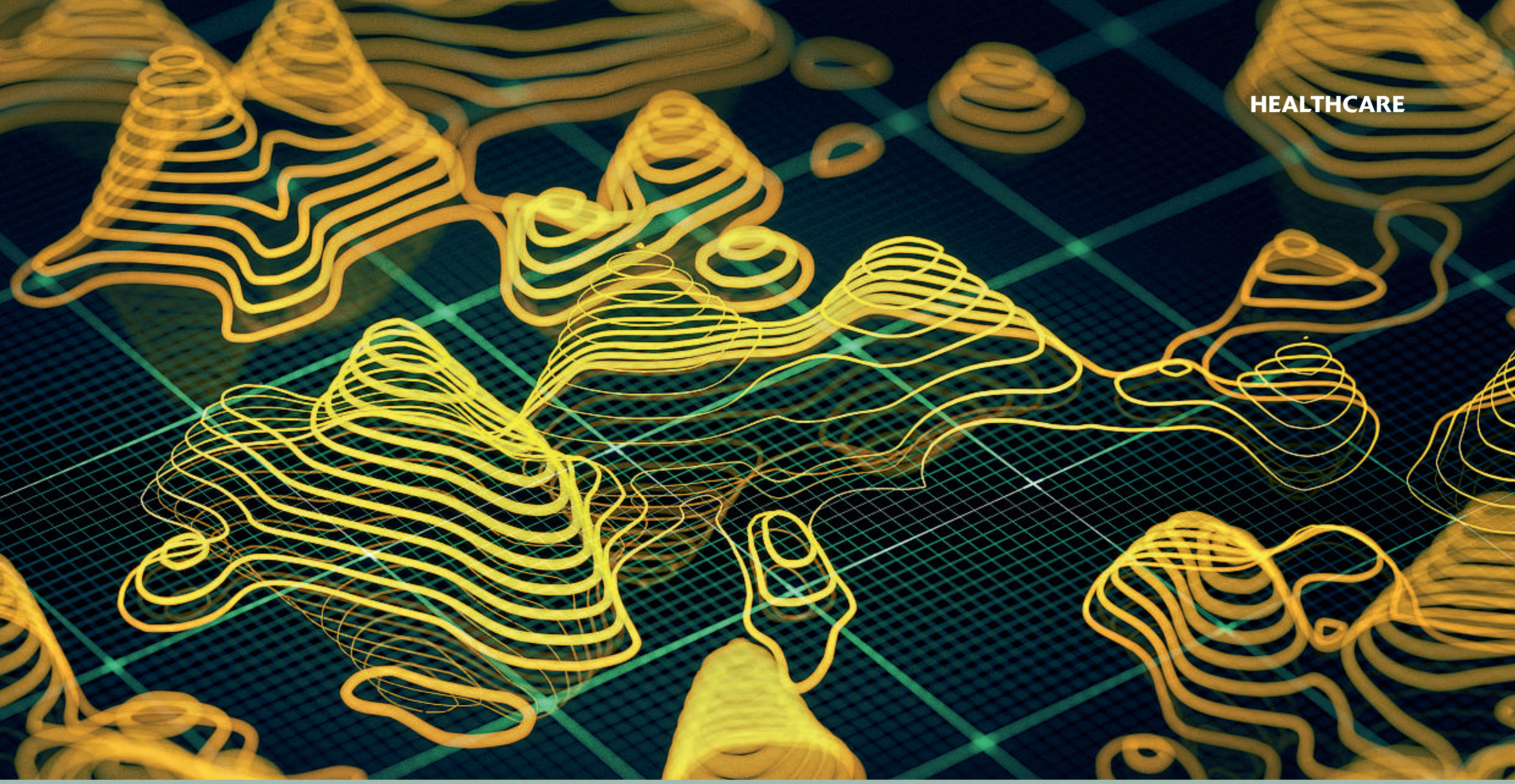


DIGITAL LANDSCAPES OF HEALTH AND DISABILITY

THE NUMBER OF PEOPLE WITH SOME DEGREE OF IMPAIRMENT IS INCREASING DRAMATICALLY AROUND THE WORLD. 3D AND RELATED METHODS OFFER AN ACCESSIBLE WAY TO PLAN FOR AND RESPOND TO A WIDE VARIETY OF ISSUES, ARGUE HAMISH ROBERTSON AND NICK NICHOLAS

We live in an increasingly digital world. The influence of information systems and the virtual environments they help generate are on the rise globally. Some fields, such as the spatial sciences, are on the leading edge of this transformation, while others, such as the human services, are proving very mixed adopters.

