Health Complexity

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HEALTH
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Figure 2

25 leading risk factors for the global burden of disease

Leading risks 2000	Percentage of total DALYs, 2000
1 Particulate matter pollution	10·6 (8·5 to 12·3)
2 Child growth failure	9·3 (6·4 to 11·1)
3 Low birthweight and short gestation	8·9 (8·3 to 9·6)
4 High systolic blood pressure	6·3 (5·2 to 7·4)
5 Smoking	5·6 (4·7 to 6·5)
6 Unsafe water source	4·0 (2·3 to 5·2)
7 Unsafe sanitation	3·3 (2·7 to 3·9)
8 High fasting plasma glucose	3·1 (2·8 to 3·5)
9 High LDL cholesterol	2·6 (1·6 to 3·6)
10 Unsafe sex	2·6 (2·1 to 3·2)
11 High body-mass index	2·5 (1·1 to 3·9)
12 High alcohol use	2·4 (1·9 to 3·1)
13 No access to handwashing facility	2·3 (–0·5 to 4·9)
14 Kidney dysfunction	2·2 (1·9 to 2·4)
15 Occupational injuries	1·6 (1·5 to 1·7)
16 Secondhand smoke	1·6 (0·8 to 2·4)
17 Diet low in fruits	1·3 (0·5 to 2·0)
18 Iron deficiency	1·3 (0·9 to 1·7)
19 Diet high in sodium	1·2 (0·3 to 2·7)
20 Suboptimal breastfeeding	1·2 (0·9 to 1·5)
21 Diet low in whole grains	1·2 (0·5 to 1·8)
22 Lead exposure	1·0 (0·0 to 2·0)
23 Low temperature	0·9 (0·7 to 1·0)
24 Drug use	0·8 (0·7 to 0·9)
25 Diet low in vegetables	0·6 (0·4 to 0·9)
29 Diet low in omega-6 polyunsaturated fatty acids	0·5 (–1·7 to 1·9)

Leading risks 2021	95% UI for Ranking	Percentage of total DALYs, 2021	Percentage change in number of DALYs, 2000–2021	Percentage change in age-standardised rate of DALYs, 2000–2021
1 Particulate matter pollution	(1 to 2)	8·0 (6·7 to 9·4)	–17·2 (–25·9 to –6·2)	–41·9 (–47·2 to –35·6)
2 High systolic blood pressure	(1 to 2)	7·8 (6·4 to 9·2)	34·3 (26·7 to 42·3)	–24·3 (–28·4 to –20·0)
3 Smoking	(3 to 6)	5·7 (4·7 to 6·8)	10·8 (3·2 to 19·9)	–34·8 (–39·2 to –29·7)
4 Low birthweight and short gestation	(3 to 6)	5·6 (4·8 to 6·3)	–32·4 (–41·2 to –22·3)	–33·0 (–41·6 to –22·8)
5 High fasting plasma glucose	(3 to 6)	5·4 (4·8 to 6·0)	88·2 (80·5 to 96·4)	7·9 (3·3 to 12·9)
