Evaluating complex systems approaches to improving health

20 March 2020

Louise Marshall, Senior Public Health Fellow, The Health Foundation
Evaluating complex systems approaches to improving health

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Complex system mapping
Webinar

Complex public health challenges and local action: how does local government tackle complexity?
from The Health Foundation

And a huge thank you to everyone who has joined us today.
Laurence Moore
Director, MRC/CSO Social and Public Health, Sciences Unit, University of Glasgow

Vanessa Er
Research Fellow, London School of Hygiene and Tropical Medicine

Harry Rutter
Professor of Global Public Health, University of Bath
• We will address a selection of the pre-submitted questions

• Submit technology questions via the box on your screen

• Join the conversation on Twitter: #THFcomplexsystems
Moving towards a complex systems approach to population health intervention research
Moving towards a complex systems approach to population health intervention research

Laurence Moore

MRC/CSO Social and Public Health Sciences Unit, University of Glasgow
March 2020

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The 2000 MRC Guidance

Framework for design and evaluation of complex interventions to improve health
Mirthele Campbell, Ray Fitzpatrick, Andrew Haines, Ann Louise Kermond, Peter Sandercock, David Spiegelhalter and Peter Tyrer
BMJ 2000; 321:694-696
doi:10.1136/bmj.321.7262.694

Feasibility and piloting
- Testing procedures
- Estimating recruitment and retention
- Determining sample size

Development
- Identifying the evidence base
- Identifying or developing theory
- Modelling process and outcomes

Evaluation
- Assessing effectiveness
- Understanding change process
- Assessing cost effectiveness

Implementation
- Dissemination
- Surveillance and monitoring
- Long term follow-up
Is this the effective solution?
• Many of the most promising interventions don’t get / can’t be evaluated in this way
  – Service and policy innovation
  – Complex population level policies

• Those that are identified as effective in a controlled trial then fail to replicate outcomes in the real world
  – Not implementable
  – Implementation failure
  – Not transferable across contexts
  – Wider system effects emerge

• Production line of ‘effective interventions’ that generally don’t work!

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## Simple, complicated, complex...

<table>
<thead>
<tr>
<th>Simple</th>
<th>Complicated</th>
<th>Complex</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flat pack furniture</td>
<td>Rocket to the moon</td>
<td>Raising a child</td>
</tr>
<tr>
<td>The components and instructions are essential</td>
<td>Formulae are critical and necessary</td>
<td>Formulae have limited application. Adaptation and flexibility are key</td>
</tr>
<tr>
<td>If all the bits are there and instructions are followed in order, the result is consistent</td>
<td>Sending one rocket to the moon increases assurance that the next will be okay</td>
<td>Raising one child provides experience but no assurance of success with the next</td>
</tr>
<tr>
<td>No particular expertise is required but helpful to be good with an allen key</td>
<td>High levels of expertise in a variety of fields are necessary for success</td>
<td>Expertise can contribute but is neither necessary nor sufficient</td>
</tr>
<tr>
<td>Produces standardised furniture</td>
<td>Rockets are similar in critical ways</td>
<td>Every child is unique and must be understood and responded to as an individual</td>
</tr>
<tr>
<td>The designed furniture will be reproduced</td>
<td>There is a high degree of certainty of outcome</td>
<td>Uncertainty of outcome remains</td>
</tr>
</tbody>
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Adapted from Rogers, 2008
Expanding on complexity

- Not just that interventions are complicated, with many components
- Complex interventions cannot be divided into discrete sets of actions with predictable, stable and linear consequences
- Rather they involve emergent, unpredictable, and non-linear associations between components and outcomes
- Complexity does not lie solely in the intervention, but crucially in its dependence on the wider system (health or education system, broader social systems)
Systems Approach

- A system: a set of things—people, cells, molecules or whatever, interconnected in such a way that they produce their own pattern of behaviour over time (Meadows, 2008)

- What works? What contributes to improving the system in a positive way?

