Health in a Dynamic World

STEPS Working Paper 5

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1. INTRODUCTION

The intimate relationships between societies and ecosystems have, throughout history, given rise to complex challenges to human health (Ranger and Slack, 1996). McNeil (1977), for instance, documents how health problems have co-evolved with ecological dynamics associated with different forms of human settlement, available technologies and livelihood strategies. He argues that the burden of parasitic and infectious diseases grew as people lived in closer proximity with a small number of other species. He also relates the major pandemics of the plague several centuries ago to changing patterns of global trade. Diamond (1998) argues that human coexistence with potential pathogens is central to understanding the divergent development paths of the continents. The development of institutions and governance arrangements to help people and societies cope with sickness similarly has a long historical provenance (Porter 1997). They characteristically include rules of behaviour to improve public health and arrangements for generating and making available specialised medical knowledge. Diamond (2006) documents the devastating impact on society of an inability to respond adequately to health-related challenges.

Such historical analyses underline several things. First, whether at global, continental or local scales, health is central to sustainability: major health problems can dramatically damage societies and economies and their durability and resilience over time. Second, the dynamics of human health - and the disease ecology that influences it - are intimately entwined with social, technological and environmental change. Third, whether the pathways that unfold lead to sustainability or otherwise, depends very much on institutions, power and knowledge. These concerns with pathways to sustainability - and especially their implications for the wellbeing of poorer people living in developing and transitional economies - are central to the newly established STEPS Centre at Sussex.

Global health systems are reaching a turning point. Health is rising up the political agenda in many countries. In regions experiencing rapid economic growth, this is associated with the rise in age-related health problems, changing ex-

pectations linked to economic growth and the development of the media, the emergence of new epidemic diseases and the spread of markets for medical goods and services. Elsewhere, the response to HIV and AIDS has attracted increasing political attention, although the cost of treating chronic diseases is also becoming a concern. The public and the political elite in rich countries have become increasingly interested in the health problems of poor countries and possible threats to global wellbeing. Science increasingly promises solutions to health problems through new drugs, vaccines and other technologies. Governments and private foundations have committed a lot of money and these commitments could grow. This is creating big opportunities for improving the lives of poor people. It is also creating risks that measures taken by the rich and powerful to protect themselves could damage the wellbeing of the poor. For example political pressure by citizens of rich countries for protection from perceived risks of epidemics may divert attention and resources from interventions aimed at addressing the immediate problems of the poor.

This working paper aims to stimulate thought about how to make the best use of these opportunities and reduce the risks. It brings together thinking from several disciplines relevant to understanding the dynamics of human health and the institutions and governance arrangements for organising responses to disease. It suggests some concepts and approaches helpful for understanding these, linking to those laid out in more detail in other papers in this series (see especially STEPS Centre Working Papers 1, 2 and 3 on Dynamics, Governance and Designs). It proposes elements of a research agenda to address emerging health challenges in today's rapidly changing world.

The context of rapid change, in both the ecology of human disease and the use of specialised knowledge to influence this ecology, is central to the discussion. Human ecology has been changing very quickly since the onset of the industrial revolution and the rate of change has accelerated during the past half century. This has contributed to the emergence of major health challenges, such as the introduction of HIV to the ecosystem, pollution-related disasters and the fear of a pandemic of Avian Influenza. We are likely to experience more such challenges. The numbers of humans and domestic animals are increasing rapidly.[1] A growing proportion lives in densely populated localities and under livelihood

[1] They are projected to reach 6.5 billion humans, 1.3 billion cattle, 1.1 billion sheep and 1.0 billion pigs by the turn of the 21st Century. A large proportion of the people who have ever lived are alive today. One understanding of a species' biological history is in terms of numbers of individuals, episodes of reproduction and interactions between that species and others. From that point of view, a substantial proportion of human biological history is taking place now and the number of potentially major health challenges per period of time is likely to grow.

conditions that have major consequences for interactions with potential pathogenic organisms. Some developments in technology and social organisation have greatly enhanced the capacity of humans to live healthy lives, but others have introduced stressors, including chemicals and particulate pollutants, to ecosystems. Social and technological changes have increased the volume and speed of travel, providing new mechanisms for the rapid spread of pathogenic organisms and environmental stressors. We are at an early stage in the management of the potential health consequences of rapid ecological change (Brownlie et al 2006).

At the same time - and especially since the mid-20th Century - knowledge and the capacity to apply it towards the achievement of human purposes has developed rapidly.[2] This includes diverse strands in the systematic study of the world that constitutes scientific knowledge, as well as the multiple ideas and ways of knowing that constitute popular or lay knowledge. We have new technologies and new types of organisation that enable complex divisions of labour in increasingly sophisticated medical care systems. The effective use of relevant knowledge to address health problems has made an important contribution to the quality of many people's lives. For instance, the development of public health was instrumental in making possible the successful urbanisation that began in the 19th Century and scientific advances provide effective responses to many health problems. Developments in a number of scientific disciplines suggest many future possibilities for reducing suffering and prolonging human life. These same changes have also been associated with the emergence of new patterns of social inequality and new forms of poverty.

This paper is intended to complement a body of work that documents the burden of disease and projects morbidity and mortality trends (Mathers and Loncar 2006; Mathers et al 2006). It focuses on the uncertainty associated with dynamic and complex systems and different ways of understanding or 'framing' these, and the special challenges this presents to individuals and societies in dealing with rapid change. Its aim is to stimulate debate about the forms of knowledge and governance arrangements for dealing with health challenges appropriate for shaping pathways to sustainability that meet the needs and priorities of specific groups of poorer people.

[2] A very high proportion of all written work in the history of humanity has been written by someone alive today.

In section 2, we suggest that a variety of factors during the mid to late-20th Century led to a widespread belief in the inevitability of both economic and technological development and continuing health improvements. This was grounded in a broad set of assumptions about relative stability (ie gradual and predictable change over time) in socio-political, ecological and technological systems. Most projections of future developments are still based on this kind of assumption.

In section 3, we explore emerging evidence, as well as new understandings, of the co-evolving nature of human-disease-ecology-technology dynamics. These raise challenges for addressing health problems in a sustainable manner, and meeting the needs of poorer and marginalised people. They show why assumptions about stability and inevitable progress can make health interventions dangerously unsustainable, for instance as ecology 'bites back' in treatment-resistant infectious organisms, or as poorer people find themselves caught in low productivity, low health status vicious circles.

Section 4 explores how the realities of health institutional and governance arrangements are unfolding, and how governance arrangements are shaped by and in turn shape systems dynamics. They reveal new complexities in the interactions between multiple actors across scales, and in the politics of knowledge. Some of these emerging arrangements are responses to perceived inadequacies of existing approaches. The section outlines some recent bodies of work that contribute to an understanding of emerging governance realities.

Major challenges remain in understanding and working to influence the relationships between social-ecological-technological dynamics, and governance - in other words, integrating the insights that sections 3 and 4 review. This involves the resolution of a number of tensions: (i) between the benefits from knowledge and technologies based on simplifying and universalising assumptions and the uncertainty associated with rapidly changing and complex realities; (ii) between the increasing capacity for innovation and the need for stable rules and norms to organise coherent responses to challenges; and (iii) between the potential for rapid response and the risk of greater uncertainty and instability due to the growth in the number of people involved in producing, accessing and applying diverse forms of health-related knowledge. This third tension speaks also to the diverse ways in which different people and groups may frame, understand and prioritise health-related goals. In this context, it is insufficient to speak simply of sustainability of social-ecological-technological systems in relation to health in general terms. We also need to acknowledge Sustainability, or the particular dimensions of health, wellbeing and related system properties valued by par-

ticular groups (see STEPS Working Paper 1 on Dynamics), and the contestation over priorities that these can entail.

It is impossible to draw together all knowledge relevant to an understanding of a rapidly changing reality. Responses based on past experience and accumulated scientific knowledge are often highly efficacious, but they can miss new realities, complex, long term, impacts, and conflicts with the experiences and goals of particular people. Thus it is important to take into account knowledge and understandings - or framings - of health problems from multiple viewpoints, and to appreciate how each may be linked with particular interests and power relations. The major challenge for the health work of the STEPS Centre is to identify approaches for responding to health challenges that take into account the importance of science and social science to the design of effective responses to health challenges, while acknowledging the reality of complex and dynamic systems. This involves a willingness to acknowledge uncertainty, multiple framings, and the influence of power relationships. It is in this light that the conclusion reflects on key elements of a research approach and agenda.

2. THE ILLUSION OF INEVITABLE PROGRESS AND STABLE HEALTH SYSTEMS

Contemporary health systems developed in response to the challenges and crises noted at the beginning of this paper. For a relatively brief period during the second half of the 20th Century, a set of beliefs about how to understand and deal with health problems dominated, based on optimistic expectations about the inevitability of both economic growth and health improvement. These beliefs have become unsettled, but continue to influence thinking about health systems. This is one reason, for example, why it has been so difficult to formulate an effective global strategy for meeting the challenge of HIV (Barnett and Whiteside 2002).

Concerns with public health were central to the building of nation states in 18th and 19th century Europe (Anderson and May 1991). During the early period of industrialisation and urbanisation, many societies experienced social disorder and major health problems (Szreter 1997; Szreter and Mooney1998). In addition to upsurges of civil conflict and periodic epidemics of infectious disease, there was a fear of deteriorating health and breakdown of previous social relations, particu-

larly in the localities experiencing rapid change. Writings of the period reflect the mid-19th Century anxiety that the new social order might be unviable in the face of major health problems such as cholera (Engels 1845 Virchow 1879; Williams 1987). Responses to these crises contributed to the creation of modern nation states with their many social responsibilities, including public health, and to the development of a number of scientific disciplines.

Emergent understandings of disease-population relationships, together with record-keeping, statistics and the application of probability theory to modelling aggregate behaviour, formed the basis for new state institutions and policies (Hacking 1983). For instance, national public health systems were put in place in Europe following epidemics of water-borne disease in rapidly urbanising areas (Porter 1999; Evans 1990). Foucault (1978), and many others, have pointed out the impossibility of separating the scientific framing of many social problems from issues of control in contexts of inequality in access to economic goods and political power. This is particularly evident with the spread of scientific and associated managerial approaches into the developing world through imperial and colonial interventions in public health (Doyal 1979; Arnold 1988; Vaughan 1991, White 2000; Yeoh 2003). These often articulated uneasily with diverse local forms of knowledge and practice. They rested heavily on the nascent sciences of epidemiology and public health, concerned with understanding health at an aggregate population level. Interventions largely reflected the needs of settlers and the colonial elites.

By the end of the 19th Century, existential fears of uncontrolled epidemics had subsided and public health systems were well-established. Many of the diseases that had threatened the security of Europe during the mid-19th Century were redefined as 'tropical' and newly established institutes of tropical medicine were assigned the task of generating knowledge about them. European institutes were funded as part of the colonial enterprise, while in the United States, large charitable foundations were an important source of finance. Christian churches and medical missions played an important role in the provision of medical care in many countries. The control of these diseases was associated with major development enterprises and with military security. The dominant discourse increasingly understood health and disease to be part of a set of biological or 'natural' processes, separate from the socio-political - with the latter assumed to be able to control the former. Of course, there was a persistent counter-discourse amongst social reformers, revolutionaries and anti-colonial intellectuals.[3]

[3] Doyal 1979 and Navarro 1982 provide useful summaries of the major arguments from this critical tradition.

