Systems thinking, knowledge and action: towards better models and methods

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The way we think about how research, policy and practice inform and interact with each other shapes our efforts to improve health and social outcomes. In this paper we describe linear, relationship and systems models with regard to how they approach bridging evidence and policy/practice, or turning knowledge into action. We contribute to the knowledge to action (KTA) systems thinking discussion by highlighting four interconnected aspects of this model we believe merit exploration: evidence and knowledge, leadership, networks and communications. We conclude with the challenge of developing measurement methods for systems research to better understand the KTA process.

Introduction

The way we think about how research, policy and practice inform and interact with each other dramatically shapes our efforts to improve health and social outcomes. This paper portrays the development of knowledge to action (KTA) thinking and the emergence of systems thinking in the health sector but the discussion should be applicable across sectors. The ways in which many of us involved in health system improvements think about research, policy and practice interactions have changed markedly over the last five years, powered by our realisation of the following:

- Typical practice change from knowledge translation or KTA activities is only about 8–15% (Grimshaw et al, 2001; Crowley et al, 2004). The results from past ways of thinking just are not good enough.
- If we want more evidence-informed practice, we need more practice-informed evidence (Green, 2006).
- The above is as true for policy as it is for practice: KTA as conceptualised thus far does not fit with the underlying politics of health policy making (Mitton et al, 2007).
- Health service problems are best seen as embedded in systems, the dynamics of which we need to understand in order to solve problems (Leischow et al, 2008; Huang et al, 2009).
- There is a growing consensus that the critical issues related to health and health system improvement relate less to the dissemination or diffusion of evidence, and more to its implementation (Glasgow and Emmons, 2007; Green et al, 2009). Implementation is much more complicated than dissemination or diffusion, given
the increasing specialisation in both academia and practice – and the concomitant increase in new communities with their own professional languages, traditions and goals (Lervik et al, 2007).

So, what are the options for thinking through the research–policy–practice – or, as we call it, the KTA – cycle? We see three generations of thinking about how KTA works: (1) linear models, (2) relationship models and (3) systems models. Our personal experience over the years and our review of the literature highlight the benefits of systems thinking, as encompassed in the last of the three models, in approaching KTA (Best et al, 2008a, 2008b, 2009). We are pleased to see scholars increasingly drawing on the concepts – if not the explicit language – of systems thinking in theorising KTA. While there is no one model that could serve every situation, KTA as a field would be well informed by the holistic, population-based, ecological approach that is systems thinking (Van de Ven and Johnson, 2006; Mitton and Bate, 2007; Landry, 2007; Ward et al, 2009).

Our objectives with this paper are:

• to contribute to the KTA systems thinking discussion by highlighting four interconnected aspects of such a model that we believe merit more exploration: evidence and knowledge, leadership, networks and communications;
• to stimulate debate among our colleagues on at least three topics:
  – the four areas we discuss are well-established separate areas of scholarship. What more can we learn from them, both individually and together, in order to improve health policy and practice through KTA?
  – what tools do we need to develop that will allow us to measure KTA approached through a systems lens?
  – what do we need to learn from sectors other than health? What can they learn from us – and what might we be able to learn from each other?

We begin with an overview of conceptual approaches to KTA, expand on one of those approaches – the KTA systems thinking model – and then highlight in turn the four aspects of evidence and knowledge, leadership, networks and communications. We conclude with a call for others to join the discussion on systems thinking and KTA.

Conceptual approaches to KTA

Linear models

Expanding the ‘three generations’ perspective above, the language of linear models (eg knowledge transfer, research uptake) suggests a one-way process: researchers produce new knowledge, which gets disseminated to end users, and then incorporated into policy and practice. In the linear model, knowledge is seen as a product, generalisable across contexts, whose use depends on effective packaging (Best et al, 2008a). Information technologies are often emphasised in this model, perpetuating the myth that knowledge is the same as data, and that transferring it effectively depends
on sophisticated computing technologies. Crowley et al (2004) illustrate this linear thinking with a model that represents the dominant thinking behind most biomedical research and has driven most of the intervention and research design for KTA studies to date.

In summary, if knowledge to action is seen from a linear perspective:

- knowledge is viewed as a product;
- production to application is seen as moving through relatively discrete, predictable and manageable stages;
- the exchange process is largely one-way, from research producer to research user;
- effective communication is the key to successful outcomes.

