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COMMENTARY

Rethinking health systems strengthening: key systems thinking tools and strategies for transformational change

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While reaching consensus on future plans to address current global health challenges is far from easy, there is broad agreement that reductionist approaches that suggest a limited set of targeted interventions to improve health around the world are inadequate. We argue that a comprehensive systems perspective should guide health practice, education, research and policy. We propose key 'systems thinking' tools and strategies that have the potential for transformational change in health systems. Three overarching themes span these tools and strategies: collaboration across disciplines, sectors and organizations; ongoing, iterative learning; and transformational leadership. The proposed tools and strategies in this paper can be applied, in varying degrees, to every organization within health systems, from families and communities to national ministries of health. While our categorization is necessarily incomplete, this initial effort will provide a valuable contribution to the health systems strengthening debate, as the need for a more systemic, rigorous perspective in health has never been greater.

Keywords Health systems strengthening, systems thinking, global health

KEY MESSAGES

- Transformational, systems level changes are needed to better use scarce resources and to achieve the health MDGs. Such changes require new ways of thinking about health and approaches to improve health outcomes.
- We propose key 'systems thinking' tools and strategies that have the potential for transformational change in health systems—in health practice, education, research and policy.

Systems thinking and health systems strengthening: a novel opportunity for synergy

Global health decision makers are at a crossroads. High level meetings and community level advocacy groups in recent years have highlighted the challenges that lie ahead: the post-Millennium Development Goals (MDGs) global health agenda, burgeoning non-communicable diseases, achieving universal health coverage and strengthening fragile health systems in low- and middle-income countries. While reaching a consensus on future plans to address these challenges in a rapidly globalizing and interconnected world is far from easy, there is broad agreement that reductionist approaches to improving global health in the last three decades that witnessed substantial increase in health investments in selective interventions have been inadequate to address present ills and prepare health systems for future challenges. This unpreparedness is especially true with investments in health systems strengthening that have been fragmented and unsystematic—focusing on one or two health system functions in isolation—as has been the case with planned and sustained responses that underpinned disease-specific programmes. When addressing health challenges, the importance of taking a holistic view is increasingly recognized (Atun and Menabde 2008; Swanson *et al*. 2010; Pourbohloul and Kieny 2011) and has been proposed as one of four guiding principles for global goal setting after the MDGs (Waage *et al*. 2010). In this paper, we reason that a comprehensive systems perspective—a consideration of all individuals and institutions that impact health and their dynamic interactions over time—should be central in future health practice, education, research and policy. We then highlight key 'systems thinking' tools and strategies that have the potential for transformational change in health systems.

While a comprehensive approach to strengthening health systems is not a new concept, the recent surge of interest in viewing health systems as complex, adaptive systems presents novel opportunities for synergy and increasing capacity in local communities and organizations. The so-called 'vertical', 'targeted' or disease-specific programmes that originated in the 1980s and proliferated in the last two decades have been variably successful at delivering specific interventions such as immunizations, anti-retroviral treatment for AIDS and directly observed short-course treatment (DOTS) for tuberculosis, with considerable health benefits. However, the long-term impact of these programmes on health systems is unclear, with unsystematic evidence for positive and negative effects (Samb *et al*. 2009; Atun *et al.* 2010; Atun *et al.* 2011). This realization of limited documented positive effects on health systems of targeted health investments has led to a renewed interest in 'health systems strengthening' (HSS) (Sundewall *et al*. 2011), with an emphasis on principles such as financing national health strategies, integration, local ownership and sustainability. However, in spite of this renewed interest, there is no consensus on the meaning of the term 'health systems strengthening' (Marchal *et al.* 2009; Swanson *et al*. 2010). Consequently, HSS approaches too often focus on a narrow aspect of the health system such as family planning, community health workers, financing schemes or particular interventions.

Systems thinking can complement and enrich the prevailing reductionist approaches to health improvement and the current HSS movement, by improving health practice, education, research and policy. Even in the absence of an agreed definition and approach, systems thinking has already provided insights into tobacco control (National Cancer Institute 2007), aided in the simulation of a variety of health care processes (Katsaliaki and Mustafee 2010) and led to improvements in the way that health service providers are trained (Philibert 2004; Frodeman 2010).