The basic structure of the modern health sector was established and consolidated during the wave of globalisation and colonisation that was disrupted by the outbreak of the First World War. The institutional arrangements[4] were based on the nation state in a small number of economically powerful countries. They created complex health systems involving government, regulatory agencies, the legal system, large corporations, charitable foundations and a variety of non-governmental, religious and community organisations. These arrangements reflected both dominant understandings of public health and medical science and prevalent economic and social arrangements (Bloom et al forthcoming).[5] The health services of colonies reflected both colonial influences and the needs and interests of the local state. Characteristically, a highly segmented government service provided basic public health for the majority and sophisticated services for the privileged elite. These systems gradually broadened their services for the majority of the population to include basic medical care provided by paramedical workers. Some countries also had a regulated private sector that replicated regulatory structures from one of the dominant countries. A number of analyses have documented how this near-global health system replicated and reinforced social inequalities. [6]

In the 20th century, advances in scientific knowledge radically transformed people's abilities to influence the biology of disease. Before the introduction of sulphonamide drugs in the mid-1930s, physicians practising what is now called conventional or allopathic curative medicine had little to offer patients beyond their time, advice and encouragement. While substantial advances had been made in related areas such as nutrition, hygiene, disinfectants, antiseptics, vaccination and surgery, most diseases were 'treated' by attending to the patient's basic needs until they recovered or died (Lewis, 1983). Just over 30 years later, in 1968, the U.S. Surgeon General felt able to proclaim that 'The war against diseases has been won' (Greger, 2006, p. 85). This euphoric statement was primarily based on the development of antibiotic remedies. It was assumed that the widespread use of these 'magic bullets', combined with the application of

[4] Such as colleges of medicine and surgery which validate qualifications.

[5] There is a long history of debate about the degree to which the governance arrangements that emerged reflected functional needs or power relationships in, for example, the emergence of self-regulating professions and a pharmaceutical sector combining large private corporations and powerful regulatory agencies. Recent analyses of institutional development emphasise the strong influence of an institution's early history on its subsequent development (Pierson 2000; Pierson and Skocpol 2002). This has led to an emphasis on the multiple influences on health system structure including the role of dominant ideas and understandings.

[6] See Doyal 1979; Illiffe 1987; Turshen 1989; Navarro 1992; Marks 1994; Lee and Zwi 2003; Farmer 2005.

childhood vaccinations and improved environmental conditions, would steadily eliminate the threat from disease. 'Victories' or near victories, at least in Europe and the US and in some cases in the developing world, against measles, diphtheria, pertussis, tetanus, malaria, polio and smallpox, strongly reinforced this perception. At its heart lay an essentially static framing of the interrelationship between humans and disease, which assumed the existence of a 'fixed set' of diseases that medical science would sequentially eradicate.

In the 1960s and 1970s many ex-colonies and post revolutionary societies became strongly committed to the reform of their highly unequal health systems through the provision of universal access to health care. These commitments were a response to popular demands articulated within political movements and were based on a belief that people had been denied access to effective technologies for improving their health. The 1930s experience of the Soviet Union in creating a state-run public health system influenced these strategies. The basic assumption was that governments should lead efforts to overcome major shortages in the number of facilities and health workers and in the availability of pharmaceuticals and other health-related commodities. In many countries government became a monopoly supplier of organised health services, managed through a command and control bureaucracy. The assumption was of relatively homogeneous and stable needs across nation states, even globally - so that standard delivery models (as well as standard technologies) could be rolled out. This was consistent with a broad development approach that focused on overcoming major shortages in human, physical and financial resources. The international community endorsed these views in the Alma Ata Declaration (WHO 1978) and the so-called Health For All Strategies of the WHO (Kickbusch 2003). This approach was associated with dramatic improvements in health indicators in many countries, including some of the poorest.

The longer term outcome of these health development strategies has been variable. Some countries established highly effective health systems but others failed to do so. A large range of interventions has been effective, but others have failed, proved unsustainable or been resisted. The broad assumption was, and often remains, that stable institutions could be expected to deliver a relatively standard set of interventions. Much analysis of failure remains within this vein, focusing on specific problems of implementation. Thus for instance problems of resource scarcity (financial, physical and human) are highlighted, leading to arguments for a combination of revised government priorities and inter-country resource transfers to low-income countries (Simms et al 2005; Garrett 2007). Equally gaps in the availability of technological solutions are highlighted, with progress and investment in new scientific knowledge expected to fill in - as with

the search for vaccines against malaria, for instance. The dominant emphasis in international health remains on the identification of and then rapid 'scaling-up' and 'rolling-out' of such interventions (Commission on Macroeconomics and Health 2001). More fundamentally, however, health intervention failures highlight emergent problems as assumptions about stable institutions and standard interventions confront more complex, dynamic and diverse realities. As they interplay with dynamic social and political systems, for instance, problems of accountability have resulted (e.g. Pritchett and Woolcock 2004), while power relations have sometimes undermined poorer people's access to resources, livelihoods and wellbeing (Birdsall 1999; Farmer 2005; Lee and Zwi 2003). Furthermore, as we explore in the next section, health interventions also confront highly dynamic human-disease ecological systems, and the varied experiences and framings of these by different social groups. Addressing health problems effectively in this dynamic context requires, we suggest, new ways of thinking about institutions, governance and the design of interventions. These need to be more responsive to such dynamics and the ways they play out in diverse settings.

This brief account has done little justice to the vast literature on the links between health, disease and development (Bloom and Sachs 1998; Marmot 2005; Wilkinson and Pickett 2006). Its aim has been to draw out how much of the debate has been based on assumptions of a relatively stable world, of disease as part of biological systems that can be treated as separate from social and political processes, of the universal appropriateness of dominant biomedical models, of steady technological and economic progress, and of institutional arrangements for health service delivery that can easily be transferred from one context to another.

This optimistic view is increasingly contradicted by experience. These include both specific health intervention and system failures, as well as major reversals in health status and life expectancy in some countries in Africa and the former Soviet Union. These have punctured the comfortable assumption that problems of illness will inevitably diminish. Households, communities and entire societies can become caught in vicious circles of health-related impoverishment. It has become clear that gains in health are fragile, depending on a wide variety of factors. Addressing the dynamic ways these interact is a central task, to which the next section turns.

3. HEALTH AMIDST DYNAMIC SYSTEMS

The evolution of pathogens and their interaction with bodily processes, technologies, and socio-political and demographic change is often highly interdependent, non-linear, and context-specific. This points to the need for a more complex and dynamic perspective on human-disease-ecological systems. This needs to take seriously the possibility that different people and groups frame and experience system dynamics in different ways; that dynamics involve inherent uncertainty, and that processes and their effects often operate over overlapping temporal and spatial scales. These issues and arguments are elaborated more fully in STEPS Working Paper 1 on Dynamics. This section develops and illustrates key aspects in relation to health through sub-sections that move from a focus on the dynamics of disease and disease-population interactions, to perspectives that link disease ecology with interacting ecological and socio-political dynamics, illustrated from industrial as well as rural contexts, to a consideration of the impact of shocks and stresses. These emphasise the importance of systems properties such as resilience, leading into a discussion of challenges for Sustainability.

THE EVOLUTIONARY DYNAMICS OF PATHOGENS

A first challenge to linear views of the relationship between human and disease ecology comes from evidence of the capacity of pathogens for very rapid evolution. It is several decades since Francis Crick originated the often quoted 'Orgel's Second Rule' (Dennett 1995), named after a colleague, which states that "Evolution is cleverer than you are". In the present context it expresses the fact that the evolutionary 'trial and error' approach of pathogens will typically defeat the most carefully thought out human defence strategies. Evolution is also giving rise to entirely new human pathogens, typically by the process known as zoonosis, when non-human viruses cross the species barrier (Woolhouse, 2002).

One dynamic framing of human-pathogen relations from an evolutionary perspective is provided by Lederberg (1998, p.1):

> 'Our relationship to infectious pathogens is part of an evolutionary drama. Here we are; here are the bugs. They are looking for food; we are their meat. How do we compete? They reproduce so quickly, and there are so many of them.... Their numbers, rapid fluctuations, and amenability to genetic change give them tools for adaptation that far outpace what we can generate on any short-term basis.'

HIV, for example, can generate more than 10^9 virions per day. Its mutation rate is around 10^{-4} mutations per nucleotide, some 10,000,000 times the rate for human DNA. Each affected person hosts a vast and genetically highly diverse virus population, posing immense targeting problems for the immune system and any conceivable drug treatment. The only reason we are still here, Lederberg suggests, is that 'our microbial adversaries have a shared interest in our survival. Truly severe host-pathogen interactions historically have resulted in elimination of both species. We are the contingent survivors of such encounters because of this shared interest'.

This analysis is somewhat simplistic, to the extent that it discounts human attempts to 'compete' with pathogens, assigning humanity an essential passive role. This sits uneasily with medical advances, such as antibiotics, which allow a much more aggressive stance. An alternative approach which takes this into account, while accepting the underlying 'evolutionary drama', involves the extended phenotype concept (Dawkins, 1983), in which an organism and its artefacts are treated as an entity in terms of evolutionary processes. Dennett (1996) argues that in the case of the human species the extended phenotype should include not only physical artefacts – including drugs, antiseptics and hospitals – but accumulated human knowledge, which would of course include knowledge relating to health. Human beings do not compete with pathogens simply as 'naked apes' but as a species with a vast array of knowledge-based 'weapons', both defensive and offensive. In the ongoing evolutionary struggle with disease each side may hold the temporary advantage but there is no certainty as to even the medium term outcome.

POPULATION-DISEASE DYNAMICS

Emerging evidence and understandings of the dynamics of disease spread within populations provide more nuanced understandings of the development of disease in contexts of economic, social and ecological change. Simple mathematical models of disease (e.g. Hethcote, 2000) divide populations into three groups: the susceptible, the infected and the recovered (the last usually assumed to have acquired some degree of immunity). The dynamics of any disease can then be specified in terms of: (a) transitions between these states; (b) increases in total population size via birth or in-migration; and (c) decreases in population size via death (including deaths resulting from the specified disease) and out-migration.

A 'successful' pathogen (in terms of self-replication) will have a high contact rate, spreading easily from infected to susceptible individuals, and a long infection period, avoiding both the early recovery or death of an affected individual. The product of the contact rate and infection period is a determining factor in terms of the proportion of the population that will be infected. This is known as the 'basic reproductive ratio' because it can be shown to be equivalent to the average number of secondary cases caused by each infectious individual in a totally susceptible population. When this ratio is greater than 1, the number of cases will increase, whereas when it is less than 1, the disease will always fail to spread. Estimates have been made for a variety of diseases, including AIDS (2-5), smallpox (3-5), measles (16-18) and malaria (greater than 100). Where the basic reproductive ratio is relatively low, such as with smallpox, it is possible to reduce the susceptible population below a threshold, which leads to eventual eradication. This is much more difficult for measles or malaria, where the disease will persist even if a relatively small proportion of the population is susceptible.

The above estimates for the basic reproductive ratio assume that it is independent of population size, implying that contact rates in small and large populations are similar. This framing of the model is based largely on empirical evidence from OECD countries and is open to question. The contact rate is often primarily determined by social and cultural factors and cannot be estimated from a purely bio-medical perspective. As work in participatory epidemiology argues, better understandings of real population-disease interactions require models to be geared to real ecologies and social and cultural dynamics. These often throw up major qualifications to epidemiological models and their assumptions. Recent work, for example, has emphasised the variation in contact rates across population members and suggested that the role of 'super-spreaders', individuals with very high contact rates, has to be understood in order to understand the development of many diseases (Lloyd-Smith et al, 2005). A number of authors have postulated a high correlation between contact rates and population density (Garrett, 1995). They suggest that rapid population growth in urban centres, especially in less developed economies, has resulted in overcrowded accommodation and highly congested transport systems which, combined with inadequate water and sanitation services, provide greatly increased opportunities for person to person disease transmission. On this basis, the four-fold growth in the world population over the last century (fig. 1) is seen as providing the "tinder" which will allow a pandemic to "explosively hit world populations like a flash flood" (Greger, 2006, p.69). But, whether and how this will happen also depend, crucially, on socially and politically-shaped patterns of population distribution and living conditions. (Woolhouse, 2003; Brownlie et al, 2006)

The impact of population growth interacts with increased population mobility, and the socio-economic factors shaping it. Much attention has focused on the more than two billion air journeys a year that make the isolation of a disease outbreak an increasingly formidable task.[7] In some countries internal rural-urban migration is equally important. For example, 80-100 million Chinese constitute the so-called 'floating population', who work in the more prosperous urban areas and typically return to their family homes in poor, and possibly relatively isolated, rural areas at least once each year to celebrate the Spring Festival.