If the Big Data concept is to have a genuinely transformative effect on the way we live, it seems clear that key policy domains such as health, ageing and disability will need to benefit from this rapid expansion of the digital domain. It is particularly important that digitisation, digital data management and its analysis will need to be able to show benefits for sick people, older people, people with disabilities and other vulnerable groups. This is no marginal concern. With rates of chronic disease and disability rising internationally in conjunction with rapid population ageing, the number of people with some degree of impairment is increasing dramatically.

One way ahead we can see in this growing complexity is to connect digital data and analytics to the most pressing health and disability concerns of the coming decades. One of the potential areas for this lies in the use of three-dimensional and related methods to present complex issues and their effects in a relatively accessible manner. The concept of the digital landscape could potentially be applied to planning for and responding to a wide variety of health, disability and ageing issues.

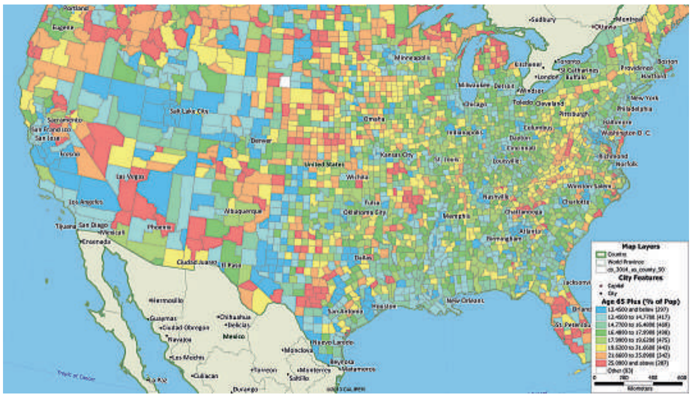
Spatial data mining and visualisation principles suggest that even with the many data quality issues that exist, we can build effective pictures of the impact of these problems for most countries and at various scales. The value in this lies in the demand for services, the cost and resource implications of responding effectively, and the capacity to sustain these developments over time. The importance of visualisation tools in the midst of data saturation and uneven numeracy skills and knowledge is clear to see. One of the few ways forward to ensure some equity of treatment and support for these growing populations lies in consistent and accessible information environments that all relevant parties can access equally.