6 High body-mass index	(3 to 10)	4·5 (1·9 to 6·8)	96·5 (87·1 to 105·8)	15·7 (9·9 to 21·7)
7 High LDL cholesterol	(7 to 10)	3·0 (1·9 to 4·2)	27·0 (20·8 to 33·6)	–26·1 (–29·6 to –22·4)
8 Kidney dysfunction	(6 to 10)	3·0 (2·6 to 3·4)	49·5 (42·7 to 57·0)	–12·4 (–16·5 to –7·9)
9 Child growth failure	(6 to 14)	2·6 (1·4 to 3·5)	–69·8 (–77·5 to –62·4)	–71·5 (–78·8 to –64·4)
10 High alcohol use	(7 to 11)	2·5 (2·1 to 3·1)	12·4 (2·6 to 20·9)	–25·8 (–32·0 to –20·4)
11 Unsafe sex	(11 to 17)	1·5 (1·4 to 1·7)	–35·0 (–44·6 to –20·1)	–52·4 (–58·9 to –42·3)
12 Diet low in fruits	(11 to 22)	1·5 (0·6 to 2·3)	22·5 (15·5 to 34·0)	–26·6 (–30·9 to –20·5)
13 Unsafe water source	(11 to 24)	1·5 (0·8 to 2·0)	–60·1 (–67·1 to –53·2)	–66·3 (–72·0 to –60·2)
14 Diet high in sodium	(8 to 36)	1·4 (0·3 to 3·2)	27·6 (1·3 to 41·2)	–26·8 (–40·9 to –19·1)
15 Diet low in whole grains	(12 to 23)	1·4 (0·6 to 2·1)	30·1 (24·0 to 36·6)	–23·3 (–26·9 to –19·5)
16 Secondhand smoke	(11 to 26)	1·2 (0·6 to 1·8)	–16·0 (–22·0 to –6·5)	–45·3 (–48·9 to –40·3)
17 Iron deficiency	(12 to 23)	1·2 (0·9 to 1·6)	1·6 (–2·1 to 5·3)	–18·1 (–21·2 to –15·2)
18 Lead exposure	(10 to 52)	1·2 (0·0 to 2·4)	28·8 (6·9 to 42·2)	–23·9 (–28·9 to –18·4)
19 Unsafe sanitation	(14 to 23)	1·1 (0·9 to 1·4)	–63·8 (–69·8 to –57·6)	–69·2 (–74·4 to –63·2)
20 Occupational injuries	(15 to 21)	1·1 (1·0 to 1·2)	–25·2 (–30·7 to –20·3)	–43·6 (–47·5 to –39·8)
21 Drug use	(17 to 24)	1·0 (0·8 to 1·1)	31·1 (23·6 to 38·3)	–4·6 (–10·1 to 0·8)
22 Low temperature	(19 to 26)	0·9 (0·8 to 1·0)	9·6 (–1·5 to 21·6)	–39·5 (–44·2 to –34·5)
23 No access to handwashing facility	(11 to 53)	0·8 (–0·2 to 1·8)	–60·5 (–68·9 to –52·3)	–65·7 (–73·4 to –57·8)
24 Diet low in vegetables	(20 to 29)	0·7 (0·4 to 1·0)	21·8 (13·3 to 35·7)	–28·5 (–33·4 to –21·3)
25 Diet low in omega-6 polyunsaturated fatty acids	(11 to 53)	0·6 (–2·0 to 2·3)	32·9 (23·4 to 38·8)	–21·3 (–25·7 to –17·0)
36 Suboptimal breastfeeding	(30 to 40)	0·3 (0·2 to 0·4)	–71·3 (–75·7 to –66·2)	–71·4 (–75·8 to –66·4)