While there has been much discussion of disease risks associated with flows from poorer to richer locations, for example with the rise in TB in Europe and the United States linked to migration from Africa and Asia, flows in the opposite direction have been given less attention. During the SARS outbreak of 2003, some rural communities in China denied access to anyone from the perceived urban centres of the outbreak and a number of African countries restricted travellers from Toronto, where a number of cases had been identified.[8] These precautions responded to the potentially devastating impact of SARS in areas which had very limited capacity for identification, containment or treatment of the disease.

EMERGENCE AND RE-EMERGENCE OF INFECTIOUS DISEASES

The growth and current size of global populations - of both people and domestic animals (see Figures 1 and 2) - can be seen as key factors in terms of the emergence or re-emergence of disease. This is argued to be via a number of related but distinct pathways (Brownlie et al, 2006). Two derive from the link between population size and the number of individuals infected by a given disease. First, the latter is directly related to the probability that new pathogens or new strains of existing pathogens will arise via spontaneous genetic mutation within those human hosts. This is probably the source, for example, of the nine currently identified subtypes of the most common HIV pathogen, the HIV-1 group M virus, and the variety of 'circulating recombinant forms' of that virus which are regarded as hybrids of the other subtypes (AVERT, 2007). Second, if drugs are used to treat such an infected population, the result will typically be induced evolution of the pathogens, as strains with greater resistance to those drugs tend to predominate.

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[7] Source: http://www.oag.com/oag/website/com/OAG+Data/News/Press+Room/Press+Releases+2006 /OAG+Review+of+2006+030606

[8] Personal observation and communications.

A third pathway is 'zoonosis', the process whereby disease passes to humans from other species. The extent to which zoonosis has contributed to recent emergent and re-emergent diseases is open to debate, but a relatively recent editorial in the Lancet (2004, p.257) states that "all new infectious diseases of human beings to emerge in the past 20 years have had an animal source". Given the huge reservoir of known and unknown pathogens in animal species it seems extremely likely that the number of such diseases will steadily increase (WHO, 2004).

Both wild and domestic species are implicated in zoonosis. The HIV-1 virus is assumed to have evolved from a very similar virus found in the wild chimpanzee species Pan troglodytes troglodytes (Gao et al.,1999). On the other hand "Integrated pig-duck agriculture, an extremely efficient food production system traditionally practiced in certain parts of China, puts these two species in contact and provides a natural laboratory for making new influenza recombinants" (Morse, 1995, p.11). Current concern relating to the H5N1 avian influenza virus has focused on the transfer of infection from domestic poultry to humans, but it is generally accepted that wild birds are the primary reservoir for the disease (Lancet, 2004). One obvious distinguishing characteristic between these two potential sources of human infection is that while the wild populations of most species (notably mammals, birds and fish) have tended to decline in numbers, growth in domestic livestock populations has mirrored that in the human populations which consume them or their products (Figure 2).

It is plausible that the links discussed above between human population size and the risk of disease emergence and spread apply equally to domestic animals. Absolute population size increases the risk of spontaneous mutations. Yet as with human-disease interactions, a Malthusian perspective is insufficient without taking account of technological and political-economic conditions. For instance, the widespread use of antibiotics to prevent cross-infection between animals kept in close confines almost certainly promotes the evolution of drug resistant strains. The conditions of animal production also influence the likelihood of transmission of infections by keeping animals in close proximity and by transporting animals over long distances.

It is also necessary to consider the potential for an increased contact rate between domestic animals and humans. One major international report on emerging zoonotic diseases suggests that rapid economic growth and urbanisation in Asia, associated with the development of large industrial-type poultry and pig production units constitute a major risk factor (WHO, 2004, p. 26). While much attention has focused on the implications of intensive, industrialised

livestock production methods, it should not be overlooked that small-scale producers have also responded to the increased demand for animal products, even among the poorest populations. In many countries, chicken farming is one of the few income generating activities open to poor women, possibly with the aid of a loan from a micro-credit agency. International NGOs have encouraged the provision of goats to poverty-stricken households in dryland regions where there is limited scope for alternative agricultural activities. Small-scale production clearly poses a different but possibly no less compelling series of risks and uncertainties in terms of emergent or re-emergent disease. Contact between livestock animals, humans, and wild species will typically be substantially higher.

Proposed links between human population growth and the risk of zoonotic disease from wild animal species focus primarily on the environmental impacts resulting either from the 'invasion' of areas which have previously been at most sparsely inhabited or from radical changes in land use. Perhaps the most remarkable illustration of this pattern relates to the emergence of zoonotic hemorrhagic fevers over the second half of the 20th century, as rainforests were cleared for crop or livestock cultivation in South America (Greger 2006). Two other hemorrhagic fevers are seen as resulting from deforestation and population shifts in Africa: Lassa Fever and Rift Valley Fever (Morse, 1995). Here the contributing political-economic dynamics have varied from dam construction to diamond mining and logging. For instance as roads have been driven into isolated and remote areas, increases in population and commercial activity to support logging operations have resulted in an upsurge in demand for bushmeat, wild animals killed, butchered and sold locally for food. It is now widely believed that this practice may have been responsible for the initial transmission of the HIV virus to humans and that the transmission of a range of retroviruses is 'a regular phenomenon and a cause for concern' (Wolfe, 2004, p.932).

Figure 1: World population (million) 1890-2000

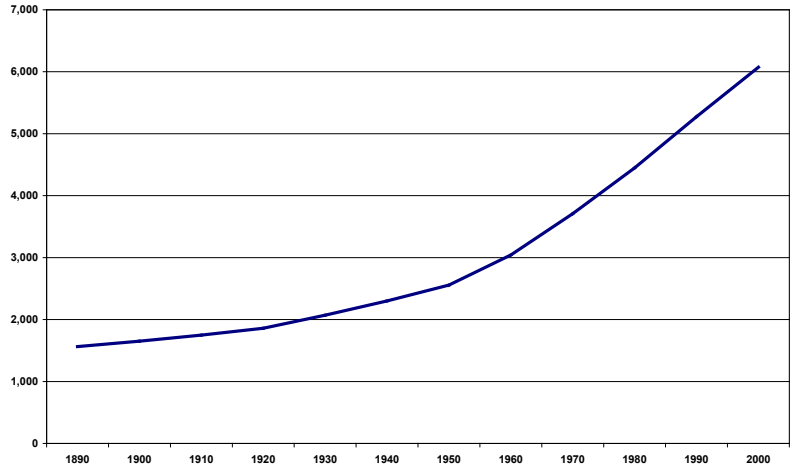
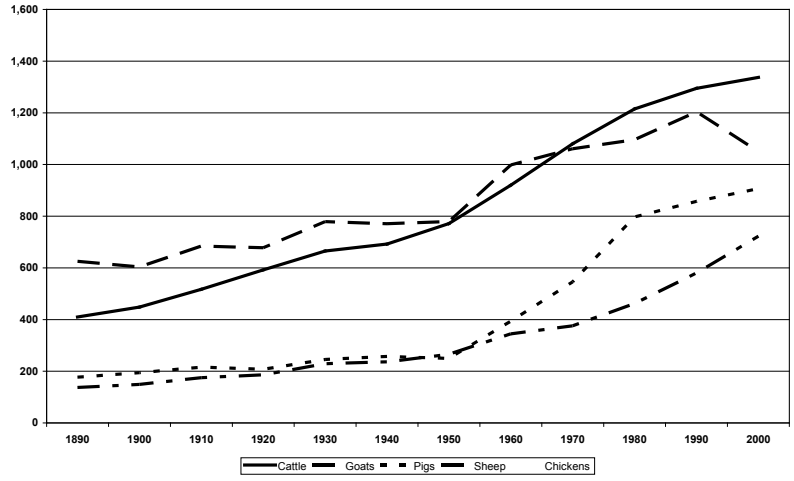


Figure 2: World livestock numbers: Cattle, Goats, Pigs, Sheep (million) and Chickens (10 million) 1890-2000



HEALTH AND ECOLOGICAL-SOCIAL-TECHNOLOGICAL SYSTEMS

Examples of the emergence of infectious disease illustrate the intimate intertwining of disease dynamics with socio-political, economic, ecological and demographic change. Similar processes can be seen in technological and urban developments which produce a wide range of impacts on ecology and human health. These include road accidents, indoor air pollution, threats to women's reproductive health, chemical and biological exposures and so forth. These diverse impacts operate on different time scales with some occurring relatively fast and others having long-term, drawn-out consequences. Some are more predictable than others; all occur in varying magnitudes. Although traffic accidents are the fourth leading cause of the current burden of disease (Mathers and Loncar, 2006), in this paper we focus on industrial and occupational disease because they illustrate particularly well the intertwined dynamics of socio-political, economic processes, ecological and demographic change.

The scale of industrial and occupational ill-health is huge and rising. Each year 270 million workers have occupational accidents, 360 thousand employees die and 160 million workers contract occupational diseases (Rantanen et al, 2006: 7).[9] Industrial diseases are expected to increase as economic shifts, business re-engineering, new technologies and changes in work organisation occur: '(w)hatever happens in the world of work, occupational health remains an issue', said the President of the International Commission on Occupational Health in September, 2006.[10] Industrial diseases have a long history – in China lung damage and lead poisoning from mining have been traced back to the Song (1000 B.C.) and Ming (14th-17th Century) Dynasty (Liang and Xiang, 2004). In recent times, new patterns of global production have been associated with deterioration in workers' safety, health and work conditions (Rantanen et al, 2006: 7). In developing countries – where an estimated 2.4 billion people are employed, basic occupational health and safety standards are seldom met and only 15 percent of workers have access to occupational health services.

Thurston and Blundell-Gosselin (2005) argue for an ecological understanding of the dynamics of industrial health, one that moves beyond the farm or factory setting, to examine how wider and interrelated social, physical and environ-

[9] Occupational and work-related diseases are not systematically recorded and it is difficult to find reliable data on this (Rantanen, Lehtinen and Savolainen, 2004). In addition, under-reporting of health statistics is common in certain sectors, such as farming (Thurston and Blundell-Gosselin, 2005).

[10] http://www.icohweb.org/pres_addr.asp accessed 6 December 2006

mental factors affect health. Kirby argues similarly that analysis of urban space should include ideas of flux and unexpected consequences in conjunction with processes and responses which produce new technologies, new products and new by-products (cited in Cutter and Tiefenbaker 2006). Solecki's idea of the urban environment as a 'hazardscape' in which natural, technological and social hazards are combined (Solecki, 1990 Cutter and Tiefenbaker 2006) provides for a dynamic understanding of how social, physical and environmental factors create risk. These approaches, which emphasise risk, flux, unexpected consequences, of social and economic relationships and multiple settings are relevant to all situations where industrial health is an issue. In developing contexts, it is necessary to examine the multiplicative nature of occupational disease, injury and risk. Smith and Ezzati (2005) introduce the term 'risk overlap' to refer to the way that certain communities experience 'household' and 'community' risks simultaneously.

Cutter (2006) argues that 'The world is becoming a more toxic place in which to live', pointing out that over a hundred major chemical accidents have occurred in the past 20 years resulting in over 8000 deaths and 190 000 known injuries (Cutter, 2006b). In his review of major industrial crises, involving at least fifty fatalities, Shivastava (1987) concludes that developing nations are more likely to experience these crises due to inadequate safety mechanisms and industrial structures. He argues that the rate of incident and the potential for harm has intensified. Downey and van Willigen argue that 'the poor, the working class, and people of colour are disproportionately likely to live in environmentally hazardous neighbourhoods' (2005: 289). Their residence in these surroundings has a harmful effect on their mental wellbeing and, because this effect is mediated through their identity, the results are more severe for minorities and poor than for whites and wealthier people. This local experience of vulnerability is perpetuated across national and international contexts. Understanding industrial health therefore needs to address how political-economic dynamics interact with social and technological ones.

