



## Review Article

# One Health Approach: Veterinary Perspectives in Global and Indian Context

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### ABSTRACT

Conjoint relation should exist between human-animal-ecosystem interfaces for the sustainable development. Any breach in the equilibrium results in an asymmetry in the sustainability eventually results in the emergence of global issues. Approach from only human medicine cannot alleviate the threats; veterinary medicine, environment conservation should also contribute equally to palliate the inevitable scourges. The concept gained high impetus in the past half decade time even though the theme established its roots from time immemorial as an integrated medicine concept and termed to be 'One medicine'. The idea of 'One health' replaced 'One medicine' with the help of coactive translational inputs from various streams of knowledge recognizing the significance of health to medicine. The tri-junctional human-animal-environment interaction forms the essence of 'One health' concept which underlines the collaboration across all species. The 'One health' concept has its own benefits to address the current problems like emerging infectious diseases, food safety and security, pollution, antimicrobial resistance, bioterrorism, global climate change pattern and so on. The present article deals with the history of consolidated thinking of 'One health'; the global emergence and impact of 'One health' and need for encompassing the idea in current scenario with special mention to Indian perspective.

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### INTRODUCTION

Current century faces various issues round the world which include rapid population explosion, urbanization and globalization, international trade and commerce, intensified livestock production, encroachment into ecosystem, increasing food prices and crises regarding the use of natural resources periling the economic status of a nation and its health. Crises occurring in the phase of health research for humans and animals can be correlated to the complex issues addressed globally. The socio-ecological system (SES) constitutes the relationship of the environment with the ecology of humans and animals. Poised commixture of socio-ecological systems result in the Health for Socio-Ecological System (HSES) (Ostrom, 2007; Zinsstag et al., 2011; Min et al., 2013). Achieving health for humans and animals with the ecosystem in which they inhabit require a coordinated efforts between human and veterinary medicines which forms the kernel of 'One Health' (Conrad et al., 2013; Zinsstag, 2013).

#### *History of One Health*

The history of healing dates back to the ancient healers- 'the priests', gaining knowledge and skills in anatomy and pathology out of slaughtering the sacrificial animals to detect the purity of them (Leviticus 1,3). In olden times,

such 'priest doctors' cared both the humans and animals (Schwabe, 1984).

As the civilizations advanced in due course of time, the impetus gained by the concept got ups and downs. The Egyptian literature 'Kahun Papyrus' (1900 B.C.) described the chimeric animals and man in their mythology. Papyri also dealt with the importance of vector borne diseases (Driesch and Peters, 2003) which was proved to be controlled by the use of mosquito nets. Babylonian king Adadapla-iddina (1068-1047 B.C.) constructed a temple for goddess Gula who was worshipped as healer and protector from rabies and was represented by the figure of dog (Day, 2011).

Later in 11-13<sup>th</sup> century, Chinese Zhou dynasty stressed the importance of integrated public health system in the society; principles of Yin-Yang were practiced through the acupuncture therapy in humans and animals. Xu Dachun, the Chinese physician wrote in his book 'On the origin and development of medicine' that "The foundations of veterinary medicine are as comprehensive and subtle as those of human medicine and it is not possible to place one above the other" (Driesch and Peters, 2003).

Medical science reached its climax towards the end of first millennium under the influence of Arabs with specific textbooks like *Kitab-al Baytara* (Rüegg, 2004). Greek

scholars Aristotle (384–322 B.C.) and Hippocrates (460–367 B.C.) corroborated the idea of integrated medicine. Hippocrates in his book ‘On Airs, Waters and Places’ proposed the need of a clean environment for healthy living (<http://classics.mit.edu/Hippocrates/airwatpl.html>), which was extended to Roman civilization by the contribution from Galen (130–200 A.D.). Hippocratic–Galenic concepts flourished to the renaissance through Europe and the future developments were carried out by Leonardo da Vinci (1452–1519) with his comparative anatomy thoughts and drawings.

