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Environment: the neglected component of the One Health triad



See [Articles](#) page e264

The One Health approach was conceptualised as a global public health strategy that encourages interdisciplinary collaboration and communication on health at the human-animal-environmental interface.¹ It is defined by the American Veterinary Medical Association as “the collaborative effort of multiple disciplines—working locally, nationally and globally—to attain optimal health of people, animals, and our environment”.² The One Health Approach gained popularity in response to zoonotic public health emergencies such as the outbreaks of severe acute respiratory syndrome, Middle East respiratory syndrome, H1N1 influenza, Ebola, and Zika. One Health is also prominent in several global commitments and political declarations such as the Sustainable Development Goals, the International Health Regulations, the Global Health Security Agenda, the UN Paris Agreement on climate change, and the UN Political Declaration on Antimicrobial Resistance. It forms the basis of the tripartite alliance of WHO, the Food and Agriculture Organization of the United Nations, and the International Organization for Animal Health.

One Health consists of the triad of human health, animal health, and the environment, but the latter is often neglected, as evident from its absence or cursory mention in most of the initiatives mentioned. This neglect of the environment was also a key finding of the systematic analysis of One Health Networks (OHNs) reported by Mishal Khan and colleagues in *The Lancet Planetary Health*.³ The paper highlights to the funders of OHNs the importance of ensuring the equitable inclusion of the human, animal, and environmental sectors of the triad against a consensus definition of One Health to ensure a return on investment by transparent monitoring and evaluation of explicit One Health outputs, outcomes, and impact that improve the strategic direction, coordination and efficiencies of OHNs, locally, regionally and globally.

The environment is the most dynamic and consequently the most confounding sector of the One Health triad as evident from the examples of antibiotic resistance and climate change. Antibiotic resistance has been described as the “quintessential One Health issue” as it exists in all three sectors. The relative roles

of the three sectors in the development, transmission, and persistence of antibiotic resistance are, however, poorly understood.⁴ Antibiotic resistance is a direct consequence of the selection pressure from warranted and indiscriminate antibiotic use in human and animal health⁵ and antibiotic exposure in the environment. Use of antibiotics in animal production systems at sub-therapeutic doses for prolonged periods creates optimal conditions for bacteria to entrench antibiotic resistance genes. These genes are subsequently transferred to human pathogens or commensals via humans, contaminated food, or the environment. Antibiotics used in humans and animals are frequently analogues of each other, which potentially drives the transmission of resistance between humans and animals, and there is growing evidence linking antibiotic consumption in livestock to antibiotic resistance in the clinic.^{4,6} The burden of antibiotic resistance is least well understood in the environment. Environmental bacteria, which are quantitatively the most prevalent bacteria, serve as reservoirs of resistance genes that can become incorporated into human and animal pathogens over time. These resistance gene reservoirs are augmented by the influx of resistance genes from livestock and human waste into the environment. They are further augmented by the entry of antibiotic residues from pharmaceutical industries, intensive livestock farming, and hospitals, which disrupt the soil and water microflora in addition to exerting selection pressure for the development of resistance.⁴ The environment is subject to variable weather patterns, particularly fluctuations in temperature, humidity, and precipitation (not the least of which is as a result of climate change) that affect bacterial ecosystems, making the environment a vacillating sector in the One Health antibiotic resistance triad.

Environmental issues have gained greatest traction in terms of climate change and its adverse effects on the health of humans, animals, and the environment. Climate change compromises the ecological and environmental integrity of living systems⁷ by inducing lifecycle changes in pathogens, vectors, and reservoirs; new and emerging

diseases of plants and food and domestic and wild animals; trophic cascades; interfering with the synchrony between interacting species in a particular habitat; and modifying or destroying habitats.⁸ It has been termed the “threat multiplier” in that it adversely affects infectious diseases, zoonosis, food security, food safety, and local, regional, and global responses to them.^{7,8} Aligning One Health with climate change could entrench the environmental sector in the One Health triad.

The inextricable links between human, animal, and environmental health necessitate a systems approach to One Health. This approach acknowledges that health and disease occur within complex molecular, biological, ecological, economic, social, policy, and political systems. The approach focuses on understanding the functioning of systems, both individually and collectively, in terms of their dynamic relationships, feedback loops, interactions, and dependencies.⁹ The success of OHNs is thus contingent on coordinated, interdisciplinary, transdisciplinary, multidisciplinary, multi-stakeholder, multipronged systems partnerships underpinned by national and international policies that suspend sectoral interests for the advancement of One Health.

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I declare no competing interests.

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