The Importance of a One Health Perspective in a Changing Environment

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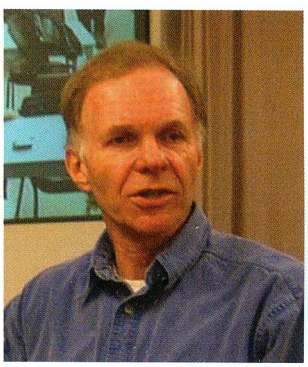

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Introduction

One Health recognizes that the health of people is connected to the health of animals and the environment — Centers for Disease Control and Prevention (CDC) (1)

The One Health view leads the scientific community to consider the interconnectedness of humans, animals and the environment rather than studying them in isolation. This, advocates believe, can lead to improvements in understanding, preventing and treating human and animal diseases. There is nothing new here; we have always understood that the three are connected, that their Venn diagrams intersect.

However, rapidly changing global conditions have brought about a spike in attention to the One Health framework. What conditions specifically? There is an increase in human migration brought about by politics, sectarian aggression, improved transportation systems and, most notably, climate change. Warming of the planet has affected human and animal migration patterns — and not just large land and sea animals but small vectors as well — and these have had a particularly noticeable impact on human health. The mosquito, for instance, which we'll discuss in a moment, has had a field day venturing into regions once known to be inhospitable to these temperature-sensitive insects. The climate impacts insect vectors, which, in turn, impact animal and human health.

The point is that a constellation of conditions has altered how humans and animals interact, where they interact and the health implications of their encounters. We will look at several examples later in this article.

More than an academic exercise, this framework for understanding the complex interrelationships is valuable for clinicians. Their expectations for the surfacing of a disease and their diagnoses and treatments of patients can benefit from an understanding of a broad range of contributing factors, especially in a time of accelerating changes.

Consider this example: Warming temperatures hasten the movement of plants and animals to regions where earlier

they could not have survived. The Aedes aegypti mosquito has been found in large numbers in sections of North America where it was never before seen. Consequently, diseases borne by Aedes aegypti are spread to humans and animals in areas where the diseases previously were rarely a concern. Fortunately, the spread of Zika never reached the levels predicted by some researchers in the early days of the disease outbreak, but Zika did attain a geographic spread we would not have expected only a decade or two earlier when the climate was more hostile to the vector.

Consider another factor: Not only does a warming climate enable the mosquito to venture into new territory, but viruses grow more quickly in warmer temperatures, which allow the virus to develop more rapidly within the mosquito's body. That's a critical point when you consider the relatively short lifespan of a mosquito — about 10 to 12 days. According to Tom Scott, a professor of entomology and epidemiology at the University of California, Davis, that's also about how long, on average, it takes for a virus to grow. So ordinarily most mosquitos have only a brief day or two to spread the disease. When the virus within the mosquito grows more rapidly, however, it arms the mosquito for more of its life to infect people before it dies (2). This is no small matter when so many viruses are spread by the mosquito, which now has more days to spread an infection across a wider geographic region. This example lays bare the interconnectedness of animals, humans and the environment.

In this brief introductory article, we look at the implications of considering the intersection of human and animal health and conditions of the environment. WiRED International, a non-profit organization that provides global health education in underserved regions, is configuring its training programs to reflect the principles of One Health. There is often more human-animal contact in places WiRED works than in most Western countries. Moreover, the impact of climate change can be even greater. Food-growing areas have dried up, forcing entire populations to move; sea level rise has driven people back from the sea; vectors have become more aggressive because of warmer temperatures and increased rainfall; and people in under-served regions often don't have the resources to fend off mosquitos, ticks, chiggers and other carriers. There is every reason to believe that these threatening conditions will continue and expand into the future, and so the importance of a One Health framework offers a critical structure for the understanding of human and animal health, now to be reflected in WiRED's training material.