Environmental and occupational risks
Behavioural risks
Metabolic risks

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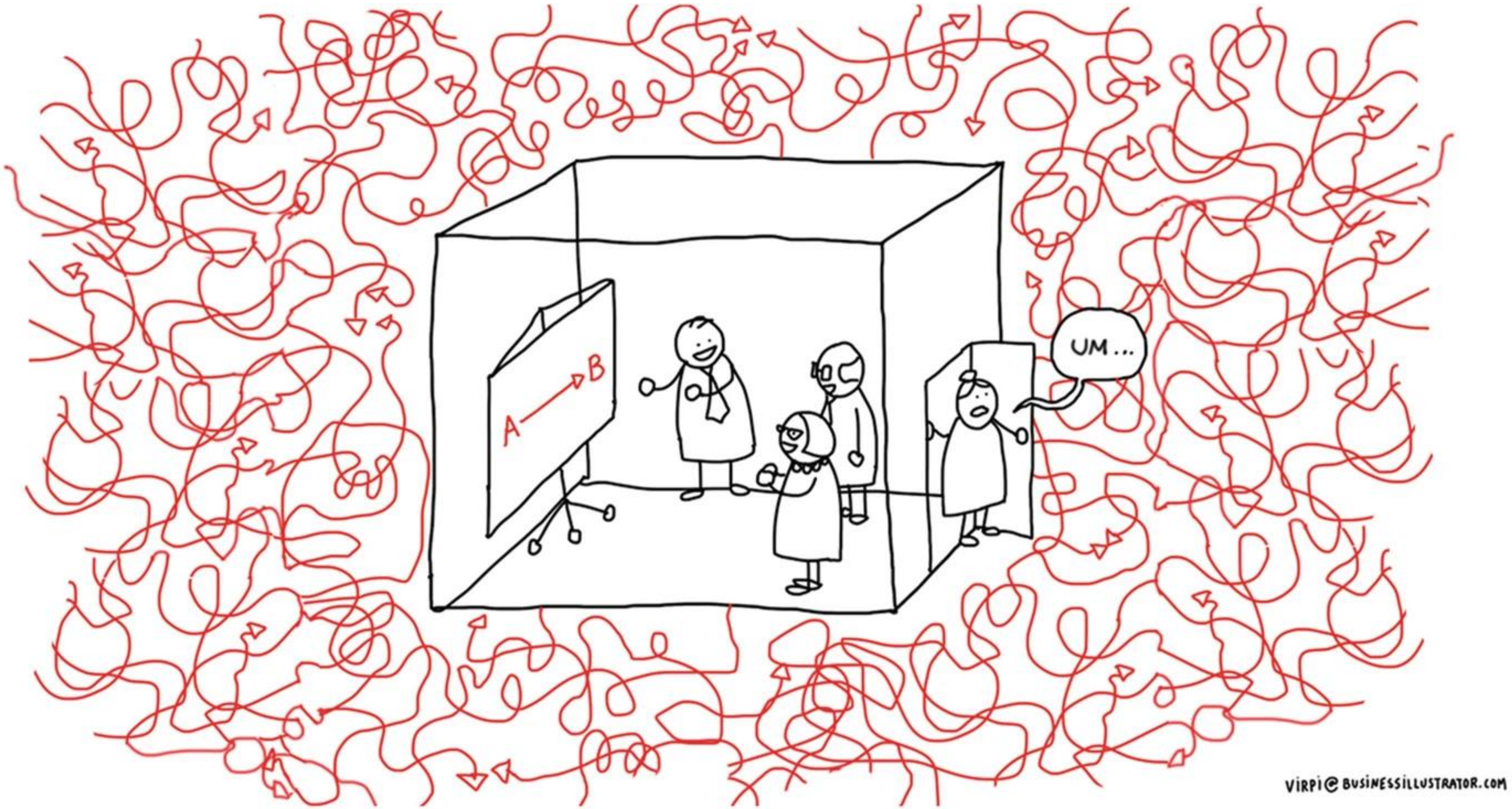
Health is a complex phenomenon



