# Table of Contents

Introduction .......................................................................................................................... 3

Knowledge Use: An Overview ............................................................................................. 4

Health Systems as Complex Systems ..................................................................................... 5

Addressing Complex Health System Problems: Four Case Studies ......................................... 7
  Clinical Care Management Case Study ................................................................................. 7
  NETS Case Study ................................................................................................................ 8
  CLAHRC Case Study .......................................................................................................... 9
  East London Integrated Care Case Study ............................................................................. 11

Knowledge-to-Action on Complex Problems in Health Systems: Summarizing the lessons learned and posing some questions ...................................................................................... 13
  Theme 1: The balance of central and distributed authority in organisations and systems .......... 14
  Theme 2: The importance of emergence ............................................................................. 16
  Theme 3: The need for co-produced knowledge .................................................................. 17
  Theme 4: A range of leadership positions and styles ............................................................ 18

References .................................................................................................................................. 19

APPENDIX: Knowledge-to-Action Group Members .................................................................... 23
Introduction

Worldwide, politicians, policy makers and health service administrators are challenged by how best to improve health systems.\(^1\) One of the most frequently mentioned challenges is how to make better use of evidence to improve both the delivery of specific services, and health system functioning overall.

“Why is it that even when we know what will improve health system functioning, we have difficulty acting on that knowledge?” is a question that often arises.

The relevant field of enquiry – variously known as knowledge translation, research utilization, knowledge transfer, knowledge mobilization, knowledge-to-action,\(^2\) knowledge brokerage and a host of other terms, has advanced considerably over the last few decades. Increasingly, evidence use is seen as a process rather than an event [1]. We challenge the notion that evidence is a thing apart, generated in isolation and then passed on to those who will use it. It is acknowledged that different cultures of evidence prevail in policy sectors, health service bodies, local authorities and other organizations [2]. The very meaning of “evidence” and the question of what constitutes it are the subjects of lively debates in which the lines between evidence and knowledge become blurred. However it is defined, we seem to accept that evidence does not by itself solve problems [3, 4, 5]. The myriad elements of context – including the subtle but determining roles of power [6] and politics [7] – are recognized as critical.

There is also more talk about health system problems as complex – non-linear, dynamic, no single point of control [8] – and about what approaches are required for such problems [9]. The word “complexity” appears increasingly in journal articles and – more importantly, as it signifies broader awareness and holds the promise of uptake – in health system documents and the discourse of health system stakeholders.

Unfortunately, this complexity discourse seldom reflects a deep understanding of what we face and how to deal with it [10]. Although the language of complexity is on the increase, we are not necessarily “walking the talk.” We confuse complexity with what is merely complicated (see Table 1 and [11, 12, 13]). We know complexity approaches to health system improvement are needed, but the knowledge about what they comprise, and how to initiate them, is not sufficiently developed for stakeholders to draw on in their day-to-day work.

A Knowledge-to-Action Group (KTAG - see Appendix for members) has worked over the past year on how best to address complex issues in health systems. One task has been the production of this paper for a workshop, organised by the KTAG, with policymakers, practitioners and academics engaged in health system improvement. The aim of the workshop is to unpack complexity so we can develop guidance, for ourselves and others, on how to act within it. A particular challenge will be to avoid simplifying complexity, in an attempt to produce practical advice [14,15].

To support us in this task and prepare the ground for our deliberations, the paper starts with an overview of knowledge use and a discussion on complexity as it relates to health systems. We then present four case studies of knowledge-to-action in complex systems, summarize the lessons learned in the context of selected papers that have particular relevance for KTAG members in their work on health system improvement, and pose questions arising from these lessons.

At the workshop, we will invite feedback on the lessons and refine the questions based on participants’ expertise and experiences – what did we get right and where did we go wrong? What have we missed? How can the lessons from the case studies inform future policy and practice? Participants will debate

\(^1\) Broadly speaking, health systems comprise activities whose primary purpose is to promote, restore and/or maintain health.