Food security of the time was a concern due to the menace caused due to the outbreak of Rinderpest in terms of loss of meat. Pope Clement XI appointed an Italian veterinarian Giovanni Maria Lancisi (1654–1720) for controlling the disease. Besides controlling Rinderpest, he was also successful in controlling malaria by propounding the use of mosquito nets (Palmarini, 2007).

John Hunter (1728–1793), the famous experimental pathologist also backed the concept of comparative medicine. The science of immunology is recollected by the fame attained by Edward Jenner (1749–1823), trailblazing the small pox vaccination to James Phipps. The schooling of veterinary medicine dates back to the foundation of the first veterinary school at Lyon in France on January 1761 by Claude Bourgelat (1712–1779) with an intention to eradicate rinderpest. He expressed his idea on integrated medicine as, “*Either medicine (human medicine and veterinary medicine) will mutually enlighten and perfect the other when we discard the derisory, harmful prejudice*” (Monath et al., 2010).

The 19<sup>th</sup> century was reckoned as the Golden era of integrated medicine. Rudolph Virchow (1821–1902), the German pathologist, regarded to be the father of comparative medicine and cellular pathology, coined the term “zoonoses” to note those diseases spread between animals and humans (Saunders, 2000). His father was a butcher; Virchow conducted works on Cysticercosis, bovine tuberculosis and the life cycle of *Trichinella spiralis*, which continues to vex the present day world.

### **One Medicine**

Stating that, “*between animal and human medicine there is no dividing line, nor should there be. The object is different, but the experience obtained constitutes the basis of all medicine*” (Dunlop and Williams, 1996), Virchow enlightened the concept of one medicine to his student, William Osler (1849–1919), a Canadian physician who is regarded to be the father of Veterinary Pathology in North America. Osler has carried out systematic post-mortem examinations to derive the statement embracing the concept of ‘One medicine’– “*Veterinary medicine and human medicine complement each other and should be considered as ‘One medicine’*”. He conveyed the message to North America on his return from Berlin (Dukes, 2000).

The contributions of Louis Pasteur (1822–1895) and Robert Koch (1843–1910) were noteworthy in connection to the one medicine concept. John MacFadyean (1853–1941) proposed the zoonotic potentiality of bovine tuberculosis through milk dejecting the ideas of Koch who counseled the least spread of tubercle bacilli by way of milk. The successful laboratory staining used for the diagnosis of anthrax bacilli till date was also suggested by MacFadyean and hence the name to the reaction with Polychrome Methylene blue (Monath et al., 2010).

### **One Health**

The innovative works carried out by the esteemed American Veterinary Epidemiologist cum Parasitologist, Calvin W. Schwabe (1927–2006), among the Dinka pastoralists of Sudan and Fulbe pastoralists of West Africa (Majok and Schwabe, 1996) led to the proposition of the idea of ‘One health’ in 1976, rather than a clinically implicated term– one medicine. He asserted that “*there is no difference of paradigm between human and veterinary medicine, and is the extension of notions of comparative medicine. Both sciences (human as well as veterinary medicine) share as general medicine, a common body of knowledge in anatomy, physiology and the origin of disease in all species*” (Schwabe, 1984). Hence in due course of time the term ‘One health’ egressed from the conventional idea of one medicine which considered ecosystems and its relevance in global public health and animal health development (Zinsstag et al., 2009).

James H. Steele (1913–2013) succeeded in extending the ideas of Schwabe and instituted a separate Veterinary Public Health wing in Centre for Disease Control and prevention (CDC), the then Communicable Disease Centre. His idea was perfectly mirrored in the phrase ‘One World, One Medicine, and One Health’ (Monath et al., 2010; Schultz, 2014).

The imbibitions of ‘One health’ concept can be better perceived through the integrated efforts undertaken by the eminent veterinary virologist, Frederick A. Murphy and the physician, Karl M. Johnson to untangle the Ebola haemorrhagic fever in Africa (Monath et al., 2010). Several other consolidated cases exist where in quislingist approaches were made in order to inculcate the topic on one health globally.