Complex public health problems

Public health problems are multifaceted and constantly evolving, and they **emerge from a complex and 'messy' world** characterized by interactions, non-linearity, interference, feedback loops, adaptation, and evolution.

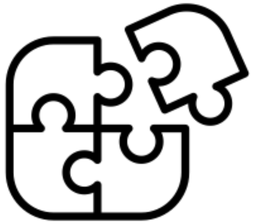
Simple

The relationship between
cause and effect is obvious

$A \longrightarrow B$

Complicated

The relationship between cause and effect is clear,
but requires expert analysis

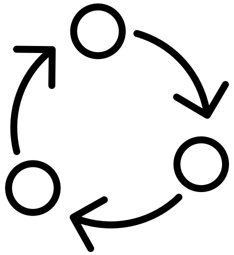


Complex

The whole is different than the sum of the parts

Interconnected
mechanisms

Dynamics



Chaos

The relationship between
cause and effect cannot be determined

We need to ask a **new type of questions**

Complex Systems Lens

Look for diversity instead of averages

Study non-linearity and feedback instead of assuming linearity

Explore interactions, networks, and group dynamics instead of assuming independence

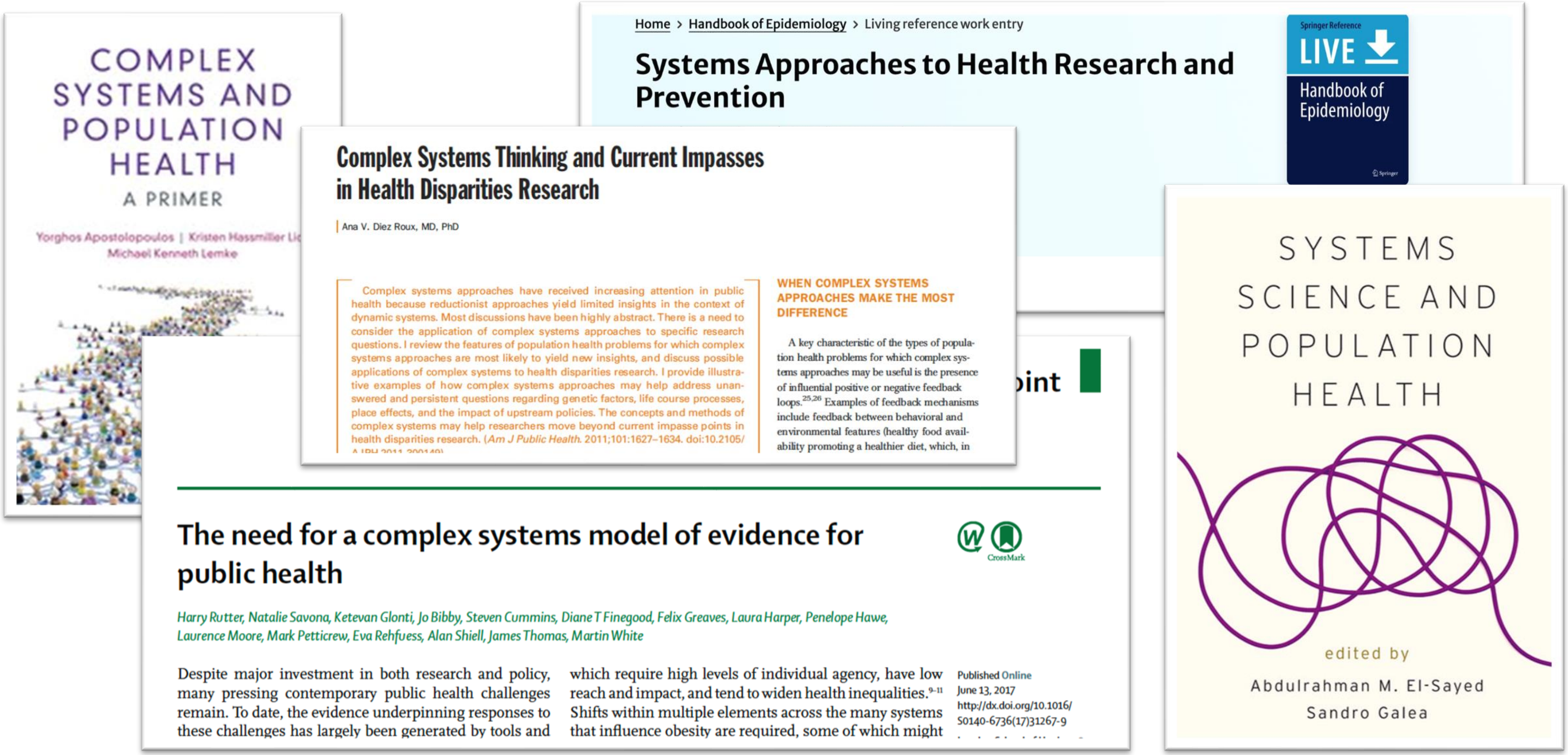
Assess the importance of context in time and space instead of assuming standardized conditions

Study evolution across generations instead of ignoring history

Identify emergent features of complex systems instead of isolating single effects

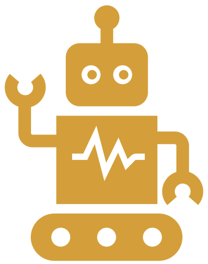
Rod NH et al. Epidemiology 2023

Complexity thinking in public health

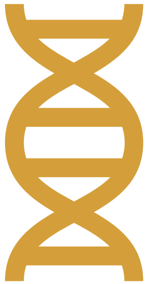


How do we *understand* complex health phenomena?

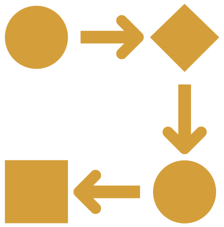
Three core dimensions that directly relate to complex systems



the health ***patterns*** that emerge from complex systems



the ***mechanisms*** that produce them



the ***dynamics*** that make them change over time

Rod NH, Broadbent A, Rod MH, Russo F, Arah O, Stronks K.
Complexity in Epidemiology and Public Health. Epidemiology 2023

Smoking – a public health success?

Navigating in an era of complex health issues

Patterns

Describe the emergence of complex public health issues across spatial-temporal scales

Delineate the problems and set boundaries for targeted intervention in specific subgroups

Mechanisms

Understand how elements of a system interact at multiple levels to create complex public health issues