\(^2\) The term “knowledge-to-action” has been adopted for the work described in this paper.
the lessons and questions in break-out sessions on the case studies, coming together at the end of the workshop to determine next steps towards providing practical guidance for those involved in health system improvement. Our final discussion will focus on: which stakeholder groups need to do, think, believe or know what in order for a complexity-based KTA approach to succeed? What tools would help which stakeholders? How would we – individually and collectively – know if our efforts were working? How can our thinking be taken back to our respective organisations and inform practice?

Knowledge Use: An Overview

“Using knowledge” is a practice as old as humanity, and knowledge as a tool has been critical in the process of human evolution [16]. Studying the process of knowledge use is more recent – but not as recent as some might think. It can be traced back to Francis Bacon at least [17]. Even in the 1880s, Tarde set out to learn why, given 100 different innovations conceived at the same time, a few will spread but most will be forgotten [18].

Scott et al [19] cover the development of the knowledge utilization literature between 1945 and 2004, finding primarily rural sociology articles – whose authors confirmed many of Tarde’s observations – prior to the ‘60s. From the mid-‘60s until the mid-‘80s the major domains were innovation diffusion, technology transfer, and knowledge utilization. Beginning in the mid ‘80s and growing rapidly, a fourth scientific domain, evidence-based medicine, emerged, followed by evidence-based public health in the late ‘90s [20]. In another categorization, Greenhalgh et al [21] identified 13 largely independent research areas that provided evidence relevant to the diffusion of innovations in health service organisations. Four early ones – rural sociology, medical sociology, communication studies and marketing – were followed by development studies, health promotion and evidence-based medicine. Organisational and management studies were also identified as relevant to diffusion of innovations.

In the last decade, the literature on the use of health research evidence (as distinct from knowledge creation) – referred to as knowledge transfer, translation or mobilization, dissemination and implementation, implementation science and other terms – has grown dramatically. There is increasing interest in related theories, frameworks and models, and a rapid proliferation [22]. A dedicated reader of this literature will note the advances, but also the repetition of much earlier work. For example the notion of “push, pull and exchange” in knowledge translation [23] is very similar to – but does not reference – the three-part model (research, development, diffusion; problem solver; social interaction) developed by Havelock in the ‘60s [24], itself based on a comprehensive review of the then-existing scholarship on dissemination. Critiques of early knowledge translation models and the evidence based medicine movement as linear and lacking attention to context [1, 25] have relevance – especially in the field of medicine – but determinants of knowledge use, including political will and professional autonomy, have been discussed in many literatures for some years.

Rare in the literature, though, is discussion on the synergistic nature of the broader determinants of research use in complex systems, where seemingly minor barriers may interact in ways that are difficult to predict [22]. Another issue with the broad KTA literature is its primarily conceptual or rhetorical nature [17]. The Knowledge-to-Action Group sees a particular gap in empirical knowledge on how to work with, and within, the complexity of health systems.
Health Systems as Complex Systems

Health systems are the product of actions by human agents. In turn, the actions of those agents are constrained by the structures they inhabit and that arise as a consequence of their actions. These structures may be concrete, such as formal and informal organisations and institutions, or they may be looser and more social in nature.

Health systems are complex systems in that they are non-linear; dynamic; composed of individuals whose goals and behaviours are likely to conflict and who adapt their behaviour through experience; and have no single point of control [8]. Because of these characteristics, outcomes in a system are unpredictable: they emerge from interactions among individuals within the system through an evolutionary process of self-organisation. Complex systems are resistant to conventional change management methods because social processes are not linear: change occurs when people within the system acquire new information – which they may do in a variety of ways – that alters their understanding. Complex systems are context-specific and dynamic. What works in one context or at one point in time may not work the same as the system changes. It is the interaction between strategy or intervention and context that determines outcome [26]. (See Table 1 for some differences among complex, complicated and simple systems).

The overall implication for systems with these characteristics is that they cannot be forced to comply with behavioural and performance dictates using conventional means; the people involved are sufficiently intelligent to find ways to serve their own interests [27], and conflicts arise due to these often competing interests.

