2016

Medicine in the anthropocene: Modern healthcare and the transition to an ecologically viable society

Zywert, Katharine

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Katharine Zywert, PhD Student, University of Waterloo, kzywert@uwaterloo.ca

Supervisors: Dr. Stephen Quilley & Dr. Jennifer Lynes

Abstract

The Anthropocene, a novel geological epoch in which human activities significantly affect the course of ecological change, is transforming health systems. Faced with the converging pressures of declining resource and energy flows, the extinction of medicinal plant species, changing ecologies of disease, aging demographics, and challenges to existing welfare state policies, health systems need to find new ways to operate in an alternative social-ecological regime. Preliminary research suggests that promising strategies for adaptation could involve lowering the material and energetic throughput of health services and medical technologies by reinventing social arrangements of care and designing preventative medical interventions that incorporate broader recognition of the social, cultural, and ecological dimensions of health. This paper presents three promising alternatives for health systems in the Anthropocene: the degrowth movement, Transition Initiatives, and salutogenic design.

Introduction

In this paper, I want to bring us first out of our local contexts, so that the systems lens we're looking through observes the planet on the scale of geological time. It is from this vantage point that I want us to think about health systems. To do this, I will introduce the idea of the Anthropocene, then outline the problem context for my research, which investigates how the dynamics of this new epoch will affect human health. I will then discuss the large-scale social-ecological transformations we will face in the coming decades and propose what I think are the minimum specifications for redesigning health systems to address these challenges. Next I will consider some of the ways that design is addressing the tensions of the Anthropocene, through degrowth economics, Transition Initiatives, and the salutogenic design movement.

The Anthropocene

The Anthropocene is an emerging scientific term for our current geological age. It marks a profound break with the Holocene epoch, a phase of climate stability which humanity has enjoyed since the end of the last ice age (Steffen et al., 2015; Zalasiewicz et al., 2010; Lovelock, 2014).
With the industrial revolution, humanity created the mechanisms of mass production and consumption, and consequently began to exert a stronger influence on the biosphere. Since 1950, there has been a tremendous speeding up of the impacts of human economic activity on the function of planetary systems (Steffen et al., 2015). Steffen et al. (2015) call this the "great acceleration" and demonstrate how growth in human population, GDP, and energy use are coupled with a rise in carbon dioxide concentration in the atmosphere, surface temperature, and ocean acidification. These and other effects of the growing human socio-economic sphere have produced the environmental signatures of the Anthropocene, including global warming, altered weather

patterns, crashing biodiversity, and rising levels of pollution (Steffen et al., 2015; Zalasiewicz et al., 2010).

The Problem Context

The social-ecological dynamics of the Anthropocene will profoundly disrupt human health systems. I will give a few specific examples of the changes that are already occurring. As we destroy massive tracts of tropical rainforest, we are causing the extinction of medicinal plant species (Blakemore, 2016). As the climate warms, ecologies of disease are shifting. Disease vectors like mosquitoes and ticks are migrating into more temperate regions (Singer, 2009). New drug-resistant infectious diseases are emerging (Davies, 2015; McElroy & Townsend, 2014; Baer, Singer & Susser, 2013; Singer, 2009). At the same time, chronic diseases like cancer, diabetes, and dementia are rising as a result of people living longer, more sedentary lives (Hidaka, 2012). Fast, cheap global transportation networks have dramatically increased the risk of pandemics sweeping through geographically distant populations (Homer-Dixon, 2006). There is an epidemic of depression and anxiety in affluent countries, especially affecting young people (Hidaka, 2012). Among people in regions directly disturbed by climate change, we are seeing a rise in conditions known as ecosyndemics, clusters of illnesses caused by pollution and exacerbated by vulnerabilities such as entrenched poverty and lack of access to primary health services (Singer, 2009).

