

Emerging Global Health Challenges and Integrated Health Models

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ABSTRACT

Despite the achievements of modern biomedicine and public health in reducing disease incidence and improving human well-being globally, emerging infectious diseases, and more recently, emerging chronic and degenerative diseases are reversing these gains. New models and intervention approaches are needed that go beyond those of conventional biomedical and public health thinking and intervention approaches typically narrowly framed on the basis of reductionist models of health. This paper reviews the application of the ecological perspective in public health and associated systems ecological-oriented frameworks for addressing these emerging disease crises. Their utility as a means of integrative research and interventions that combine biomedical, social and environmental dimensions of health is increasingly being demonstrated. The social-ecological systems framework, which only relatively recently has begun to be applied in health science and practice, is particularly promising.

Introduction

Modern biomedicine and public health have contributed remarkable achievements to human well-being, especially in terms of contributing to the reduction of infectious diseases worldwide. This has included the eradication of dreaded diseases such as smallpox and the control of common childhood diseases (polio, measles, rubella, etc.) that once claimed millions of lives and caused suffering of tens of millions. This was made possible through improved diagnostics, surveillance, therapeutics, vaccines and an associated modern health system infrastructure.

These spectacular advances in health sciences during the first half of the last century are largely a result of the emergence and widespread acceptance of the biomedical paradigm in which the discovery of microbes and establishment of ‘germ theory’ played a central role. By the late 1960’s it was widely believed that infectious diseases had been conquered, or were at least conquerable in the case of malaria, dengue and other vector borne diseases (VBD) that appeared to be in retreat.

This confidence, together with a shift in attention to emerging chronic diseases toward the end of the last Century, resulted the diversion of funding away from field and ecologically oriented VBD research, training, and control campaigns. This, and the enthusiasm for laboratory and clinically oriented programs fueled by the continuing stream of breakthroughs in molecular biology-based technologies, largely collapsed what had been a more rationally

balanced set of approaches in medicine and public health.

Yet, by the 1980’s the HIV/AIDS pandemic followed by the appearance of new antimicrobial resistant strains of bacterial pathogens confidence that infectious diseases had been conquered began to erode. Major setbacks also increasingly became apparent in the efforts to control vector-borne diseases (VBDs), particularly with the resurgence of malaria and dengue fever worldwide.

Subsequently, entirely new diseases of wildlife origin like HIV/AIDS, SARS, NIPA, Highly Pathogenic Avian Influenza (HPAI/H5N1), and Ebola took the biomedical science and public health communities by surprise. Remaining in the background were, and still are, numerous neglected tropical diseases, most of them zoonoses or VBDs, the control of which remains challenging.

Formal recognition of ‘emerging infectious diseases’ (EID) as a new category of microbes (newly identified variants and re-surging or re-emerging pathogens as well as antimicrobial resistant strains) came in the early 1990’s [1]. Along with it came a realization that despite the power and authority it had deservedly gained the modern biomedical paradigm by itself may be insufficient. In fact, a strict interpretation of germ theory’s ‘Koch’s Postulates’ not only has undergone revision [2], but the idea of microbes as ‘bad’ and typically a threat to health has been challenged [3].

Human population growth and human-caused environmental changes accelerating with an unprecedented intensity and scale particularly since the mid-1900's is recognized as underlying cause of much of the EID problem [4]. These disease emergence drivers are emblematic of the era of modern development and can be seen as an extension of modern medical and hygiene interventions introduced a century earlier [5]. Together they radically modified (and continue alter) landscapes and ecosystems worldwide producing what has become a continual state of social, ecological and evolutionary imbalance [6].

Here I discuss how this global health challenge has helped focus attention on the need for rethinking the infectious disease research agenda, by integrating biomedical, social, and environmental sciences, employing ecological perspectives. I conclude with a discussion of how this may also apply to chronic and degenerative diseases whose incidence has been dramatically increasing worldwide.

Beyond reductionist models in the health sciences

The biomedical and behavioral sciences' application of ecological perspectives in the form of social ecology to public health interventions [7,8], acknowledges the critically important role of people's interactions with their physical and socio-cultural surroundings. These models borrowed from biological ecology the multilevel conception of nature, which in biological is expressed in the form of 'levels of organization hierarchy'—from cells to ecosystems and ultimately the ecosphere [9]. This conception of nature forms the central idea in ecology as an integrative science [10].