Complex problems are similar to complex systems. The components within the problem are in synergistic multiple interaction with each other and cannot be solved in a step-by-step manner. At the core of complexity are relations and interactions that do not obey the cause and effect laws of physics. Multiplex interactions mean that outcomes are not easily predictable. The rate of change cannot be known a priori. Complexity is not simply about there being many moving parts; it is about what happens when these parts interact in ways that cannot be predicted but that will nonetheless heavily influence or shape the probabilities of later events [11, 22].

Complex problems are often called wicked problems [28] because they are unique, difficult to delineate, and impervious to established quality improvement methods. There is no complex problem within a health system that does not arise as a consequence of the deliberate or unintended consequences of human action. It follows that human action could be mobilized to solve these problems. What is needed are deliberately coordinated sets of interventions and creative efforts of individuals and organisations at many jurisdictional levels and system levels and from different sectors [10, 23]. These interventions and efforts must not, however, attempt to control or manipulate the system, but rather must work within it.

The essentially political nature of a health system in which the interplay of power occurs is also key to any intervention aimed at improvement. Collective effort to solve complex problems does not mean that everyone “needs to be on the same page.” Elected officials, whose actions are critical to address problems, do not necessarily want to hear about or understand their complexity [15]. But those with the power to influence the outcome must in some way be taken into account as part of the context, and their needs addressed. While rational or linear models may not yield a satisfactory account of knowledge-to-action in policy or practice, these models will always underlie the public language of

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3 www.in-source.ca
politicians and others and serve to justify their actions – and therefore cannot be entirely dispensed with in the discourse of health systems [29].

Table 1: Differences between simple/complicated and complex systems (adapted from Finegood, 2011 [30])

<table>
<thead>
<tr>
<th>Simple or Complicated Systems</th>
<th>Complex Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Homogeneous</strong>: identical / indistinguishable structural elements</td>
<td><strong>Heterogeneous</strong>: large number of structural variations</td>
</tr>
<tr>
<td><strong>Linear</strong>: a relationship with constant proportions</td>
<td><strong>Nonlinear</strong>: cause does not produce a proportional effect</td>
</tr>
<tr>
<td><strong>Deterministic</strong>: same result always occurs for a given set of circumstances; predictable</td>
<td><strong>Stochastic</strong>: an element of randomness leads to a degree of uncertainty about the outcome</td>
</tr>
<tr>
<td><strong>Static</strong>: little changes over time or change is more predictable</td>
<td><strong>Dynamic</strong>: changes occur over time; the past has an impact on the future</td>
</tr>
<tr>
<td><strong>Independent</strong>: subsystems are not influenced or controlled by other parts of the system</td>
<td><strong>Interdependent</strong>: subsystems are interconnected or interwoven not just interactive</td>
</tr>
<tr>
<td><strong>No feedback</strong>: open chain of cause and effect</td>
<td><strong>Feedback</strong>: a closed chain of causal connections</td>
</tr>
<tr>
<td><strong>No adaptation or self-organisation</strong></td>
<td><strong>Adaptation and self organisation</strong>: system has ability to structure itself, to create new structure, to learn, or diversify</td>
</tr>
<tr>
<td><strong>No connection between levels or subsystems</strong></td>
<td><strong>Emergence</strong>: collective behaviour occurs that cannot be simply inferred from the behaviour of components</td>
</tr>
</tbody>
</table>
Addressing Complex Health System Problems: Four Case Studies

The following four case studies of knowledge-to-action on complex problems have been selected to illustrate the key themes and concerns that lie at the core of this paper. They are presented briefly in the form of background, objectives, methods, key learning and a “so what?” summary.

Clinical Care Management Case Study

Background
In the province of British Columbia (BC), Canada, the Ministry of Health’s Innovation and Change Agenda includes an initiative to improve clinical care management (CCM) [31]. The CCM initiative includes 11 clinical guidelines in areas such as hospital service delivery for seniors, stroke, sepsis, surgical checklists, glycaemic control and venous thromboembolism. This project was designed to understand health system change by examining guideline implementation in the six health authorities across BC.

Objectives
1. Engage the full range of key stakeholders in CCM implementation.
2. Develop and apply standardized data collection and thematic analysis protocols.
3. Apply systems thinking tools to show how enabling and constraining mechanisms play out in different contexts.
4. Make recommendations to improve implementation and future scaling up of large-scale change initiatives.