SYSTEM DISTURBANCE: SHOCKS, STRESSES AND LONG-WAVE EVENTS

As preceding sections have shown, complex dynamics impinge on human health and will affect any attempt at intervention. Complexity, non-linearity and interactions across multiple scales are frequently characteristic of population-disease systems. They are compounded further by interplay with social, political and technological processes, leading to a picture of complex, dynamic social-ecological-technological systems. Different groups in society often understand

and experience such dynamics and their effects in very different ways. Further, as we show here, such systems can become subject to disturbances of various kinds, whether generated internally to the system (e.g. a shift in the ecology of a disease organism, or in population mobility) or externally (e.g. the impact of conflict or war, or the arrival of a new disease). While some disturbances take the form of relatively short-term shocks, others are manifested as long-term stresses. As disturbances interact with existing systems dynamics over time so this can give rise to complex 'long-wave events'. In this sub-section we discuss each of these kinds of system disturbance in turn. They are, we suggest, becoming increasingly prevalent. This underlines the importance of addressing the systems properties that enable people and societies to remain resilient and robust in the face of disturbance. It also underlines the need to move away from equilibrium based policy framings towards approaches that respond to such dynamic challenges.

Short-term shocks

Dominant health policy and development models have paid relatively little attention to questions of dynamics, grounded as they often are in assumptions of stability and linear progress. Nevertheless, there has been growing attention to the importance of shocks. One example is the World Bank's social risk management framework, which focuses on how households employ a number of strategies to minimise the risk of shock, mitigate their impact and cope with the impact on their livelihood capacity (Holtzman and Jorgensen 2000). This might translate in terms of health shocks into a combination of preventive programmes and increased individual responsibility to reduce risk, the availability of competent medical care and mechanisms that enable people to insure against uncertainty of costly illness and arrangements to help people cope with disability or early death (Bloom 2004a). There is a parallel set of discussions around the impact of environmental disasters, war and civil disorder (Wisner et al 2005).

While many policy debates have understood such shocks as atypical and short-term interruptions to the 'normal' pattern of development, an important stream of analysis addresses the differential effects of shocks depending on how they intersect with systems dynamics at multiple scales. Thus existing ecological, livelihood and household processes affect the impact of shocks on individual health and well-being (Wisner et al 2005). At a larger scale, there is growing interest in the institutional and political processes that shape how societies experience and deal with major shocks (Centre for Future State 2005; Fukuyama 2004; Birdsall 2007). Such factors help to address reasons for divergence: for example, why Western Europe could recover so rapidly from the chaos and

destruction of the Second World War and the serious health problems that resulted (Judt 2006), while southern Africa is having such difficulty managing its transition from colonialism and the wars associated with the struggle to end apartheid. Thus predisposing conditions and antecedents render some societies more susceptible than others to shocks. Poverty and associated high levels of inequality can feed these processes, spreading or generalising the precipitating biomedical or environmental causes. These in turn are driven by global and local interconnections with food insecurity, drought, debt and so on. The result can be geographically and socially structured vulnerabilities which drive epidemics: for instance, it is not bio-medically coincidental that sub-Saharan Africa has been hit hardest by the HIV virus.

Long-term stresses

Long-term stresses are also impinging on many social-ecological technological systems, with major implications for the dynamics of health. An illustrative example concerns the combined and multiple effects of ageing and demographic change in the context of a highly populated world. These effects are playing out over a far longer time-span than established conceptual frameworks and policy approaches can generally encompass.

The world is undergoing a demographic revolution. There are presently about 600 million people aged 60 years and over and this is set to double by 2025 and to reach two billion by 2050 (WHO 2003). Most of these older people will be living in what are currently developing countries. The phenomenon of global ageing is unique in human history and has significant implications for all sectors and across national boundaries (Eberstadt 2004; Mujahid 2006). For instance it affects economic productivity with smaller cohorts in the economically active population and higher dependency ratios. Associated with global ageing (although also with other factors) is an increase in the proportion of non-communicable diseases. The leading causes of morbidity and mortality among adults over 60 are heart disease and stroke and these are increasing rapidly in developing countries (WHO 2003). At the same time, elderly people are highly vulnerable to any new epidemic disease. The unfolding burden of disease is likely to be very uneven across and, indeed, within countries

These shifts in disease pattern, combined with the socio-economic shifts which accompany population ageing, are bringing profound implications for social dynamics and for health systems. The conditions which typify older age disease require different management from acute conditions and episodes of illness. They are often associated with impaired mobility and long term dependency

needs. They have implications for the types of personnel required, the regimes within which people are supported (both the recipient and their carers) and the technologies appropriate to their care. They also have implications for paying for treatment and care. The health systems that many low and middle income countries constructed to address the problems of a relatively young population are poorly equipped to deal with the different patterns of need. Driven by the longevity of developed country residents, research and technology development are continually expanding the boundaries of available treatments and generating expectations that medicine should have a response to every health problem. This is leading to a blurring of boundaries between medical treatments and lifestyle or recreational drugs and towards a "medicalisation" of ageing, itself. These new treatments are often rather expensive. Poorer people, especially, face hard choices about allocation of household resources around competing needs, where elderly members require long-term or expensive care. Poor countries face similar decisions at the macro level, especially where there is continuing high need for resources for endemic communicable diseases and maternal and child health in contexts of incomplete epidemiological transition. Thus ageing and demographic change are placing a variety of stresses on systems for dealing with health issues both nationally, locally and within households. Responding to these emerging dynamics effectively constitutes an unprecedented challenge.

Long wave events

Some major health shocks play out over a long intergenerational timespan with profound long-term consequences. These can be termed long wave events and the best known of these currently is the HIV and AIDS pandemic. Other examples include the wholly unexpected and unprecedented fall in male life expectancy in some countries of the Former Soviet Union starting in the 1980s.[11] Another is exposure to mass environmental contamination through chemical and other toxins. An example of this is arsenic poisoning in Bangladesh as a consequence of the unintentional release of naturally occurring arsenic compounds in the mass tube well digging programme in the 1990s. This is projected to affect between 30-80 million people.[12]

[11] Whilst life expectancy has declined over the last 30 years, it has declined particularly dramatically for men. In the late 1990s it was estimated to be 71 for women and only 59 for men (UNFPA 1998). This is thought to be due to high increases in deaths among middle-aged men from cardiovascular disease as well as external causes such as murder, suicide, accidents and poisoning.

[12] This has been called the largest mass poisoning in the world and in the worst affected produces eventual death by liver and skin cancers (Meharg 2005).

Long wave health events differ from transient shocks in several ways. First, their initial manifestation is very different. Not only are we usually not aware of their exact starting point, but we also only become aware of them by the accumulation of their apparent effects. Second, they have very different long-term implications and repercussions, often extending over many decades and probably well beyond, with a legacy passed down through several generations, often influencing socio-cultural practices and beliefs. Third, they are complex and difficult in intervention terms and tend to be beyond the purview of standard policy timeframes (Standing 2005). For instance, few are systematically addressing the question of what needs will arise for the grandchildren (let alone the great grand-children) of people living with HIV today in the poorest countries, or the intergenerational implications of mass environmental poisoning. Fourth, because there is a large amplifier effect between the specific characteristics of the originating mechanism and its macro-level effects, and because we only become aware of these by witnessing the accumulated effects, once we do become aware, the event is already well developed and has a deeply established backlog of impacts yet to come. Fifth, long wave shocks are actually a combination of multiple shocks and complex causalities some of which are irreversible, such as climate change (Yamin 2004; Bloom 2004b). Epidemic HIV and AIDS is generally associated with intertwined 'accomplices' such as food insecurity, drought and high levels of poverty and conflict (UNDP 2004). The accomplices of the fall in male life expectancy in the former Soviet Union include the collapse of earlier employment and state support systems and a crisis in gender identity (Leon and Shkolnikov 1998; Ciment 1999). The accomplices of the arsenic crisis in Bangladesh include endemic poverty and proneness to major environmental disasters, natural and human driven (UNDP 2001).

Long wave health events challenge existing conceptual frameworks, methodologies and policy responses (Barnett 2005). In conceptual terms, they require a far broader and longer-term view than characterise dominant approaches to health problems. In the case of HIV, for instance, a long-wave perspective challenges epidemiological and bio-medical approaches that frame the issue in terms of individual behaviour change or access to ART treatment. Rather, larger and longer-term societal and intergenerational consequences become relevant, such as disrupted transmission of socialisation and skills and shifts in gender relations which in turn have potentially major macro-social and further disease-ecological consequences.

Long wave events also challenge conventional ways of modelling impacts. First, these tend to have time horizons which are too short to take sufficient account of the long-term impacts on social relations. Second, economic and demographic modelling, in particular, often pick out a small number of "obvious" variables

and hold constant a range of potential effects and variables that are not within their disciplinary purview. But these very variables may overwhelm the original model. One example is the gendered impact of changes between market and non-market activity. Chronic health problems can affect the balance between market and non-market economic activities and between these and personal care burdens as households are forced to make labour substitutions or forego activities. Such impacts call for more complex modelling, that takes a broader social and ecological perspective, and that attends to the interaction of biological, social and economic processes - including other shocks - across temporal and spatial scales.

RESILIENCE AND VULNERABILITY

The importance of shocks, stresses and long-wave events in disturbing systems that are already dynamic, and the many uncertainties that pervade these interactions, highlights the importance of system properties such as resilience. Resilience can be considered as the opposite of vulnerability. Whether or not a system, or a particular group of people, is resilient or vulnerable to shocks or stresses depends, as the sections above emphasise, on much more than biological or technological factors. Intertwined socio-political processes are also key in shaping vulnerability or resilience both to exposure to the shocks or stresses themselves, and to their effects. In turn, both disturbances, and vulnerability/resilience, may be framed and experienced differently by particular groups of people.

Recent thinking on vulnerability emerging from work on HIV and AIDS illustrates these perspectives (Edström, 2007). This developed in critical response to dominant views in the early years of the AIDS pandemic, when public health professionals identified the behaviour of 'high risk groups' as the key to transmission of the virus, thus attaching the concept of risk to population groups as opposed to situations. Information campaigns were implemented to raise awareness and reduce individuals' 'risk behaviour'. These campaigns rarely succeeded in fostering the sustained behaviour change they aimed for, particularly when campaigns were based on standard messages aimed at heterogeneous populations. A different approach adopted by programmers, in the 1990s and beyond, moved from a 'risk' framework, towards a broader focus on vulnerability (Edström et al., 2002; Bates et al. 2004). This aimed to move beyond a focus on individual behaviour to contextualise and address community level determinants of vulnerability, including culture, gender and poverty. In some versions of this framework, a broad range of social factors is emphasised to the extent

that biological dimensions of susceptibility and sensitivity within vulnerability disappear altogether, losing sight of the virus. Yet as others have shown, it is the interaction of disease, social, economic and political dynamics that is key, contributing to a complex set of interlocking vulnerabilities (Barnett and Whiteside, 2002; de Waal, 2007). Thus for instance the impacts of AIDS generate specific shocks, such as sickness and loss of parents, or labour; these are compounded by others, such as droughts or hyperinflation; and influence yet others, such as a resurgence of old health problems (such as TB or malaria) or the creation of new dimensions of stigma and discrimination against already marginalised people. Global and local social and cultural contexts are thus co-evolving with the virus and with other new disease ecologies.

To understand vulnerability in relation to HIV or other major hazards requires combining two basic senses of vulnerability (Chambers 1989; UNDP 2004, Edström, 2007); vulnerability to exposure (UNAIDS 2001; Bates et al. 2004), and to potential impacts (Barnett and Whiteside 2002, Morton 2005; Gillespie 2006). The vulnerability of an individual or particular group also combines embodied and personal biological and psychological dimensions, with contextual social, environmental and political dimensions (Plumber et al. 2001; Bates et al. 2004). Resilience can be considered as the flip-side of – rather than the absence of – vulnerability – again dependent on the interaction of biological and social dimensions. Vulnerability, with frequent exposure to perceived hazards or stress, coexists with and creates agency and resilience, including avoidance capacity (Sinha and Lipton 1999).