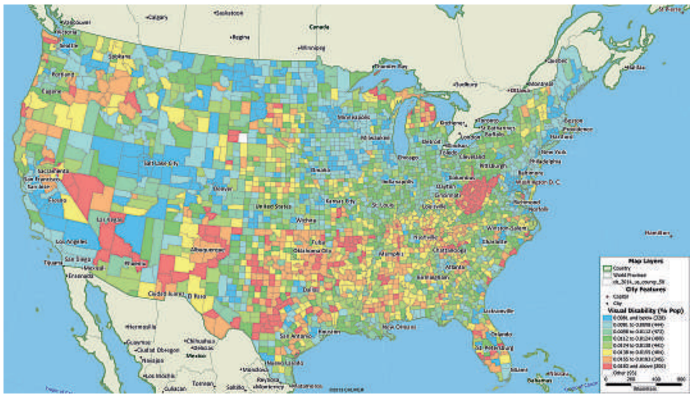
3D maps

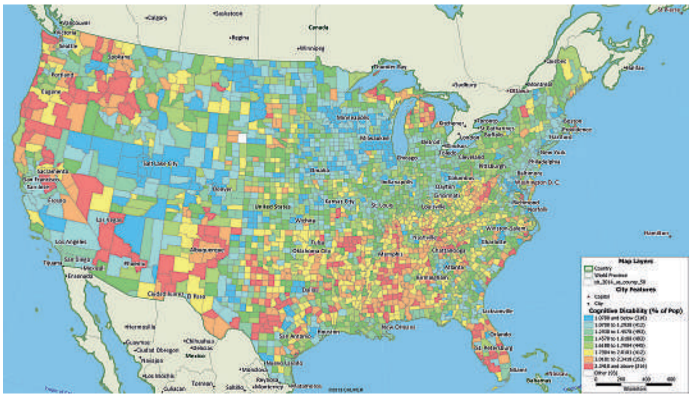
The development of 3D visual maps has been underway since at least World War Two, when stereoscopic vision was applied to aerial reconnaissance photographs. More recently, momentum has grown significantly in the field of 3D work and, indeed, 3D+ visualisation techniques such as Google Earth's use of time sliders and multi-scalar imagery (zoom in/out, pan, tilt, etc).

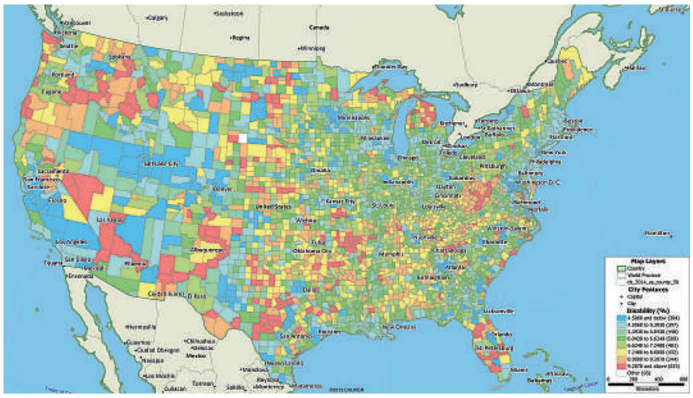
Now we are seeing growth in the use of 3D in conjunction with a variety of applications including the growing Smart City agenda. Obviously, the aim is to create a much higher resolution and more flexible simulation of the physical environments we would once have mapped in static 2D formats. Multidimensionality is a fundamental part of the complexity of the natural and human worlds and our technology is getting much better at accommodating and modelling those dimensions.

The idea of 3D mapping in computer-based information systems is an extension of the geometry and trigonometry we associate









with traditional cartography. Since Roger Tomlinson pioneered GIS back in the 1960s, we have always known that 3D was a practical objective, even if 2.5D had to suffice for so many years. Now our technology has caught up with both our mathematics and our ambitions, with a resulting cascade in applications. Some acknowledgement is warranted here of the contribution of the gaming industry to 3D developments and the demand for improved graphics cards in computers (including SimCity and the like). One of the areas in which we suggest there are potentially valuable applications for this use of spatial technology is in the health and disability sectors. Both these sectors are hugely complex human systems with significant environmental influencers and spatial science has always been a valuable part of our understanding of patterns of health and illness.

Multidimensionality is central to health problems of many kinds. Health and illness are clearly spatial phenomena, and health systems and their responses to illness and disease are inevitability spatial, too. Indeed, one of the problems of contemporary healthcare systems remains the issue of providing a consistent level of care across complex environments and jurisdictions. Who provides what services to whom and the level of health resources available within any geographical territory remain highly problematic issues in all but the smallest countries. Even then, we know that factors such as life expectancies can vary significantly within walking distance from a suburb. Spatial analysis is thus crucial to a thorough understanding of health problems and their potential resolution. In an age when the costs of healthcare in any system – public, private or mixed – are on a steep upward trajectory, spatial analysis and understanding becomes more crucial still.

Spatial literacy

Spatial literacy in the health sciences and in health policy environments is quite low. Mapping is not a core skill in healthcare education and training programmes even though many individual health professionals have a genuine interest in spatial science and its applications.