Methods
A model of complex adaptive systems and two conceptual frameworks (realist evaluation and system dynamics mapping) were used to study enablers and constraints at the macro, meso, and micro levels as well as the contextual factors that interact to determine implementation outcomes. Data collection included 37 key informant interviews balanced across the six health authorities and stakeholder groups; one focus group in each health authority; one interview with the board member responsible for quality in each health authority; a provincial workshop with 100 participants; and a web-based validation survey. Data were coded and thematically analysed using NVivo.

Key learning
- Adequate resourcing for the work of change needs to accompany an implementation plan that considers other local priorities.
- Leadership at all levels can be both an enabler and constraint, depending on commitment.
- Front-line engagement, interdisciplinary collaboration, and innovation are critical.
- Communication and capacity building are needed.
- Accountability measures are key, but need to allow for local variation and comparison.
- Evidence-based framing facilitates implementation.
- Alignment of incentives is key.
- An open and innovative organisational culture may be “the glue that binds.”

So what?
Guideline implementation – and the system change that enables it – requires a coordinated, multilevel strategy that focuses on front line innovation, leadership, and dedicated resources. The dynamics are complex, but can be addressed with a well-constructed set of guiding principles and tools.
NETS Case Study

Background
The North East Transformation System (NETS) was conceived as a bold experiment in the adoption of large-scale transformational change across a National Health Services (NHS) region in England (pop: 2.4 million). Although NHS North East performs well, exceeding required targets and performance measures set by government, the health of its population ranks among the poorest in England.

The NETS was developed to address this paradox by instigating an ambitious change programme aimed at transforming the way health services were provided in order to improve their efficiency and effectiveness. The National Institutes for Health Research (NIHR)-funded evaluation over 3.5 years comprised 14 study sites across the region and was designed to investigate the factors facilitating, and/or acting as barriers to, successful change.

Objectives
The NETS comprised three components, the impact of which the research sought to evaluate:

- **Vision** – for NHS NE to achieve excellence in health service delivery services and to sustain continuous improvement.
- **Compact** – to address the deep-seated and enduring tensions between managerial and professional values, and establish a psychological contract between managers and professionals by articulating the ‘gives’ and ‘gets.’
- **Method** – Lean thinking derived from the Virginia Mason Production System and employed by the Virginia Mason Medical Center, Seattle.

Methods
This was a mixed methods study employing qualitative (interviews (n=68), focus groups (n=2), observation, documentary analysis) and quantitative (Interrupted Time Series applied to selected Rapid Process Improvement Events) methods. The analysis employed both deductive and inductive frameworks. For the former, Pettigrew et al’s ‘receptive contexts for change’ framework, comprising eight factors, was used. Interview data were coded and thematically analysed using NVivo.

Key learning

- Successful transformational change in a complex system takes time and demands consistency, constancy of purpose and organisational stability.
- Constant changes in policy, organisation and funding and in the NHS’s external environment pose particular challenges when it comes to embedding transformational change.
- Leadership style is critical to success and was a key factor in those sites where quality improvement occurred.
- Importance of the Compact, of training and development, of not becoming fixated on the method, of localism.

So what?
Complex system change can succeed even across a whole region but requires stability and commitment to the long haul, clear leadership, passionate and committed change champions, and engagement by all levels of the system. A major factor that resulted in the NETS not fully realising its ambition was the impact of the wider turbulent NHS policy environment that caused serious disruption affecting relationships and structures, resulting in a loss of momentum and direction. Despite the difficulties, several study sites demonstrated positive impacts and provide important lessons for survival and future-proofing transformational change in messy contexts.
CLAHRC Case Study

Background

Between 2008 and 2013 in England a large investment was made in nine partnerships between higher education institutions and local health services. These Collaborations for Leadership in Applied Health Research and Care (CLAHRCs) were funded by the National Institute for Health Research (NIHR) to generate and implement research evidence through prolonged interactions between academia and health services. The CLAHRCs were a natural experiment with an explicit remit to close the gap between research and practice within a model of partnership - partnerships that were (more or less) established at the time of their response to the call for funding. Funding was recently released for the continuation of these nine CLAHRCs and for the creation of four new ones.

