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Zoonoses and One Health: A review *vis-à-vis* Role of the Veterinarian

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ABSTRACT

Zoonoses are infections or infectious diseases transmissible under natural conditions from vertebrate animals to humans. They involve a wide range of causal agents including: viruses, bacteria, parasites, fungi, and prions. Infectious agents transmitted from animals to humans account for most outbreaks of novel pathogens worldwide. Although zoonotic diseases have been recognized for many centuries, their impact on public health has increased in the recent past. Last few decades, have been momentous in the history of veterinary medicine as an array of new infectious agents/diseases depicting animal-human connection were reported and researched worldwide. The increasing frequency of zoonotic disease events underscores a need to focus on the areas of concern and formulation of management strategies. The need for One Health approach at the human-animal-ecosystem interface is being increasingly realized for effective investigation, prevention and control of any emerging zoonotic disease. The unique dynamic interaction between the humans, animals, and pathogens, sharing the same environment should be considered within the "One Health" approach. This paper aims to review the risk factors for the emergence, highlight some of the emerging zoonotic diseases prevalent and discuss the role of a veterinarian in the disease investigation, prevention and control.

Key Word: Zoonosis, One Health, Public Health, Veterinarian.

I INTRODUCTION

In recent years, zoonoses and communicable diseases common to man and animals have gained increasing attention worldwide. According to World Health Organization (WHO), zoonoses is defined as diseases and infections that are naturally transmitted between vertebrate animals and humans. Various human diseases have their origins in infected animals, and have hence highlighted the need for a better understanding of animal diseases in terms of their

epidemiology, mechanism of transmission to man, diagnosis, prevention, and control. A zoonotic agent can be bacteria, a virus, a fungus or any transmissible disease causing agent. Among reported infectious diseases, 61% are zoonotic in origin (1). The negative effects of zoonoses are far reaching. High incidence rates continue to cause significant morbidity and mortality in both humans and animals. Moreover zoonoses can be a serious drain on a country's economy, which in turn can have wide repercussions for a society's health. This makes it imperative to examine the health effects across species, in order to fully understand the public health and economic impact of such diseases. This in turn is very important to help implement specific treatment and preventive programs. One of the most striking aspects of new, emerging and re-emerging zoonotic diseases has been the unexpected nature of their occurrence. Drastic changes in the environment, such as deforestration, intensive agricultural, rapid expansion of population, global warming, international trade , travel and human encroachment into wildlife habitats are key factors for zoonotic disease emergence (2,3) also environmental pollution with toxic chemicals are hazardous and threaten human and animal populations (4). With unprecedented rates of population movement and concentration in urban areas, new rapidly transmissible disease dynamics are emerging. This will be influenced by the increased demand for mutton, milk, poultry meat, and other animal products, and changes in both extensive and intensive livestock production systems. Environmental change, which is often considered a major driver of disease emergence, is ubiquitous with negative trends frequently discussed in terms of significant deforestation, soil erosion, desertification, wetland degradation and species extinctions (5). The ongoing global environmental and socioeconomic changes may create favorable conditions for emergence and transmission of vector-borne diseases. To restraint an emerging zoonotic threat, the cornerstone is early detection of a rise in incidence of a specific disease. The emergence of an infectious disease appears to be the end result of a multi-factorial complex process, it becomes very difficult to predict and respond to it quickly.

An emerging zoonosis as 'a zoonosis that is newly recognised or newly evolved, or that has occurred previously but shows an increase in incidence or expansion in geographical, host or vector range' (6). They are believed to be a potential threat to the human health and have a negative economic impact. Zoonitic diseases like anthrax, tuberculosis, plague, yellow fever and influenza, have been reported to be transmitted from domestic animals, poultry and livestock. However, over the past few decades, changes in the environment, human behaviour and habitat, there have been incidences of these infections are emerging from wild animals. The increase in the incidence of zoonotic diseases is clearly evident. However, this increase may not only be the result of the actual increase in the rate of emerging zoonotic infections across the globe but also a result of our enhanced ability to detect and identify the etiological agents. With the advent of new diagnostic techniques, the sensitivity and specificity of our detection and diagnostic capability has increased many-fold. Even then if a pathogen does not cause a significant disease outbreak, it may still go undetected.

A number of factors are responsible for the emergence of zoonotic diseases. The environments associated with pathogens and their reservoir hosts is not static and is constantly changing. Various factors that have been instrumental in bringing that change include the modernisation of farming practices, particularly in the developing world, habitat destruction; human encroachment and climate change (7, 8, 9). It becomes very vital to evaluate, analyze and understand the effect of these changes on the interactions between various pathogens and their hosts and between the host and other species, including wildlife, livestock and human beings. Understanding these interactions and the impacts is very crucial and it may guide us towards the development of mitigation strategies and enable an effective and timely response. Vector distribution is hugely influenced by the Climate and habitat changes. It also results in introducing pathogens formerly restricted to certian geographically into naive populations of potentially susceptible animals and humans. For example the geographical ranges of some dangerous zoonotic diseases such as West Nile virus (WNV), chikungunya virus (CHIKV) and dengue virus are constantly expanding. This is primarily a result of the movement of vectors into newly established habitats. This results in the mixing of previously isolated vectors and also introduces the agents to new potential vectors (10).