- Interventions conceived as interruptions in systems

- Outcomes emerge from the interaction of the parts of a system in ways that cannot be predicted from the properties of the individual parts; a system cannot be understood by breaking it down to its individual entities and studying each part separately.
... changes the focus of interventions

- From targeting individuals with interventions to bring about behaviour change
- To upstream action to create the conditions, contexts, relationships that support behaviour change
- From one-off brief interventions
- To systemic, sustained change in schools, workplaces, policy, culture
... changes the focus of evaluation

Is it effective?

Does it contribute?
Taking a systems perspective

• Implement ‘complex systems approaches’ to evaluation

‘Rhetoric urging complex systems approaches is only rarely operationalised in ways that generate relevant evidence or effective policies.’ (Rutter et al, 2017)

• Approaching all interventions through a systems perspective can encourage:
  • Researchers to develop research questions which take into account the wider contextual factors that influence an intervention.
  • Encourage researchers, funders, practitioners and policy makers to develop, evaluate and implement (whole) systems interventions.
Is it the intervention that’s complex?

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## Approach to evaluation

<table>
<thead>
<tr>
<th>Approach</th>
<th>What does taking this approach look like for evaluation?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Efficacy</strong></td>
<td>To what extent does the intervention produce the intended outcome in experimental settings?</td>
</tr>
<tr>
<td><strong>Effectiveness</strong></td>
<td>To what extent does the intervention produce the intended outcome in real world settings?</td>
</tr>
<tr>
<td><strong>Theory-based</strong></td>
<td>How do context and mechanisms interact to produce outcomes?</td>
</tr>
<tr>
<td><strong>Systems</strong></td>
<td>What contributes to changing the system (in a positive way)?</td>
</tr>
</tbody>
</table>
### Is it the intervention that’s complex? Or the evaluation perspective?

<table>
<thead>
<tr>
<th>Evaluation Perspective</th>
<th>Intervention</th>
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<tbody>
<tr>
<td></td>
<td>Simple</td>
</tr>
<tr>
<td></td>
<td>Complicated</td>
</tr>
<tr>
<td></td>
<td>Complex / adaptive</td>
</tr>
<tr>
<td>Efficacy</td>
<td></td>
</tr>
<tr>
<td>Effectiveness</td>
<td></td>
</tr>
<tr>
<td>Theory / Realist</td>
<td></td>
</tr>
<tr>
<td>Complex Systems</td>
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</tbody>
</table>

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Complex Systems intervention example

- Assets based approaches to community development and place based intervention
  - A set of processes to engage with public and key stakeholders, identify their priorities, develop shared trust, identify key actions and take forward in partnership
  - Ownership, embedded, sustained

- Specific targets, actions, health outcomes cannot be prespecified and will vary across communities
- Continual adaptation, responsiveness, revision required
- Delivered intervention and achieved outcomes emergent

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**Core Elements**
- Consider context
- Develop, refine and (re)test programme theory
- Engage stakeholders
- Identify key uncertainties
- Refine the intervention
- Economic considerations

**Feasibility**
Assessing the feasibility and acceptability of the intervention and evaluation design in order to make decisions about progression to the next stage of evaluation.

**Evaluation**
Assessing an intervention using the most appropriate method to address the research questions.

**Implementation**
Deliberate efforts to increase the impact and uptake of successfully tested health innovations.

**Develop the intervention**
Either developing a new intervention, or adapting an existing intervention for a new context, based on research evidence and theory of the problem.

**Identify the intervention**
Choosing an intervention that already exists (or is planned), either via policy or practice, and exploring its options for evaluation (evaluability assessment).
Systems approaches to public health evaluation: What are they and how are they applied?
Systems approaches to public health evaluation: What are they and how are they applied?