Systems thinking, a novel lens through which we can view the world, is a broad array of approaches and methods. Some approaches, such as collaboration across disciplines and sectors, are well established in the health sector (though applied to various degrees), while many others, such as systems modelling techniques (described in the research section below) are not as well known or established. Recent publications, such as *Systems Thinking for Health Systems Strengthening* (de Savigny and Adam 2009) have influenced the debate, providing a useful introduction to complex adaptive systems, and offering strategies for testing and disseminating systems-level tools through networks of practitioners. We provide a brief overview of complex adaptive systems and systems thinking in Box 1.

In this paper we contribute to that debate by highlighting some key systems thinking approaches to HSS and consider their application to health practice, education, research and policy. We identify three overarching themes in relation to systems thinking approaches: collaboration across disciplines, sectors and organizations; ongoing, iterative learning; and transformational leadership (Box 2).

Systems thinking to transform health practice

At the practice level, how might we best foster shared vision and the capability for systems thinking in health? While practitioners on the ground are constrained by a wide variety of factors (inter alia, regulatory policies, credentialing, social norms, varying levels of evidence to support interventions, erroneous assumptions about health, commercial pressures, conflicts of interests, and inadequate education and training), they maintain some level of professional independence, allowing them to impact the health of their communities regardless of constraints. The degree of success of these health producers depends on their ability to collaborate with other key stakeholders around a shared vision, while anticipating ways that others will react to their actions. The key objective of developing systems thinking at practice level, then, is to create and nurture 'learning organizations' at all levels that bridge across disciplines, communities and sectors; organizations that are continuously working together to create a common future (Senge 1994; Chunharas 2006).

Learning organizations are needed because changing disease burdens to more chronic conditions brings new challenges to health systems that have been designed to deal primarily with acute conditions at a specific point in time. These challenges stem from increased complexity due to diverse disease causes (including the social and behavioural determinates of health), and diseases that span the lifetime. Health practitioners and

Box 1 A brief overview of complex adaptive systems and systems thinking

Health and other social systems have been described as complex adaptive systems (CAS) that adjust in dynamic and sometimes unpredictable ways to changes within the system itself or in the context in which it operates. CAS have a myriad of components (such as citizens, patients, communities, providers, policy makers, programme implementers, etc.) that are continuously interacting and adapting to other component changes and changes in the environment. The distinctive features of health and other complex systems include self-organization, constant changes, feedback loops, non-linearity, time lags between inputs and outcomes, history dependence and unintended consequences of policy interventions (de Savigny and Adam 2009).

Systems thinking is an approach that describes and considers the characteristics and effects of CAS, and attempts to maximize their positive effects while minimizing unintended negative effects. It is widely applied to diverse sectors, including engineering, economics, ecology and business, and it is an emerging approach in health systems research with tremendous potential to address challenges related to public health (Mabry et al. 2008; Mabry et al. 2010). Systems science methodologies consider dynamic relationships between elements ranging from cells to individuals and organizations, and the impact that those relationships have on the entire health system. Implications for research, policy and practice in public health are significant (Homer and Hirsch 2006; Sterman 2006; Leischow et al. 2008). Many systems thinking approaches and methodologies have been successfully applied to health and other sectors (Jackson 2003).

Box 2 Three overarching themes in systems thinking tools and strategies

1. **Collaboration across disciplines, sectors and organizations**: Any approach to improve a health system will require that actors reach beyond their area of expertise or practice, and collaborate with colleagues with different experience, knowledge and goals.
2. **Ongoing, iterative learning**: Systems-level change requires a recognition that the context is continuously changing. As such, actors need to continuously adapt, learn and apply new knowledge to current challenges. Recognition of the importance of learning from experience opens additional approaches for research and practice, including qualitative and mixed methods research to understand subtleties of systems design and dynamic actions in implementation.
3. **Transformational leadership**: Visionary and courageous leaders are needed to challenge the prevailing paradigm; sacrifice personal and organizational interests for systemic benefit; enhance inter-organizational collaboration (Best and Holmes 2010); and advocate for change. People in leadership roles need not be the traditional heroic, charismatic individuals; leadership can and should be 'distributed' throughout organizations over time. Health workers at all levels of the system can be transformational leaders by challenging basic assumptions about how health is delivered; mobilizing around a shared vision of equity and efficiency; and elevating the values, vision, mission and morals of all stakeholders. Organizational culture that embraces such leadership is critical.