### **One Health: Definition**

Humans do not exist in isolation, but are a part of large living environment and are regarded to be interrelated to the inhabiting ecosystem (Scott, 2008). The elements in which the humans dwell have been reckoned as the core theme of the concept. One health initiative task force of American Veterinary Medical Association defined ‘One health’ as “*the collaborative effort of multidisciplinary working locally, nationally and globally– to attain optimal health for people, animals, plants and our environment*” (AVMA, 2008).

The interconnectedness of the humans with animals and ecosystem was enunciated by William Foege, epidemiologist who played a crucial role in the small pox eradication, as “*you cannot tell the story of human health separate from animal health or environment health*” (Atlas et al., 2010). This triphasic interaction between human– animal– ecosystem forms the soul of one health. The slogan ‘One World–One Health’ gained new heights and momentum when Wildlife conservation society, Canada conducted a conference at Rockefeller University, New York on the topic of “*Building interdisciplinary bridges in a globalised world*” in September 2004 to discuss the movement of diseases among human, domestic and wild animal population and to set a holistic approach to the prevention of epidemic or endemic disease and maintain ecosystem integrity. The resolutions were well known to be Manhattan principles (Wildlife Conservation Society, 2012).

World Health Organisation (WHO), Food and Agricultural Organization (FAO) and World Association

for Animal Health (OIE) joined their hands for a tripartite collaboration on one health when the concept was sprouted. Later on, United Nations International Children's Emergency Fund (UNICEF) and World Bank supported the junction. At present the theme is taken into account by many national and international agencies across the globe (Gibbs, 2014).

#### *One Health Commission*

On June 25, 2007, American Medical Association (AMA) House of Delegates passed 'One health' resolution to promote partnership between human and animal medicine with the consent of American Veterinary Medical Association (AVMA). After a month, AVMA presided over by Roger Mahr set a task force to charge the impulse gaining 'One health' concept to offer better health services to both animals and humans (Kahn et al., 2008).

#### *Need for One Health*

The purview of one health lies in multitudinous fields like emerging infectious diseases, antimicrobial resistance, surveillance, comparative medicine, bioterrorism, conservation medicine, biomedical research, food safety/security, regulatory enforcement, land use pattern, climate change, global trade and commerce, public health, wildlife promotion and protection and so on. All these branches are now getting compartmentalized and environmental issues are not contemplated properly in infectious diseases; for the reason which the concept should have a broader outlook worldwide (Block, 2001; Daszak et al., 2001; Atlas et al., 2010; Dhama et al., 2013). Ecosystem is an inextricable factor of human as well as animal health. Veterinarians are considered to be the sanctified professional group likely to see both humans and animals and the ecology of agents with special reference to the vector potentiality (Mersha et al., 2012; Malik et al., 2013).

Recent drifts taking place in the globalised world include emerging infectious diseases (Avian influenza, Swine flu, zoonotic Enterohaemorrhagic *E. coli*, SARS) need to tighten the concept of 'One health' with a high degree of collaboration to tackle the issues smoothly (Dhama et al., 2013; Malik et al., 2013). Studies have revealed that 60.3% of the identified infectious agents are zoonotic in nature of which 71.8% are originated from wildlife (Jones et al., 2008); 75% of the emerging diseases (132/175) were zoonotic (Asokan et al., 2011). World Bank (2010) estimated a direct loss of US \$2 billion and an indirect loss of \$20 billion on the zoonoses.

There exists a correlation between socio-economic, environmental and ecological factors for the emergence of diseases. For instance, low latitudes are high risk zones for zoonoses, wildlife and vector borne infectious diseases. Landscape transformation adds up to the environmental factor contributing to disease emergence (Myers and Patz, 2009; Cascio et al., 2011). The modern high speed travel allows the infectious agents getting disseminated round the world in less time than its incubation period (SARS, H1N1 pandemic) bringing the notion of exotic or foreign diseases meaningless. Such etiological agents require proper scientific reporting to initiate speedy control efforts by way of systems like ProMED mail (Programme for Monitoring Emerging Diseases) by International Society for Infectious Diseases (ISID) and World Animal Health Information