Vanessa Er
Acknowledgements

Work
• NIHR SPHR Guidance on systems approaches to local public health evaluation, Part 1 and 2.
• Evaluation of public health interventions from a complex systems perspective: a critical review of methods and findings

People
• Matt Egan, Elizabeth McGill, and Tarra Penney
• Systems Guidance Team: Mark Petticrew, Natalie Savona, Karen Lock, Steve Cummins, Richard Smith, Dalya Marks, Martin White, Margaret Whitehead, Jennie Popay, Rachel Anderson de Cuevas, Lois Orton, Frank de Vocht, Petra Meier, Harry Rutter and others.
Outline

• Appreciate different schools of thoughts in the study of complex systems

• Recognise different methods to evaluation of public health interventions from a complex systems perspective

• Describe how these methods are applied
Brian Castellani (2019) Map of Complexity Sciences
Complex systems: Two traditions


**Systems thinking**
- Has much longer roots going back to Ancient philosophy: Aristotle, Heraclitus and Lao Tsu
- A collection of theories associated with different disciplines
- Including more qualitative approaches.

**Complexity Science**
- Developed in the twentieth century
- Strongly influenced by mathematics and uses computational modelling
- Applied to lots of other disciplines like biological sciences, physics, engineering, and social sciences.

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What are the main methods?

- Qualitative Research Using a Complex Systems Framework
- System Mapping
- Agent Based Modelling
- System Dynamics Modelling

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How are they applied?

1. Starting point often the intervention
2. Sampling wider group of stakeholders
3. Could involve mapping the system
4. Analysis may refer to specific systems theories and frameworks – e.g. Westhorp, Meadows, Finegood - or more adhoc
5. Compare stakeholder perspectives
6. Focus on events over time
7. Adapt the evaluation over time

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Example 1: Qualitative Research

Aim
Evaluate Connecting Communities (C2), a learning programme designed to create transformational community change

Intervention
C2 aimed to create the context for service providers to consult with their communities and ensure that service provision adequately responded to community needs.

Case study design that used several qualitative and participatory research methods.
1. Semi-structured interviews with a range of actors in the system
2. Non-participant observation during course delivery, listening events and community partnership meetings.
3. Participants provided input into findings

Underpinned by Complexity Theory
1. dynamics of the system overtime as they changed and evolved in response to the intervention
2. relations between those living and working in the community


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1. Starting point often an initial definition of the system and its boundaries
2. Formally structured mapping process – e.g. Group Model Building
3. System map made up of variables and causal relationships (e.g. stock and flow diagram).
4. Model the map. Use assumptions or data to give values to each part.
5. Run the model. Try varying specific values to simulate the effect of an intervention or a change in context.

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Example 2: Agent-Based Modelling

Aim
Model the impact of sugar-sweetened beverage (SSB) warning labels on overweight and obesity prevalence among adolescents in three U.S. cities.

Intervention (Scenarios Modelled)
1. different levels of efficacy for a food labelling intervention,
2. compliance of food retailers,
3. compensatory eating, and
4. population characteristics such as illiteracy rates and socio-economic status.

Data
National Health and Nutrition Examination Survey for height, weight, and SSB consumption and purchasing habits,
U.S. Census Bureau for sociodemographic characteristics and sources for the location of food retailers.

## Summary

<table>
<thead>
<tr>
<th>Stages of evaluation</th>
<th>Aim</th>
<th>System mapping</th>
<th>Qualitative systems evaluation</th>
<th>Network analysis</th>
<th>Agent based modelling</th>
<th>System dynamics modelling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theorising</td>
<td>Identify and compare stakeholder understandings of a system.</td>
<td>●</td>
<td>●</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Identify and compare stakeholder understandings of how a planned intervention might interact within a system.</td>
<td>●</td>
<td>●</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prediction</td>
<td>Hypothesise and simulate how the intervention may impact on and interact with the system</td>
<td></td>
<td></td>
<td></td>
<td>●</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hypothesise and simulate how agents within the system might react and interact in response to an intervention</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>●</td>
</tr>
<tr>
<td>Process evaluation</td>
<td>Understand how an interaction has impacts within the system in the real world, including impacts of variation in local context</td>
<td>●</td>
<td>●</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impact evaluation</td>
<td>Quantify the impact of the intervention on key system parameters in the real world</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Further prediction</td>
<td>Hypothesise and simulate how the intervention may impact the system over a longer time horizon or in a different context.</td>
<td></td>
<td></td>
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<td></td>
<td>●</td>
</tr>
<tr>
<td>(extension of impact evaluation)</td>
<td>Hypothesise and simulate how agents within the system might react and interact in response to an intervention over a longer time horizon or in a different context.</td>
<td></td>
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<td>●</td>
</tr>
</tbody>
</table>
Concluding points