As the debate about vulnerability/resilience in relation to HIV emphasises, then, resilience is a property that is itself part of dynamic systems. It involves not just bio-physical and ecological conditions but crucially, the ways these interact with socio-cultural processes and power relations. Such perspectives also draw attention to the possibility that different people and groups understand and experience vulnerability/resilience (and the dynamics shaping it) in different ways - linked to different notions of what Sustainability might be.

IMPLICATIONS FOR SUSTAINABILITY

The degree to which a system is resilient in relation to shocks and stresses - as well as related properties such as robustness, stability and durability (see STEPS Working Paper 1 on Dynamics) - are key to whether it is Sustainable. Whether at the scale of a household, community or a nation, and whether the system is centred on disease-ecological-social-technological dynamics or also

structured around health service interventions and institutions (what is often termed a 'health system' in the literature), such properties are central to the pathways to Sustainability or otherwise that may emerge over time. The notion of Sustainability (as opposed to sustainability in a general sense) recognises the particular Sustainability goals that different groups in society might hold, as linked, for instance, to their notions of wellbeing, or livelihood or development priorities.

The discussion above has emphasised the importance of considering pathways to sustainability in ways that depart from linear views of human, social, technological and ecological development. Pathways involve both complex dynamics, and major uncertainties. Thus it is difficult accurately to predict the relative importance of different factors over different time scales. Although for instance one can say with confidence that, in the absence of major technological advances, there will be major epidemics of new diseases or untreatable forms of existing ones, it is impossible to define whether the time scale is in years or in generations. Although one can say with certainty that the HIV epidemic and the consequences of demographic change will have enormous social, economic and health impacts over the next few decades, the ways these will play out in different places, and amidst the complex dynamics of viral resistance, are hard to predict. And while one can predict with confidence that new technologies will create new ways to relief human suffering and new approaches for making these technologies widely available, how different societies will receive and adapt them is more uncertain. The combination of inexorable and predictable change and highly unpredictable and potentially major risks and uncertainties presents great challenges to individuals and societies.

There are growing divergences between localities and population groups in both economic development and health (Wade 2003). Regions have very different trajectories of development and disease ecology, and pathways to Sustainability are conditioned by such divergent, dynamic contexts. Recent reports have identified two particular kinds of area and population group where complex, unfolding dynamics are leading to particularly significant Sustainability challenges (Brower and Chalk 2003; Brownlie et al 2006). These suggest valuable case study foci for the STEPS Centre.

One constitutes the many parts of Asia experiencing radical economic and social change associated with very rapid urbanisation, technology-led economic growth, increasing standards of living and changing patterns of inequality and social segmentation. This is creating densely populated urban centres and expanding peri-urban fringes. There are often rapid increases in meat consump-

tion with consequent changes in animal husbandry. Economic growth, demographic and epidemiological transition and accompanying rises in demand for health services have outstripped the capacity of organised health systems. This has encouraged the emergence of highly pluralistic health systems. The rapid spread of market relationships has encouraged more individualistic approaches to problems and less willingness to rely on governments. Rapid economic growth has contributed to rising expectations of the benefits of medical care and strong demands for the latest drugs and medical interventions. In addition to generating unnecessary costs, this increases the risk of treatment induced complications and antibiotic resistant organisms. These areas are potential centres for the emergence of new health challenges. They are also likely to be centres of institutional innovation in response to these challenges.

A second constitutes places that have experienced economic, social and institutional decay associated with shocks and long-wave events that have overwhelmed social coping mechanisms. Many are found in sub-Saharan Africa. Contributing processes include varied combinations of post-colonial or post-revolutionary transition, economic crisis, civil disorder or cross-border conflict, and periodic ecological disasters and chronic ill-health, including infection with HIV. The lack of access to effective family planning and the associated high rates of population growth is an important contextual factor (Cleland et al 2006). Some countries have experienced decay in government systems and in community and family coping arrangements. This can lead to the concentration of people in peri-urban settlements, camps for displaced people or poor rural hinterlands. The combination of drought and dwindling water supplies linked to climate change, poor sanitation, compromised immunity associated with malnutrition and chronic disease and weak health systems leading to widespread and inappropriate use of drugs raise the risk of the emergence of new diseases, the development of treatment resistant versions of existing diseases and the amplification of epidemic disease arising elsewhere.

Health in today's world is thus strongly conditioned by dynamics - in human-ecological systems, in interlinked social and technological systems, and in the interaction of these with shocks and stresses over multiple scales. Such dynamics lead to the possibility of multiple pathways conditioned by dynamics, replete with uncertainties. These unfold in different ways in particular places, as shaped by their contexts and histories. While some pathways may lead to Sustainability as valued by particular people and societies, others may not, instead precipitating increased vulnerability, poverty and social injustice. In responding to health challenges in this context, much current thinking around policy, institutions, management and regulation is inadequate. Reliant on linear, predictable models of change and on assumptions of stable institutions, it informs approaches that

are not up to the task of dealing with dynamics, complexities and uncertainties. Rethinking governance approaches in relation to health is thus an essential challenge, and one to which we turn in section 4.

4. ADDRESSING HEALTH GOVERNANCE CHALLENGES

This section focuses on changing political and institutional processes for addressing health-related challenges. As described in section 2, dominant models have assumed that states, with international support, could and would plan for and deliver modern health services to their populations. They have also assumed that organisational arrangements are easily transferable between social and economic contexts. Yet emerging institutional and governance arrangements in many countries challenge these assumptions, revealing new dimensions and complexities in the interactions between multiple actors across scales, and in the politics of knowledge. STEPS Working Paper 2 presents an overview of these transformations in governance in general terms. This section, in tracing some of their specific manifestations in the health context, echoes the broader paper in revealing problems in blueprint approaches to institutional development that rely on importing models from outside. There is a need to focus on arrangements that work in particular contexts - such as innovative examples of partnership between the state and civil society around the delivery of services (e.g. Centre for the Future State 2005). The construction of institutions and approaches must also be understood as a political process, in which deliberation and reflexivity amongst different actors who might frame system dynamics and goals in different ways is essential.

Indeed, questions of knowledge and framing are central to health governance. If health systems can be understood as ways of producing and organising access to expert knowledge and the technologies that derive from it (Bloom and Standing 2001; Bloom et al forthcoming), questions arise about how such forms of expertise represent systems dynamics, and respond to the Sustainability goals of different groups. In many countries, far-reaching changes have been taking place in the power relations and institutions which mediate the production and dissemination of health-related knowledge. Some of these changes and points of instability are outlined below, addressing, in turn, shifting relationships involving markets, state-society relations, citizenship, and global institutions and governance. As we will argue, dynamics, and the ways they are understood, both shape and are shaped by governance arrangements.

PLURALISTIC HEALTH SYSTEMS AND MARKETS

The reality of health systems in many low and middle-income countries is very different from the vision of the Health For All Strategies of the 1970s. Bloom and Standing (2001) describe highly pluralistic health systems with a variety of service providers and sellers of health-related commodities operating in formally unregulated markets. Mackintosh and Koivusalo (2005) document widespread commercialization of health care with limited or no regulation.

Pluralistic health systems have arisen as a response to several factors, including broader political, economic and technological dynamics. Economic and structural crises behind the problems of many public sector systems have hastened the spread of markets as shortages and the livelihood strategies of health workers have contributed to a dramatic increase in the use of private providers. In many countries the boundary between public and private health sectors has broken down and public health providers commonly engage in market-like activities. At the same time, open availability of pharmaceuticals and the training of large numbers of paramedics has fed the growth of unregulated markets in health care through drug outlets and private entrepreneurs.

The pluralistic health systems of the early 21st Century are very different from the post-colonial and/or post-revolutionary systems that Health For All Strategies were designed to strengthen. Individuals can now, at least potentially, choose between a wide spectrum of providers of health-related services and they can buy almost all drugs and medical commodities in organised and unorganised markets. These markets create major uncertainties for people seeking the appropriate providers to consult, creating significant instability of responses. They give much influence to the expectations of users, which in some instances can lead to overly optimistic expectations of technology and a tendency to seek large quantities of expensive care. They give a lot of influence to market actors and their efforts to generate demand through advertising and other channels. They also create major financial barriers to access to care. The most common policy response has been to call for more effective regulation and 'better' governance by the state. However, the same dynamics that led to the development of these pluralistic markets undermine the appropriateness of established arrangements premised on stability and stable institutions (Bloom et al forthcoming; Peters and Muraleedharan forthcoming; Ensor and Weinzierl 2006), requiring a rethinking of regulation appropriate to plural, and rapidly changing systems.

STATE INSTABILITY, POLITICAL CULTURE AND POLITICAL ECONOMY

Pluralistic health systems exemplify the limited reach of formal, institutional arrangements in many low-income countries. This may always have been the case in many areas: thus Mamdani (1996) traces the creation of regulatory systems confined to participants in the "formal" economy to the late colonial period, leaving the remainder of the population with limited contact with these structures and relying heavily on more informal social arrangements. Duffield (2001) argues that the decay of government structures associated with shocks and stresses linked to prolonged civil disorder and warfare have led to an increasing reliance on informal arrangements outside the state sector, especially in many African countries. Gough and Wood (2004) suggest that informal, community arrangements now play a key role in providing resilience and meeting health needs in many countries.

Pritchett and Woolcock (2004) suggest that a major reason for the lack of 'success' of state arrangements is that the organisational models from advanced market economies, on which they have been based, do not function as expected, given both prevailing socio-political dynamics, and the different political histories and ways of 'doing politics' (or political cultures) in the settings of many developing countries. For instance, formal rules and norms of behaviour may conflict with political-culturally embedded patronage systems. They may thus prove ineffective in discouraging powerful people from acting against the interests of the less powerful. This applies particularly to health service activities that involve much interaction between providers and users of services and which require much discretion on the part of technical experts. However, embedded ways of doing politics have their own, culturally-valued logics (e.g. Bayart 1992, Hyden 1983). Thus viewed from the perspectives of those involved, patronage systems may have a logic that benefits both patrons and clients in culturally-valued terms. The mismatch between the logics of formal state health system arrangements, and those embedded in political history and culture, is often vast. It is only widened by approaches that assume that imported models will 'work' as expected and then treat failure as implying the need to reapply the same model with greater force (see Fairhead and Leach forthcoming).

Governments face conflicting pressures in formulating health development strategies. Formal health systems rely on a belief in social and political stability: that providers and regulators of services will adhere predictably to certain socially accepted rules to perform effectively (Gilson 2003; North 1990; Denzau and North 1994). In the absence either of these rules and associated behavioural norms, or of shared value in their logics - both characteristics typical of

dynamic, multiply-framed systems - health institutions have low capacity to respond to individual or societal health challenges. It is particularly challenging to create institutions that command wide acceptance in the context of deep structural inequalities and historical segmentation in service access (Bloom 2001), as well as deep divisions in people's framings of what constitutes an appropriate Sustainability goal Building consensus around institutional arrangements that are understood to be legitimate, fair, enforceable and appropriate in a given context is thus a political process requiring deliberation, whose outcome depends on the breadth and effectiveness of participation (Farmer 2005).

The growing political profile of health has nevertheless created new political spaces for such deliberation and struggle over the construction of health systems and policy to take place. The creation of mechanisms for citizen participation in planning in Brazil (Cornwall and Shankland forthcoming) and the increased willingness of the Chinese media to document serious problems in the health sector are examples from very different settings of a rising political engagement with this issue. Political debates about pathways to Sustainability in health and the roles of government, the market, civil society and citizens in constructing this future are set to grow.

CHANGING RELATIONSHIPS AROUND HEALTH-RELATED KNOWLEDGE

Since the late 19th century professions have been the main way of defining and managing access to 'expert' knowledge in health and have been one of the major organisational exports from Europe and North America. Health professions arose out of struggles between states, markets and providers to regulate pluralistic environments, define competent practice and restrict entry to health practice. However, this kind of professional model has arguably been transplanted less successfully in some other parts of the world. A number of authors have noted that professions have considerably less power and autonomy vis-à-vis the state in many developing countries (Nigenda and Solozano 1997, Iliffe 1998) and that this manifests in incomplete professionalisation and weak maintenance of standards. Others have argued that professions have managed to wrest greater autonomy from the state as a consequence of its failing regulatory capacity and the flight of state-employed practitioners to private practice (Mutizwa-Mangiza 1999). So the extent to which professions have been able to create and maintain a monopoly of expert health knowledge is variable across the world. This has implications for the kinds of arrangements that are likely to emerge in terms of how expertise is made accessible to users, whether through mediated or unmediated ways.