The common emerging diseases in South Asia include avian influenza, rabies, Japanese encephalitis, leptospirosis, Hanta virus, Severe Acute Respiratory Syndrome (SARS), Nipah virus, cysticercosis, echinococcosis and schistosomosis (WHO/FAO/OIE). In addition to the above, in India, plague and anthrax are also considered important zoonotic diseases. In India diseases like tuberculosis, brucellosis, and salmonellosis and other food-borne illnesses are of interest to epidemiologists and public health veterinarians because of the greater incidences both in animals and humans. About 30% of the total global cases of tuberculosis are found in India (WHO). The prevalence of Tuberculosis in India is in a upward swing and owing to the fact that M. bovis can also circulate in a human to human cycle and that too in a more devastating manner needs an extensive study and understanding than M. tuberculosis. Brucellosis is highly prevalent in the bovine population of the India. B. melitensis often affects human population. Even today, mass scale vaccination of animals of animals against it is not practiced in india, except in some farms. An estimated 59000 people die from rabies across the world each year, with around 90% of these deaths occurring among children living in rural areas in Africa and Asia. In India alone, estimates range between 18000 to 20000 human deaths from rabies each year (11). Dog population control and compulsory vaccination of dogs are part of ongoing efforts to contain the disease but have met with only partial success. An intensified programme of public education can also help in reducing the menace of disease. Japanese encephalitis is and endemic disease in India and many countries of Asia including China and Japan. J.E first appeared in India in the year 1955 and the first outbreak occurred in 1973 in West Bengal. However, it was only after 1978 that the disease became widespread. The disease continues to spread to newer areas. Avian influenza (bird flu) has also seen a increased prevalence over the past years and the major risk factors include Increased mixed farming activity, import/export of poultry to meet excessive demands of protein and unregulated marketing in birds and other

livestock in congested areas. Leptospirosis is caused by Leptospira interrogans, a corkscrew-shaped bacterium, found in aquatic environment. It is estimated to cause 1.03 million cases and 58,900 deaths every year [12] In india it was first reported from the Andaman Islands in 1929 and has since affected all parts of India (13). Rural farm workers have been found to be more vulnerable to the disease. A need for intensive surveillance for leptospirosis in the northern parts of India has been suggested (14).

The concept of One Health is not a new, but it has become more important in recent years. This is because many factors have changed interactions between people, animals, and our environment. These changes have led to the emergence and reemergence of many diseases. Over the past several researchers including Louis Pasteur and Robert Koch and physicians such as William Osler and Rudolph Virchow have demonstrated the definitive collaborative links between animal and human health. The one health is a concept that aims to bring together human, animal, and environmental health. As per one health commission, "one Health is the collaborative effort of multiple health science professions, together with their related disciplines and institutions – working locally, nationally, and globally – to attain optimal health for people, domestic animals, wildlife, plants, and our environment" (15). The One Health approach recognizes that the health of humans, animals, and the environment are interdependent and that promoting optimal health in any of these sectors requires cross-sectoral collaboration, communication, and respect. The Word Health Organization, World Organisation for Animal Health, and the Food and Agriculture Organization of the United Nations have recognized their shared responsibility to use One Health approaches for addressing a number of complex global challenges, such as rabies and antimicrobial resistance (16) Implementation of a One Health approach requires a team effort that brings together professionals who come from a variety of disciplines, including human medicine, veterinary medicine, ecosystem health, and agriculture. The key role in recognizing and reporting outbreaks however would be that of physicians and veterinarians. There has to be an enhanced communication channel between hospital epidemiologists, veterinarians, and local public health officials which would help accelerate an immediate local response. Moreover it would also help identify whether the unusual diseases or outbreaks involving animals and humans were anyhow related or not. Over the years a need has been realized to collaborate the research setup of physicians and veterinarians which would go a long way improve our understanding of zoonotic agent-host interactions. Physicians and veterinarians need to work together to and should include collaborations in comparative medicine research. Comparative medicine includes the study of the anatomic, physiologic, and patho-physiologic processes across species, including humans. However significant attention has to be is paid to infectious diseases, specifically the study of host-agent interactions.

In general routine practice most veterinarians contribute to public health during. Veterinarians contribute to the cause of one health lending their contribution in a number of ways. The key role of a veterinarian lies in the Diagnosis, Surveillance, Epidemiology, Control, Prevention, and Elimination of Zoonotic Diseases. Moreover in

addition to managing direct zoonotic diseases in animals, they also diagnose, investigate, and control indirect zoonoses and non-zoonotic communicable diseases that may affect humans. The other areas where veterinarians play a crucial role include Management of Health Aspects of Laboratory Animal Facilities and Diagnostic Laboratories, Biomedical Research, Health Education and Extension and Production and Control of Biologic Products and Medical Devices. By contributing in all these areas, veterinarians eventually contribute significantly to the One Health concept. Veterinarians can play an important role in public health to control zoonotic diseases. Unfortunately in India human and veterinary diseases have been treated as separate field and medical and veterinary medical have little or very less communication/ collaborate with each other. The collaboration between the physicians and veterinarians should be increased and diversified. It would help assess a patient's potential zoonotic disease risks from animal exposure which can be very crucial particularly for high-risk immunocompromised patients. On the research frontier collaborative comparative medicine research projects should be conducted by physicians and veterinarians to investigate zoonotic agent-host interactions. Multiagency-sponsored comparative medicine projects and more training grants for veterinarians interested in careers in research are needed which would go a long way to increase our understanding of how zoonotic diseases expand their host range and would, ultimately, improve prevention and control strategies.

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