

Complex systems and individual-level approaches to population health: a false dichotomy?



Population health and health inequalities are best conceptualised in a complex systems model with interdependent elements at various levels within a connected whole.¹ This perspective suggests that wide effects on health, such as socioeconomic, cultural, and environmental factors as well as social, behavioural, and biological effects, interact in generating population health outcomes.² Debate has focused on an oversimplified argument pitching so-called upstream approaches against so-called downstream approaches, thus calling for a shift of focus and funding from individual-level approaches to population-level approaches.^{3,4} We argue that this distinction between approaches is based on a false dichotomy. Movement of resources from one level to another will not promote the science and practice of public health. An ambitious agenda should be embraced through the study of the interaction of multiple levels within systems relevant to population health.

Discussions about complex systems sometimes tend to reify them causing commentators to overlook the people who constitute these systems. Actors are central in any population health system—whether those actors are policy makers, industrialists, public health professionals, researchers, or members of the public. They engage in multiple actions, practices, and patterns of behaviour, linked in complex relationships with each other and their social and material world. Systems thinking requires understanding of feedback loops. The upstream and downstream metaphor implies a passive linear flow with people at the end and is therefore an inappropriate model for a system in which people are active agents at many stages and levels, generating harms and benefits to health. For example, creation of a climate that is favourable to interventions for tobacco control and in which smokers feel encouraged and empowered to stop is likely to be fostered by people who are successfully stopping smoking. Success is influenced by the use of evidence-based—what some would call individual-level—support for cessation as discovered by randomised controlled trials and substantiated by real world assessments.

The common argument that individual interventions have low reach and effect and tend to widen the gap in health inequalities³ is an overgeneralisation that

obscures the difference between absolute and relative health inequalities. Interventions delivered directly to individuals, such as vaccinations and support for smoking cessation, reach millions of individuals and have an indisputable effect on population health.^{5,6} Moreover, specialist support for smoking cessation offered to individuals can reduce inequalities.⁷ Unfortunately, because of austerity policies, cost-effective individual-level support has already been widely reduced⁸ and it would be unfortunate if claims about its insufficient effect justify further disinvestment.⁹

The association between agency and social structure is continuous, dynamic, and relational and the emergent properties of the system arise from social practices that constitute the dynamic interaction. Individuals are at the heart of this interaction as are groups of individuals; for example, those with interests that are often vested that might contradict population health (eg, the commercial world whose bottom line is private profit). To improve population health, individual behaviours should be recognised as key elements that affect population health; to intervene without a thorough understanding of behavioural complexities (eg, how they cause and respond to feedback loops, interactions, threshold effects, and unintended consequences) is to ignore a key part of the complex system of population health and to undermine the potential for effective interventions.

A new model is needed for public health that is built on a sophisticated and nuanced understanding of complex systems, from microbiological (eg, interactions between environment and epigenetics) to global (eg, climate change) factors. Some successful population health campaigns, such as the response to pandemic flu or the global campaign for smoking cessation, show the effectiveness of multisystem and multilevel endeavours on population health.^{5,6}

Some properties of complex systems cannot be directly predicted from its elements and are more than the sum of its parts. To identify such properties, factors that can be directly predicted from the system's elements need to be established. This identification requires systematic modelling of the main effects, mediators (mechanisms), and moderators (effect modifiers) between influences

and interventions in the wider physical, economic, policy, and sociocultural microenvironments and macroenvironments that interact with individual, behavioural, and biological factors.¹⁰ New methods of dynamic systems modelling are required that can identify targets, parameterise complex influences, uncertainties, and inequalities, and assess the effects of perturbation and policy over time. Methods such as agent-based modelling and microsimulation are beginning to be used in population health studies; however, the world beyond health should be used to identify state-of-the-art methods that can be integrated into these researches.

The increasing recognition that multiple organisations and community networks are enmeshed in complex systems is an important antidote to the general tenor of the way public health policy has been developed and implemented for decades. However, if we focus on the system at the expense of what is known about individual actions, our conceptions and evidence will be the poorer for it.

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- 1 Dahlgren G, Whitehead M. Policies and strategies to promote social equity in health. Stockholm: Institute for Futures Studies, 1991.
- 2 Kelly MP, Kelly R, Russo F. The integration of social, behavioural and biological mechanisms in models of pathogenesis. *Perspect Biol Med* 2014; **57**: 308–28.
- 3 Rutter H, Savona N, Glonti K, et al. The need for a complex systems model of evidence for public health. *Lancet* 2017; published online June 13. [http://dx.doi.org/10.1016/S0140-6736\(17\)31267-9](http://dx.doi.org/10.1016/S0140-6736(17)31267-9).
- 4 National Collaborating Centre for Determinants of Health. Economic arguments for shifting health dollars upstream. A discussion paper. Antigonish: National Collaborating Centre for Determinants of Health, 2016.
- 5 West R, May S, West M, Croghan E, McEwen A. Performance of English stop smoking services in first 10 years: analysis of service monitoring data. *BMJ* 2013; published online Aug 20. DOI:10.1136/bmj.f4921.
- 6 Centers for Disease Control and Prevention. Ten great public health achievements—United States, 2001–2010. *MMWR Morb Mortal Wkly Rep* 2011; **60**: 814–18.
- 7 Hiscock R, Bauld L, Amos A, Fidler JA, Munafò M. Socioeconomic status and smoking: a review. *Ann N Y Acad Sci* 2012; **1248**: 107–13.
- 8 Anderson W, Cheeseman H. Reading between the lines: results of a survey of tobacco control leads in local authorities in England. London: Cancer Research UK, 2016.
- 9 Kelly MP, Barker M. Why is changing health-related behaviour so difficult? *Public Health* 2016; **136**: 109–16.
- 10 Araújo-Soares V, Sniehotta FF. Healthy psychology: healthy choice architecture. *Nat Hum Behav* 2017; published online July 24. DOI:10.1038/s41562-017-0155.