# Systems approaches to public health evaluation

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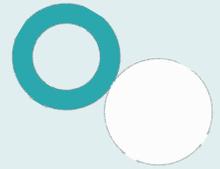
# Acknowledgements

**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 research methods review (under review, *Social Science & Medicine)*

**People**

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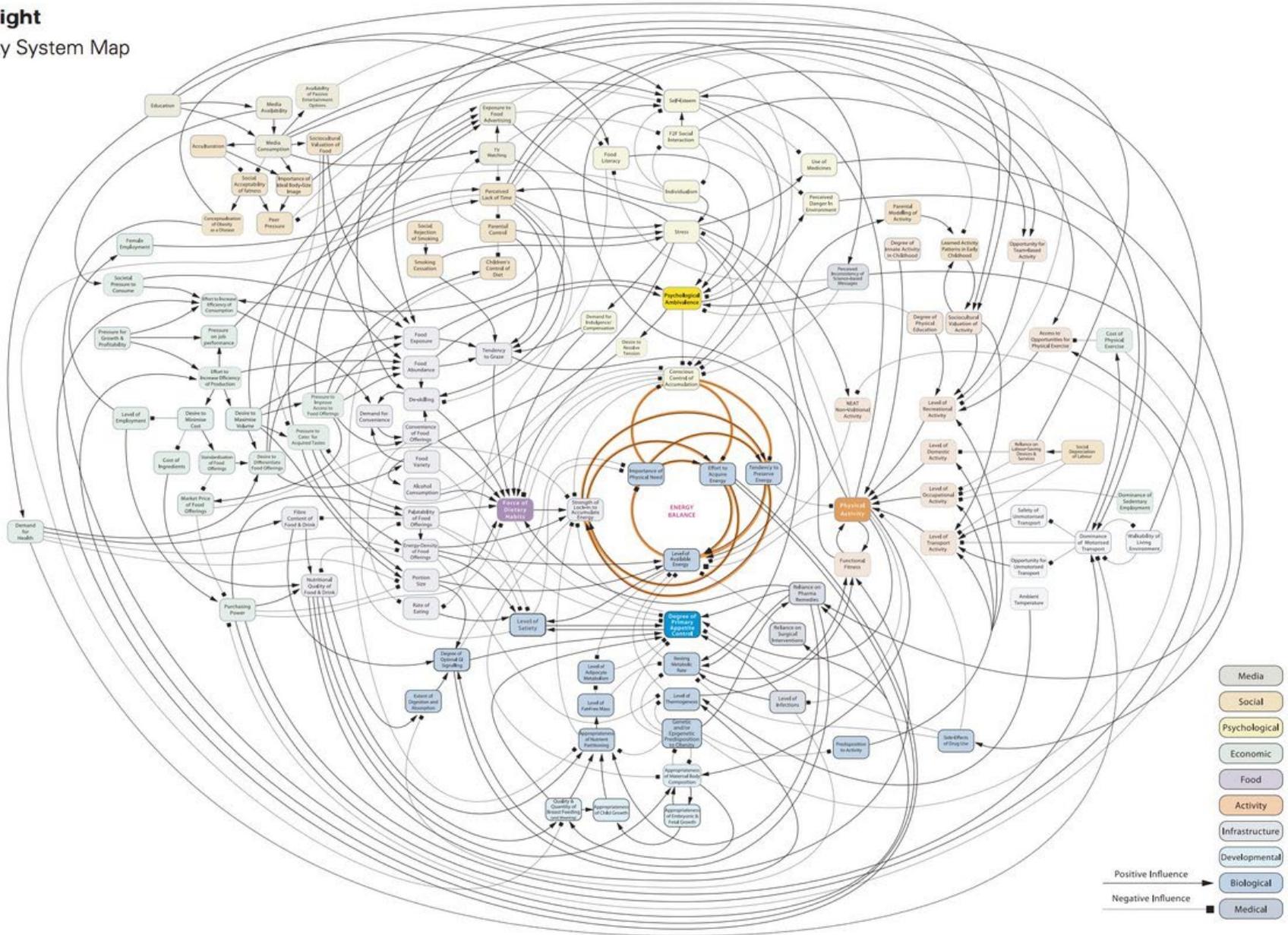
# Outline

- What is systems thinking?

- Why might we want to apply a systems perspective to public health evaluation?