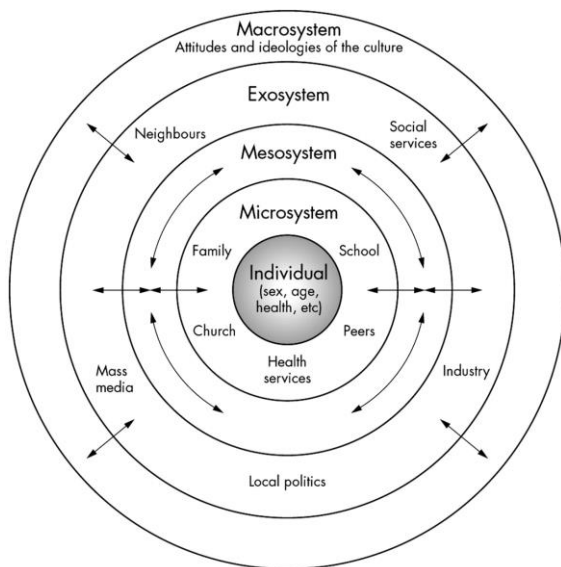


Figure 1. This diagram of McClaren and Hawe [16] illustrates the linkages between the numerous factors in the environment that influence an individual's life course including vulnerability to disease based on Bronfenbrenner's ecology of human development framework. This includes linkages between settings that a person may or may not be directly exposed to, but that are nonetheless important as they impact a person's immediate environment.

The complexity of factors and processes that underly infectious diseases, especially the transmission systems of zoonoses and VBDs, go well beyond the scope and analytic resolution of biomedical science (especially conventional medical training), and even conventional public health (e.g., epidemiology, hygiene and sanitation, etc.). Besides human behavior these factors include human ecology, pathogen/parasite and vector ecology and evolution, as well as the processes of the ecosystems of which the hosts and parasites are components [11,12]. The case of the Liver Fluke as the purported cause of relatively high liver cancer incidence in Northeast Thailand demonstrates how ignoring this complexity may actually undermine rather than support a public health campaign [13].

How this complexity can better be understood, including as a basis for more effective infectious disease interventions, drew attention to the idea of 'social-ecological systems' as new way of framing the global emerging infectious disease problem. This new way of framing disease problems first received attention of health scientists at a meeting associated with the United States National Institutes of Health Roadmap for the Future initiative more than a decade ago [14]. The social-ecological systems framework grew out of an area of research that originated in the field of systems ecology. It developed over a period of several decades, maturing a little over decade ago [15]. It can be seen an extension of ecological perspectives first employed in the health sciences, such as that illustrated in Figure 1. However, this and other early ecological models were developed prior to the recognition of EIDs, the newly emerging chronic and degenerative diseases, and the environmental changes occurring in parallel with them on a global scale.

The recently adopted Sustainable Development Goals (SDGs) of the 2030 Agenda for Sustainable Development represent a big step forward in recognizing the need to address the linkages between health, environment, and development. It is inescapable that an ecological systems-based approach, such as that offered by the social-ecological systems framework, is required to simultaneously address the roles of poverty, inequality and vulnerability in relation to global health challenges [17]. Figure 2 illustrates the more recent conceptualization of the breadth of factors that interact to affect health from a social-ecological systems perspective.

Ecology and rural health in Southeast Asia and beyond

Social-ecological systems framing of health is particularly relevant to health in rural areas. The health of individuals and communities in rural environments

is more immediately dependent on nature and natural resources, as indicated in Figure 2, than is the case for urban dwellers. Rural people also are more directly exposed to the negative affects of the degradation of these resources currently taking place at an alarming nearly everywhere in the world.

taking place throughout the developing world. Chronic psychosocial stress also is associated with behavioral changes that predispose to cancer such as increasing alcohol consumption, which, for example, has reportedly grown several-fold in Thailand since the 1960's [20].