Professions are complex institutions which embody potentially contradictory characteristics which play out in different ways as environments change. Professions and professionals bring with them particular understandings of bodies, diseases and health management. These combine to 'frame' the social-ecological-technological systems with which health is integrated in different ways, some grounded in equilibrial notions, others more dynamic. In the advanced market economies, two trends have been particularly evident. One is a degree of transformation of professional practice through greater non-medical concerns and oversight. Examples are non-medical management, stronger cost control measures and patients' pressure groups. The other is what is seen as a more generalised distrust of "experts" , and a redefinition of expertise to encompass lay and experiential forms, as older established hierarchies of control and ideologies of scientific certainty and paternalism are challenged (Williams and Calnan 1996). This brings with it diverse and often contested framings of health knowledge from different groups- doctors, lay people, patients and so forth.

For both developed and developing countries, two key issues are evident. First, the so-called 'problem of trust' manifests itself in a different way in developing countries (Gilson 2005). Medical knowledge tends to be more pluralistic, with often well established systems of non-allopathic practice. These systems have their own traditions of managing access to expertise which are more socially embedded and may be more trusted. Second, and by contrast, the bio-medical professions have a much shorter history of implantation and their monopoly of expert knowledge is increasingly being challenged by changes from several directions, global and local. It is useful to outline these challenges.

A first relates to the weakening of regulatory systems manifested in the growing marketisation of health care services. Iliffe (1998) argues, in the context of East Africa, that the greatest threat to professional monopoly has been the rise in self-treatment from pharmacies. Self-treatment has been shown from health expenditure surveys in many countries to be one of the main resorts of people, particularly the poor, in pluralistic environments.

Second, there are increasing challenges to the authority and legitimacy of professions as guardians of privileged knowledge, and to the framings they embody, as information becomes increasingly available to a whole range of service providers. These include a growing number of informal providers who have picked up information from working with qualified practitioners, or from an eclectic range of sources. Users of health knowledge have also increasingly gained access to such information through the market in services and from sources such as the media and in some places, the internet. Such rapid changes in the availability

and spread of health-related information threaten the gate-keeping roles and functions of professional knowledge institutions. Pharmaceuticals, which are in theory restricted to prescription, are now often freely available over the counter or mediated by a pharmacist. Marketised health care tends to bypass regulated referral systems or create its own informal referral networks which cut across the formal ones. Other routes to health knowledge, such as informal networks and internet sites, present unmediated forms of access (Lucas forthcoming). People increasingly access, select and sometimes re-interpret health-related information for themselves. The rise in access to diverse forms of health-related knowledge has paralleled and been linked with an increase in the availability of medical goods. In many places drugs are available from several sources, as are diagnostic technologies. Internet-based services for self-testing for sexually-transmitted illnesses are just one example. Self-diagnosis and treatment is an obvious option in a situation characterised by informed consumers and a choice-rich environment of health provision. Advertising of these products can increase awareness of clinically defined disorders and influence how responses to certain conditions come to be conceptualised.

Third, evident failures of established experts to address or deal effectively with health-related issues and crises have contributed further challenges to the monopoly of expertise. In OECD countries, such challenges have been linked to well publicised scandals such as Bovine Spongiform Encephalopathy (BSE) in cattle and people (Van Zwanenberg and Millstone 2003). In developing countries, such perceptions of failure amongst experts have tended to be more related to problems of chronically poor service delivery, such as absenteeism of providers and poor quality of services and to failures in drug regulation and the widespread availability of sub-standard products (Bloom and Standing 2001).

Fourth, there is growing evidence of challenge to biomedical epistemologies and framings as the sole source of legitimacy for defining and addressing health-related problems. People in diverse settings have long made use of a variety of forms of knowledge, non-biomedical as well as biomedical, in health-seeking, as established literatures on medical and therapeutic pluralism have long emphasised (e.g. Baer 1995, Janzen 1978, Scheid 2002). Medical sociology and anthropology have documented how people combine different therapeutic forms - biomedical Islamic, and herbal for instance - in sequences to address a given ailment; the culturally-grounded ways that biomedical diagnoses, drugs and treatments are interpreted (e.g. Bledsoe and Goubaud 1986), and how the existence of plural providers can influence the ways each operates (as in the formalisation of traditional healing, Last 1986). Likewise, the interplay between formal biomedical framings of health issues, and the - often very different - ways that illness and therapy are experienced - has long been recognised (e.g. Kleinman 1988).

Yet several more recent features of the health-knowledge landscape are coming into view. These include recognition that the very categories and distinctions - of biomedical and non-biomedical, modern and traditional, as well as others such as between public and private health institutions - may not make sense to, and shape the health-seeking practices, of local populations. Such categories are legacies of colonial and post-independence models of health systems and practice, and continue to dominate and be reproduced through research and practice in relation to formal health delivery systems. But quite different distinctions may be as central to people's actual health-seeking and reflection on it, as in rural Guinea where more salient to local thinking and practice are distinctions between gendered spaces; strength-building vs. cure; certainty or ambiguity of ailment; injection vs. oral therapies; and quality, all of which cut across biomedical-traditional divides (Fairhead et al forthcoming). In a similar way, in the UK, recent parental thinking and practice around vaccination has been shaped by tensions between individualistic framings and population/social framings of possible vaccine effects - each framing involving a cluster of biomedical and non-biomedical perspectives with broader value questions (Leach 2005, Fairhead and Leach forthcoming).

More recent features also include growing popular and patient critique of, and challenge to, conventional biomedical perspectives. These challenges have been particularly evident in European and US settings. They frequently involve issues where medicine is seen to be failing or to have little to offer - such as the management of reproduction, chronic illness (e.g. Anderson and Bury 1988) or disability (e.g. Oliver 1990). They also, and increasingly, involve areas where biomedical interventions are seen as experimental, ethically questionable, or as replete with risks and uncertainties, such as transplantation and new reproductive technologies, or certain vaccinations (Fairhead and Leach forthcoming) - as well as environmental and public health issues (Gabe et al 1994). Recent years have also witnessed widespread growth in the popularity of 'alternative' or 'complementary' therapies (e.g. Sharma 1992). These trends suggest signs that western consumers, at least, are coming to distance themselves culturally from some aspects of orthodox medicine. Yet Williams and Calnan (1996: 1617) suggest that such critiques involve a process of 'lay re-skilling' that does not just reject but often appropriates elements of biomedicine, linking them into agendas that better suit peoples' experiential and political agendas. They see this as a pervasive reaction to the expropriating effects of biomedicine, and modern systems of knowledge and expertise more generally in late modern conditions. Questions arise, however, about the extent and forms of such critique and challenge in transitional and developing country settings, where often the dominant political concern is to extend access to what is widely perceived to be effective medical care.

NEW FORMS OF HEALTH-RELATED CITIZENSHIP

The changing, more pluralistic, politics of knowledge in the health field are linked with the emergence of a wide variety of citizen and advocacy groups and governance networks. These often draw on critical 'lay' perspectives and forms of experiential expertise (Collins and Evans 2002, Williams and Popay 1994). Some are constituted around 'citizen science' (Irwin 1995), where people conduct their own investigations and assemble evidence in accordance with their own experiences and framings of the issues concerned - as, for instance, in cases of popular epidemiology around environmental health issues (e.g. Brown and Mikkelsen 1990). Such forms of action reveal active citizen engagement in the politics of knowledge around issues involving science, technology and health (see Leach et al 2005). Manifestations in the health field range from self-help and self-treatment groups, to demands for and sometimes orchestrated opportunities for inclusion in policies and decisions around health issues and controversies. They include a variety of mobilisations and movements, whether claiming rights to drugs or treatments, demanding regulation of the quality of drugs and medical practices, or questioning biomedical interventions and policies. While some remain confined to particular localities, others link with national and international actors in new trans-national networks, often facilitated by globalised media and communications. The Treatment Action Campaign (TAC) that linked South African township dwellers with networks of global activism in the successful struggle to secure low-cost anti-retroviral drugs from global pharmaceutical companies has rapidly become an iconic example of this emergent 'globalisation from below' of health politics (Robins 2005).

Mobilisation has taken place around a number of issues including government provision of services and a number of initiatives to organise community health insurance and micro-credit as important sources of health finance. However, this paper focuses on cases where specific diseases have formed the basis for mobilisation. These can be of a life-threatening nature, such as in the case of HIV/AIDS or certain cancers, or the example of diabetes patient support groups in Cambodia[13]. Where a disease carries considerable stigma, a shared experience of discrimination can be offset by group acceptance and solidarity. Access to drugs and expertise has been the rallying cry of the groups that have gained international prominence. In the UK, the mobilisation to gain access to supposedly life-saving new cancer therapies, such as Herceptin, attracted considerable publicity as individuals won a court case against primary care trusts at the European court of human rights.

[13] Personal communication from Maurits van Pelt.

The case of mobilisation around HIV/AIDS provides a good illustration. Civil society actors have often led the way in vertical, horizontal and 'virtual' groupings. The main thing that unites them is a passionate, and sometimes desperate, drive to respond to the challenges, on the one hand, and their diversity, on the other. The group most affected by HIV/AIDS, as well as being key to the dynamics of HIV/AIDS, is of course people who are already positive. This is a very diverse population, however, which presents many challenges for mobilisation and involvement. The situation in South Africa, where risk, exclusion and a struggle for survival coexisted with a robust championing of a new discourse of human rights as an enterprise of nation-building has influenced the form that mobilisation for anti-retrovirals has taken under the banner of the constitutional right to health. Robins (2005, 2006) emphasises the potential of health-related activism, strong illness identities and the scarcity of treatment to shape new subjectivities and types of health/biological citizenship. Nguyen (2005), in analysing AIDS activism in Burkina Faso, describes a 'biopolitical citizenship' that he calls 'therapeutic citizenship' which encompasses 'claims made on a global social order on the basis of a therapeutic predicament'" (ibid:126). Nguyen's emphasis on the broader industry that has arisen around HIV/AIDS issues, the heterogeneous conglomeration of different actors and the activation of global networks, captures something of the characteristics of the 'new social movements' that have mobilised around issues pertaining to health. These emergent forms of civil society mobilisation rely heavily on alliances that transcend national boundaries and connect local groups to key global players and knowledge. They are part of networked governance arrangements that are increasingly significant in shaping and responding to contemporary health dynamics.

Mobilisation is also taking place around concerns regarding risks and uncertainty associated with medical technologies and their application. Citizens may campaign for greater transparency on the part of medical scientists or the state, recognition of their experiential expertise, or greater regulation. The campaign against the combined MMR vaccine in the UK (Leach 2005) is one example.[14] Yahya (2006) describes a similar situation in Northern Nigeria, where critique of modern medical discourses fed resistance to government-led campaigns for immunisation against polio. The response to HIV in some countries has included a questioning of biomedical approaches and the advocacy of a variety of alternative treatments or hoped for pathways to Sustainability in health. This has sometimes included a resistance by government to provide access to treatment with anti-retroviral drugs.

[14] Certain parents were concerned about a supposed link between MMR vaccination and the development of autism in children. They were afraid that the denial of the veracity of the research and the continuation of large national public health initiatives were undermining their ability to make their own choice as to whether to avoid vaccination entirely or to request single vaccines.

Concerns about regulation and transparency are also evident in instances where groups mobilise around environmental exposure to harmful substances. Often the central issue is access to a range of social protection mechanisms, as in the case of Chernobyl (Petryna 2002). A related situation can be seen in the case of occupational exposure, such as asbestos mining and the link to asbestosis. Again fights for compensation from large mining companies have been a key issue (Waldman 2005). In certain instances people will mobilise for the purposes of fighting for the legal acknowledgement of their conditions as a 'real' medical entity or disability, such as occurred with Gulf War Syndrome (Kilshaw 2004).