A linear model is more likely to be a good choice for KTA when:

- classic dissemination and diffusion criteria are well met (eg high relative advantage, low complexity, low risks and costs, trialability);
- strong institutional structure and resources are in place to support the full production to application process;
- there is a supportive culture and incentives for practitioner behaviour change.

**Relationship models**

Relationship models incorporate the linear model principles for dissemination and diffusion, and then focus on the interactions among people using the knowledge. The emphasis is on the sharing of knowledge, the development of partnerships and the fostering of networks of stakeholders with common interests (Graham et al, 2006; Lomas, 2007). In the relationship model, knowledge is seen to come from multiple sources (research, theory, policy, practice), not just from the researcher. Its use depends on effective relationships and processes (Best et al, 2008a).

In summary, if KTA is seen from a relationship perspective:

- there is a clear commitment to close collaboration in both knowledge creation and knowledge use;
- linkage and exchange (Lomas, 2007), collaboration and shared learning are seen as core processes for KTA.

A relationship model is more likely to be a good choice for KTA when:

- there is consensus that local context and knowledge must be taken into account in adapting evidence-informed intervention strategies (programmes and/or policies);
- the organisational culture favours evidence-informed planning, decision making and resource allocation;
- the complexity of the problem at hand requires systems change to support practitioner change, and this requirement is accepted by opinion leaders and decision makers;
• there is a stable research agenda and platform (required structure and resources) to support two-way communication and close collaboration.

**Systems models**

The systems approach we advance here builds on linear and relationship thinking and allows us to enhance the conceptualisation of KTA. It recognises that diffusion and dissemination processes and relationships themselves are shaped, embedded and organised through structures that mediate the types of interactions that occur among multiple agents with unique worldviews, priorities, languages, means of communication and expectations (Frenck, 1992). These agents are tied together by a system (which in turn is shaped by culture, structures, priorities and capacities [Best et al, 2009]) that requires activation if its various parts are to be linked together. Consequently, a systems way of thinking is needed to bring about that activation for the purposes of KTA (Best et al, 2008b).

In summary, if a systems model is used to conceptualise KTA, it is assumed that:

• the system in question is best understood as a complex adaptive system, whose theoretical underpinnings are: systems are dynamic and constantly changing; systems themselves exist within other, interdependent systems (eg individual, organisation, community); changes in one part of the system can have unexpected changes in other parts of the system;

• understanding the roles and actions of key stakeholders, and how they are shaped by and in turn shape the dynamic system of KTA, is particularly important, echoing the circular model’s emphasis on the importance of relationships, linkage and exchange (Graham et al [2006]; Graham and Tetroe [2007]; discussed below);

• specific elements of a systems model – eg feedback loops – are absolutely critical to the KTA process.

A system model may be the model of choice when:

• all of the key stakeholders to be represented in the process can be active collaborators in the modelling and solution seeking process;

• these partnering organisations are willing to invest the considerable time and resources required to develop the model;

• KTA is positioned as a key business strategy by lead organisations, providing the opportunity to integrate the model with organisational change strategy.

Other authors have described the generations and models of KTA somewhat differently. Van de Ven (Van de Ven and Johnson, 2006;Van de Ven, 2007) sees three distinct ways of thinking about the gap between theory and practice. The first views the challenge as a problem of knowledge transfer. The second approach views knowledge from research and knowledge from practice as equally legitimate, although fundamentally different in their ontology (assumptions about ‘truth’) and epistemology (ways of knowing). This approach argues for effective ways of exchanging and using both
kinds of knowledge. The third view sees the challenge as a problem of production, suggesting a need for researchers and practitioners or decision makers to collaborate, co-producing knowledge about complex problems in what Van de Ven calls “engaged scholarship”. Van de Ven’s co-production lens is consistent with the systems lens. This articulation nicely blends recent theory from organisational sciences and management with the longstanding development of action research, beginning in the 1940s with Kurt Lewin, and more recent work on participatory research and evaluation, and community-based action on health (see Minkler and Wallenstein, 2008).

Graham et al (2006) and Graham and Tetroe (2007) offer a circular model based on a review of 31 different KTA frameworks. The model illustrates the key requirements of linkage and exchange between knowledge development and implementation, and also makes explicit the action-reflection process in an eight-step KTA cycle. Gano et al (2006) distinguish between an engineering model (aligned with our linear model) and socioorganisational models (aligned with our relationship model and to some extent the systems model) in their discussion of healthcare policy. Ward et al’s (2009) review of the KTA literature identifies linear, cyclical and dynamic multidirectional models.