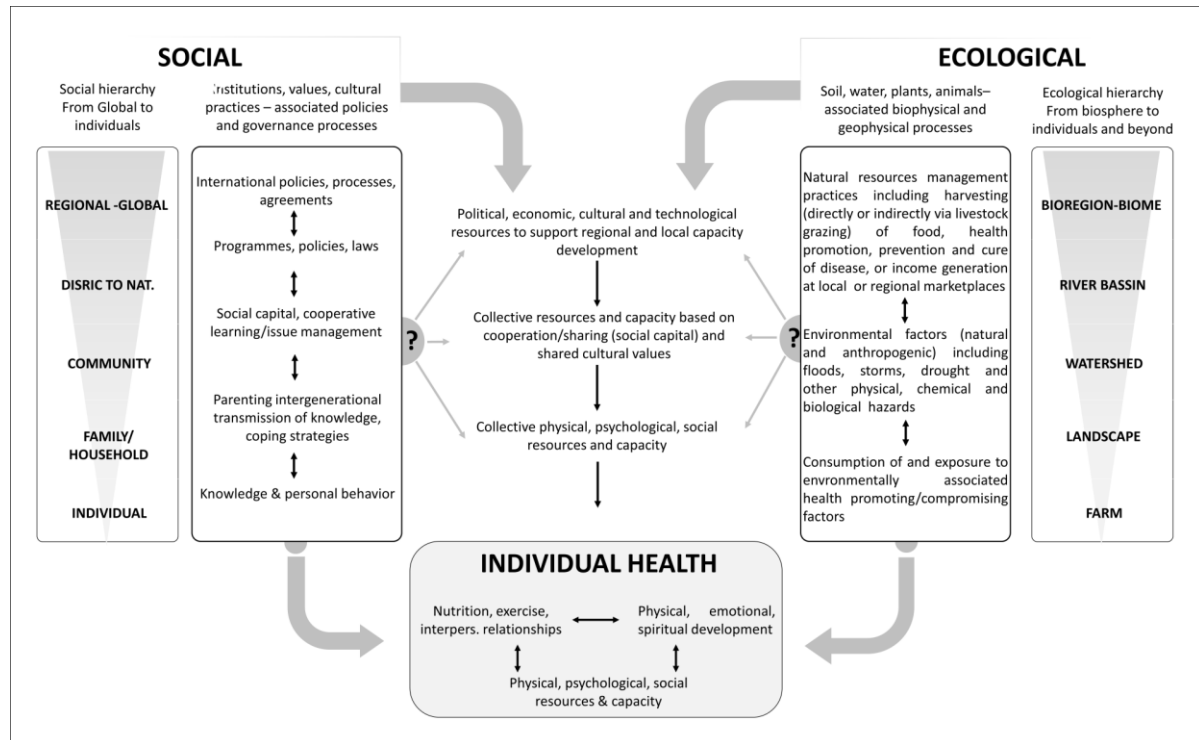


Figure 2. This diagram illustrates the interdependencies among social, ecological and health factors in rural, ecosystem-based societies intended to help guide interventions that could simultaneously address multiple SDGs directly and indirectly influencing health [18].

Moreover, rural people and communities throughout the developing world have been experiencing fundamental changes in their social, physical and biological environments largely associated with the shift away from small scale, diversified farming dependent upon traditional knowledge and farming methods, and indigenous crop and livestock genetic resources. This shift, which has tended to undermine social-ecological system resilience, is largely a result of government policies and programs. These generally have favored abandonment of these systems for larger scale, less diversified, commodity export crop production. The associated breakdown of social cohesion in local communities and the increased economic disparity is known to affect environmental, physiological and psychosocial health with mutually reinforcing influences [19].

Chronic as well as infectious disease risk increases under chronic and acute stress conditions due to both environmental and psychosocial exposures and circumstances associated with the rural transition

Environmental degradation, deforestation and agriculture intensification are significant downsides of recent decades of modernization in rural Southeast Asia [21]. Alarming, agrichemical overuse and exposure also have increased dramatically, for example, in rural Thailand in recent decades with 73% of the agrochemical imports into Thailand classified as extremely hazardous by WHO [21].

Increased cancer risk was estimated in fishermen throwing and/or placing a fish net in the water in central Thailand because of the presence of and exposure to dieldrin, DDT, β -HCH, heptachlor, and heptachlor epoxide in the canals. Similarly, drinking water or eating food contaminated with nitrates (from fertilizers) has a potential role in developing cancers of the digestive tract and has also been associated with other types of cancer. The relatively high incidence of cholangiocarcinoma in Northeast Thailand likely could be, accordingly, due more to the increasing amount of agrichemical use in agro-ecosystems than liver fluke infection [22].

