

## Complex systems analysis: towards holistic approaches to health systems planning and policy

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Diseases and health conditions are, by and large, studied in separate silos. Policies to reduce morbidity and mortality are developed within each “disease silo”. In many parts of the world, there is still no systematic evaluation of disease control or health-care programmes, thus hampering efforts to efficiently allocate scarce resources. Health is not a stand-alone phenomenon with clear boundaries.<sup>1</sup> Diseases and health conditions have multiple causes, including social. They are interrelated with nature and nurture, and evolve over time. Health systems defy simple representation. They call for novel ways of thinking to improve our ability to predict and control individual and population-based health outcomes. A holistic framework is needed to capture disparate diseases and health conditions and their intricate relationships into a unified platform. Such frameworks are developed using complex network analysis.<sup>2–4</sup>

Complex systems are composed of networks of interconnected components that influence each other, often in a nonlinear fashion.<sup>5</sup> Whether we refer to an ecosystem or a health-care system, we must acknowledge the interplay within and between such systems. Complex systems analysis goes beyond the reductionist approach of breaking complicated phenomena into simple variables; new properties and behaviours evolve from the interactions between individual components. Over the past ten years, our understanding of complex networks and their properties has improved dramatically due to the development of a new arsenal of tools and technologies. These tools allow us to map the patterns of many real-life phenomena and help us to understand the mechanisms by which they can be influenced.

A health system consists of all organizations, people and actions whose primary intent is to promote, restore or maintain health.<sup>6</sup> Delivering optimal health ser-

vices depends critically on the incidence and prevalence of infectious or chronic diseases, on social determinants and on resources available. As such, whether global or local, health systems are complex networks that permeate all dimensions of human health.

At the societal level, social interaction is the basis for the spread of pathogens, from influenza to HIV/AIDS, or individual behaviours, from obesity to illicit drug use. At the institutional level, the complex interaction between national and international organizations is the basis for designing and implementing policy decisions on governance, allocation of workforce, services and technologies, sharing information and distributing resources. At the molecular level, several diseases have a common genetic or functional origin.<sup>1,7</sup> Hence a cooperative and collaborative approach to designing health interventions is required.<sup>8</sup>

In its work towards achieving the United Nation’s Millennium Development Goals,<sup>9</sup> the global community is poised for another turning point in science. A complex systems analysis framework is needed to integrate demographic and surveillance databases, and support decision-making when resources are scarce. This framework is modular, scalable and adaptable, thus avoiding a one-size-fits-all approach to designing health policies.<sup>8,10</sup>

Scientific literature has demonstrated very little overlap between disciplines involved in studying complex systems and those concerned with health systems evaluation. We need to build on the current momentum of interdisciplinary collaboration within the developing discipline of complex system analysis. As a newer paradigm, experts and trainees are expanding the body of knowledge from complexity theory to the analysis of complex health systems networks. Regionally or nationally, such

a framework would optimize integration of the essential functions of the health system while encouraging collaborations to increase cross-pollination in health systems research. This provides a perspective capable of analysing complex health issues of the 21st century. This new endeavour merits support to achieve its full potential. ■

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