organizations operating in complex adaptive systems face particular challenges when the contexts of health systems evolve rapidly. Fundamental principles of complex adaptive systems apply, for example the critical role of collaboration, feedback loops, and strategies to engage and address resistance to change.

Health professionals will need to be able to set common goals and targets with patients, service users and relevant stakeholders, and ensure that each group or individual is properly informed and engaged. From a systems thinking perspective, increased participation provides the opportunity to break down barriers between patients and providers, and citizens and policy makers. Evidence and explicit knowledge need to be integrated with tacit knowledge of stakeholders within the working dynamic of the health team.

A number of systems thinking tools might facilitate such a change (Willis *et al.* 2011). We have briefly described system dynamics modelling and knowledge synthesis below. Concept mapping provides a rigorous methodology to integrate information from various stakeholders. The interactions between stakeholders can be characterized using social network analysis methods. Finally, programme budgeting and marginal analysis is a framework that allows for the movement of funds across budgets, and engages stakeholders from a variety of backgrounds, enabling stakeholders from diverse organizations to collaborate from a financial perspective.

In Box 3 we summarize key systems thinking strategies and tools to transform health practice.

Systems thinking to transform health education

The use of a systems thinking approach in health education to address complex problems may bring about more creative and sustainable solutions to inadequate performance of health

Box 3 Key systems thinking strategies and tools to transform health practice (National Cancer Institute 2007; Best and Holmes 2010; Paina and Peters 2011; Willis *et al*. 2011)

- Develop a shared vision and systems thinking skills among diverse stakeholders through iterative dialogue, and translate into firm commitments for collaborative action.
- Anchor the collaboration in core values, such as social responsibility and equity, a commitment to changing outcomes, and an evidence strategy that integrates needs for research and knowledge translation with policy and practice priorities (Herbert and Best 2011).
- Utilize systems thinking tools such as knowledge synthesis, concept mapping, social network analysis, programme budgeting and marginal analysis, and system dynamics modelling (Willis *et al.* 2011) to effectively manage complexity and changing dynamics (National Cancer Institute 2007).
- Consider the impact of current and new health programmes on existing health systems, and maximize positive effects (Swanson *et al*. 2009) by avoiding duplication and increasing local ownership and capacity.
- Ensure sufficient priority and investment in capacity development and transformational leadership.
- Pay attention to social, political and cultural contexts at the local level (both current and historical), as well as incentives and institutions.
- Plan for unintended consequences, and be willing and ready to adapt.
- Develop and implement programmes that engage key stakeholders through regular, strong monitoring and feedback loops, and transparent use of data.
- Strengthen existing institutions and organizations through genuine and equal partnerships.
- Embrace self-organizing 'emergent' phenomena: novel (and sometimes surprising) roles, relationships, practices and programmes that arise naturally when there is a shared vision around improved population health over time.
- Develop systems thinking among health facility managers and programme managers with the skills to develop organizational or team learning through actions using four sources of knowledge—theory, research, monitoring and evaluation, and tacit knowledge.

systems globally. Systems thinking is widely used in training curricula of disciplines outside of health that deal with complex systems, such as engineering, biology and management. A commission of health education leaders from around the globe recently recommended a historical transformation of health education, with systems considerations at the centre (Frenk *et al.* 2010). They highlighted the need for a 'third generation' of reforms in health education that incorporates 'thorough and authoritative re-examination of health professional education' focused on systems-level transformational learning and leadership (Frenk *et al*. 2010). Other health educators have also concluded that systems thinking should be a core domain in public health curricula (Calhoun *et al.* 2008) and a core competency of health research training (Gebbie *et al*. 2008).