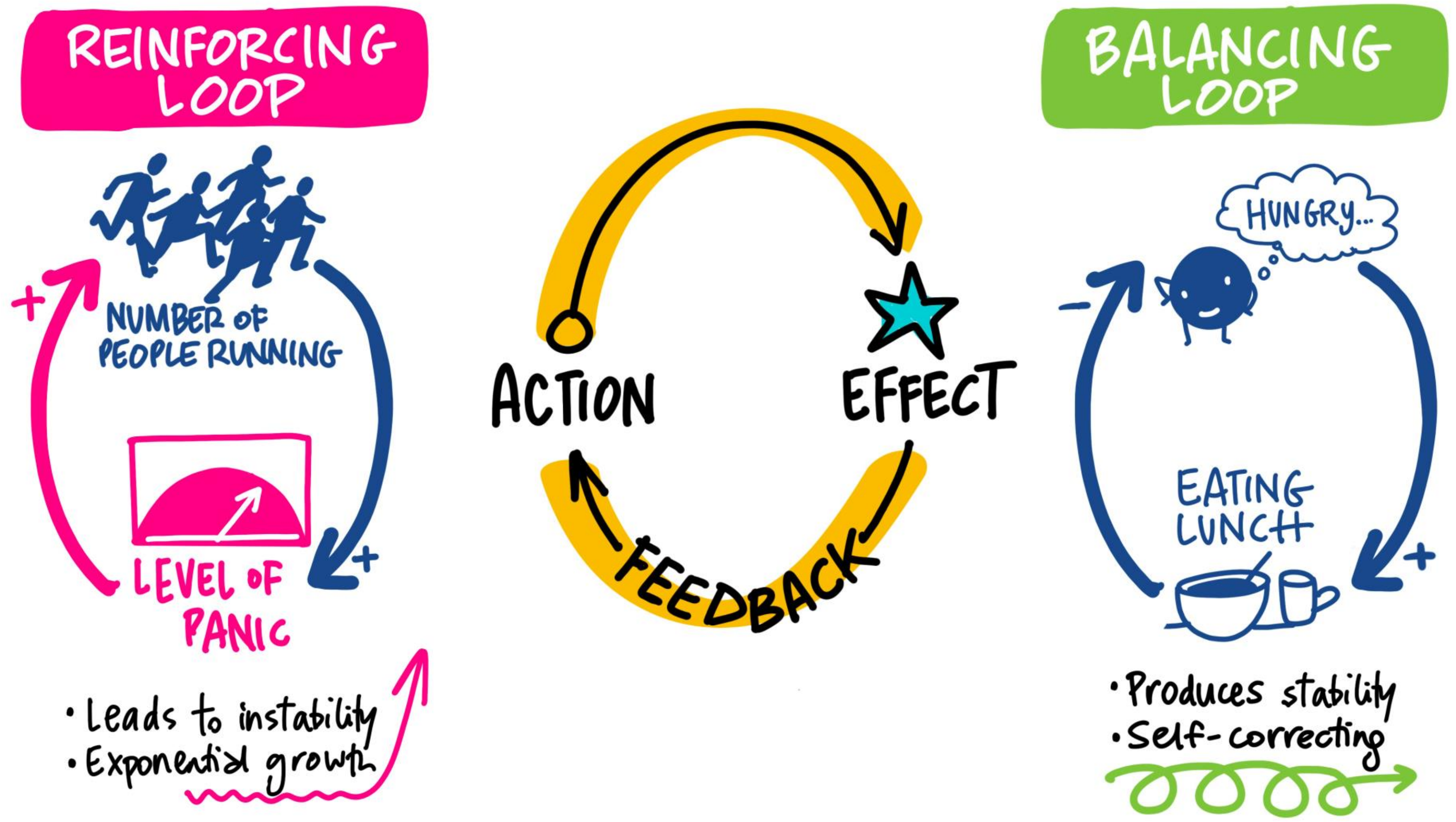
Identify central leverage points for intervention