- Some possible methods

# What comes to mind when we say 'systems thinking?'

# Foresight

## Obesity System Map

ENERGY BALANCE

Force of Dietary Habits

Physical Activity

Psychological Ambivalence

Degree of Primary Appetite Control

**Legend:**
- Media
- Social
- Psychological
- Economic
- Food
- Activity
- Infrastructure
- Developmental
- Biological
- Medical

Positive Influence →
Negative Influence ■
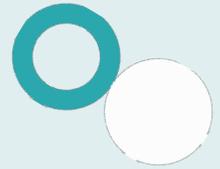
# What exactly do we mean by (complex) systems thinking?

# Complex system

*"a set of things – people, cells, molecules or whatever – interconnected in such a way that they produce their own pattern of behaviour overtime"* (Meadows 2008, p.2)

Key attributes of a **complex** system

- 'produce their own pattern of behaviour'
  - A system is more than the sum of its parts – new patterns can **emerge** from it
- Self-organising rather than centrally organised
- 'Over time' – the system is **dynamic** and time sensitive
  - The overall system may look stable because changes in one part may be 'stabilised' by responses elsewhere.
  - The overall system may transition because changes escalate.
- So, complexity is **more than just a tangled set of relationships**. Its about a system that behaves in a certain way.

# Why apply a systems perspective?

*A systems perspective involves "Consideration of the ways in which processes and outcomes at all points* **[…and at different levels…]** *within a system drive change. Instead of asking whether an intervention works to fix a problem, researchers should aim to identify if and how it contributes to reshaping a system"* (Rutter et al., Lancet 2017)

# What can a systems perspective add to evaluation?

- '**System Map**': how the different parts (people, organisations, interventions) of the system relate to each other and how those relationships can change:
  - Visualise those perspective
  - Compare and contrast across different stakeholders

- The **Big Picture**: e.g.
  - Activities that '**swim against the tide**'?
  - **Who's interests** are being served by specific approaches?
  - **Stepping stones** – small activities that could lead to larger initiatives

- More comprehensive understanding of **impacts**
  - **Larger range** of impacts – both anticipated and unanticipated
  - Understanding what **amplifies** or **dampens** those impacts (feedback loops)

- Complex **causal pathways** and **alternative pathways**
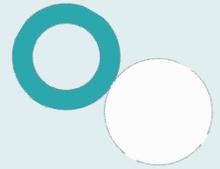
# How do we apply a systems perspective to evaluation? Some methods

# May be useful to think of two different ways to approaching systems methods

**Draw on systems and complexity methods**

- Use methods rooted in systems and complexity sciences that were developed to answer systems questions

**Draw on systems and complexity theory**

- Use systems thinking as a **heuristic** or **thinking tool**
- Apply to established methods

**What you choose to do will depend on your research question**

# System mapping

- Use for **theorising** the system of interest and the possible ways the intervention may lead to changes **across the system**
- Integrate perspectives from across the system
- Range of mapping methods:
    - Mind maps
    - Concept mapping
    - Group model building (behaviour-over-time graphs; causal loop diagrams)
    - Stock and flow diagrams (used in system dynamics modelling)

# System mapping - example

- Intervention to implement healthy eating and active living policy, systems and environmental changes for children