A variety of factors seem to shape the success, sustainability and impact on the sick of these forms of health-related mobilisation around the politics of knowledge (see Leach and Scoones 2006). At a national level a political climate that allows dissent is important. The case of HIV/AIDS suggests that the strength of commitment to the cause has been mediated by a strong group identity and also self-interest. The role of charismatic leadership is also key, as is the nature of the connections the leadership can forge. A well-networked organisation with access to legal connections and the sponsorship of powerful individuals, for example in the government or public sector, can have considerable influence. Frequently a strong backing from other civil society organisations is also evident, such as local or foreign NGOs. The reality of 'citizen mobilisation' is complex, with symbiotic relationships spanning local-global dynamics and different groups sometimes co-opting each other's interests. The picture becomes particularly layered as movements 'scale-up' over time.

New dynamics involving citizens' groups are also evident in the development of new drugs and the production and distribution of existing ones. A variety of so-called public-private partnerships has emerged for this purpose. They often involve government, foundations, civil society organisations and for-profit companies. These partnerships have had some notable successes in increasing access to immunisation and to treatment of some infectious diseases. The growing literature on such partnerships reveals the difficult balances to be made between the social need for the development and distribution of safe and effective drugs and the special interests of members of these partnerships (Buse and Harmer 2007). There is always a danger that the powerful will disproportionately influence a partnership. The relationship between large pharmaceutical companies and patient groups and health related activism is a case in point.

The Herceptin case in the UK illustrates the murky waters of industry involvement in sponsoring breast cancer sufferers to challenge the decisions of certain primary care trusts not to supply the drug. In one account, a prominent academic revealed how Roche agents attempted to provide her with a strong in-

centive (namely access to treatment) to take action against her trust and speak out (Boseley 2006). In this case, considerable pressure and publicity ensured that the drug was evaluated by the National Institute of Clinical Excellence in record time and, some argued, before sufficient evidence was available as to its efficacy or safety. A similar debate has emerged in the United States concerning the involvement of pharmaceutical companies in lobbying for government provision of immunisation against Human Papiloma Virus, associated with cervical cancer.[15]

Similarly, interactions between the pharmaceutical industry and HIV activists exemplify links that, in this case, have enabled large pharmaceutical companies to ensure some benefits even from mobilisation that on the face of it challenged their practices. The global community's difficulties in responding to the HIV/AIDS epidemic with available treatment regimens, combined with global and local treatment activism, resulted in a growing pressure for access to anti-retroviral treatment over the 1990s and beyond the turn of the century. The conceptualisation of AIDS as a security threat in the USA, with massively increased donor resources combined with declining drug prices, have led to an international commitment and momentum to roll out ARV drugs on a massive scale in developing countries. Despite initial clashes with certain governments over exemption from patent protection and pricing, the industry naturally responded to new opportunities for expanding markets.[16] It is making considerable efforts to establish a reputation for social concern reflecting, perhaps, the importance to the leading companies of maintaining political support for higher prices in the advanced market economies than in low-income countries. Such cases illustrate shifting, networked relationships between citizens and private actors that are of growing significance in the health field, yet poorly captured by conventional governance debates.

The re-medicalisation of the response to HIV has resulted in a decreasing emphasis on primary prevention. It has also created major challenges as health systems attempt to greatly expand access to effective use of drug therapy, whilst minimising the risk of the emergence of treatment resistant viruses (Van Damme et al 2006). This has led to an increasing recognition of the need for new forms of relationship between public institutions and people as patients and health providers. Robins (2005) writes of the fear of anti-retroviral drug resistance in South Africa and growing talk amongst public health professionals

[15] Washington Post editorial, 11 February 2007.

[16] Both for securing continued sales of drugs with expired or expiring patents and for building the conditions, client base and needs for new formulations of drugs.

and others of 'responsibilised' citizens, citizens with rights but also responsibilities. Such 'clients' would follow certain behavioural specifications, such as adherence to treatment and disclosure of their HIV positive status. The backing of social movements is key as health providers endeavour to balance a population perspective with a discourse of individual human rights that has been so prominent as a banner of HIV/AIDS activism. As fear of virulent multi drug resistant TB grows in tandem with the risk of retroviral drug resistance, the challenge to find effective forms of regulation responsive to citizens' own framings and rights claims will increase.

GLOBAL GOVERNANCE: NEW FORMS AND NEW CHALLENGES

New political and institutional relationships are also emerging in the terrain of international health. A wide variety of organisations now play roles across national boundaries in supplying and financing services, seeking to influence governments and regulating aspects of the health system. Echoing the emergence of multi-level governance arrangements around technological and ecological issues more broadly (see STEPS Working Paper 2 on Governance), this is creating new kinds of relationship and network linking states and local and international actors in the health field. As with national and local networks, these emergent governance relationships are both responses to and are shaping dynamic socio-political, technological and ecological systems.

One, relatively well-established dimension of these emergent trans-national relationships concerns the increasing involvement of the governments of all advanced market economies in the health systems of low-income countries. This involvement has gradually shifted from funding investment in infrastructure and training to co-financing health services. This has led to the establishment of a long-term presence of bilateral and multi-lateral donor agencies and also fostered the rapid growth of non-government organisations in the health sector of a number of countries.

During the 1990s donor agencies became increasingly convinced that poverty reduction required long-term financial commitments for service delivery. This led to the development of new aid instruments, such as sector wide approaches and budgetary support for multi-year agreements between donor agencies and government. These agreements characteristically include a variety of government commitments, often articulated in a poverty reduction strategy programme, as a condition for financial support. The implementers of these programmes are accountable to the polities of the donor countries as well as

to the local population as symbolised in the expression 'development partners'. Donor agencies and recipient governments are still adapting their practices to manage 'co-accountability' to different constituencies.

Another factor that has encouraged governments of donor countries to support health services in other countries has been the understanding of certain health benefits as global public goods (Kaul et al 1999). In some cases, such understandings are a response to concerns about dynamics involving the unpredictable mobility of people, animals and microbes. This has been associated at national levels, particularly in the United States, with an increasing perception of certain public health challenges as national security issues (Brower and Chalk 2003; Dodgson and Lee 2002; Altman 2003). This has elevated the profile of public health, especially infectious diseases in the advanced market economies. It has also given more prominence to the concerns of the electorate in the richer and more powerful countries in the development of global policy responses. The U.K. Government has recently published a report that strongly argues the need to view health as a global problem (Donaldson 2007). These concerns have led to the creation of large global initiatives to immunise children and prevent and treat several diseases. These initiatives derive funding from both governments and large charitable foundations. The most prominent is the Global Fund to Fight AIDS, Tuberculosis and Malaria, which has committed $7.1 billion for projects in 136 countries.[17]

The rules of the World Trade Organisation are gaining increasing influence over global health systems. The most prominent area of concern has been the protection of intellectual property rights and pharmaceutical products and the negotiation of the rights of government to procure low cost products to address a public health emergency (Correa 2002 and 2004; Subramanian 2004). Over time, the opening of markets for health services will become increasingly important.

These emergent global arrangements contrast strongly with the situation prevailing from the second half of the 19th Century, in which nation states were the principal locus of regulatory effort and international agreements essentially reflected perceived balances in national interests. Of course, this did not preclude countries from interfering directly in colonies and elsewhere. Fidler (1998) suggests that international agreements based solely on national interest are no longer adequate to the rapid emergence of health challenges. He focuses par-

[17] See website of the Global Fund http://www.theglobalfund.org/en/

ticularly on the role of the World Health Organisation, arguing there are strong grounds for the establishment of a mandate that transcends national boundaries. In this he follows functionalist analyses of the development of governance structures, saying little about the influence of power or framing in the design of global regulatory regimes. He argues that the response to the 2003 SARS epidemic was the first to reflect the "post-Westphalian" world in which national sovereignty is not absolute (Fidler 2004), although others would suggest that it prevailed earlier - evident for instance in the 'un-national sovereignty' of WHO smallpox vaccination campaigns in Africa in the 1960s and 70s (White 2005) and health interventions associated with military interventions. Fidler bases his argument on the role of the WHO in limiting the capacity of the Chinese government to deny the existence of a serious outbreak. His argument about the limitations on the power of even a very strong government to control information flows is convincing. However, it downplays the role of citizen action. According to Saich (2006), Guandong Mobile reported that the message 'there is a fatal flu in Guangzhou' was sent around 120 million times in three days. There are grounds to believe that the Chinese Government became concerned that a perception that it was hiding something could cause panic and threaten its legitimacy. The growing agency of informed (or misinformed) consumers and citizens may be the truly big story of this episode.

Responses to the problem of anti-microbial resistant organisms - as a key dimension of human-disease-ecology dynamics - is another illustration of the growing importance of global governance. Fidler (2003) argues that an effective anti-microbial is a global public good that needs to be preserved, drawing a parallel with 'tragedy of the commons' arguments in the environmental field (Hardin 1968) to argue that the incentives individuals face lead to unnecessary use and inappropriate dosages. He implies there may be a conflict between the right of access to treatment and the need to preserve anti-microbial efficacy. This raises challenging governance and distributional issues, particularly in the context of pluralistic health systems that are poorly regulated in formal terms. It is interesting in this regard to consider the case of Malarone, an expensive combination of two anti-malarial drugs, whose high cost has helped preserve its efficacy. However this has been at the expense of social justice: those who can afford to buy it benefit at the expense of denying access to the poor. Similar issues may apply to pricing and regulation of second and third generation anti-retroviral treatments of HIV.

The networks involved in global health governance include a large and growing number of actors, such as large private corporations, non-government organisations, advocacy groups, civil society organisations and large charitable foun-

dations. One highly visible model is the so-called public private partnerships that have been constructed with mandates to address specific health problems, often with ambitious short-term targets for developing new technologies and spreading them rapidly around the world. These actors are establishing new forms of relationship with governments and with each other. This has led to a marked fluidity of institutional arrangements with rapidly changing relationships between states and a variety of local and international entities. As Kickbusch (2003) emphasises, there is often a strong political dimension to these. Powerful actors play a political role in the reshaping of global institutional arrangements, whether in the case of the pharmaceutical companies, or the likely influence of governments of economically powerful countries.

Analysts writing from the perspective of historical institutionalism (Pierson 2000 and 2003; Pierson and Skocpol 2002; Thelen 2003) argue that health sector institutions have developed in cycles of rapid change followed by long periods of consolidation. The dominant ideas, power relationships and available solutions to functional challenges at times of rapid change strongly influence subsequent development of institutions, which are highly path dependent. Such path dependency reflects both political inertia and the high costs of implementing major institutional changes. It also reflects the key roles of power relations in the creation and maintenance of particular forms of health system (Bloom 2004c). On the one hand, such political and bureaucratic imperatives can sustain managerial approaches grounded in equilibrial ideas and assumptions, limiting ability to respond to dynamic health challenges. On the other hand, the proliferation of complex, globally networked institutional arrangements, partly as a response to such dynamics, suggests that we are entering a period of major reconfiguration. The fluidity of institutional arrangements opens up political spaces for reconfiguring governance arrangements for the future. There are discursive dimensions to these emerging arrangements, as particular configurations of institutions/power/knowledge about health problems are appearing across local and global scales, and sometimes contesting each other.

We should not expect the present situation, characterised by so much instability, diverse forms of agency, and multiple responses to health challenges and uncertainties, to persist. One scenario is that change will take place in response to major public health crises. But what will future arrangements look like? How will they balance the need to respond to the complexity of challenges in a dynamic world, and the need for rapid and coherent responses? How will they win political legitimacy and manage power differentials? Will they move once more towards the kind of highly segmented system that protected the powerful from the diseases of the poor, as in the colonial period? Or can we envisage a

move towards governance arrangements for health that seek widespread legitimacy through a more inclusive and deliberative politics that gives voice to the needs and perspectives of all social groups, including the poor?