In spite of the seriousness of these challenges, I propose that the greatest risks to health systems in the Anthropocene actually lie outside the formal domains that we usually associate with health. Instead, they exist in the broader interconnection between planetary ecology, political economy, and society. The Anthropocene threatens to dismantle the economic and institutional structures that support modern medicine. The troubling prognosis for health systems is that this dismantling is probably inevitable. The key variables likely to transform health systems in the coming decades are not aging demographics and antibiotic resistance, but declining resource and energy flows, the end of economic growth, and increasing vulnerability to rapid losses of social complexity.

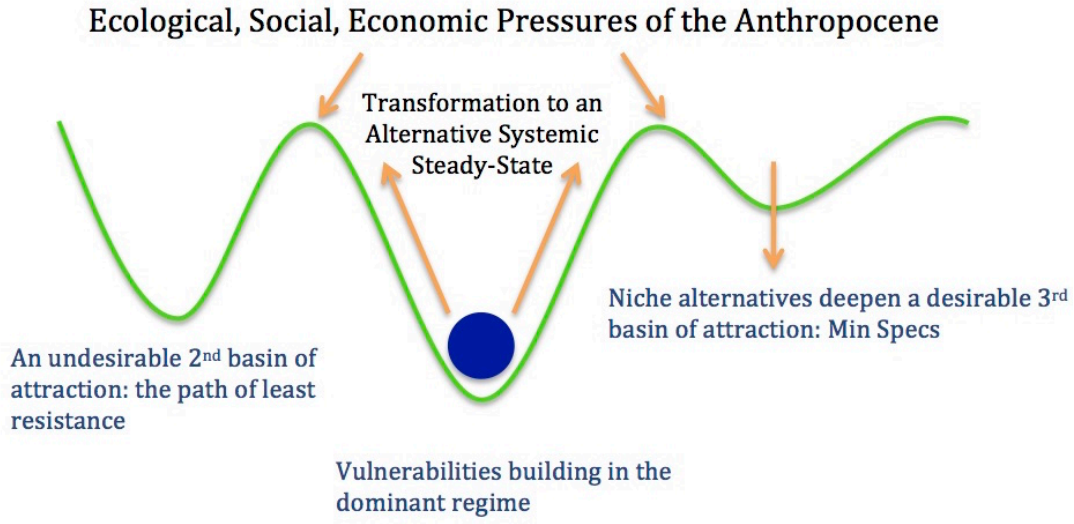
1. **Declining resource and energy flows.** We have already passed peak production of many nonrenewable resources that industrial capitalist societies rely on for continued economic and technological growth. This means that if we are to avoid catastrophic climate change, the material and energetic inputs into all sectors of the economy, including healthcare, will have to be reduced. Declining inputs will make themselves felt at the same time as aging populations in affluent countries and growing populations in the global South put increasing pressures on existing healthcare systems (Kallis, Demario & D'Alisa, 2014; Kershner, 2014; Heinberg, 2010; Raffle, 2010; Greer, 2009).
2. **The end of economic growth.** Evidence from ecological economics and natural sciences suggests that economic growth and environmental sustainability are irreconcilable (Daly, 2005; Homer-Dixon, 2006; Quilley, 2015). Attempts to increase efficiency or to redirect growth to the green economy have not resulted in absolute reductions of material or energy use at a global scale. Projections of potential future efficiency gains offer little hope of continuing to expand the market economy while accomplishing sustainability goals, and projections suggest that economic activity would have to be taking carbon *out* of the atmosphere by 2100 to stay within safe levels (Jackson, 2009; Kallis, Demario & D'Alisa, 2014).
3. **Vulnerability to rapid losses of social complexity.** Complex systems theories coupled with historical studies of civilizations such as the Romans and the Maya suggest that increased connectivity and social complexity require ever-expanding material and energy inputs that, when they can no longer be acquired, can precipitate societal collapse. The degree of integration of elements in a complex system has a strong effect on its rigidity and vulnerability.