- Developed with range of stakeholders across the system

- Visualised the community's theory of change

- Used to identify points to intervene in the system and reinforce what worked well
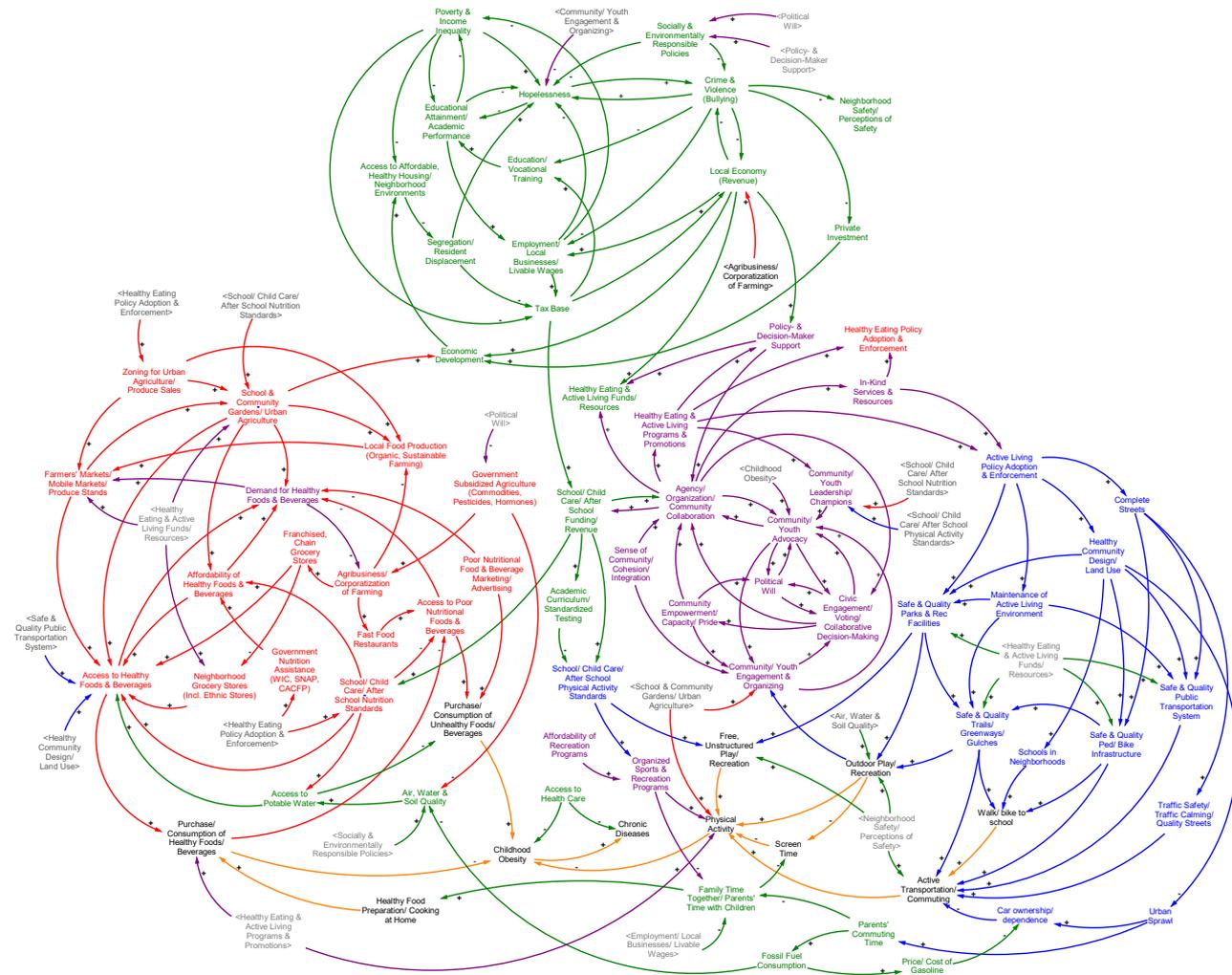


Brennan et al (2015)

# Network analysis

- Use to understand **implementation mechanisms** or to **quantify impact of the intervention** on key system parameters:
    - Which parts of network best placed for affecting change
    - Effectiveness of interventions aimed at networks
    - How to strengthen or maintain interventions overtime
- Emphasis on the relationships between individuals and organisations within a system

