maps and Google Earth). Lastly, this drive towards a broadly accessible spatial informatics paradigm is producing its own innovation drivers that increasingly seek to connect those older data paradigms with these new theories and methods [3].

1. Methods

The scenarios presented here are case studies developed by the authors as part of their research programmes in the fields of spatial science and health informatics. They only illustrate the potential of the premise we are exploring – that is, the integration of a giscience perspective to a globalising health informatics environment. As such they are developmental studies and not the endpoints of a defined or funded research programme.

In the first instance we applied this kind of approach to Australia where population ageing is seen as a presenting a major challenge to the way health and social care systems are currently designed, funded and managed. A major concern of many observers of this process is the likely impact that age-related cognitive impairments will have on those systems as population ageing progresses and if current epidemiological patterns of ageing persist. Currently there are no population-level studies of the dementias or Alzheimer's disease in Australia, an affluent country with a developed economy and significant investments in national and sub-national health information systems [4]. Yet it is already clear from Census and related analyses that the impact of population ageing in Australia is likely to vary significantly by time and location, with some states experiencing ageing sooner and at higher rates than others.

The second example, arising from our experiences with the first, is predicated on what can this application of giscience do for environments in which even national-level data sources are limited – if indeed any such resources even exist? And where health information systems themselves are also extremely finite as well as other issues confront treatment and care, such as a lack of health infrastructure and resources to address age-related issues directly. In this case, we chose Africa as a continental-level scenario where older people confront may health and social support issues and where societal and economic changes. The focus on infectious diseases along with poverty, conflict and development issues has limited the attention given to population ageing in much of the health research conducted in African countries [5]. Yet even as Africa's estimated population rises to double its current level by the year 2050, growth in cohorts of older people will expand at equal or greater rates [6].

In this scenario, we took a population estimation model for the continent of Africa and applied estimates of dementia prevalence for the whole continent from Alzheimer's Disease International. The prevalence data was sub-divided for the continent by World Health Organisation region to take into account those areas most affected by factors such as HIV/Aids and life expectancy variations [7]. The application of the regionalised prevalence rates, by age cohort, to the population data have us an estimation of *likely* prevalence for the whole continent. This model was then driven down to the sub-national level to include the major administrative geography for each country (states/provinces). Finally, we graphed the resulting data in GE Grapher to produce a Keyhole Markup Language (KML) file that could be opened by anyone with access to Google Earth™.

2. Results

The results for the continent of Africa show how spatial methods can expand on existing knowledge and visualise the results at varying scales. In a situation where we currently have very little reliable scientific data and even censuses can be problematic, this provides us with an enhanced understanding of what patterns *may* be prevalent at the both the continental, national and sub-national level concurrently. The process of taking a consistent population data set, combining it with current epidemiological understanding and geographic methods builds our understanding of what may be occurring at different scales across Africa. Even if the results are subsequently shown to be wrong, especially as new and better data becomes available, the spatial scientific paradigm informs questions about what is happening where and what we might expect to see when better data is finally produced.

The results for Australia follow a similar pattern in that while available data for population as well as dementia prevalence and incidence are much better than for most African countries, the prevalence data for dementia and sub-types are still basically estimates because no population-level research studies exist. The added dimension of spatial visualisation contributes to our understanding of what potential impact population ageing and dementia are likely to be having on local communities including those in rural and remote regions where specialist service access and provision can vary considerably to those available in urban areas.

The logic of this approach includes providing the capacity for various types of health information (e.g. prevalence and/or incidence data for chronic conditions) to be accessed in a highly visual, multi-scalar environment. Like conventional maps, KML files permit the representation of data about multiple entities in spatial relation to each other. Added benefits are that (1) we can utilise the 'what-if' characteristics of modelling temporal prevalence data against existing healthcare facilities to explore the implications for the future and (2) better understand the dynamic relationships that may exist between data sets of varying quality (e.g. prevalence estimates versus incidence data).