> Highly connected systems like our current globalized society are particularly vulnerable to tipping into a phase of creative destruction (for an ecological metaphor, think forest fire in a mature forest). Creative destruction is devastating to the established order, but also releases resources that have been tied up in the existing system to be used in new ways (Tainter, 1988, 2014; Homer-Dixon, 2006; Holling & Gunderson, 2002). Health systems will be dramatically affected by any broad-scale social collapse that, for instance, curtails industrial production of medical technologies and pharmaceuticals or that limits their international distribution.

We cannot respond to these issues with incremental change (D'Alisa, Demaria & Kallis, 2014; Lorek, 2014; Westley et al., 2011; Homer-Dixon, 2006). To address these problems will require that we wean our societies away from their dependence on fossil fuels and economic growth. For those of us concerned with the future of health systems, we are looking at a global-scale transformation, not only our institutional structures, but of our conceptual models of health, illness, and care.

Social-Ecological Systems Transformation

If we are going to talk about redesign at this scale, it is helpful to use models from systems thinking and resilience studies.



This diagram presents a way of conceptualizing change in complex systems. Here, large-scale change, affecting the function of the system, can be visualized as a transition between alternative steady states or "basin[s] of attraction" (Walker & Salt, 2012, p. 6). In this model, the ball represents the state of the system, and is pulled toward the bottom of a valley, representing a position of relative stability (Walker & Salt, 2012, p.6; Walker et al., 2004; Westley et al., 2011). The ball will change positions within the basin in response to external conditions. Complex adaptive systems usually have a limited number of influential variables with a disproportionately strong effect on the overall pattern of feedbacks in the system (Meadows, 2008). Regime-level change can occur if these variables are pushed past a particular range, causing them to cross thresholds beyond which the system flips into an entirely new systemic structure and function (Walker & Salt, 2006, 2012; Holling, 2001; Westley et al., 2011).

The deep basin of attraction that we are currently in is the steady state associated with industrial consumer capitalism. Some of its key variables include the rate of economic growth, the availability of cheap energy, and a high degree of social complexity sustained by high material and

energetic throughputs (Quilley, 2015). In healthcare, this system has been positive in many ways. Over the past two hundred years, we have seen many improvements in population-level health outcomes such as lower infant mortality, higher life expectancy, control of infectious disease, and treatment of chronic illness (Schrecker, 1999; Kunitz, 2007). We have also witnessed the expansion of primary care and the development of medical expertise, pharmaceuticals, and medical technologies (Farmer, 1999; Harrison, 2004; Janes & Corbett, 2009).

However, the dynamics of the Anthropocene are putting pressure this system's key variables, making it more and more likely that it will flip into a new basin of attraction. If this happens, the ball is likely to roll along the path of least resistance, in this case winding up in an undesirable basin of attraction. We can witness this effect by looking at areas of the world that have experienced social and economic crises. For instance, the economic crisis in Greece has caused extreme shortages of medical supplies, pharmaceuticals, and access to doctors and nurses. Due to mass unemployment, twenty-five percent of the population lost universal healthcare coverage. Serious illnesses are diagnosed late when they are more resistant to treatment, and there has been a resurgence of infectious disease including malaria and TB (Chrisafis, 2015; Bednarz & Beavis, 2012). In Syria, healthcare services have become a target for military strikes, with over 700 healthcare workers killed and 300 medical facilities bombed since 2011. Hospitals are frequently operating without standard medical technologies such as CT scanners, and must sometimes treat patients without access to electricity, water, or fuel (Singh, 2015).

These examples demonstrate that in the face of external pressures, our health systems lack adaptive capacity and quickly flip into an undesirable state where they are unable to adjust to resource and energy shortages, where they increasingly limit access for those unable to pay, and where we see the collapse of high-overhead, highly complex infrastructures, all of which results in declining population-level health outcomes.

Avoiding the path of least resistance on a global scale involves developing niche alternatives that together deepen a desirable basin of attraction for health systems (Homer-Dixon, 2006; Jackson, 2009; Westley et al., 2011). Nurturing alternatives helps to carve out pathways that make it more likely for the system to tip towards these new structures when pressures accumulate in the dominant regime (Walker & Salt, 2012).