Database (WAHID) by OIE (Asokan et al., 2013). Veterinarians play remarkable role in the isolation, identification and better understanding with respect to the epidemiological aspect of emerging infectious diseases along with other professionals. Surveillance, clinical curiosity and awareness, better training and epidemiological basis make the professionals competent to meet the challenges arising among the emerging infectious diseases (Chomel, 1998; Chomel, 2003; Jebara, 2004). The surveillance system implemented in outbreak should be proper, responsible and effective; otherwise it may give a sense of negation among the percipients as well as affects the consumer perceptions of foods of animal origin contrarily, leading to great economic loss to the producers (Decker et al., 2010).

Food safety and security is another domain which requires attention in the current global situation. World Bank (2008) data estimated approximately 3 billion people survive on less than US \$2 per day. Besides, unheralded hike in the food items have overall blown up the population to meet their day to day living. Global demand for the foods of animal origin is coming forth at its own demand which will pressurize the growth of livestock sector in the future (FAO, 2009). Factors like elimination or reduction of tariffs associated with free market reforms; advances in the refrigerated shipping and above all the high demand for foods of animal origin enriched the growth in terms of economy with special regard to the developing nations of the world. World Organization for Animal Health (OIE) provides scientific expertise to World Trade Organization (WTO) related to the livestock trade regulation. Also, WHO and FAO through Codex Alimentarius Commission (CAC) participate in this matter (Sherman, 2010). Though there exists set guidelines for trade, food safety and quarantine, rural livestock holders have no access to proper preventive or curative veterinary medical services and animals serve as a source of transmissible diseases especially zoonotic diseases like tuberculosis and brucellosis (WHO, 2006).

Global climate change (GCC) is an area where one health can be applied. Climate change affects the environment of humans and animals as well as that of vectors and pathogens infecting both. It is believed to exist a strict relationship between GCC and the factors like increased greenhouse gases (Carbon-dioxide and methane); reduction of coral reefs due to the marine and aquatic acidification and up to 40% reduction on oceanic phytoplanktons. The GCC evidenced the emergence of diseases of vector borne origin such as Dengue haemorrhagic fever, Rift valley fever (Rogers and Randolph, 2006; Slenning, 2010).

The emerging infectious etiological agents are treated using the standard therapeutic protocols, which often fails when these agents develop resistance to the specified drug of choice and hence converges towards the theme – antimicrobial resistance, which is addressed currently as a wildfire. The global theme of antimicrobial resistance also needs to be visualized through one health angle. It is nothing, but equated to the weapon against microbes losing power due to the lack of knowledge and misuse regarding antimicrobials. The topic of antimicrobial resistance is such an alarming issue that the world is facing. The multi-drug resistance (MDR), extremely-drug resistance (XDR) and total drug resistance (TDR) strains are coming up in a

devastating manner that may ruin both animals and humans in terms of economy and public health. Not only bacterial and viral agents, but also fungal agents such as *Candida* and protozoan parasites like *Plasmodium* are responsible for causing antimicrobial resistance (CDC, 2013). The recent emergence of carbapenemase resistant New Delhi metallo- $\beta$ -lactamase 1 (NDM-1) along with the other antimicrobial resistant bacteria has panicked the public health personnel in the Millennium Development Goals getting derailed from the proposed strategic plans by 2015 (Yong et al., 2009). In spite of the worldwide awareness campaigns and national programmes, the topic continues to be a menace till date taking away the lives of at least 1, 50, 000 out of about 4, 40,000 cases of emerging MDR tuberculosis, making the standard therapy more complicated and the disease a dreadful one, in terms of socio-economic lifestyle (WHO, 2013).

All these factors burden upon the health and wealth of animals and humans where in the population is exploding in such an indocile rate. The population is found to increase at the rate of 2.5 individual per second i.e., 78 million people per year and that the United Nations Population Fund data calculates the total population crossed 7 billion by October 31<sup>st</sup> 2011 and forecasted to reach 10.5 billion by 2050 with a steady decline in population growth rate. Asian nations like China and India contributes 37% of the total global population.