# Network analysis – example

- Mindfulness and cooperation intervention in children

- Pre-post design with experiment and control groups

- Assessed social network diversity and quality of positive relationships



Fuentes et al (2018)
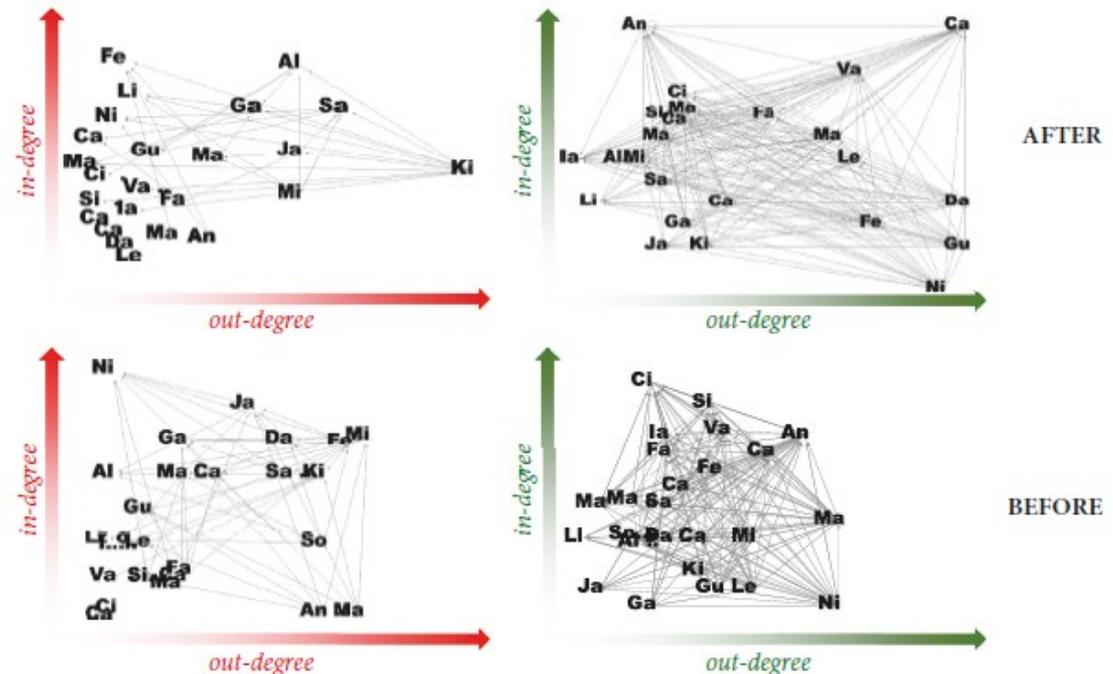
# System modelling

- Use for **predicting** how:
  - An intervention may impact on or interact with a system
  - How agents may react and respond to an intervention
- Can simulate impact of hypothetical or planned intervention (or compare several scenarios)
- Can simulate how an implemented intervention will have impacts over a **longer timescale** or **in a different context**
- Range of methods:
  - Agent-based modelling
  - Systems dynamics modelling
  - Micro-simulation
  - Others

# System modelling - example

- Agent-based model

- Assess the impact of alcohol taxation on rate of violent victimisation

- Tested multiple scenarios
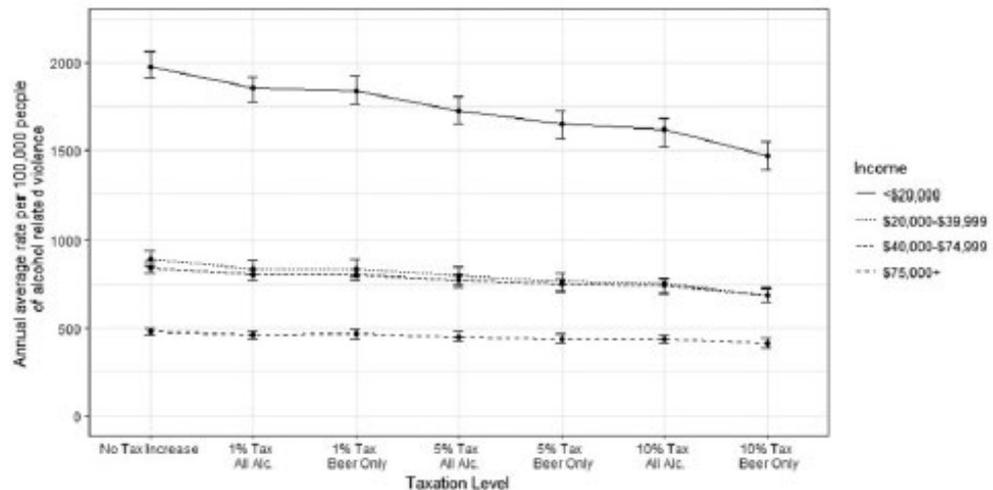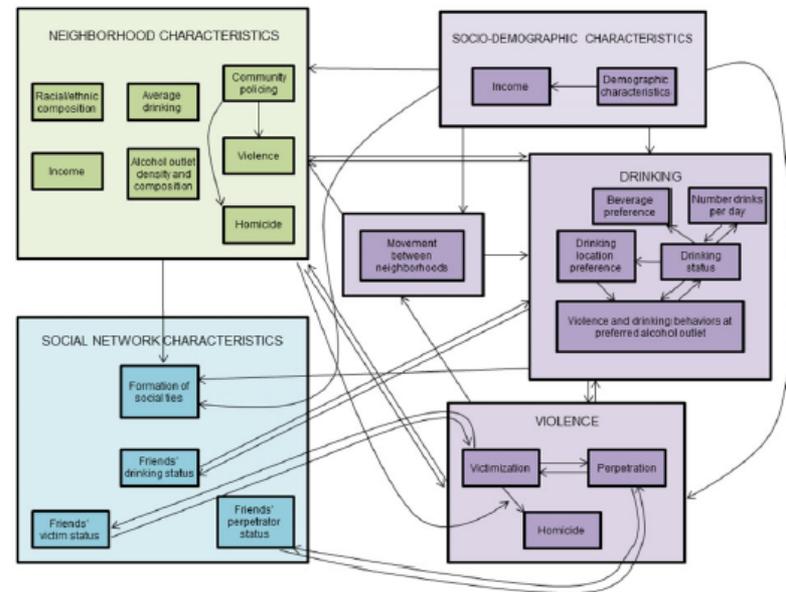
Keyes et al 2019