Western University of Health Sciences, where two of the authors of this article are professors, is launching programs that include the study of One Health for its medical and veterinary students. Yes, the concepts of One Health, around for more than a hundred years, have become more prominent during the past two decades because of the benefits evident in such an integrated view of health. Physicians and veterinarians of tomorrow — faced with the overwhelming forces in play by a changing environment and rapidly shifting patterns of human and animal migration — must embrace a wide view that includes in a single frame the understanding of the three key elements interrelated in their effects on the planet and its inhabitants.

Background history

As we stated, it has been known since the 19th century that human health and animal health are interdependent and both connected to the health of their common ecosystems. The names most associated with this thinking are Rudolf Virchow, M.D. (1821–1902), and William Osler M.D. (1849–1919), both of whom are credited with the recognition of a link between human and animal health. Prominence of this view has ebbed and flowed over the years, and resurfaced in 1964 at the University of California, Davis. It became even more pronounced in 2000, when the One Health tag was introduced as a "holistic approach" to prevent epidemic/epizootic diseases and to maintain ecosystem integrity.

The One Health concept became an approach "to designing and implementing programmes, policies, legislation and research in which multiple sectors communicate and work together to achieve better public health outcomes" (3). CDC refers to One Health as "a collaborative, multisectoral, and trans-disciplinary approach — working at the local, regional, national, and global levels — with the goal of achieving optimal health outcomes recognizing the interconnection between people, animals, plants, and their shared environment" (underline ours) (1).

The common theme among all definitions of One Health is the tight relationship among humans, animals and the environment and, accordingly, the logic of rigorous collaborations across sectors. Fundamental to such working relationships is the recognition of direct impacts on health by working across silos and optimizing resources while respecting the autonomy of the participating sectors.

The One Health approach has been formally recognized by all major health agencies, including the U.S. Department of Agriculture, CDC, the World Health Organization (WHO), the Food and Agriculture Organization of the United Nations, the European Commission and

many others.

What is the logic of One Health thinking?

One Health has gained prominence because of a measured emergence and re-emergence of many infectious diseases affecting humans and animals worldwide. At the heart of One Health thinking are causal factors such as rapid population growth, globalization of human activity and environmental changes. These factors change the dynamics of interactions among people and among people and animals and the conditions that bring about or exaggerate changes in the spread of disease. Previously, we discussed the simple example of how climate change has increased the capacity of mosquitos to spread infections more quickly and more widely. That is one of many instances where disease today can be spread at an accelerated pace.

Consider the emergence of a number of zoonotic diseases — including HIV, Ebola, Rift Valley Fever, Lyme disease, West Nile virus and many more — that have imposed worldwide risks to public health. As we noted, these risks increase with globalization, climate change and changes in human behavior, giving pathogens numerous opportunities to colonize new territories and to evolve into new forms. The most evident example in this group is Ebola, where simply touching an infected individual or the belongings of an infected individual may be enough exposure to transmit the virus. Migration has obvious implications for such a virulent disease.

Population migration patterns impact the spread of disease, and we are seeing more evidence that climate change may be a great accelerator. A warming planet endangers health by affecting water resources, agriculture, infrastructure and ecosystems. Additionally, the prevalence of infectious diseases transmitted through food, water and insects is influenced significantly by climate factors, primarily high and low temperature extremes and precipitation patterns.

Vector-borne diseases are among the most complex of all infectious disease. WHO estimates vectors to account for more than 17% of all infectious diseases (4). Further, WHO estimates that every year there are more than 1 billion cases globally and more than 1 million deaths from vector-borne diseases, such as malaria, dengue, schistosomiasis, Chagas disease and yellow fever. In the United States, the U.S. Global Change Research Program reported 14 vector-borne diseases that are currently of national public health concern (5). These diseases are difficult to prevent (vaccines are available for only a few vector-borne diseases) and control in part because the vectors themselves integrate so thoroughly within the human and animal populations.