In conclusion, there are many ways of conceptualising KTA, and there is clearly no one best model for every circumstance. However, using a systems lens from the outset ensures that all key factors that might affect the process are taken into account when developing intervention and evaluation strategies. We turn now to a further exploration of KTA in the context of systems thinking.

A systems view on knowledge to action

As discussed above, key features of complex systems that need to be taken into account in health service and intervention evaluations include: they are self-organising and constantly adapting to change; they are driven by interactions between systems components and governed by feedback; and they are nonlinear and often unpredictable, with changes on one part of the system producing unexpected changes in other parts. As a consequence of these features they are often policy resistant (Golden and Martin, 2004; Sterman, 2006; Meadows, 2008).

Demonstrating how KTA works (or does not work) in such a complex environment are Greenhalgh et al (2004), who conducted a landmark systematic review for the UK National Health Service. The review integrated 13 distinct disciplinary research traditions to paint a rich picture of the factors affecting dissemination and implementation in health services organisations. These include characteristics of the innovation and those adopting it, systems readiness for innovation, the context within which the innovation is implemented, and the processes used to foster and manage change (see Figure 1).


In sum, there is a groundswell of support for a systems view on KTA. Four aspects we believe have not received enough attention, however, are the nature of evidence
and knowledge, leadership, networks and communications. As Estabrooks and Glasgow (2006) point out, multiple theoretical perspectives – from many disciplines – are more powerful than an overarching theory for guiding knowledge translation processes. Integral to systems thinking, these four areas are also separate, rich areas of scholarship in themselves, and we believe there is much to learn from them to improve health policy and practice.

Evidence and knowledge

Following the evidence-based medicine movement, early literature on KTA focused on evidence that comes from research to demonstrate the effectiveness of interventions. The focus was on the evidence for specific health practices or policies rather than on the evidence for ways to change service delivery or policy development. Using a systems lens for KTA forces a re-examination of what we mean by evidence, and what kinds of evidence will be useful to improve healthcare (Davies et al, 2008; Glasgow and Emmons, 2007).

There is good literature on knowledge as distinct from data and information, supporting a much broader definition of KTA than dissemination of research results through information technologies. There has also been much discussion in the literature on the difference between tacit and explicit knowledge (eg Roth,
Both types of knowledge are mutually dependent and reinforcing, especially in policy or practice integration. In this view, knowledge is a much broader concept than research results. In implementing the ‘knowledge’ in KTA, we must:

- take into account the large number of elements that interact in nonlinear and dynamic ways (Sterman, 2006);
- understand context, reflecting the history of the system, and the fact that hindsight does not lead to foresight, because the external conditions and systems constantly change (Snowden and Boone, 2007);
- look beyond individual cause-and-effect relationships, but rather embark on a continuous learning process and discover emerging patterns as a foundation for more effective KTA strategies (Best et al, 2008b);
- realise that the people in the system shape the system and are influenced by the system. They make decisions based on past patterns of success and failure, rather than clear, logical rules (Osborn et al, 2002; Snowden and Boone, 2007);
- provide the right kinds of evidence in easily usable forms; support innovation and change with training and technical assistance; and integrate new knowledge into the delivery system (Wandersman et al, 2008).

Leadership

Researchers cannot foster systems change on their own – there must be collaboration and co-production throughout the knowledge creation–synthesis–application process (Van de Ven and Johnson, 2006; Van de Ven, 2007). Just as systems thinking calls for a different kind of evidence and knowledge, so it calls for a different kind of leadership (Snowden and Boone, 2007; Trochim et al, 2007). Osborn et al (2002) provide a seminal summary of changing leadership requirements in an increasingly complex system and stress the greater need to take context into account.

Snowden and Boone (2007) specifically distinguish four systems contexts for leadership: simple, complicated, complex and chaotic. In the simple system, which is relatively stable and has clear cause-and-effect relationships, traditional leadership approaches work well: command and control, delegation in well-refined role responsibilities, organised structures and discrete evaluations (Trochim et al, 2007). However, as systems become more complex, in order to adapt to their qualities, leadership needs to rely more on facilitation and empowerment, self-organising structures, participatory action and continuous evaluation: ‘Instead of attempting to impose a course of action, leaders must patiently allow the path forward to reveal itself’ (Snowden and Boone, 2007: 74). Leaders model the openness, risk taking and reflection necessary for learning, and communicate a compelling vision of the required organisational change, providing the support and personal advocacy needed to lead others towards it (Iles and Sutherland, 2001). They focus on collective, dynamic priorities for change and stability in the system, on supporting different ways of conceptualising organisations and their challenges and on developing information-sharing networks within and across organisations (Osborn et al, 2002). They recognise
patterns as they emerge from complex adaptive systems and use them to coordinate and guide action (Osborn et al, 2002).