**Figure 3** Estimated annual average rate of alcohol related violence by income and level of taxation in an agent-based model of New York City

# System framing

- Use systems thinking to **frame** an evaluation and then draw on existing methods

- Use to:
  - Develop evaluation questions
  - Theorise the system of interest and possible system-wide theories of change
  - Evaluate implementation mechanisms and unintended consequences
  - Quantify system-level impacts

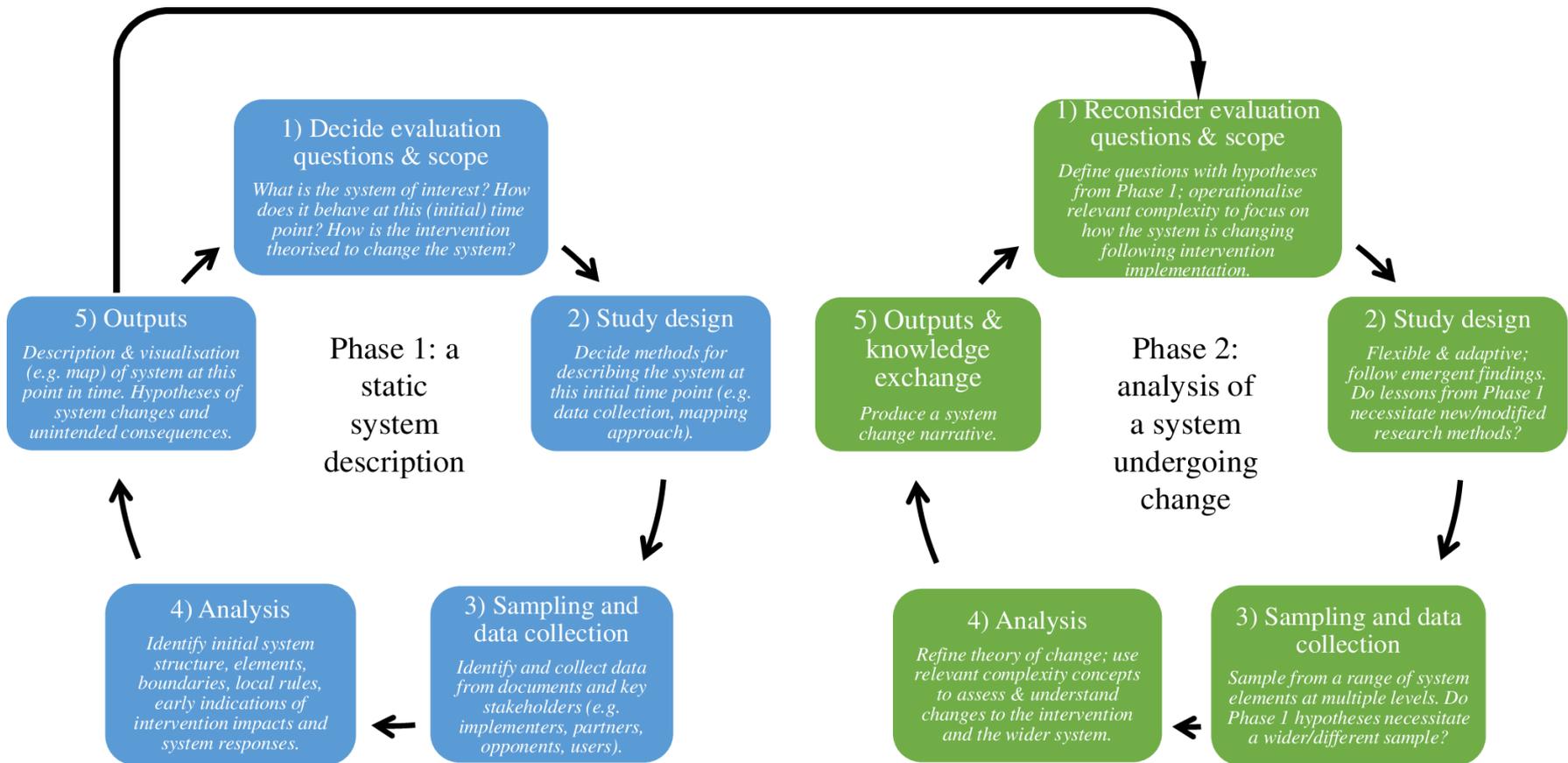# System framing – example

- Evaluation of the Public Health Responsibility Deal

- Used systems framing as a way of integrating data from several evaluation strands

**Table 1.** Components of the Public Health Responsibility Deal (RD) evaluation, and aspects of the system which they shed light on.

| RD Evaluation Components | System Attributes which these Data Illuminate (Adapted from [20]) |
|---|---|
| Logic model built on initial description of how RD would work [23], and scoping review [12] | Causal pathways within the RD systems (food, alcohol, physical activity, health at work) |
| Participant interviews [9] Analysis of organisational case studies including documents and interviews Media analysis [24] | Structures and processes in place Interests at play Feedback loops, and barriers to change |
| Qualitative systems dynamic modelling [15,25,26] using Causal Loop Diagrams (as an analytic tool) [27] built on data from pledge analyses, progress report analyses, qualitative data from interviews and organisational case studies (created as part of the current paper) | Drivers, interests, ways of working |
| Analysis of RD pledges [4–11,13,24] | |
| Analyses of evidence base [4–11,13,24] | Probability of system changing in response to specific pledges |
| Analyses of specific pledges [4–11,13,24] | Identifying whether change happened in a particular part of the system |

Knai et al 2018

# System framing – framework for process evaluations from a complex systems perspective



**Phase 1: a static system description**

1) Decide evaluation questions & scope
*What is the system of interest? How does it behave at this (initial) time point? How is the intervention theorised to change the system?*

2) Study design
*Decide methods for describing the system at this initial time point (e.g. data collection, mapping approach).*

3) Sampling and data collection
*Identify and collect data from documents and key stakeholders (e.g. implementers, partners, opponents, users).*

4) Analysis
*Identify initial system structure, elements, boundaries, local rules, early indications of intervention impacts and system responses.*