Dynamics

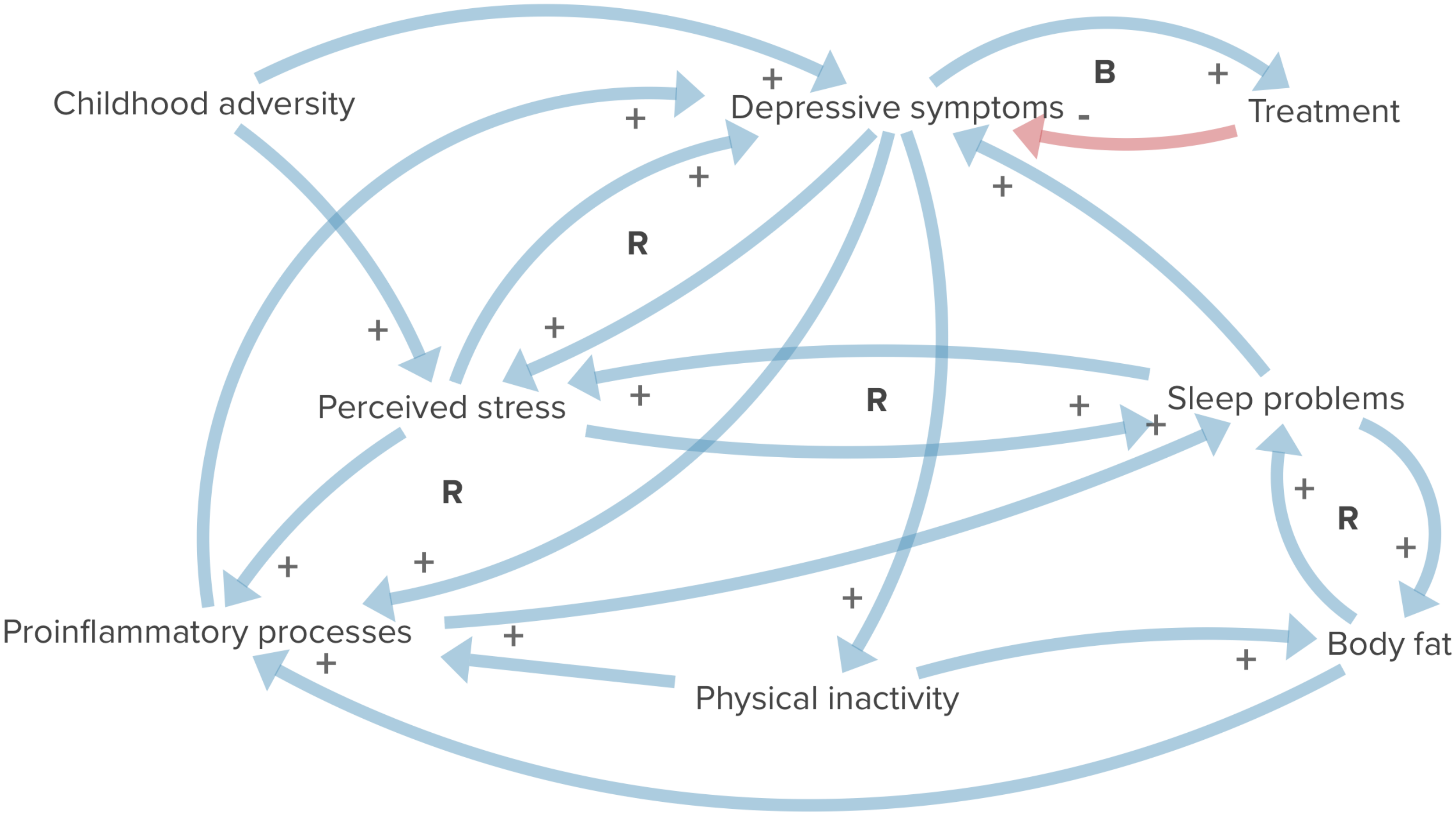
Explore how complex public health issues change over time because of dynamical processes

Intervene on vicious circles across levels, which generate excessive burdens of disease