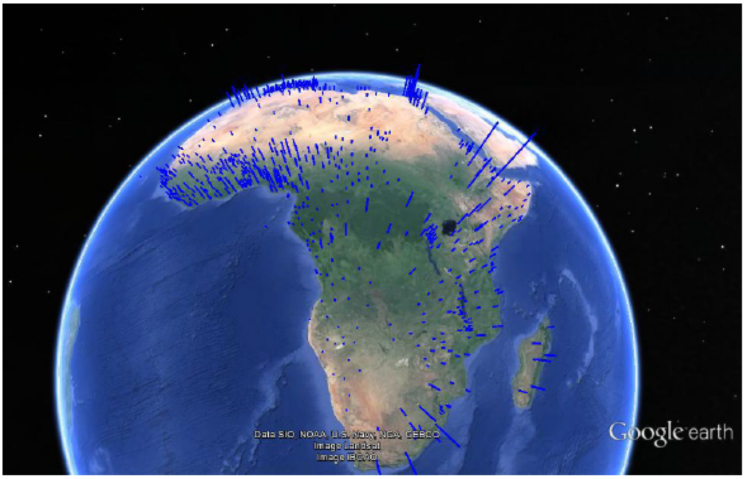

Figure 1. Alzheimer's Disease in Africa

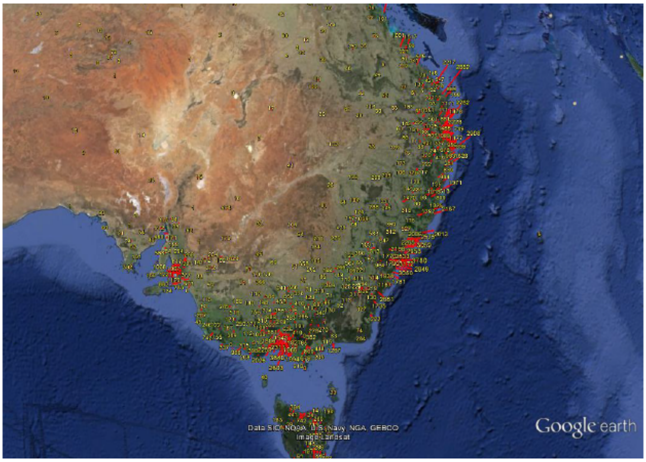

Figure 2. Dementia in Australia

3. Discussion

This paper illustrates two important aspects of the role of giscience for the wider, global health informatics environment. Firstly, we can take data known at one order of scale, such as the nation-state, and apply that to a larger scale (i.e. finer geographic detail) in order to explore and examine what we might expect to be happening at much more local levels – even when data is currently lacking, poorly collected or presently not integrated. Secondly, we can use known health information where data quantity and quality are high to help us model environments where data quantity and quality remain low. Thus, applying projected scenarios of disease expression or time-dependent incidence to explore what we would expect to see if our data systems were at the standard necessary for informed interventions, since a key aspect of the role of health informatics is not only to track what is currently happening but to provide a supporting evidence base for various interventions in complex health environments.

We have briefly examined the potential contribution that giscience offers to the field of health informatics. More specifically our focus is on the advantages of adding giscience concepts, methods and technologies to a globalizing health information environment. Our position is that giscience has already been through many of the changes necessary to make the various spatial sciences able to actively engage with each other and to develop a future spatial environment in which local, national, cultural and semantic/linguistic issues are adequately incorporated into a genuinely global giscience environment. Health informatics is at the beginning this change process and has yet to become spatially integrated. The convergence of many information science approaches in an age of 'big data' offers an opportunity to address these outstanding issues. The outcome of this unfolding process will, we believe, lead to a genuinely *spatial* health informatics paradigm. Given the rising complexity of health systems globally and their multiple scales of interaction, it is our contention that health informatics needs to be spatial in order to meet these emerging challenges.

References

[1] UNFPA. Ageing in the Twenty-First Century: A Celebration and A Challenge. New York and London. United Nations Population Fund (UNFPA) and HelpAge International; 2012
[2] Adebesin F, Foster R, Kotze P, van Greunen D. A review of interoperability standards in e-Health and imperatives for their adoption in Africa. S Afr Comp J. 2013; 50:55-72
[3] Richardson D. Real-time space-time integration in GIScience and geography. Ann Assoc Am Geogr. 2013; 103:1062–1071
[4] AIHW. Dementia in Australia. Canberra. Australian Institute of Health and Welfare. 2012; Cat no. AGE 70.
[5] Mavrodaris A, Powell J, Thorogood M. Prevalences of dementia and cognitive impairment among older people in sub-Saharan Africa: a systematic review. Bull World Health Organ. 91. 2013;10:773-83.
[6] Pillay NK, Maharaj P, Population Ageing in Africa. In P. Maharaj (ed). Aging and Health in Africa: International Perspectives on Aging. 2013. New York. Springer.
[7] World Health Organization. Atlas of Health Statistics of the African Region. 2011. Regional Office for Africa