Building Alternatives

Within the dominant regime, alternatives develop in "niches," protected spaces of experimentation in which actors can build new social, cultural, political, and economic arrangements (Westley et al., 2011, p. 767). Transition from one socio-ecological regime to another occurs when pressures at the landscape level (physical environment, economic, political, and social trends) destabilize the meso scale, providing opportunities for niches to deepen and eventually form a new basin of attraction when the system tips (Westley et al., 2011; Walker & Salt, 2006; Walker & Salt, 2012). It is therefore important to enable niche alternatives or "shadow networks" to develop in preparation for the time when pressures on the regime accumulate and precipitate system transformation (Westley et al., 2011, p. 771).

Minimum Specifications

Minimum specifications are a simple set of rules to shape action in the future. I suggest that health systems in the Anthropocene will need to adapt in ways that take into account these five considerations:

1. Find ways to decrease the energetic and material throughput of modern medicine,
2. Extract the best of modern medicine from reliance on industrial production,

consumption, and distribution,
3. Re-embed aspects of healthcare in networks of family and community reciprocity, shifting the pool of resources for health and care activities from financial to social capital,
4. Move away from individualism in medicine to incorporate broader recognition of the interdependence of social and ecological processes at multiple scales, and
5. Leverage disruptive technologies like 3D printing for manufacturing medical equipment, and ontologies that, for instance, reincorporate the human capacity for ritual and reconceptualize death and other milestones in the life course.

Degrowth

The degrowth movement represents an attempt to redefine the purpose of the economy from creating growth to generating human wellbeing (van den Bergh, 2011 as cited in Walker & Salt, 2012, p. 163; Latouche, 2006; Beddoe et al., 2009; Jackson, 2009; Schneider, Kallis, & Martinez-Allier, 2010). Degrowth theorists seek to develop a functional economy that can operate within biophysical limits and prioritize social justice (Demaria et al., 2013; Schneider, Kallis, & Martinez-Allier, 2010; Kosoy et al., 2012).

The degrowth movement assumes that wellbeing is not wholly dependent on material consumption, but that as consumption and production go down, the amount of time available for pursuing leisure activities and participating in networks of interpersonal reciprocity rise, improving life satisfaction beyond levels enjoyed in growth economies (Jackson, 2009; Victor, 2011; Kallis, Kerschner, & Martinez-Allier, 2012; D'Alisa, Demaria & Kallis, 2014).

Degrowthers propose that the transition to a post-growth political economy is possible by scaling back industrial production and consumption, decomplexifying socioeconomic institutions, relocalizing economies, and reorienting work toward service and caring professions (Jackson, 2009; D'Alisa, Demaria & Kallis, 2014). In a degrowth economy, care, education, health, and environmental restoration provide meaningful opportunities for employment and anchor a new labour-intensive, prosumption-oriented economy (Missoni, 2015; Kallis, Demario & D'Alisa, 2014).
In terms of redesigning health systems, the degrowth movement advocates for shifting resources from curing to prevention and freeing up people's time and energy to create full family and community lives that are imbued with a sense of purpose, meaning, and fulfilment. Care activities have a pivotal role in degrowth politics, and are seen as one of the ways to temper the excesses of mass consumption, as caring for others provides a more enduring basis for self-esteem and status than consumer goods. Degrowth policies would also release resources from unnecessary positional spending, redirecting limited financial resources towards basic goods like education and health (Missoni, 2015; Kallis, Demario & D'Alisa, 2014).

Transition Initiatives

The Transition Town movement began in the UK, spearheaded by the community of Totnes, which became concerned about peak oil and climate change (Hopkins, 2008; Richardson, Nichols, & Henry, 2012). Transition Initiatives are community-based projects that build local resilience for a future without oil. They are organized around the goals of economic relocalization, developing decentralized, renewable energy infrastructure in preparation for energy descent, reskilling to provide for basic needs locally, invigorating local food production, developing local currencies, and cultivating local medicinal capacities. Transition designers create solutions that are intended to

generate outcomes over long time horizons and at multiple scales, increasing the resilience of local communities while relieving pressures at the global scale (Irwin et al., 2015; Hopkins, 2008; Richardson, Nichols, & Henry, 2012).