#### **Benefits of One Health**

The concept of 'One health' mainly aims at reviving the integration of human health, animal health and environmental health for mutual benefit (Klement et al., 2009). The collaborative thinking requires inter-professional interaction across the species. AVMA has noted the benefits of 'One health' which includes improving animal and human health globally through the collaboration among all health sciences, meeting new global challenges through interdisciplinary interactions, developing centres of excellence for education and training in specific areas, increasing professional opportunities, and gaining scientific knowledge to create innovative programmes to improve health (Kahn et al., 2007; AVMA, 2008).

A conjoint effort from part of medical practitioners, veterinarians as well as ecologists and environmentalists is requisite in implementing the concept which still remains as a theoretical idea (Conrad et al., 2013). The five C's for implementing the one health includes consensus among stakeholders, collaboration among professionals, co-operation among inter-disciplinary groups, coordination among partner agencies and commitment (political and financial) by donors, partners, organizations and governments. A financial assistance of US \$1.3 billion spends for one health per year till 2020 for low and middle income nations (World Bank, 2010).

#### **Indian Perspective**

Data regarding 'One health' approach is not well formatted in India. The country possesses 37 veterinary colleges and nearly around 350 medical colleges. The factors in India are conducive for the emergence of infectious agents; some among them includes- uncontrolled population, unhygienic living condition, poor personal hygiene, sharing workforce

on farming by close contact with the domestic animals and poultry (Asokan et al., 2011).

Indian subcontinent is congenial for the outbreak of infectious diseases; proven zoonoses are prevalent to the subcontinent due to the suitable host factors, prevalence of vectors, and environmental factors. When it comes to reality, the awareness on zoonoses is pitiful among medical graduates (Sekar et al., 2011); studies by Kakkar (2011) support the fact that majority (more than 80%) of the medical graduates is illiterate about the emerging zoonoses, neglected zoonoses and pet related zoonoses. The developed nations have authorities like CDC (United States), *MedVetNet* (European Union) for enforcing programmes on zoonoses where as in India these are lacking.

The existing control programmes for zoonoses in India comprises of National Standing Committee on Zoonoses (SCZ) by Government of India which functions to recommend policies, operational research and inter-sectoral collaboration; National Centre for Communicable Diseases (NCDC), Indian Council for Medical Research (ICMR), Department of Animal Husbandry, Dairying and Fisheries (DADF), Wildlife Institute of India (WII), Outreach programme on zoonoses led by Indian Veterinary Research Institute (IVRI), Indian Council for Agricultural Research (ICAR), International Development Research Centre (IDRC), World Health Organization (WHO), International Livestock Research Institute (ILRI); the Road Map to Combat Zoonoses in India (RCZI) that aims at capacity building for surveillance and response, advocate health promotion and to promote collaborative research with Public Health Foundation of India (PHFI), State Agricultural Universities and some private enterprises. Also, ICMR-ICAR collaboration exists for the control of zoonoses as well as acts as a platform for one health partnership. A proposal has been forwarded for instituting Centre for Advanced Research on Zoonoses at the national level. Task forces constituted by Department of Biotechnology (DBT), Department of Science and Technology (DST) and on Rickettsial diseases by ICMR are supporting the research on diagnosis and control of important and emerging zoonoses. The Food Safety and Standards Authority of India has been established under the Food Safety and Standards Act, 2006 as a statutory body for laying down science-based standards for articles of food and regulating manufacturing, processing, distribution, sale and import of food so as to ensure safe and wholesome food for human consumption (Malik et al., 2013). The High pathogenic Avian-Influenza (HPAI) surveillance as well as policy making has been formulated with the help of joint task force and joint monitoring group on Avian Influenza from sub-district to national level. Besides this, national programmes operated by Ministry of Health and Family Welfare include control for vector borne diseases (Japanese Encephalitis, Kala-azar), Tuberculosis, Dengue, Leptospirosis and Anthrax (<http://www.mohfw.nic.in>). Intergovernmental Panel on Climate Change (IPCC) studies reported that the per capita availability of water would drastically decline from 1840 m<sup>3</sup> in 2001 to an expected value of 1140 m<sup>3</sup> in 2050 which will jeopardize with the expected temperature rise of 0.68 °C per century resulting in anticipated cholera and hepatitis outbreaks in the eastern coastal regions of the nation (Copenhagen Summit, 2009). Hadley Centre for Climate Prediction and Research (based