A particular challenge in health when viewed through a systems lens is that the need to coordinate KTA across organisations increases as complexity increases. Leadership ‘in the spaces between organisations’ often has to occur without a formal acknowledgment of authority, allocation of resources or clear accountability (Best and Hall, 2006). Drath et al (2008: 636) provide a compelling argument that the very foundations for thinking about leadership need to shift from a focus on leaders, followers and common goals to a focus on ‘three leadership outcomes: (1) direction: widespread agreement in a collective on overall goals, aims and mission; (2) alignment: the organisation and coordination of knowledge and work in a collective; and (3) commitment: the willingness of members of a collective to subsume their own interests and benefit within the collective interest and benefit’.

Organisational networks

Networks function at the individual, inter-unit and interorganisational level (Brass et al, 2004). Provan et al (2007: 482) take this multilevel view further by looking at whole networks, defined as ‘a group of three or more organisations connected in ways that facilitate achievement of a common goal. Network members can be linked by many types of connections and flows, such as information, materials, financial resources, services, and social support’.

Networks are understudied, particularly in health systems, yet there is an intriguing logic to them – and a strong trend for a greater use of them in complex systems (eg partnerships, coalitions, alliances and communities of practice) (Provan and Milward, 2001; Provan and Contractor, 2007; Crilly et al, 2009; Riley et al, 2009). Networks are believed to be powerful strategies to increase the effectiveness of KTA. They feature centrally in systems-oriented models of leadership, providing a nexus for further study of the critical relationships between leadership and network influences (Osborn et al, 2002).

The business literature outlines the advantages to such structures as joint ventures and strategic alliances, in terms of information sharing, innovation and speed of diffusion (Brass et al, 2004; Provan et al, 2007). Best and Hall (2006) have reviewed the literature on interorganisational partnerships.1 It suggests that as the degree of collaboration increases, there are six key factors in realising the promise of ‘the collaborative advantage’ (Huxham, 2003) found in such networks:

- **Clear common aims.** It often takes time and cycling through direction setting, action and trust building to build the superordinate partnership–level goal, common language and aims to enable and sustain a productive partnership.
- **Trust.** This essential foundation builds on itself over time with success, often starting with modest, low–risk initiatives.
- **Collaborative leadership.** Effective interorganisational partnership requires sustained, engaged leadership and a shift in leadership style from ‘command and control’
leading and managing to facilitating and empowering, from delegation to participation.

- *Sensitivity to power issues.* In an interorganisational partnership, each partner brings different resources to the table. Effective collaboration requires careful negotiation of expectations and groundrules for decision making.

- *Membership structures.* Shared understandings about what the collaboration involves and formalised rules, roles and structures enable participation. Both governance and task structures are important. The evidence shows the need for effective coordination infrastructure with agreed action strategies, and sufficient resources, capacity and role clarity to support good communication and management functions. Because membership often is dynamic and changing, continuing work is essential to sustain the shared understanding and common focus. Effective coordination structures speed uptake of innovations.

- *Action learning.* Effective collaborations continuously improve through feedback loops and reflective shared learning.

Nevertheless, evidence for how these factors operate in complex systems to increase KTA effectiveness specifically is sparse. Provan et al (2007) found only 26 empirical, network-level studies in total. Fourteen of the studies were in the health services sector, perhaps reinforcing the fact that networks are increasingly seen as a useful structure in the complex world of health systems. Granted, the Provan et al review had a tight focus. For example, the review excluded many studies of ‘small world’ networks (Watts, 1999) that focus on the actions and ties of sub-networks or cliques. A case can be made that local clustering into dense sub-networks with short paths and relatively few ties can be a particularly effective way to organise health systems. Green (1990) summarised several caveats to coalitions and concluded that a ‘Noah’s Ark Principle of Partnering’ is likely to be a more effective action model than large multi-organisational coalitions, since small cliques are better positioned for action.