Public health challenges and risk factors, including chronic diseases, infectious diseases, mental health problems, obesity, imbalanced nutrition, smoking, and alcohol and substance abuse, emerge from a complex system of spatio-temporal interactions at the biological, socio-behavioural and economic scales. Systems thinking trained public health professionals address these complex challenges by designing effective interventions to maximize the positive health outcomes, while minimizing unintended negative consequences. High-impact prevention and control programmes for polio eradication (Thompson and Tebbens 2007) and smoking cessation (Levy *et al.* 2010) are examples of interventions that were designed by public health professionals, using systems thinking expertise. Public health professionals with systems thinking expertise, complemented with traditional training in reductionist approaches of studying causal-effect relationships, are better prepared in designing public health solutions to effect changes at multiple scales of interaction to improve health outcomes.

Graduating health students must have a sense for the key drivers of health in a population, and the leadership skills to mobilize around leverage points in the system through increased interdisciplinary team practice and learning, social mobilization and political advocacy, regardless of their area of specialization.

Contemporary health practice needs to address multi-factorial chronic diseases that span multiple disciplines and sectors, and this imperative should be reflected in health training curricula. While in the past teaching and learning in health have primarily focused on technical learning, a number of institutions now routinely include disciplines such as organizational management, social sciences, institutional analysis and systems sciences in their health curricula. In Box 4, we highlight systems thinking tools and strategies that have shown promise in transforming health education.

Educating health professionals to apply systems thinking will require not only changes in curricular content, but also a need to base teaching and learning within the reality of a continuously changing health system on the ground. Ongoing learning must occur at all levels of the health system, from the most peripheral health workers who interact closely with the communities to policy makers and educators. Since the complexity of health improvement is best learned in practice, academic centres should extend training into the health systems within their communities.

Box 4 Key systems thinking strategies and tools to transform health education (Frenk *et al*. 2010)

- Focus on transformational learning that leads to locally responsive and globally connected health systems leadership.
- Implement competency-based health curricula and team-based learning that is periodically reassessed to address the changing health needs of the community. Expand academic centres into academic systems that include communities by reaching out to community members and engaging in participatory research.
- Incorporate systems science approaches and methods, such as knowledge synthesis, concept mapping, social network analysis, programme budgeting and marginal analysis, and system dynamics modelling (Willis *et al*. 2011) as core, foundational components of health curricula.
- Promote trans-professional education in medicine, public health, nursing and health policy through case studies and practical experiences that encourage collaboration across disciplines such as economics, ecology, anthropology and organizational management, and that break down traditional professional and disciplinary silos.

Systems thinking to transform health research

A key objective of research in the health sector is to produce reliable and valid evidence to inform policy and practice. While the randomized controlled trial (RCT) is considered the gold standard in medical research, RCTs in isolation are inadequate to address complex challenges inherent in the context of health systems contexts (Mabry *et al.* 2010). Indeed, RCTs by design control for the variables that we might be most interested in: interactions between medications, interventions, projects, providers and communities. Health systems research, which aims to capture such complexities, by necessity, needs to be multi-disciplinary and multi-method (Mills 2012).

Qualitative health research can help understand health systems complexities: the behaviours of actors, and the perceptions and culture of the people related to health systems (Atun *et al.* 2005). Often these behaviours can be described by feedback loops. Moreover, qualitative research identifies facilitators and barriers to the implementation of health programmes, and its results add to the comprehension of social, political and economic factors associated with contemporary and emerging health problems. Quantitative methods are usually used in health research, using methods such as clinical trials, analysis of resource allocation of health services, and cost effectiveness of health programmes and disease transmission patterns. In quantitative analyses, health researchers have traditionally sought to answer a specific question at a particular point in time by controlling for all other variables as much as possible; analysis is restricted to one subsystem.

This traditional, reductionist approach to research widens the gap between knowledge and practice. A paradigm shift is needed in knowledge translation that takes a systems view (Best and Holmes 2010) by: embracing complexity in research; considering local context; widely applying community-based participatory and action research methods; studying organizational networks and the ways that they collaborate to impact health; and supporting leaders who strengthen the link between research and practice.