The problem here is not that we expect every health, ageing or disability professional to be a GIS expert. However desirable that might be, it would be unreasonable at this stage in the development of highly visual big data environments. Rather, the risk is that a lack of familiarity and even comfort with the basic concepts and methods of GIS and related spatial technologies may inhibit adoption in an organisation. Some innovative person or department might decide this is the way to go but be stymied by a lack of organisational awareness of not only the benefits of 3D applications but also the concepts underpinning them. So, there remains an essential information/education/promotion (or mix) component to pushing this agenda forward across a variety of industries and organisational types.

Consequently, we need to be leveraging every possible aspect of the developmental pathway of the spatial sciences if we are to make inroads into areas such as epidemiology, health informatics, as well as health programme design, delivery and evaluation. This can occur via three main strategies:

1. Integration wherever possible with existing health sector approaches (add-ons and overlays).

2. Promoting the innovative aspects of spatial science and technology that go well beyond current approaches in healthcare, even when the technical capacity exists for the inclusion and application of such innovations.

3. Targeting strategic and tactical health sector events such as conferences or innovative projects. One of the benefits of highly innovative projects gaining coverage and acceptance is that they create room for related technologies to occupy.

The field of 3D is one such innovative domain that we need to be promoting more effectively to healthcare systems including funding bodies, insurers and quality control. If providers such as Microsoft can see the promise of maps and 3D visualisation, the writing is clearly on the wall.

Waiting for clinical or administrative sub-systems in healthcare to catch up is unlikely to create the leverage we need. Instead, we need to look to points of leverage, especially critical issues such as timely responsiveness, acute event management and cost management in dynamic environments such as the health of ageing populations, disability health and underserved or vulnerable populations, including high-cost sub-groups such as those people presenting to emergency departments with unusual frequency or those with complex care needs. These pathways are more likely to offer the spatial science industry opportunities and especially so for new and emerging technical innovations in the field.

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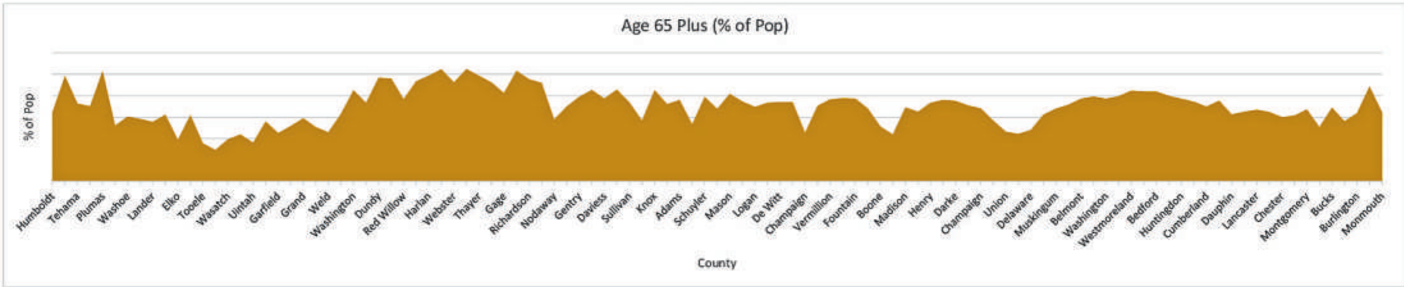