Implications of climate change and vector control

With respect to environmental impact on vector populations, the current debate on climate change around the world and especially in the United States takes on a new urgency. Despite overwhelming evidence from thousands of studies, remarkably there is a small but influential group that argues climate change is a fiction. Their resistance to the data is more than a curiosity when it translates into policies that directly impact human and animal health. Curbing the use of fossil fuels can slow the changes already underway, but unaltered, continued burning of carbon-based fuels will lead to exaggerated environmental conditions with dangerous consequences. One of them is to increase the deadly impact of disease-bearing vectors.

Zoonotic diseases

We have discussed vector borne diseases, but zoonotic diseases, infections shared between humans and animals, are a key feature of One Health discussions. Zoonotic diseases can be caused by the range of infections, including bacteria, viruses, parasites and fungi. Moreover, zoonotic diseases are more common than many people think. CDC reports that more than 60% of infectious diseases in humans are spread from animals and that 75% of new or emerging infectious diseases are spread from animals (6).

How are the infections spread? In four ways:

Direct contact. Humans can be infected by coming in contact with body fluids from an infected animal. Being bitten or scratched and even touching an animal can transmit the infection.

Indirect contact. Environments in which animals have lived or roamed may harbor the infectious agents that can be picked up by humans. Barnyards and watering troughs are common areas for indirect contact.

Vector-borne. We have discussed vectors earlier. Insects such as mosquitos and ticks are considered to be animals for this discussion, and as we have seen, their bites and stings can transmit infection.

Foodborne. The feces of infected animals can be found on fruits and vegetables that have not been properly washed. Undercooked meat or eggs and unpasteurized milk can also become a source of infections. CDC reports that fully 1 in 6 Americans each year become sick from eating contaminated food.

It has long been known that animals can transmit disease to humans, so nothing is new here. But, how does this fact fit into our discussion of One Health? While

animal-human transmission has occurred for thousands of years, new migration patterns — caused by factors we noted earlier, including political turmoil, climate change influences on food resources and sea level rise — elevate the concern for rapidly changing patterns of human to human and human to animal contact.

Plants once unable to survive in the cool temperatures associated with higher elevations and higher latitudes now move into these areas that have warmed from climate change, and the animal populations that live in these habitats move as well, putting animals in contact with humans to whom they have not been previously exposed. Diseases travel and spread with their animal hosts and introduce humans to new profiles of infectious diseases (7). The dynamics are complex and involve the interplay of human institutions and human-animal contact, climate change, food supplies and shifts in available land where humans can survive.

Yes, there has always been human and animal migration; what is new is the speed with which it is occurring today (8). The movement of populations is faster. Droughts, floods, extreme temperatures, wild fires and other environmental conditions are accelerating and, accordingly, the migrations of humans, animals and plants are occurring at a faster pace. These rapid changes make the framework of One Health thinking ever more important in our understanding of the influences on human health. While the bottom line concern of physicians is the health of human beings, it is becoming ever more evident that we cannot think about human health in isolation. That was never a wise construction and it is even more untenable today at a time when the influences on human health are more complex, more evident and happening ever more rapidly.

Healthcare professional roles in One Health

Communication and collaboration among healthcare professionals — along with their national and international affiliates and their alliance with the United Nations and nongovernmental organizations — play a significant role in the advancement of One Health. This is so because collective action is more effective than individual group action; collective advocacy draws greater public awareness of the interrelationships among human, animal and environmental health.

Such alliances naturally take us beyond the conventional settings of healthcare professionals — hospitals and clinics, medical and veterinary schools, research labs. A natural follow-on to One Health thinking is that an evolving role of medical and veterinary professionals is to inform the debate. No one can speak with greater authority than these experts who recognize the One Health construction, who know the science and recognize the constellation of forces acting on human and animal health. At the end of the day, it may fall to medical and veterinary practitioners, who see health impacts on the ground, to be certain the One Health view is represented in critical policy discussions at the local, regional and global levels.

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