Research in systems modelling and simulation has shown promise in capturing the complex, dynamic nature of health challenges (Katsaliaki and Mustafee 2010). More specifically, agent-based modelling and discrete event simulation can be useful in the micro-level planning of health services (e.g. modelling hospital departments, bed and equipment capacity planning, appointment scheduling, facility location and relocation); Monte Carlo simulation methods have been widely used in health economics, and can be used for health risk assessment, for the economic evaluation of health interventions, and for cost–benefit analyses pertaining to competing technologies and healthcare strategies; and system dynamics modelling considers feedback loops in dynamic behaviours and health systems activities, and can be used for the evaluation of public health policies (Atun *et al.* 2007), and for the training of health-care policy makers (to facilitate the understanding of the dynamics of an epidemic). While it is very challenging to capture an entire health system in systems modelling and simulation, they are nevertheless powerful tools that are underutilized in health systems research (Homer and Hirsch 2006).

The changes in health research approaches that incorporate systems thinking would likely result in a shift from the current 'research-to-practice' model to an 'applied research paradigm, similar to that of engineering, which integrates research and practice' (Livingood *et al*. 2011). Such a paradigm shift would result in applied scientists with instincts and capacities to apply a variety of systems tools to gather and synthesize data, narrowing the knowledge translation gap between research and practice, and mobilizing communities around health promotion despite varied contexts. In Box 5, we summarize these key systems thinking strategies to transform health research.

Systems thinking to transform health policy

Policy makers too often approach health systems from a mechanistic perspective, assuming that implementing a particular policy will lead to a predictable change in the behaviour of local actors (such as providers, professionals and citizens), thereby ignoring the interactions between them. This line of thinking leads increasingly to detailed incentives and regulations from the top down, a so-called 'command and control' approach to policy (Rouse 2007). This approach is not as

Box 5 Key systems thinking strategies and tools to transform health research

- Adopt a culture that continuously identifies knowledge gaps in practice processes and ensures action research to fill gaps in needed knowledge.
- Embrace holism in research by widely incorporating mixed methods and interdisciplinary research into traditional health research, including:
  - Action (Meyer 2000), process and community-based participatory research.
  - Institutional and organizational (Royston 2011) management research.
  - Social sciences research (Gilson *et al*. 2011).
  - Systems science, operations and complexity theory methods and approaches, such as agent-based models, discrete event simulation, Monte Carlo methods, system dynamics modelling, knowledge synthesis, concept mapping and social network analysis.
- Recognize the complementarity of systems research and more conventional, reductionist research methods.
- Engage policy makers and potential research users in planning for research and through to the process of interpretation of findings and implications for actions to ensure relevance (of research outputs) as well as receptivity (of potential users) of research findings.

effective in complex systems such as health because with so many diverse determinates of health, and so many possible interventions to address challenges, there is no universally appropriate policy. As such, the command and control approach too often results in unintended consequences such as duplication of services, inefficiencies, policy resistance (Atun and Olynik 2008), erosion of capacity, dependence and other negative effects (Sterman 2006), because local actors focus on goals and indicators related to their health subsystem (such as short-term disease, programme or patient specific indicators; processes such as supply chain management; or particular health system building blocks), 'gaming the system' to maximize individual gain at the expense of the larger system. The need to consider the implications of policies outside of the intended realm of impact has been highlighted by work focusing on 'health in all policies' (Puska and Ståhl 2010).

Systems thinking proposes that policies should be based on widely-accepted 'simple rules' (Plsek 2001) that will facilitate dissemination to front-line practice implementation by rallying all stakeholders to understand, analyse and improve the health system as a whole. Thereby, local health practitioners will innovate and adapt based on local context to improve community health, while strengthening the overall health system. Since it is impossible to dictate the actions of every independent actor that impacts health, these simple rules should be as limited and as widely accepted as possible; for example, 'citizens are entitled to basic health services', 'providers are to be reimbursed for value', or 'health planners should consider the impact that policies or programmes have on the existing health system'. Simple rules can be high-leverage points that lead to long-term transformative change. Since local actors innovate in ways that policy makers might not even imagine, they must set aside basic assumptions about health and its delivery (such as the traditional role of providers) that could constrain local health producers.