FEEDBACK LOOPS

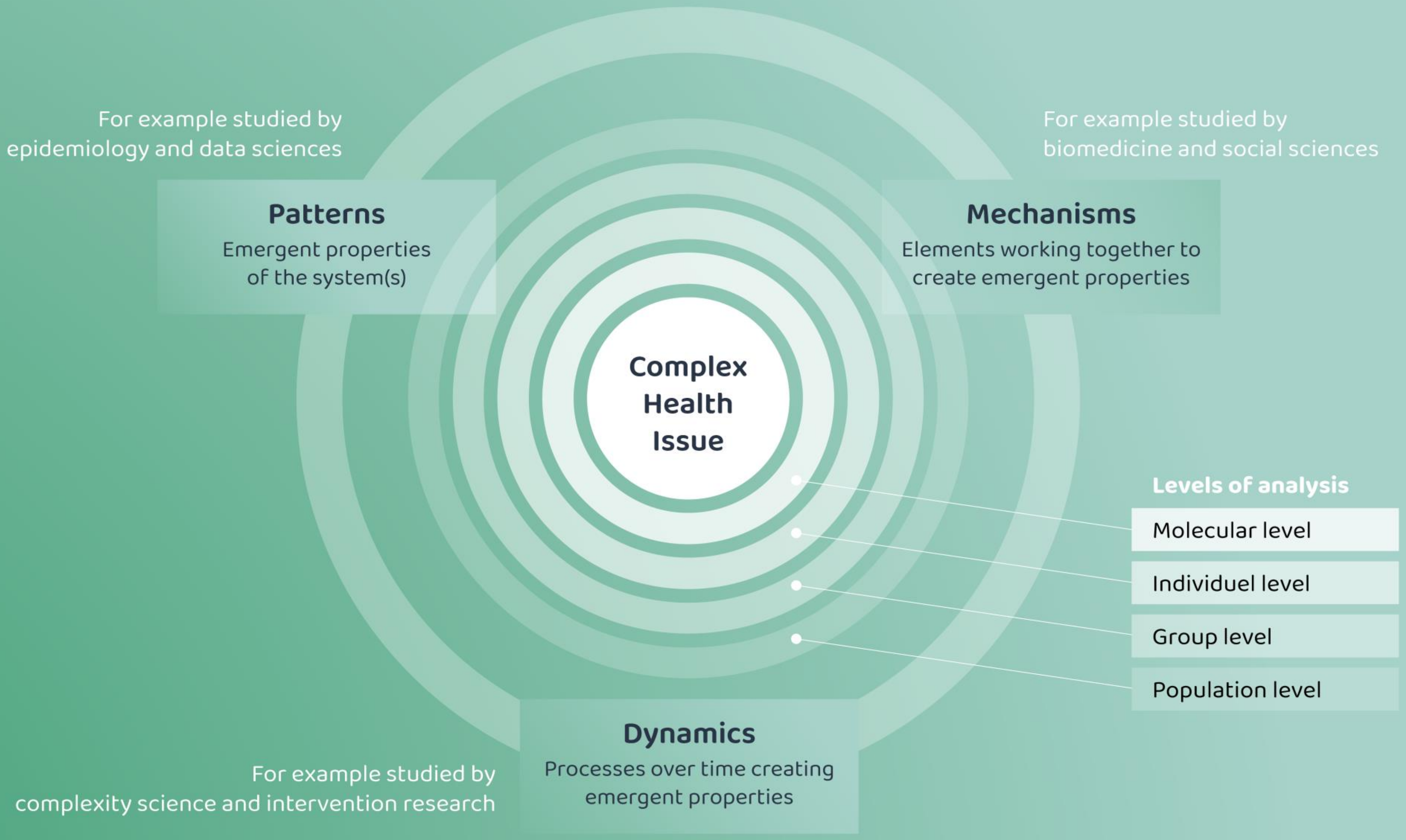


Mental health crisis – understanding the dynamics



Uleman J et al,. Mapping complex public health problems with causal loop diagrams. Int J Epi 2024

HEALTH COMPLEXITY FRAMEWORK



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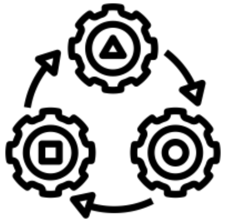
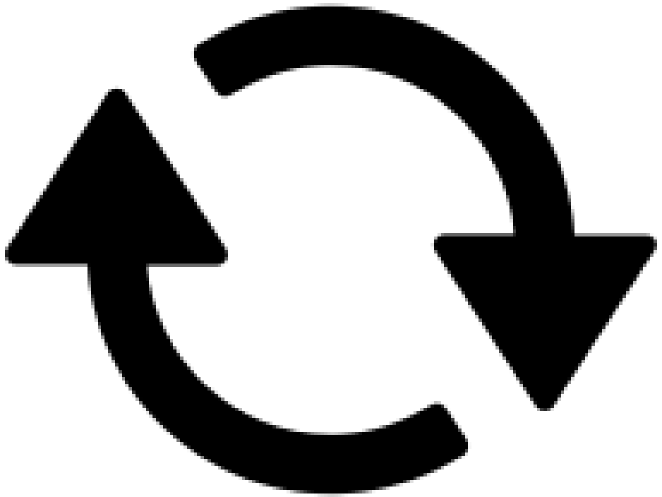
Why
health problems emerge

