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

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RW undertakes consultancy and research for and receives travel funds and hospitality from manufacturers of smoking cessation medications. JB has received unrestricted research funding from Pfizer to study smoking cessation. The other authors have no competing interests.
Population health and health inequalities are best conceptualised in a complex systems model with interdependent elements at various levels within a connected whole. This perspective suggests that wider influences on health such as socio-economic, cultural and environmental factors as well as social, behavioural and biological influences interact in generating population health outcomes. Recent debate has focused on an oversimplified argument pitching “upstream” against “downstream” approaches, calling for a shift of focus and funding from individual-level toward ‘upstream’, population-level approaches.

We argue that this distinction between approaches is based on a false dichotomy. Moving resources from one level to another will not promote the science and practice of public health. We should embrace a more ambitious agenda by studying the ways in which multiple levels within systems relevant to population health interact.

In talking about complex systems, there is a danger of reifying them and forgetting the people who make up systems. Human 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 a multitude of actions, practices and patterns of behaviour, linked in complex relationships with each other and the social and material world around them. Systems thinking requires understanding 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, creating a climate that is favourable to tobacco control interventions and where smokers feel encouraged and empowered to stop is itself likely to be fostered by people experiencing success at quitting, which is influenced by use of evidence-based - what some would call ‘individual level’ - support for cessation as discovered by RCTs and confirmed by real world evaluations.

The common argument that ‘individual’ interventions have low reach and impact, and tend to widen health inequalities is an overgeneralisation which obscures the difference between absolute and relative health inequalities. Interventions delivered directly to individuals such as vaccinations and smoking cessation support reach millions and have an indisputable impact on population health. Moreover, smoking cessation specialist support offered to individuals has been found to reduce inequalities. Unfortunately because of austerity policies, cost-effective ‘individual-level’ support has already been widely cut and it would be unfortunate if claims about limited impact justify further disinvestment.

The relationship between human agency and social structure is continuous, dynamic and relational and the emergent properties of the system arise from social practices which constitute that dynamic interaction. Individuals are at the heart of this, as are groups of individuals e.g. those with interests, often vested, that may be in contradiction to population health (e.g. the commercial world whose bottom-line is private profit). To improve population health, we need to understand that individual behaviours are key to population health; intervening without a thorough understanding of their complexity (e.g. 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.

We need a new model for public health evidence built on a sophisticated and nuanced understanding of complex systems from microbiological (e.g. interactions between environment and epigenetics) to global
(e.g., climate change) factors. Some successful population health campaigns such as responses to pandemic flu or the global campaign for smoking cessation demonstrate the effectiveness of multi-system, multi-level population health endeavours\textsuperscript{5,6}.

Some properties of complex systems cannot be directly predicted from the elements within it and are more than the sum of its parts. This is important when it comes to agency and responsibility for population health. In order to identify such properties, we need to be able to identify what can be directly predicted from the elements within the system. This requires at least a systematic modelling of main effects, mediators (mechanisms) and moderators (effect modifiers) between influences and interventions in the wider physical, economic, policy and socio-cultural micro and macro environments in interaction with individual, behavioural and biological factors\textsuperscript{10}. We need new methods of dynamic systems modelling that can identify targets, parameterise complex influences, uncertainties and inequalities, and evaluate perturbation effects and policy impacts over time. Methods such as agent-based modelling and micro-simulation methods are beginning to be used in population health, but we need to look to the world beyond health to identify state-of-the-art methods that we can bring into the study of population health.

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. If we focus on the system at the expense of what we know about individual actions, our conceptions and evidence will be the poorer for it.

References