In addition to funding the CLAHRCs, the NIHR funded an evaluation to develop an explanatory theory to answer the question; ‘implementing research through CLAHRCs: what works, for whom, why and in what circumstances?’. The final report was produced in July 2014.

Objectives

- Study how CLAHRCs provide a context for implementing research in real time, over time.
- Identify and track the implementation mechanisms and processes used by CLAHRCs and evaluate intended and unintended consequences (impacts) over time, and determine what influence these, with particular attention to contextual factors.
- Determine whether/how CLAHRCs develop and sustain interactions and communities of practice.
- Identify indicators that could be used for further evaluations of the sustainability of CLAHRC-like approaches.

Methods

The study is a longitudinal, multiple-method realist evaluation case study using both formative and summative methods, with active participation of CLAHRC members. Data were collected over four rounds through interviews, observations, feedback/workshop sessions and documents within three CLAHRCs with over 200 participants.

Data analysis was conducted through inductive and deductive processes, which facilitated the realist task of programme theory and hypotheses generation, hypotheses testing and refining, and programme theory specification.

Key learning

- Interpretation of the ‘brief’ provides a path dependency which is difficult to alter, particularly in contexts where leadership teams are not reflective, where there is a lack of attention to evaluation/learning, and where the path is reinforced by funders’ expectations.
- The collaboration’s engineered (structure), social (leadership/roles) and aesthetic (identity) architectures shape more or less facilitative conditions for knowledge mobilisation – e.g. can emphasise existing epistemic and professional differences and impede communication, knowledge flow and sharing. Therefore it is helpful if these architectures are aligned to provide a scaffold that is sustainable but also resilient (i.e., needs some flexibility).
- The starting point of the collaboration (e.g., quality and nature of existing relationships between services and higher education) is critical to how stakeholders ‘figure out’ (more or less organically) their approach and processes to closing the gap between research and practice – and thus the sustainability of these in contexts that are in constant flux (i.e., the NHS).
CLAHRC case study, cont’d...

- Strong (clear vision, thoughtful allocation of resources, reflective) central/core leadership combined with distributed leadership (e.g., through investing in boundary spanners) is facilitative of collective action around implementation. Leadership (style, approach, roles) therefore might be the ‘oil’ that lubricates the system.
- Some tension in the system, for example between collaboration and competition, can be a facilitative, as well as an inhibitory force in knowledge mobilisation activity.
- Incentives and motivations for engagement (‘what’s in it for me?’) can vary within and across individuals, professions and organisations – therefore they need to be made visible.

So what?
In order for knowledge mobilisation within the context of collaborative arrangements such as CLAHRCs to be greater than the sum of its parts (i.e., more than a collection of separate projects) attention is required to alignment, learning/evaluation, feedback, individuals/collective starting points, incentives and rewards, but can be harnessed through supportive structures, processes, roles and with attention to these over time.
East London Integrated Care Case Study

Background
The WELC (Waltham Forest, East London and City) Integrated Care Programme in East London, UK, is a four-year £68m programme that aims to radically redesign care for a population of almost one million people in an area facing significant health and social challenges. It is being designed and delivered by a partnership between the main commissioners and providers in the locality, as well as local government. The programme is based on systematic risk stratification of the whole population to support case finding for those most at risk of hospitalisation, a focus on helping people to live independently and remain socially active, a commitment to implementing best evidence, avoiding duplicated effort in situations where a patient has many people involved in their care, and a commitment to shared learning using new models of partnership working.

A national summative evaluation of the programme is being carried out, comparing outcomes in East London with similar programmes across England. In addition, the East London stakeholders wanted to support a local, more process oriented and formative evaluation. Working with their local Academic Health Science Network, they commissioned a participative evaluation using a new ‘Researcher in Residence’ model.

Objectives
- Understand the extent to which the principles and practices advocated by the WELC programme are understood, valued and enacted by the key stakeholders at all levels in the programme.
- Explore and describe the ways in which the programme is attempting to achieve its stated objectives.
- Feed back the insights gained to the participants in an iterative way to help them to increase the chances of achieving their objectives.

