



Environmental health: The most neglected part of one health

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ABSTRACT

One health concept and perspectives have gained momentum in past few years in global health sector. Keeping in view the increased popularity of “one health” American Veterinary & Medical Association has defined it as the emerging interdisciplinary field that inherently collaborates human, animal and environmental aspects to combat emerging global health problems especially related to zoonotic public health emergencies. According to key findings of “One Health Networks (OHNs)” environmental factor is the most neglected part of one health triad that consists of human-animal-environment interface. Currently, human and animal health has been constantly threatened by rise of novel challenges like antimicrobial resistance, environmental pollution, epizootics, pandemics, development of multifactorial chronic ailments etc which needs an interdisciplinary and intersectoral expertise. Ecosystem health and its adverse effects on human and animal health have gained greatest attention over recent years as it serves as melting pot for all infectious diseases. Despite of achieving global success in the field of “One health” it is still in embryonic stage in our country. So, the success of one health requires breaking down the shackles that still separate human and veterinary medicine from environmental, evolutionary and ecological sciences that will ultimately lead to desired equilibrium and dynamics in maintaining healthy ecosystems.

Introduction

New challenges always demand new approaches. Over the past few decades, human civilisation has been threatened by rise and spread of certain infectious agents that leads to significant increase in global mortality and morbidity rate. With the emergence of epizootics, epidemics, zoonoses at regular interval in past few years has led to the outburst of global pandemic in the form of COVID-19 in 2020 which made human life more critical. Apart from that, some of the greatest advances and holistic scientific approach in human and animal health care sector has also been threatened by the emergence of antimicrobial resistance, environmental pollution, occurrence of various multifactorial and chronic diseases etc. (Destoumieux-Garzón *et al.*, 2018). With the exponential rise in global human population and its associated problems like industrialisation and various geopolitical issues like habitat destruction,

bidirectional migratory movements of mankind and behaviours in ecosystem has led to the better understanding of different emerging and reemerging disease dynamics. Therefore from global health security perspective which includes an integration of human health, animal health, plant health, ecosystem and biodiversity, the “One Health” concept was enforced in 2004 by breaking down all the interdisciplinary barriers between human and veterinary medicine (Zinsstag *et al.*, 2011). Keeping in view the above hindrances in the pathway of scientific development, “One Health” was formulated from “One Medicine” concept in 2004 that assembles human and veterinary medicine in response to zoonoses (Davis and Sharp, 2020). It is defined by the American Veterinary Medical Association as “the collaborative, multisectorial, coordinated and transdisciplinary approach of working locally, nationally and

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globally in order to attain optimal health of people, animals, and our environment” (Lee and Brumme, 2013). The “One Health” concept got substantial attention in past 15 – 20 years due to occurrence of various emerging and reemerging zoonotic diseases like SARS, MERS, H1N1 influenza, Ebola, and Zika, Nipah, Marburg etc. (Evans and Leighton, 2014). Apart from that, “One health” recognises the connecting link between human, animal and environmental factors that leads to epidemics and pandemics as it was promoted by several international agencies like WHO, World Organisation for Animal Health (OIE), the Food and Agriculture Organization (FAO) of the United Nations (UN), the World Bank since 2010 in order to monitor global activities that ultimately hampers global health (Khan *et al.*, 2018).

Overview of One Health

One Health triad consists of 3 components viz. human health, animal health and environmental health but the latter part is ignored in most of the times which was identified as key finding of systemic analysis of various One Health Networks (OHNs) (Essack, 2018). When European health and environmental ministers met World Health Organization (WHO) regional director for Europe on June 15, 2017 in Ostrava, Czech Republic for the sixth ministerial conference on Environment and Health they recognised that the holistic approach of welfare of human population could not be achieved with negligence of Ecohealth (Khan *et al.*, 2018).. The environment acts as the most dynamic and astounding sector of one health as it’s quite evident from the evolution of antimicrobial resistance and climate change. Antimicrobial resistance is defined as a complex and versatile problem that grasps human and animal health thereby threatening the global economy and security (White and Hughes, 2019). Recently, emergence and rapid geographical dissemination of 2 antimicrobial resistance genes shook the entire world. An enzyme New Delhi metallo-beta-lactamase 1 (NDM-1) that offers resistance to almost all antibiotics was detected from the tap water samples and environment in India and Bangladesh respectively in 2010 (Islam *et al.* 2017). Similarly, MCR-1 (mobilized colistin resistance-1) gene, a plasmid borne gene conferring colistin resistance, was detected from pigs population in China in 2014 and has eventually

moved to other countries later on (Liu *et al.* 2016). According to WHO report in 2019, antimicrobial resistance is regarded as the top ten threats to global health thereby suggesting the need for coordinated integration of environmental, aquatic and wildlife issues for better AMR surveillance (White and Hughes, 2019).