5) Outputs
*Description & visualisation (e.g. map) of system at this point in time. Hypotheses of system changes and unintended consequences.*

**Phase 2: analysis of a system undergoing change**

1) Reconsider evaluation questions & scope
*Define questions with hypotheses from Phase 1; operationalise relevant complexity to focus on how the system is changing following intervention implementation.*

2) Study design
*Flexible & adaptive; follow emergent findings. Do lessons from Phase 1 necessitate new/modified research methods?*

3) Sampling and data collection
*Sample from a range of system elements at multiple levels. Do Phase 1 hypotheses necessitate a wider/different sample?*

4) Analysis
*Refine theory of change; use relevant complexity concepts to assess & understand changes to the intervention and the wider system.*

5) Outputs & knowledge exchange
*Produce a system change narrative.*

McGill et al (In Press).

# Summary

| Stages of evaluation | Aim | System mapping | Network analysis | System modelling | System framing |
|---|---|:---:|:---:|:---:|:---:|
| Theorising | Identify and compare stakeholder understandings of a system. | ● | | | ● |
| | Identify and compare stakeholder understandings of how a planned intervention might interact within a system. | ● | | | ● |
| Prediction | Hypothesise and simulate how the intervention may impact on and interact with the system | | | ● | |
| | Hypothesise and simulate how agents within the system might react and interact in response to an intervention | | | ● | |
| Process evaluation | Understand how an interaction has impacts within the system in the real world, including impacts of variation in local context | ● | ● | ● | ● |
| Impact evaluation | Quantify the impact of the intervention on key system parameters in the real world | | ● | | ● |
| Further prediction (extension of impact evaluation) | Hypothesise and simulate how the intervention may impact the system over a longer time horizon or in a different context. | | | ● | |
| | 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. | | | ● | |

(Under peer review, subject to change)

# Reflections

- Use a systems approach to widen the scope of your evaluation

- Be explicit about the approach you're taking and the underpinning theory

- Adaptive nature of the evaluation

- There is room for development and innovation in systems thinking and public health evaluation

# NIHR SPHR Systems Guidance

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# Thank you!

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