Methods
The ‘In-Residence’ model places the researcher as a key member of the delivery team, rather than an external observer of change, bringing a body of academic expertise to the team and placing a shared responsibility on the researcher for the successful delivery of the initiative. It builds on theory and evidence from the fields of knowledge mobilisation and participative research. Drawing data from a range of sources – the established evidence and theory in the field, individual and group interviews, documentary analysis and participant observation – the researcher is responsible for holding up a mirror to reflect the activities of managers, clinicians and service users, and then feeding new insights back to the participants.

Key learning
- Both commissioners and providers of health services appear to like the ‘In-Residence’ model and see it as a useful way of drawing on academic expertise.
- The researcher is engaging with the concept of being immediately useful to practitioners and enjoys attempting to integrate scientific knowledge with other ways of knowing and understanding. At the same time, they find the role demanding and are concerned about the risk of losing ‘academic objectivity.’
- It takes a long time to develop an effective relationship in which the academic and service partners understand and trust each other.
- New insights are being gained from the embedded and participative model that might not have been gained from more traditional health service research methods.
So what?
Participatory models of research and evaluation are common in other sectors but have not achieved traction in the health sector. Early findings from this work suggest that they have the potential to add great value to current evaluative approaches, though a number of questions about the ‘In-Residence’ model remain.
Knowledge-to-Action on Complex Problems in Health Systems: Summarizing the lessons learned and posing some questions

The KTAG’s work over the past year has suggested there is a need for guidance of both a realistic and practical nature so that those working on health system improvement can be better equipped to “walk the talk” of complexity. Further, we believe learning from the above case studies could form the basis of such guidance. Four themes across the case studies have been pulled out:

1. The balance of central and distributed authority in organisations and systems
2. The importance of emergence
3. The need for co-produced knowledge
4. A range of leadership positions and styles

These themes – interdependent and overlapping but considered separately for the purposes of discussion – are expanded on below. Questions are posed for each theme that workshop participants will discuss further in the context of the case studies and for broader relevance. The questions are not exhaustive and additional ones will be encouraged at the workshop.
Theme 1: The balance of central and distributed authority in organisations and systems

In a complex system no one stakeholder has ultimate control or authority. A key feature of health systems is their multi-level, multi-stakeholder nature requiring inter-organisational and often inter-sectoral cooperation to implement effective strategy [32, 33, 34]. The case studies presented above demonstrate the importance and pervasive nature of this cooperation.

For planned change to occur in a complex system, the actors within the system must play their part. For better or worse, all of these actors have a range of accountabilities and responsibilities, allegiances and loyalties, and power and influence. There may be good intentions on the part of these actors, but perverse incentives and power dynamics often interfere [9, 35, 36].

Formal organisations are one obvious mechanism to enact planned change, because of their governance arrangements and accountability relationship with the people who work for them. But in many ways the “command and control” nature of organisational structures – in place to enact such accountability – runs counter to how successful knowledge-to-action would work best in practice [34, 36]. People may have job descriptions that limit their responsibilities, or suffer punitive measures for not “playing by the rules”: neither situation motivates or reflects how work gets done.

In other ways, though, organisational structures can facilitate KTA on complex problems. Shared values, visions and goals at the organisation level are key to transformation. Organizations can also create a culture that binds the values and attitudes critical for development of trust and shared learning, which are foundational to KTA [37, 38]. Reviews of large-scale organizational change highlight the role of culture in facilitating and mediating improvements consistent with a complexity view of KTA [39, 40, 41]. Finally, organisations have resources to support change initiatives directly, and to build capacity among their members to do so. They also can offer incentives and implement ‘inhibitors’ that both inspire collaboration and manage dissent.

The case studies show how important it is for organisations is to strike a balance between central and distributed authority. In CCM, the implementation plan was managed centrally but authority for decision-making was distributed such that local priorities could be considered; the study also highlights the critical role of culture. NETS demonstrates the importance of organisational stability as well as consistency and shared purpose – a freezing of certain arrangements is essential if change is to flourish. The CLAHRC study suggests that the “scaffold” needs to be strong but also allow for flexibility. The WELC study describes how a group of stakeholders worked separately from the national initiative to understand change at a local level.