Local innovation leads to naturally adaptive systems, and computer techniques can model and simulate the dynamic paths by which stakeholders respond to a given stimulus (Sterman 2006), with systemic policy analysis thereby predicting the unintended consequences of policy reforms on sometimes surprising, 'emergent' behaviours. By designing regulatory frameworks that allow systems to be adaptive, rather than mechanical, this understanding of human behaviour can move policy away from regulatory specificity and toward flexible approaches that can accommodate dynamic complexity. Embracing uncertainty in health decisions can facilitate the design of policy to structure complex adaptive systems in ways that can appreciate systemic interconnectedness and assess multi-sector effectiveness (Smith and Petticrew 2010). Understanding this evolutionary design of the health system by observing and identifying local intervention successes through feedback loops, the system can be optimized over time to promote long-term positive health effects (Sterman 2006).

In Box 6, we summarize the systems thinking strategies and tools to transform health policy. In Box 7, we present an example of systems thinking in Thai health policy.

Conclusion

Transformational, systems level changes are needed to better use scarce resources and to achieve the health MDGs. Such changes require new ways of thinking about health and approaches to improve health outcomes. In this paper, we have outlined specific tools and strategies to transform health practice, education, research and policy. Our list is not exhaustive, but we hope it makes a valuable contribution to the HSS debate at a time when there is a great need in health for a more systematic, comprehensive and rigorous consideration of systems thinking tools and strategies.

The proposed tools and strategies can be applied, to varying degrees, to every organization, from families and communities to national ministries of health. However, to bring about transformational change in health, professionals will need to gradually transition away from exclusively applying reductionist health approaches, while simultaneously embracing systems thinking and widely accepted guiding principles (Swanson *et al*. 2010). The very categories that we created (health practice,

Box 6 Key systems thinking strategies and tools to transform health policy (Plsek 2001; Sterman 2006; Rouse 2007)

- When health challenges and solutions are complex, avoid 'command and control' approaches that dictate detailed health delivery strategies and incentives.
- Implement policies that incorporate simple rules and incentives, allowing local practitioners and others to innovate around health efficiency and quality.
- Focus on high-leverage changes that are likely to have long-term positive effects, such as transformation of health curricula, health systems impact assessments (Swanson *et al*. 2009) and reimbursement for value (McMahon and Chopra 2012).
- Develop computer models to simulate dynamic complexity and conduct what-if analysis, thereby planning for unintended consequences.
- Challenge basic assumptions about health and its delivery.

Box 7 Example of systems thinking in Thai health policy

The Thai health system research institute took the lead in proposing the establishment of potentially transformational organizations in the late 1990s, as health reform was underway. One such organization is the National Health Assembly, a forum to regularly engage key stakeholders in the health system and solicit policy recommendations to the cabinet. Bringing together the various stakeholders in the health system, the National Health Assembly facilitates inter-organizational collaboration, iterative feedback on health policy, and local participation to encourage ownership and innovation.

The National Health Assembly has since proposed 5–10 policy recommendations each year for the past 5 years, and has served as a mechanism to create participatory learning and policy development in the Thai health system. While not all policy recommendations have been implemented, the active participation of civil society has added value in placing health at the core of many public policy debates. A few examples of policy issues that have been discussed and proposed have included health impact assessments, the impact of the mining industry on people's health, disaster preparedness and community empowerment.

education, research and policy) should not be considered in isolation but as a whole, as they influence and complement one another. The publications and recommendations that we have highlighted in this paper demonstrate the need to embrace collaboration across disciplines, sectors and organizations; on-going, iterative learning; and transformational leadership, making those considerations central and foundational to health improvement worldwide. We argue that a paradigm shift towards systems thinking will strengthen health systems effectively around the globe thereby leading to improved health outcomes.

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Conflict of interest

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