Figure 1: Planning a systems-informed evaluation: decision cycle, practical considerations and methodological choices.

Reflections

• Widen scope of evaluation – beyond the intervention

• Explicit about the approach taken and underpinning theory

• Room for development and innovation - theories and methods
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## Complexity - concepts

### Table 1: Terms that help describe changes within systems

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>System cohesion</td>
<td>Are you evaluating aligning or conflicting with what other stakeholders want? Are your goals undermined or helped by other activities or events that take place? Is your activity 'swimming against the tide'?</td>
<td>A workplace health promotion initiative is met with cynicism and indifference when it occurs during a period of company downsizing and redundancies.</td>
</tr>
<tr>
<td>Trade-offs and choices</td>
<td>If you or your organisation prioritise the funding and delivery of one intervention, what has been deprioritised?</td>
<td>An investment to transform an urban brownfield site into a park has prevented plans to build homes there – although there is a housing shortage.</td>
</tr>
<tr>
<td>Unintended consequences</td>
<td>Is your activity leading to any unplanned benefits or harms? Are these a direct result of the activity, or a consequence of how another part of the system has responded?</td>
<td>Many types of system responses are unintended, hard to predict and could include both harms and benefits. The examples of adaptation, spill-over, feedback and emergence we give below could all be ‘unintended’.</td>
</tr>
<tr>
<td>Adaptation</td>
<td>How does the system respond to a change? Does a specific change prompt people or organisations to do more or less of something? Does that lead to further changes across other parts of the system?</td>
<td>Promoting healthy school dinners in primary schools may lead to children using “pester power” with parents to change dietary habits at home (or may lead to parents responding by giving children unhealthy pack lunches).</td>
</tr>
</tbody>
</table>

Q&A

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Timescales

• How to meaningfully evaluate complex systems in the long term when planning and budgets are done on year-by-year base? (managing conflicting long term vs in-year priorities)

• How to navigate evaluations with politicians that are focused on seeing quick, clear change in mid/long term outcomes and/or the bottom line (e.g. reduced CVD and reduced spending)?
Inequalities

- Are systems approaches suitable for understanding health inequalities and how to change them at local levels, taking account of how they are situated more broadly?
Complexity and ‘overwhelm’

• How do we achieve a balance between understanding the complexities of factors that contribute to public health issues (e.g. obesity), whilst not becoming 'overwhelmed' by the complexity of the problem, both from a research and a policy/practice perspective?
Theories of change

• How do theories of change or conceptual models fit into evaluating a systems approach?
Uncertainty

• How are you accounting for uncertainty and how it is impacting the effectiveness of your approaches and interventions?

• Complex systems are dynamic and adaptive, with unintended consequences of actions. How can you still define appropriate indicators/measurements for systems change when designing an evaluation?
Methods

- I would be keen to hear about the use of novel methods in evaluating change within systems approaches. The School for Public Health Research guidance eludes to novel methods, but doesn't provide too many examples for these.
Attribution & what can’t be evaluated

• How can you isolate the impact of your actions when there are many parallel or overlapping factors which may impact on your measure of success?

• What elements of an approach can be evaluated and what elements are unrealistic to evaluate in practice?
Resources & skills

• How best can you undertake an effective whole systems evaluation with limited resources and funding?

• What skills are needed to do systems evaluations?
Stay in touch

Ways of staying involved / learning more:

• Register for updates:  
  www.health.org.uk

• Get in touch:  
  info@health.org.uk
Thank you