in United Kingdom) put forward a Regional Climate Modelling (RCM) system which provides a better idea regarding the temporal assessment of climate changes in a particular region using Providing Regional Climates for Impacts Studies (PRECIS). Applying the same to Indian conditions using the presumptions of IPCC, it was found to increase the annual mean surface temperature at the end of this century from 2.5°C to 5°C and is expected to be more pronounced in northern parts of the nation; an increase of more than 20% of the existing showers during summer monsoon especially in western coastal as well as central western part of India except in Punjab, Rajasthan and Tamil Nadu; a wide temperature range of maximum as well as minimum temperatures was also forecasted. The major green house gas, carbon-di-oxide, is figured to get increased which will get contemplated as a climatic issue predisposing the chances of infectious diseases especially vector-borne diseases which will worsen the economy as well as living style of our country (Kumar et al., 2006; Singh et al., 2011). The climatic issues are also to be addressed holistically in connection with the triad of epidemiology at a new platform rather than as a sole compartment, which will otherwise draw back the development of the concept.

India being a developing nation and the drug resistance studies are taken as an interesting field, reports of common Gram-negative bacteria like *Escherichia coli*, *Klebsiella pneumoniae*, *Salmonella*, *Pseudomonas aeruginosa*, *Neisseria gonorrhoea*, *Vibrio cholera*, and Gram-positive bacteria such as *Staphylococcus aureus*, Group-B *Streptococcus* have raised issues of acquiring antimicrobial resistance (Ganguly, 2011). The fatal consequences of veterinary therapeutics in the food chain are often ignored even though we are consuming the foods of animal origin. Veterinarians, livestock and aquaculture industries make use the antimicrobials for therapeutic purposes as well as growth promoters in feed which will accumulate in food chain. Due to the dearth of legislations and proper government regulations, in using antimicrobials in veterinary practice (Singh et al., 2009), the theme attained a public health concern (Kuehn, 2007). Since cattle-rearing is the prime livelihood among the rural society, the inadequate and indiscriminate therapy exacerbates the condition (Arya et al., 2008).

The implementation of each and every programme requires a scheme of evaluation. Knowledge, Attitude and Perception (KAP) analysis is performed by some workers to evaluate the impact of one health intervention programmes. The knowledge refers to the degree of understanding on associated issues; attitude implies to the feelings of respondents to the understanding and perception is nothing but the awareness on the topic (Di Giuseppe et al., 2008). Narrod et al., (2011) applied the KAP analysis on pathogenic avian influenza outbreaks in African countries. There exists an observable gap between the knowledge and application in the health delivery (Zinsstag et al., 2007). The time is lacking and challenges to be addressed remain plentiful ahead.

## CONCLUSION

By the latest trends in globalization and industrialization, the size of the entire world has shrunken into a global village especially in facets of health and disease. Recent challenges do not fit the globe entirely into a single compartment; rather a collaborative approach is required.

“Health for All” should be the slogan that came out from the society to cater the needs of today. Emerging infectious diseases and other issues always represent a complex interaction among animals, humans and ecosystem perturbations which require a multi disciplinary approach to find its solution. The salient features of one health program emerge from the interconnectedness between physicians, veterinarians, environmentalists and even comparative pathologists and public health officials.

Since veterinarians are well versed with the comparative medicine and preventive medicine, it is the duty from part of the professionals to infuse the ‘One health’ concept to the community in equality with physicians as well as environmentalists. It is well said that solving today’s threats and tomorrow’s problems cannot be accomplished with yesterday’s approaches. Foreseeable visionary ideas should come up with particular regard to apply the concept of ‘One health’ into action.

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