

Moving towards a complex systems approach to population health intervention research Laurence Moore

Knowledge Exchange Cycle



The need for a complex systems model of evidence for public health

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Despite major investment in both research and policy, many pressing contemporary public health challenges remain. To date, the evidence underpinning responses to these challenges has largely been generated by tools and methods that were developed to answer questions about the effectiveness of clinical interventions, and as such are grounded in linear models of cause and effect. Identification, implementation, and evaluation of effective responses to major public health challenges require a wider set of approaches^{1,2} and a focus on complex systems.^{3,4}

A complex systems model of public health conceptualises poor health and health inequalities as outcomes of a multitude of interdependent elements within a connected whole. These elements affect each other in sometimes subtle ways, with changes potentially reverberating throughout the system.⁵ A complex systems approach uses a broad spectrum of methods to design, implement, and evaluate interventions for changing these systems to improve public health.

Complex systems are defined by several properties, including emergence, feedback, and adaptation.³ Emergence describes the properties of a complex system that cannot be directly predicted from the elements which require high levels of individual agency, have low reach and impact, and tend to widen health inequalities.⁹⁻¹¹ Shifts within multiple elements across the many systems that influence obesity are required, some of which might only have small effects on individuals but can drive large changes when aggregated at population level.¹²

Although randomised controlled trials of individual-level interventions are relatively straightforward to do, it is often impossible to randomise a population-level intervention, such as the introduction of a national tax on sugar-sweetened beverages, or the multiple factors that support cycling, such as physical infrastructure, spatial planning, and integration with public transport. Approaches to research that aim to understand single components within systems,¹³ or attempt to factor out the system context using randomisation and control, are thus of limited use for identifying how to influence complex systems to achieve improved population health and wellbeing.³⁴

However, research funding, research activity, and the published evidence base are all heavily skewed towards studies that attempt to identify simple, often short term, individual-level health outcomes, rather than complex, multiple, upstream, population-level actions and

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The 2000 MRC Guidance





The 2006 / 2008 MRC Guidance



Developing and evaluating complex interventions:

new guidance

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RESEARCH METHODS & REPORTING

Developing and evaluating complex interventions: the new Medical Research Council guidance

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EDITORIALS

New MRC guidance on evaluating complex interventions Clarifying what interventions work by researching how and why they are effective

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Provenance and peer review : Commissioned, extender nally peer reviewed.

Citethileas 84/2006;337:a1597 doi:10/105(bm);s1927 It is eight years since the publication of the Medical Research Council's original report on methods for developing and svahausing randomised concolled utials for complex interventions.¹ Although presented as a "discussion document," due MRC framework and its comparison paper have often been cited as authoritative guidance on methods. Other people, however, have found the definition of the complexity of intervencions arrow and misconceive ed³ and the suggested phases for developing and evaluasing complex intervencions as unbelgfully similar to commercial drug evaluation. However, the report can probably be credited with simulating much of the ongoing debase about appropriate methods and concepts in bealthcare we aluaxion—particularly when the intervention of interest is hard to define, hard to evaluate (using conventional experimental methods), or just hard to explain.

The MRC has now updated its original report (www.mrc.ac.uk/compleximew encionspuidance) to reflect recent developments in methods and lessons learnt in applying them. The guidance is summarised in the linked article by Craig and colleagues (doi:10.1186/bmja1655).³ It has a broader scope than the original version—it covers observational methods as well as randomised controlled trials and implementation as well as the development and evaluation of interventions; it also has a broader definition of complex inservations have not development and or alumino of barying multiple components.

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www.mrc.ac.uk/complexinterventionsguidance

A less linear model



Is this the effective solution?



How many silver bullets have we found? Harry Rutter's 'Olive of evidence'



- Many of the most promising interventions don't get 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
- Production line of 'effective interventions' that generally don't work!

RE-AIM framework



RECOMMENDED PURPOSE OF TRANSLATION/EFFECTIVENESS RESEARCH

To determine the characteristics of interventions / policies / programmes that can:

- <u>Reach</u> large numbers of people, especially those who can most benefit
- Be widely <u>adopted</u> by different settings
- Be consistently <u>implemented</u> by staff members with moderate levels of training and expertise
- Produce <u>replicable</u> and <u>long-lasting</u> effects (and minimal negative impacts) at reasonable cost

Glasgow RE et al Am J Public Health. 2003;93:1261–1267

Not just implementation context...



Source: Dahlgren and Whitehead, 1991

Levels of the Environment in Bronfenbrenner's Ecological Systems Theory



(Bronfenbrenner, 1979)

So, it's all quite complex...

Simple, complicated, complex...

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



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?



Approach to evaluation

Approach	What does taking this approach look like for evaluation?
Efficacy	To what extent does the intervention produce the intended outcome in experimental settings?
Effectiveness	To what extent does the intervention produce the intended outcome in real world settings?
Theory-based	How do context and mechanisms interact to produce outcomes?
Systems	What contributes to changing the system (in a positive way)?

Is it the intervention that's complex? Or the evaluation perspective?

Evaluation Perspective	Intervention			
	Simple	Complicated	Complex / adaptive	
Efficacy				
Effectiveness				
Theory / Realist				
Complex Systems				

Complex Systems interventions

- 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

Programme theory

- Importance of developing a programme theory
 - To describe intervention and hypothesised mechanisms
 - To identify context dependencies
 - To identify key uncertainties / research questions
 - Place a boundary around scope of evaluation (system boundary)
 - To plan evaluation design
 - Continually refine intervention, update programme theory
- Shared understanding of what intervention is, how it will lead to change, what contextual / system factors it may depend upon, how it may best be evaluated



Key innovations in evaluating public health interventions

- Not just researcher-led but existing / planned interventions / policies / innovations in practice
- Much greater involvement of non-academic stakeholders in
 - Intervention design
 - Programme Theory
- Careful consideration of evaluation perspective
 - Efficacy / evaluation to theory / systems
- Adopt a broader range of methods, suited to the question
 - Including systems science methods





Transdisciplinary Research for the Improvement of Youth Mental Public Health

Network activities

Young people's mental health research priority setting workshop

Tuesday 14 January, Belfast Email <u>sphsu-triumph@glasgow.ac.uk</u> for more information

Plus-funding call to be launched Spring 2020

Small-project grants to support research into prevention of mental ill-health and promotion of wellbeing for young people











Transdisciplinary Research for the Improvement of Youth Mental Public Health

The TRIUMPH network aims to bring together young people (11-25 years) with researchers, health practitioners, and policy-makers across the UK to find new ways to improve youth mental health and wellbeing, especially among those whose need is greatest

Join the network: http://triumph.sphsu.gla.ac.uk/

Get in touch: sphsu-triumph@glasgow.ac.uk

Follow us: @TRIUMPHnetwork

CO-DESIGN & CO-PRODUCTION WITH YOUNG PEOPLE







PHASE aims to bring together public health and simulation experts to deliver translational research that uses agent-based models to address the complex challenges faced by decision makers in the prevention of non-communicable diseases

Our objectives:

- Build and support multi-disciplinary research teams to address population health challenges
- Support methodological innovation

- Co-develop research programmes between modelling specialists and decision makers
- Provide evidence to enable change within complex systems to prevent non-communicable diseases

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