Unless and until we have a complete comprehensive understanding of ecosystem dynamics it is impossible to assess the degree of alteration and adulteration caused by various anthropogenic factors in the direction of evolution, occurrence and dissemination of infectious agents. The genotype of all microorganisms originate in their natural environment through various genetic alterations like mutation, recombination, transduction, hybridisation and express their phenotypic traits by colonising different hosts at different point of time (Destoumieux-Garzón *et al.*, 2018). Currently, majority of infectious diseases are zoonotic in origin and among them three-fourth originate in wild animals. The mechanism underlying the emergence of disease in human population directly links to domestication of wild animals and transgression of species barrier. Basically, vector borne transmission agents develop due to above transgression mechanism along with some other factors which includes environmental perseverance, host diversity, community interaction etc. (Kelly *et al.*, 2020).

Devastation of natural habitat, and climate change adds more misery to the terrible degradation of ecohealth. All these environmental issues act as a confirmed catalyst in the process of occurrence and reoccurrence various infectious agents that flare up the adverse effects on the health of humans, animals and environment (Levy, 2015). In recent past, global climate change induced certain alteration in life cycle of pathogens, vectors and reservoirs thereby assisted in development of various destructive epidemics like H1N1, H5N1, coronavirus, Ebola, Zika, dengue, chikungunya, Nipah etc. Global warming is solely responsible for appearance of new diseases in plants and animals in a particular area that had never appeared before by altering the synchrony between interacting species thereby modifying their natural habitat. Example – schistosomiasis and chikungunya emergence in European continent, Ebola epidemic in Western Africa (Gebreyes *et al.*, 2014).

Similarly, trade globalisation and industrialisation of agricultural practices have occurred in a short span of evolutionary time scale. These trends are accompanied by ecological, behavioural and a socio-economic change induces loss of biodiversity that leads to colonisation of new territories by infectious agents. The intensive farming and breeding practices like offensive use of pesticides, fertilisers and antibiotics lead to the generation of new variant of insecticide resistant mosquito species (etioloical agent of malaria, arboviruses, filariosis, dengue, etc.) which is also resistant to certain antibiotics in bacteria (Stoate *et al.*, 2009).

Environmental pollution is acknowledged as another major factor responsible for degradation of ecosystem. Human and animal population are vulnerable to several pollutants resulted due to increased anthropogenic releases in the environment, certain emerging pollutants like micro and nanoplastics, along with emission of certain natural toxins like shellfish poisoning due to microalgae. Due to urbanisation, wildlife and domestic animals are on the verge of extinction due to continuous exposure to natural contaminants thereby reducing their chances of survivability and reproducing ability (Essack, 2018)..

Control Measures

In this rapidly developing world, where anthropogenic activities have a devastating effects on ecosystem, it has also created a loophole in the “One Health” framework. Therefore the concept of “resilience” emerged as a fruitful opinion to describe the response to ecosystem disturbances. Resilience is defined as the ability of socio-ecosystem to absorb disturbances created by external force in order to maintain a dynamic equilibrium state (Destoumieux-Garzón *et al.*, 2018). All the natural phenomenon of biological diversity like predation, competition, host-symbiotic relationship are required to maintain fitness of ecosystem as it helps in diluting the spread of infectious agents and disease transmission. Sometimes nature provides best possible solution to restore its natural integrity. Bacteriophages are regarded as natural predators of bacteria that help in reduction of bacterial population in the environment (Argov *et al.*, 2017). Similarly, use of anti-microbial peptides opens up a

new direction in pathogen dynamics. Being a part of innate immune response, it acts by destabilising the biological membranes by forming trans membrane channels and thereby enhance immunity by working as immuomodulators (Destoumieux-Garzón *et al.*, 2016). Another important aspect regarding control of pathogens at human-animal-environmental interface is development and implementation of certain management policies that upholds the transboundary regulations. Therefore, a tripartite initiative have been taken jointly by OIE, WHO and FAO that aims to work in close connection with various intergovernmental organisations, research institutes, private sector farms and other stakeholders in order to write another glorious chapter of “One Health”(Herten *et al.*, 2018).

Conclusion

Despite of the worldwide support and commitment by various international organisations in the direction of one health concept has increased manifold but seems to be a daunting task in its implementation. Development of one health platform at grass root level is the most challenging task as some activities might not be feasible without external funding. Political invasion from various sectors proves to be a major challenge in front of scientific communities to implement “One Health” concept thereby limiting the development of trans disciplinary approaches and integrated operational actions (Aggarwal and Ramchandran, 2020). In the book Zoobiquity: what animals can teach us about health and the science of healing , the authors remark, ‘In a world where no creatures are truly isolated and diseases spread as fast as jets can fly, we are all canaries and the entire planet is our coal mine. So, before any species comes under the sentinel of danger, it’s the duty of everyone to understand the scientific basis and rich heritage of “One Health” concept before it’s become too late. Famous Russian writer Leo Tolstoy quoted some beautiful lines regarding environment that is “one of the first conditions of happiness is that the link between man and nature shall not be broken” which illustrates the importance of environmental health in safeguarding the “One Health”.

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