**Communications**

Communications theory has experienced a similar trajectory to KTA, from linear, sender-to-receiver models and their variants (eg the incorporation of feedback into models or the simultaneous encoding, decoding and process models) through cultural theory models (which equate to the relationship model discussed above), to systems models. The last of these suggests that communications within, between and among individuals and organisations is so complex that it can never be fully understood (certainly not ‘pinned down’) – but that it is possible to observe patterns and processes (Heath and Bryant, 2000).

Despite the embracing of a systems approach by many communications scholars, and the widespread agreement that it is an advance over the previous perspectives of scientific management and human relations (Barnett and Thayer, 1997), in much KTA literature communications is still conceived of as information packaging and dissemination, increasingly through information and communications technologies.
It is a limited view of what strategic communications has to offer KTA. Lervik et al’s (2007) three approaches to knowledge integration provide an illustration. The syntactic approach is related to information processing – the conduit model of communication. The semantic approach recognises that there are local conventions of meanings and interpretations, requiring encoding and decoding of information. Although the semantic approach is an improvement on the syntactic approach, it still assumes that there is no human meaning making involved – the KTA is only a matter of getting the language right. The third approach, the pragmatic approach, equates with a systems lens. This approach recognises that knowledge in one community may have negative impacts in others (a fact that is often lost in the zeal to get knowledge into action). In other words, KTA involves issues of individual and organisational credibility and reputation, politics and power. Liyanage et al (2009) underscore this aspect of KTA, discussing its failure when parties are unwilling or unable to exchange knowledge due to difficulties of confidentiality, culture, fear or loss of autonomy or expertise. Collaboration in the KTA cycle then is not just about what knowledge is produced and taken up, but also about identifying interdependencies and trade-offs, and negotiating interests. Strategic communications, best conceived as an ongoing process with the goal of mutual understanding, has much to offer here.

Conclusion

This paper has discussed the increasing popularity of systems thinking in KTA. We have highlighted four interconnected areas whose further exploration we believe will advance the thinking – evidence and knowledge, leadership, networks and communications. We challenge our colleagues to join us in exploring existing theories in these areas and generating new, cross-disciplinary ones related to systems thinking and KTA.

In this exploration, it will be important to share learning across sectors. This paper portrays the emergence of systems thinking and KTA in the health sector. Ideally, our theories and conclusions should be applicable to other sectors (taking the critical role of context into account), and theories and conclusions generated in those sectors should be applicable in the healthcare arena. By way of examples, increased attention to the systems perspective can be seen in the management sciences (see Van de Ven and Johnson, 2006; Nonaka et al, 2000) and in the public sector in areas such as education and social services (see Attwood et al, 2003; Walter et al, 2004).

Systems thinking has transformative implications for both policy and practice, and for research. For policy and practice, it highlights:

- the importance of coordinated and effective interventions across multiple levels of change (e.g. individual, organisational, community);
- the need to ensure readiness and sufficient capacity before launching major KTA initiatives;
- the importance of distributed, collaborative leadership and accountability throughout the system;
• the critical role of strategic communications to catalyse, coordinate and support change.

For research on KTA, systems thinking underscores the central role of context and its influence on process and outcome. Research design and methods must rely less on randomisation and more on the need to learn from natural experiments and case studies. To build a body of more practice-based evidence (Green, 2006), we need to create evaluation systems that both support continuous learning at the application level, and pool practice-based evidence across contexts. The complexity of KTA systems suggests that more theory-based intervention research is required to ensure sufficient consideration of the interplay of factors in measurement tools.

This leads to our final point. We close with a higher-level challenge for systems thinking in KTA, one we will need to overcome in order to demonstrate success. That is, while there is a range of research methods designed to better understand whole systems (e.g., systems dynamics modelling, social network analysis, concept mapping; Leischow et al., 2008), they are sophisticated and demanding evaluation tools. Of course, in urging a view on systems as complex, we do not propose that measuring them should be simple. However, we do need to think about tools. These tools would be sufficiently powerful, reliable and valid to provide useful feedback on how the programme or policy is working, and to guide improvement efforts. They would be supported by training and technical assistance to enable adaptation to local context. Finally, they would allow practitioners, policy makers, decision makers and researchers to continuously evaluate their processes and outcomes.

In sum, systems thinking holds much promise for KTA, providing a framework for new ways of reflecting, acting and evaluating to transform research–policy–practice processes.

Note
1 See also Zakocs and Edwards (2006) for a review of factors affecting community coalition effectiveness.

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References


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