The KTAG acknowledges that change initiatives do not stop at organisational boundaries. Beyond one organisation may be higher authorities such as governments – both the public service and elected officials. We also acknowledge that change initiatives involve extra-organisational players on which success depends, but with which there may be no formal reporting relationship and therefore no opportunity for a strategy on central versus distributed authority. These players – which may include partners in the initiative, other bodies to which organisational members also have accountabilities (e.g., professional organisations), advocacy groups, media and so on – are a critical part of the context in which action on complex problems is undertaken.

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4 An organisation is defined here as a formal, structured institution or association. The term “system” is broader referring to these formal institutions and the broader network of interdependent individuals and organisations that influence each other in their work.
Central and distributed authority questions:

- *How can organisations best achieve a balance of central and distributed authority to maximize KTA on complex problems?*

- *How can a balance of central and distributed authority be enabled beyond single organisations to the broader system? Why has the policy rhetoric of decentralisation been so difficult to deliver in practice?*

- *How can organisations balance varied accountabilities and allegiances to motivate and move people towards a shared goal: what incentives and inhibitors could be used?*

- *How can organisations become less fixated on engineering structures and more focused on relationship building and connectivity?*
Theme 2: The importance of emergence

Related to central and distributed authority but at the level of an intervention is the balance between deliberate and emergent strategy. Deliberate strategy, where outcomes are determined at the outset, action plans are developed and followed, and summative evaluations are conducted, is the method of many organisations and cross-organisation initiatives. The CLAHRC case study is an example of how an initiative brief set such a deliberative path from the outset based on the funders’ expectations [42].

But in a complex system, it is not possible to predetermine what steps will bring about positive and long-lasting change. A systems approach rejects the notion of “flawlessly preplanned change based on accurate predictions of the consequences of action” [43, p. 77]. Learning and adaptation must be enabled on-going, and evaluation systems are needed that both support this learning and adaptation at the application level, and collect evidence across contexts [44]. The growing consensus is that indicators and accountability frameworks are best if built from the front-line up, with commitment and support in place from senior leaders [45, 46].

A NETS case study learning was the importance of not becoming fixated on the method – it is a means to an end rather than an end in itself. With WELC, a process evaluation fed back insights to the participants iteratively to help them increase their chances of achieving the objectives. With the CLAHRC case study, the funders’ expectations from the outset provided a path dependency that was difficult to change.

A promising shift in health system thinking that supports emergence is away from pilot projects and towards prototypes [10]. Well-designed pilot projects serve several important functions, including prudent testing of innovations before widespread implementation, and making a case for organisational investments. However, in complex systems, it is not likely that a pilot can offer much in the way of guidance for the next implementation: the determinants of success are dynamic and shift with every new context; it is the interaction between the strategy and this context that determines outcome [26].

The logic of prototyping is to test a small-scale innovation and then iteratively, with evaluation and feedback, continuously refine and improve it until it is ready for large-scale application. This logic is compelling, but it is often at odds with the quick answers demanded by policy makers and managers, who prefer to know up front – and are often held accountable for knowing up front – “what is the problem and how do we fix it?”

The Riley et al [10] analysis found consistent reference to the important role of framing KTA as system interventions rather than projects. A critical question is how organizations and systems can scale up from individual prototypes to design and adapt, implement, and continuously improve initiatives so that the sum is greater than the parts [47].

Emergence questions:

- How can we make the case that the simple rules of cause and effect – and straightforward solutions – do not apply in complex systems?
- How can organisations and systems scale up from individual prototypes, to design and adapt, implement, and continuously improve initiatives so that they become part of how we operate?
- What are the barriers to spread and share efforts? How can they be confronted and overcome?
- Are deliberate and emergent approaches to change on a continuum? If so, how should someone decide where to operate on that continuum?
- How can we best use knowledge about the dynamics of institutions and the actors in them to further our understanding of health systems?
Theme 3: The need for co-produced knowledge

Many people see the conduct of research as a distinct activity, important but not integral to the delivery of services [32, 48]. This view is held within health care organisations, where research can be seen as detracting from care and competing for funds within tight budgets. The perception also holds within academia, where research funding mechanisms, incentives and academic priorities perpetuate independent knowledge creation, or what has been called Mode 1 research (“conventional scientific research, driven by curiosity and dispassionate inquiry, which produces evidence that is taken up and applied – or not – by decision-makers who had no influence on its focus or approach”) [36, p. 507].