The transition movement insists that "the future with less oil could be prefereable to the present, but only if sufficient creativity and imagination are applied early enough in the design of this transition" (Hopkins, 2008, p. 53). Transition Towns develop new models for health systems organized through diverse local networks of healthcare centers that offer preventative programs, biomedical and complementary treatments, and health promotion activities. Partnerships with local schools educate about healthy living, offering courses on nutrition that span agriculture to cooking, strengthening ecological, social, and personal health in tandem. Medicinal plants are cultivated locally and pharmaceuticals are manufactured in small batches (Hopkins, 2008). Growth in access to meaningful work, increased levels of physical activity, and more satisfying daily lives reduce rates of stress and anxiety disorders (Hopkins, 2008; Richardson, Nichols, & Henry, 2012).

Salutogenic Environments

Salutogenesis means focusing on factors that promote health, as opposed to pathogenesis, factors that cause disease. Salutogenic design embeds preventative healthcare into the structure of social institutions and the built environment. Principles of salutogenic design include creating infrastructures that support human health and avoid disease through, for instance, ecological architecture that purifies the air and water, grows healthy food, and restores environments, or urban design that promotes physical activity and other healthy behaviours. In this approach, design is used to reduce the burden of disease, averting downstream costs for health systems (Dilani, 2015). One of the most significant aspects of the salutogenic approach is that it incorporates recognition of the importance of the social and ecological context for maintaining human health. It also attends to physical health through the design of ergonomic, non-toxic spaces, mental health by facilitating personal control, reducing anxiety, and furnishing aesthetic and spiritual elements, and social health by enabling access to community networks (Dilani, 2015).

Conclusion: Innovation Space

The pressures of the Anthropocene are opening up a new innovation space for health systems. Sociologically, pre-modern and modern societies are characterized by a series of dichotomies. The term pre-modern society as I am using it here refers to societies that have not gone through a process of modernization through industrialization, integration of a formal market economy, and globalization (see Giddens, 1990). With degrowth, the Transition Town movement, and aspects of salutogenic design, we may be looking at a future that embodies an alternative kind of modernity that is not premised on mass consumption, cheap energy, and extreme levels of social complexity. We could be looking at a future where our basic material needs are met locally, where we live in more tightly knit communities, where our economic and cultural activities are more embedded in place, and where the meaning we derive from life is more closely bound to our communities. This opens up space to reimage things like health and illness, care and community obligation, the meaning of death and other milestones in the life course, the role of ritual, and the subject of healing from individuals to social and ecological processes (Zywert & Quilley, forthcoming).

Right now, our health systems appear to be hurtling along the path carved out by the medicine of our industrial capitalist, highly complex society. This medicine is technological, with a leading edge in novel gene therapies, nanomedicine, robotic surgical techniques, and wearable technologies. It cures individuals, extends the lifespan, and enshrines health as a human right

(Farmer, 1999; Beck & Beck-Gernsheim, 2002; Bauman, 2012; Beck, 2016). But there is also another kind of medicine that humans have wielded for thousands of years. This is the medicine of place-bound communities in a resource-constrained world. It is embodied, ritualistic, invested with cultural significance, and community-centric rather than individualized. It engages the age-old, innate human capacity to imbue life with meaning, to care for each other, and to heal using the pharmacopeias that we have on hand, those of local medicinal plants and the abilities of human consciousness (Turner, 1977; Katz, 1982; Schepper-Hughes & Lock, 1987; Sutherland, 2015). The innovation space opening up in the Anthropocene offers not a return from one to the other, but an opportunity to intentionally design an integration that can serve as the basis for health systems in an alternative modernity, one that is ecologically viable at the global scale.

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