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FROM THE EDITOR

Emerging Infectious Diseases at the Intersections of Human, Animal, and Environmental Health

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The health of humans, animals, and their shared environments is inextricably interconnected. These connections are particularly evident in the increase in infectious disease emergence in recent decades.[1,2] Up to 75% of emerging infectious diseases are zoonotic, ie, caused by viruses and other microbes "spilling over" from nonhuman to human animals.[1,3] Such infections can be deadly, as seen with Ebola, SARS, MERS, and, more recently, COVID-19. Fatality rates in some Ebola outbreaks have been as high as 90%.[4] Climate change elevates risk of cross-species transmission events and epidemics,[5,6] along with disruption of natural ecosystems (eg, deforestation, extractive industry, farming practices) that increase interaction among human and nonhuman animal reservoirs and create more opportunities for microbes to jump species. A 2022 World Bank report states: "Sixty percent of the drivers of the 100 biggest outbreaks since 1974 fall within the domains of land-use change, especially related to forests and food systems, in particular livestock operations."[7]

Risk of zoonotic spillover increases in areas where human and nonhuman animals come into close proximity, such as areas where live markets or some hunting practices are common. Greater, more rapid movement of people and nonhuman animals also means emerging diseases can quickly spread regionally and globally, highlighting the urgent need to apply interdisciplinary approaches to prevent pathogen spillover and transmission.[7,8] One such approach is One Health, defined by the World Health Organization as "an integrated, unifying approach that aims to sustainably balance and optimize the health of people, animals and ecosystems. It recognizes that the health of humans, domestic and wild animals, plants, and the wider environment (including ecosystems) are closely linked and interdependent."[8]

Although this approach emphasizes cross-disciplinary collaboration among epidemiologists, public health authorities, community leaders, ecologists, vaccine developers, and veterinarians to address disease control and transmission prevention, conflicts about priorities can emerge that raise ethical questions. Low- and middle-income countries are frequently at higher risk of spillover events,[9] and they can be inequitably harmed during epidemics.[10] Work at the intersection of clinical, agricultural, and wildlife communities is often complex and fraught with competing interests and differing cultural values. For example, a Nipah virus outbreak in Malaysia from September 1998 to May 1999 was thought to result from local ecological changes that brought the virus host bats in close proximity to intensive pig farming operations, with subsequent viral spillover from bats to pigs to humans.[11] The epidemic was eventually controlled by medical-agricultural collaboration and involved the slaughter of over a million pigs, which had important fiscal consequences for farmers.[12] This example highlights the need to balance livestock and public welfare when promoting sustainability.

Another such example is SARS-CoV-2, which may have originated from spillover from bats to humans via a live animal wet market.[13,14] Interestingly, since 20% of mammal species are bats,[15] bats are frequently implicated as potential sources of emerging human diseases.[16] Yet bats are also essential parts of healthy ecosystems, and efforts to reduce spillover infections to humans by simply culling bat populations have often resulted in increased virus transmission risk.[17,18] Interdisciplinary approaches are thus key to responding to emerging infectious diseases, zoonotic spillover, changing ecological landscapes, and disease transmission trends.

A third example of spillover events that highlights the need for interdisciplinary collaboration is Rift Valley fever. Occurring in both livestock and humans—with farmers, herders, veterinarians, and slaughterhouse workers at highest risk—Rift Valley fever periodically causes devastating epidemics in certain regions of Africa and the Arabian Peninsula.[19,20] Key effective public and environmental health collaboration efforts can include vaccinating nonhuman animals, which protects them and reduces human infection risk. Yet doing so requires financial and political players' participation.[21] Such examples and their social, cultural, and ethical complexities are considered in detail in this issue of the *AMA Journal of Ethics.*

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