While Mode 1 research will and should continue, there is a need to rethink the current division of research and practice or policy. Ideally, research and practice would not be seen as separate activities undertaken by distinct groups of people (researchers and practitioners or policymakers), but would be conceptualized as an overall approach to linking the generation and use of evidence [44].

Mode 2 research offers another way. It is problem-based and collaborative, with questions framed by those who plan, deliver and receive services working with researchers to co-produce and implement knowledge [10, 32, 34, 36, 49]. Van de Ven [50] uses the term engaged scholarship: “a participative form of research for obtaining the different perspectives of key stakeholders . . . in studying complex problems” (p. 90).

A related issue is the need to integrate co-production into organisational structure and strategy [10, 32, 49]. A recent review found that organisations in which the research is fully integrated with structure and processes can outperform those that pay less attention to the contribution research has to offer [51]. One example of such integration is described in the WELC case study: a Researcher-in-Residence or embedded researcher model as a way to support co-production of knowledge [49, 52]. Both commissioners and providers of health services see the model or approach as a useful way of drawing on academic expertise. But while researchers appreciate the need to integrate scientific knowledge with other ways of knowing and understanding, they are concerned about losing ‘academic objectivity.’ The CCM case study also showed that this objectivity in the form of evidence-based framing was key to the implementation of guidelines.

While Mode 2 research seems increasingly attractive to those in all stakeholder groups, there is work to be done to create situations in which academic and health system partners understand and trust each other and work towards shared goals while respecting the differences in their roles [48].

Co-produced knowledge questions:

- How can we best get enhanced collaboration among players who are driven and rewarded by different incentives and structures? Do we need to change those incentives and structures? Could we?
- How do we best deal with the differences in the power base of different individuals?
- Why is it so difficult to embed participatory approaches to research and evaluation in health services?
Theme 4: A range of leadership positions and styles

Both formal and informal leadership is critical for KTA in complexity [53, 54], a fact underscored by each case study. The CCM study notes that leadership at all levels can be either an enabler or a constraint, depending on the commitment. For NETS, leadership style was seen as critical to success and was a key factor in sites where improvement occurred. The CLAHRC case study notes the importance of strong central leadership combined with distributed leadership for collective action on implementation. In fact leadership – including style, approach, and roles "... might be the ‘oil’ that lubricates the system" [42].

A recent realist review of the literature underscored the importance of blending designated with distributed leadership [39]. Related concepts include adaptive leadership, engaged leadership, collaborative leadership, servant leadership and quiet leadership [55]. It is clear that effective KTA on complex problems requires individuals at all levels to be involved in leading change efforts. Designated leadership responsibilities include development of shared vision and values, investments in capacity building, and alignment of accountabilities. Strong leadership is also critical to the development of organisational cultures that support continuous learning and embrace change.

Attention has recently been paid to the critical role of leadership for health policy in complex systems [56, 57]. Forest et al [56] stress the role of policy capacity, weaving throughout the policy process the stages of consultation, development, adoption, implementation, evaluation and sustainability. They highlight the need for “more health actors to join the fray and move from their traditional position of advocacy to a fuller commitment to the development of policy capacity, with all that it entails in terms of leadership and social responsibility” [p. 265]. Edmonstone [58] has highlighted inadequacies in current UK leadership strategy with its misplaced emphasis on competencies, and the importance of context and capability to leadership. A clear challenge for successful KTA in complex systems will be how best to create and sustain such leadership.

Leadership questions:

- How can we best develop leadership capability?
- What skills and capabilities do leaders require?
- How does the agency provided by formal leaders differ from the agency of other actors inside and external to organisations?
- What does leadership of emergent change look like?
References


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