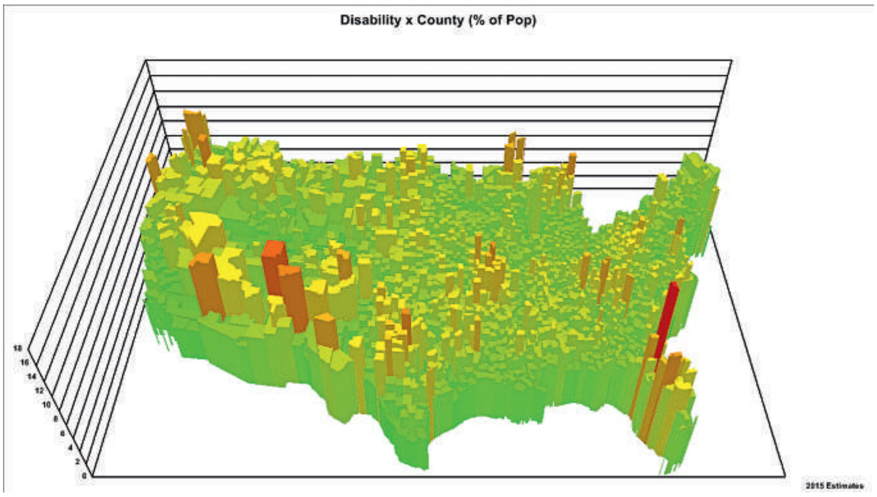
Information integration

So how might 3D and more broadly multidimensional software applications influence healthcare systems? One important issue lies in information integration. Currently, even many digital information systems, within and between, healthcare and the ageing and disability sectors lack high levels of interoperability. The need for this situation to be resolved is hard to understate in the context of the many ageing populations and rising levels of disability associated not only with ageing but also chronic disease and accidents and injuries in developing countries. Numerous improvements will be needed to ensure the affordability and sustainability of such systems moving forward.

Given the complexity of any one of these areas, the need for better information integration and analysis is central to providing information that reflects the level of connectedness that exists between these domains in the real world. Current advances in 3D reflect this need for managing complexity across distance and at variable scales.

A second key consideration lies in what is often called programme management. This can refer to the funding, clinical or service delivery branches of health, ageing and disability. What is clear is this is often done with only limited reference to the composition and distribution of the population. Especially so as these relate to the accessibility of services and the complexity of health/illness/disability conditions. Thinking about how 3D (and 3D+) analysis and visualisation might support the strategic level of information interoperability through to the actual delivery of services offers a considerable space of opportunity to suppliers operating in these markets.

The concept of 'landscapes' and three-dimensionality can readily be applied to demographic, epidemiological, infrastructure and financial aspects of the provision of health, ageing and disability services. Current technologies and specialist applications coming out of the gaming sector and high-level spatial sector innovation, as well as VR work and the like, all have potential value and utility in these areas. To be able to visualise the relationships between population factors, disease problems, existing service provision and financial concerns is surely the next step in 21st century health and disability management.



Multidimensional mapping is already gaining momentum if clinical fields such as neuroscience, molecular topography, and even cancer research. In theory, at least, this should make it easier to promote and sell the utility of 3D mapping tools and products to the wider health, ageing and disability sectors. A problem is that innovation, even in these advanced fields, is far from uniform with some researchers driving change while others lag. Part of the solution may lie in the 'look and feel' aspects of 3D simulation and visualisation – the less abstracted the formats, the easier they are to relate to and connect with current practices and concerns.

Finally, we need to think beyond the more obvious benefits of the 'landscape' approach provided by 3D mapping and analysis. Often 3D contoured maps and data surfaces can disguise important variations while emphasising the benefits of the 3D visual effect.

An example of this lies in taking transects of 3D landscapes. This is where the user takes a cut through or across the landscape from one selected point to another, similar to the 'brain slice' in neurological research. This can show, for example, the degree of variability from one city to another or across a region or even within an urban area. These types of variabilities are of growing importance globally as urbanisation continues and inequalities in health and illness grow. This means, effectively, that you can the benefits of the 3D 'cake' and those of taking different virtual slices of the cake to explore variations across smoothed surface models. This permits users and audiences to shuttle between the 3D visual effect and the data variations between spatial points or locations. This too needs to be emphasised as an application in the expanding visual data environments we are seeing in business and elsewhere.

Representation is key

So, as the complexity of the health and disability issues we face globally continues to grow and as data collection and analytics compound this scenario, the need also grows for tools and strategies that can simplify and clarify the key issues that need to be addressed. More particularly, the issue of how close to representing the reality of everyday health, disability and ageing work these products become may be the deciding issue. Given the continuing popularity and advances in fields such as VR and robotics for surgical work or integrated CAD for design and planning, there are obvious and expanding points of intersection for spatial science applications. The landscapes of health, disability and ageing are themselves becoming more like the 3D products we can provide. Perhaps the point of intersection is closer than we think.

THE LESS ABSTRACTED THE FORMATS, THE EASIER THEY ARE TO RELATE TO

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