Interconnected mechanisms and dynamic change over time

How
to realise change



Replicating action functionality across contexts

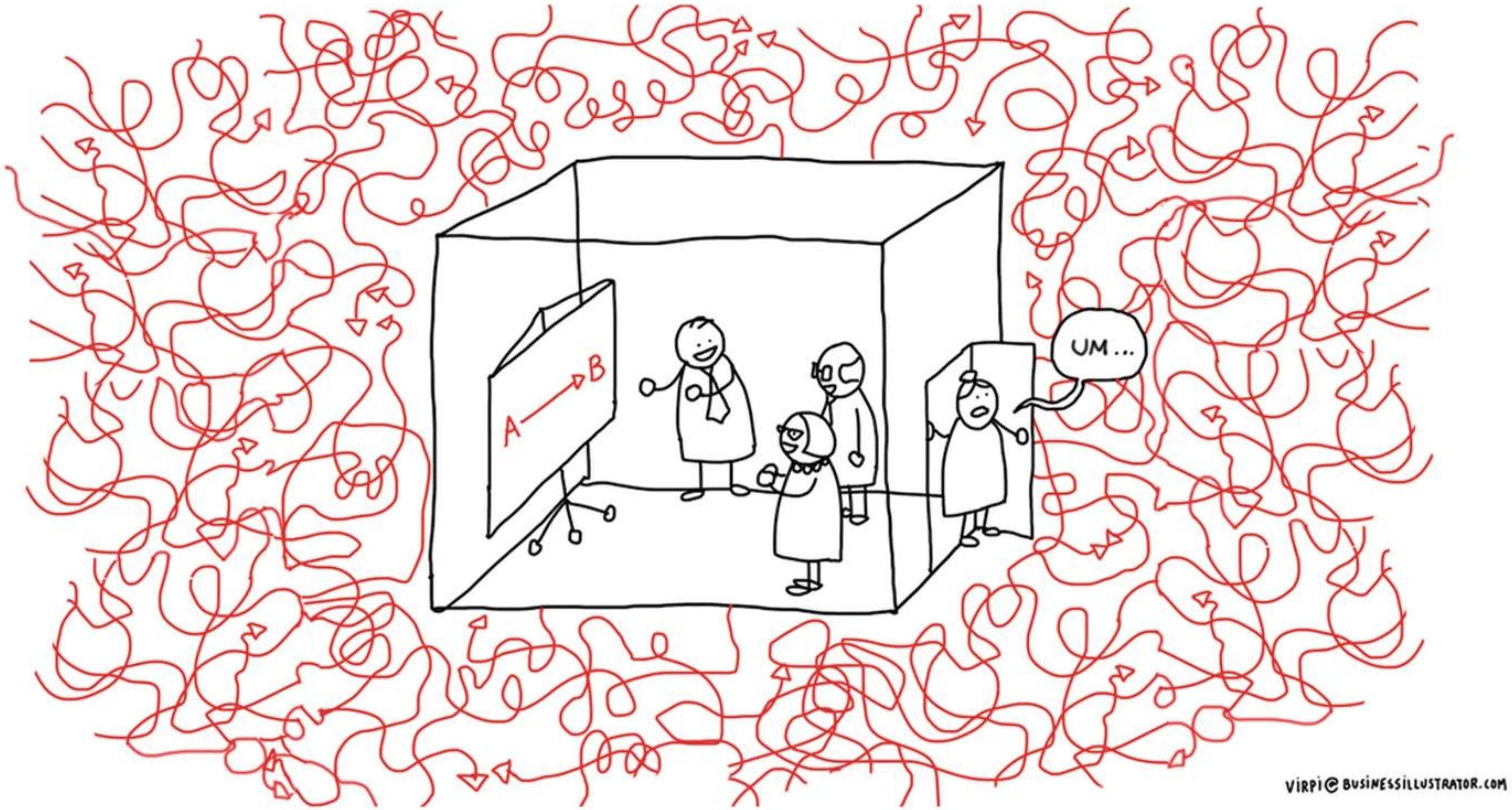


What
should be done

Dynamic set of actions aimed at changing the function of the system

EVIDENCE-BASED *complexity* PUBLIC HEALTH

Thank you for your attention!



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COPENHAGEN HEALTH COMPLEXITY CENTER

Core research agenda on complexity

Concepts Understanding complexity	Data Studying complexity	Methods Modeling complexity	Culture Living with complexity
We will develop a conceptual toolkit for health complexity, which will revise and improve our understanding of population health	We will acknowledge that population health is an emergent property of the totality of exposures during a life-time and within networks and systems	We need a new toolbox of visual and analytical approaches to capture the high dimensionality of complex systems in public health	We will study complexity in daily life to add depth to our understanding of health complexity
Systems-oriented approach Real-world health **Viewed through the lens of complex systems** *Interactions, feedback & group dynamics*	**Complete life histories** 2+ million people **Layers of data** *Health, social, neighborhood & environment*	**Fusion of methods** AI methods & causal inference **Multi-dimensional space** *Networks and groupings*	**Lived experiences** The micro-dynamics of complexity **Engagement research** *Communicating complexity*
Next-generation public health theory for complex phenomena	Globally unprecedented platform for real life complexity analysis in health	Novel methods for complexity analysis in public health science	A creative space for exchange between science, practice, policy and the population

Interdisciplinarity · **International network for health complexity science** · **Capacity building**

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