Social-ecological system resilience and community health

Not only are rural populations' health dependent upon, and in fact interdependent with their environment, the same is true for urban dwellers. Their health similarly depends on their knowledge and skills which influence health behavior. The acquisition, maintenance, and transmission of healthy lifestyles depends upon unimpaired cognitive and emotional capacity. These qualities (or the lack of them) are reflected by problem-solving and decision-making capacity of families, the communities they constitute, and the larger social-ecological systems in which they are embedded.

Obviously, this capacity is needed as the basis for not only sound decisions affecting health but dealing effectively with uncertainty and managing risk collectively by a community. Awareness and perception of the environment (in fact the social resources as well), depends on individual and collective knowledge, awareness and skills. Termed social and cultural capital [23], these have been described as essential, along with ecological or natural capital, to how social-ecological systems retain, build, and lose resilience [24].

Finally, the importance of the maintenance and utilization of local knowledge, including traditional ecological knowledge [25] is a component of this conception of resilience. It has been shown to be essential for sustainable land use and environmental management practices as well as traditional medicine and healing practices. Integration with complementary modern biomedical technologies and treatment are increasingly widely accepted as essential to health systems that are truly effective and accessible. The current conventional health systems model, for example, described in reference to universal health coverage ignores how rural and even urban communities' function as social-ecological systems. Instead it is aligned more with a top-down, commercially oriented health services model, based predominantly on the Western allopathic medical-pharmaceutical paradigm that arguably not only is culturally insensitive but economically infeasible [26].

Emerging chronic and degenerative diseases

The dramatic increase in chronic, degenerative diseases, which collectively have been referred to as 'cardiometabolic diseases of civilization,' is rapidly surpassing EIDs as an even more challenging global health problem [27]. Though the ecological perspective is widely accepted as critical to understanding EIDs as well as risk behavior in relation to some chronic diseases, this is not case for this more recent emerging disease crisis.

However, the evidence shows this is, in fact, explained mainly by human's ecological transition in terms of lifestyle and especially diet and nutrition. As suggested by their description "as diseases of

civilization," chronic degenerative diseases are typically found to be rare and often non-existent in non-industrialized cultures, with their longevity often similar to that of modernized societies [28].

Increased consumption of processed foods [29] and metabolism disrupting chemicals [30] may play important roles among other environmental exposures. More generally though, the increasing incidence of chronic and degenerative disease is believed by many researchers a consequence of the mismatch between our genetic heritage, which was molded by living with nature, and modern lifestyles.

Modern human populations' increasing separation from biologically diverse natural ecosystems and agroecosystems, and consumption of the plants and animal harvested from them rather than factory farms arguably are an important factor contributing to the current chronic and degenerative disease crisis [31]. This lends yet more support to the need to reframe health problems employing an ecological perspective.

Concluding thoughts

Health researchers and practitioners face the task of finding new ways to understand and more effectively address a wide range of emerging global health challenges. This will undoubtedly include disease and health related problems not yet even recognized, as was the case when modern health sciences emerged just over a century ago. The biomedical model and the theories of hygiene and sanitation that proved so successful then—and provided the foundation upon which today's predominantly Western allopathic oriented health systems are based—are giving way to new understandings.

Recognition of the need for new perspectives driven largely by the introduction of the ideas of positive health and health promotion [32] coincided with and undoubtedly were influenced by the development of ecological perspectives applied to disease and health. Parallel developments in biological ecology led to, among other things, the development of social-ecological systems theory. The framework and unique conception of resilience it provides offers a promising new way of thinking and set of tools for health research and practice. These are similarly applicable to a wide range of biological, social, and environmental challenges pertinent to sustainable development. Thus, the current focus on achievement the Sustainable Development Goals, nearly all of which have a health dimension when a health promotion-ecological perspective is considered, presents a unique opportunity for the health sciences.

To best exploit this opportunity, it may be helpful to consider that how a problem is framed determines the research questions asked, therefore the type of evidence generated and ultimately whether a health problem actually is meaningfully addressed and

ultimately solved [33]. Problem framing is integral to evidence-based research in public health, which has been defined as the “informed, explicit, and judicious use of evidence that has been derived from any of a variety of science and social science research and evaluation methods” [34]; and, is considered one of the defining characteristics of global health [35].

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