5. RESPONDING TO DYNAMIC HEALTH CHALLENGES: TOWARDS PATHWAYS TO SUSTAINABILITY

New understandings of the interaction between human ecology, technology and society highlight the mismatch between dominant models of health problems and responses, and the realities of complex systems dynamics. Indeed given the latter, using established intervention models may be wasteful and ineffective. They may even exacerbate the underlying processes themselves, or work against the interests of poorer and marginalised people. Also, fear of disasters has generated a search for simplistic solutions aimed largely at reducing the anxieties of the electorate in rich and powerful countries (Bourke 2005; Furedi 1997), often disregarding the impacts on poorer people. For instance given the nature of the amplifier mechanisms in long wave events, frameworks like scaling-up current standardised services may well prove ineffective. Rather, what is needed are approaches that acknowledge dynamics, complexity and the diverse framings and goals of different groups, but that avoid policy paralysis arising from a sense that it is all too complicated. This entails thinking about scaling up in terms of amplifying diversity and adaptability of responses, as opposed to relying solely on enlarging or simply replicating standardised interventions.[18] The final section of this paper explores elements of a research agenda towards possible approaches to addressing the health-related challenges that are likely to unfold amidst interacting socio-political, ecological and technological dynamics. It considers key questions for a STEPS agenda towards identifying pathways to Sustainability in relation to health.

[18] In the case of HIV, the few attested prevention strategies, such as specific harm reduction and empowerment initiatives with groups key to the impact and to the transmission of the virus, came from close attention to the interactions between the virus and affected populations. In the case of arsenic poisoning in Bangladesh, the most viable responses seem to be multiple relatively local initiatives to manage affected water sources more effectively. These are approaches that emphasise adaptation and learning and in specific situations, in ways that incorporate the perspectives of those affected - as advocated in broader discussions of policy approaches in dynamic, uncertain situations (see STEPS Working Papers 1, 2 and 3 on Dynamics, Governance and Designs).

This is not the first time that human societies have coped with major health-related challenges. One relevant comparison is the 19th Century experience of the first industrialised countries. These countries experienced rapid urbanisation, increased movements of people and goods and the emergence of new patterns of socio-economic inequality. Poor people in urban areas experienced high burdens of disease and limited life expectancy. A series of cholera epidemics affected all social groups. Responses to the early outbreaks focused on individual survival and calls for divine assistance, but an understanding gradually emerged of cholera as a natural phenomenon that reflected failings in social organisation for public health (Williams 1987). Coalitions of scientists, health professionals, representatives of the growing middle class and, to some extent, the organised working class, eventually built a political consensus for action. This resulted in the establishment of several scientific disciplines and many of the institutional arrangements now conventionally associated with effective government, including the provision of safe water and the disposal of human wastes. It eventually led to the creation of modern health systems.

We are again experiencing rapid changes in patterns of settlement, of mobility and of inequality and poverty on a global scale. This has been associated with a variety of health challenges (Szreter 1999). Coalitions for change are being constructed. We seem to be approaching a period of major reconfiguration of health systems. However, there are crucial differences from the 19th Century, many of which have been discussed in this paper. For instance:

- Elite groups in low and middle-income countries are largely protected from infection by water purification, immunisation and effective treatments for many infections. They often live apart from the poor in 'gated cities'. Their sense of security may impede the construction of political consensus for public health, although this may be countered by a growing sense of insecurity from globalised movements of people, animals and microbes.

- Population ageing, growth in the burden of chronic disease and development of medical care technologies have created new expectations for treatment. Reforms to public health services could previously be linked to greater access to health care at modest cost. This is no longer possible, and governments and political movements face very difficult choices in negotiating rights to health care. The continuing development of expensive new treatments for chronic diseases and the rapid spread of information about these treatments make these choices increasingly difficult.

- The dramatic rise in education, in access to biomedical knowledge, and in popular and 'lay' framings makes the previous model, in which policies were determined by a few people in elite social groups and countries according to professionalised framings of health problems, implausible. People are less likely to accept the authority of top-down modes of government; there are greater demands for citizen voice; and governments need to earn legitimacy for taking public health actions.

- Networked forms of governance are emerging, yet complex patterns of power relations and inequality complicate coalition-building. For instance the legacy of post-colonial and post-revolutionary nation-building and the international human rights framework has established expectations and nascent rights, which create challenges for the negotiation of health policies that claim broad social legitimacy in the face of large structural inequalities.

- Developments in the media and in information technology have accelerated responses to challenges and to new therapeutic opportunities. They have increased the availability of diverse sources of information, and uncertainties, by which any given health intervention might be judged; they have made individual understandings and expectations increasingly important, but have also enhanced the possibility of panics and over-optimistic assessments of new therapies.[19] This creates extremely difficult choices for policy-makers.

- Institutions have transformed a great deal over the past century, both shaped by and shaping dynamic socio-political and human-ecological relationships. The health sector now includes many hybrid forms of organisation, partnership and network, linking public and private across global and local scales. It is no longer useful to think of policy in terms of a dichotomy between ideal types of government bureaucracy and private entity.

- Global governance is decreasingly dominated by a few countries. The rise of new economic powers is challenging the stability of global arrangements, as is the great importance of trans-national corporations, non-government organisations and private foundations. A variety of

[19] One example is the heavy media coverage of the potentially devastating impact of a pandemic of influenza or another infectious disease. This could lead to political pressure in the richer countries for measures aimed at reducing the fear of an uncertain future at the expense of a neglect of the more certain needs of the poor and powerless (Van Damme and Van Lerberge 2000; Bonneux and Van Damme 2006).

citizen groupings at local, national and international levels asserts increasing influence over government policies. Local and global media play an increasingly important role.

Given these transformations, we cannot expect a repetition, at the global level, of the 19th Century experience of state building for public health. Rather, there are now a number of contending scenarios for the development of responses to health challenges. These imply different relationships between institutions and social-ecological-technological dynamics, and imply different pathways. Some may lead to Sustainability, others may not; while they have divergent implications for meeting Sustainability goals as framed and valued by poorer and marginalised people. Thus we could be entering a period of reconstruction of state capacity and the emergence of national and global public health systems organised and financed by governments supported by large financial flows to low-income countries. Alternatively, we may experience the further growth and consolidation of structural inequalities and the emergence of so-called 'apartheid' or 'gated city' models of public health, implying resilience against epidemics at a national or global level, but at the costs of social injustice. This would imply certain populations enjoying high levels of health-related services, while others receive minimum services. It would be associated with a 'city-state' model of global development with centres of formally-organised economic and social activities surrounded by areas of deprivation where informal regulations prevail. The development of an illicit market for body parts for transplant operations illustrates the kinds of unequal valuation of wellbeing and even life that this model of development could institutionalise. As a third scenario, at a global level international health governance may become reconfigured around a dominant consensus on critical global and local health threats linked to understandings of dynamic systems, and ways of responding to them in adaptive ways that address the priorities of the poor. On the other hand, global governance may also be captured by corporate and contending multilateral interests such as international trade bodies.

The changing landscape of knowledge and power in relation to health also suggests alternative scenarios. For instance, the growth of information technology could lead to quite new ways of organising medical care. For example, the linkages between people with specific diseases and vertically integrated pharmaceutical/service delivery companies could strengthen, fostering models of managed life-time care but with a potential for a problematic 'medicalisation' of chronic conditions that entraps poorer people in heavy treatment expenses while denying alternative approaches for dealing with disease. Alternatively, horizontal coalitions of informed citizens could emerge that press for government action to enhance equity and create regulatory arrangements for highly

devolved health systems in which very different, more reflexive and deliberative relationships between state, market and civil society organisations become established.

It is unlikely that any one of these, or indeed other, imaginable models will dominate global systems in the foreseeable future and some may co-exist and influence each other. The plausibility of each scenario highlights the fluidity of present arrangements and the likelihood that the outcome will be determined by the forms that responses to new challenges take. The health work of the STEPS Centre aims to promote debate and reflexivity concerning the ways different perspectives on systems dynamics and governance arrangements co-evolve, and their implications for poverty reduction and social justice. Centrally, we aim to contribute to the development of institutional arrangements that give voice to the concerns of the poor in this dynamic world. Such arrangements need to be designed to promote pathways to Sustainability, in the sense of promoting and maintaining system structures and functions important to poorer people, and enhancing resilience and robustness in the face of shocks and stresses. To move towards this goal in turn requires research approaches that attend to several key sets of issues.

RESPONDING TO COMPLEX, DYNAMIC DISEASE ECOLOGIES

We need to know more about the inter-relationships between social, technological and ecological dynamics in the generation of health challenges and responses to them, taking account of non-linear dynamics and path dependencies across multiple scales. This involves the identification of strategies that deal effectively with the interactive and cumulative effects of shocks, stresses and long wave events, that build resilience and that help individuals and societies escape from low efficiency, low health status vicious circles. It also involves the use of understandings of dynamics to identify potential unintended outcomes of specific interventions, an acknowledgement of the great uncertainty that adheres to many health-related decisions and the construction of adaptive and reflexive approaches for responding to them.

RECONFIGURING GOVERNANCE FOR AN UNCERTAIN WORLD

We need new understandings of and approaches to health governance that recognise interactions of multiple institutions, actors and networks, and that take into account the political economy of social arrangements and of knowledge in framing and responding to health problems. This involves recognising and

responding to a range of changing realities. As the role of individuals and citizen groups in responding to health challenges increases, we need to understand how they gain access to different forms of health knowledge, assess their reliability and act. For instance, a decision to provide countries with large quantities of drugs should be complemented by measures to support informed citizenship through dialogic approaches and to build regulatory partnerships to reduce the risk of exposure to sub-standard drugs and of the development of treatment-resistant organisms. Equally, as health systems undergo change involving a variety of actors, networks and other entities, we need to understand how legitimated institutional arrangements and intervention designs can be produced in the face of different framings of health challenges, and what strategies might best address divergent and conflicting goals. The construction of languages that enable and legitimate shared rules and social norms; deliberative and reflexive approaches to governance; and appraisal designs that aim to open up the range of perspectives included and to broaden out the range of options for policy, all offer potential ways forward of relevance to addressing health challenges (see STEPS Working Papers 2 and 3 on Governance and Designs). Developing and applying these in settings of extreme inequality nevertheless poses enormous challenges. Especially in settings where powerful actors seek to influence governance arrangements in their own interest, it is crucial to explore the potential both of deliberative approaches, and of other types of collective responses that can counterbalance this.

CONSTRUCTING PATHWAYS TO SUSTAINABILITY IN DIVERSE CONTEXTS

Both the dynamics of human-disease-ecological systems and governance arrangements, and the framings and understandings that underpin them, emerge in particular ways in particular places. They have specific histories and socio-political contexts that influence both present patterns and pathways to future change. Current arrangements both reflect the experience and institutional constructions of the past, in path-dependent ways shaped by political history and culture, and respond to new challenges, patterns of inequality and technological opportunities. As an alternative to approaches that assume that dominant models can be unproblematically transferred, scaled up and rolled out, we need to address how such standard approaches are reinterpreted and acquire new meanings in particular contexts. We need to address how alternative responses to specific health challenges can be constructed in ways rooted in and appropriate to diverse contexts, and how this can help build pathways to Sustainability in health that address the perspectives and priorities of those with little economic and political power.

It is by integrating such concerns with dynamics and governance through a lens that gives weight to the specificity of particular places and their histories, that the STEPS Centre is developing a 'pathways approach' to health issues. As this paper has argued, today's world is characterised by dynamics - in intertwined ecological, social and technological systems - that are posing major new health challenges. The mismatch between these and the assumptions of mainstream, historically-embedded policy and management approaches are becoming more evident than ever, contributing to situations that compromise sustainability and the interests of the poor. Turning these tendencies around, while making the most of the opportunities for health advances represented by current global interest and rapid technological advance, will require some major rethinking and reworking - in understandings of the systems that affect health, and of governance arrangements that can respond to them effectively. Only in this way can we envisage the construction of pathways to Sustainability that can ensure resilience amidst the health challenges of the 21st century in ways that simultaneously enhance poverty reduction and social justice.

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