Review Article

One World, One Health - Veterinary Perspectives

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ABSTRACT

Multidisciplinary efforts at global, national and local levels are required for creating One Health for the benefit of our planet, mankind and animals. A plethora of emerging global issues viz., international trade and travel, global warming, rapid population growth, ecotourism, food safety concerns, continuous increase in migration of people from rural to urban areas, and changes in traditional livestock rearing practices to meet the demand of higher animal protein production leading to increased risk of emergence and re-emergence of several zoonotic diseases, and all these factors affect human health. Wrong diagnosis and misdiagnosis causing thousands of deaths everyday worldwide have increased the agony and certainly, require one health approach globally. Increased antimicrobial resistance, extreme variability of RNA viruses, involvement of domestic and migratory birds and wildlife in disease transmission have made the scenario of the spread of zoonotic diseases more complicated than ever before. Moreover, cross-border diseases make the health concept more critical as they cause major economic shutdowns across the countries. These issues have created an urge to control emerging and zoonotic diseases at global, national and regional level at a quicker pace than ever before. Joint venture via a collaborative approach from experts of various fields, laboratories and countries certainly seeks attention for One Health to maintain the global integrity. Regional and local networking systems of various international organizations should make use of the highly sensitive and specific methods, both molecular and serological, including cost effective and pen-side diagnostic methods, to detect pathogens at the earliest. Dearth of antiviral drugs, increased antimicrobial resistance among zoonotic organisms, and inadequate compensation during adoption of stamping out policies have created crisis with respect to disease control and preventive measures. This requires heightened biosecurity measures, disease surveillance and monitoring activities, in addition to judicious vaccination. In this regard, developmental vaccinology, generating a variety of new generation vaccines, and advanced delivery systems require special mention. This review deals with all these aspects, which will be beneficial to create One World, One Health concept.


INTRODUCTION

One Health requires multidisciplinary efforts at global, national and local levels, for the sake of our planet, mankind and animals. It was initiated at the American Veterinary Medical Association (AVMA) Annual Convention (2007) as launched by the American Medical Association along with AVMA and the Centers for Disease Control and Prevention (CDC). One health concept is governed by a great deal of interest as well as resources. To a certain level it is due to the greater popularity attained by the term population health. Successes up to a certain extent to provide understanding of socioeconomic gradients in health status at depth even though achieved, it has not yet led to sufficient development of corresponding policies that can effectively reduce the inequalities in health (Glouberman and Millar, 2003; Tsui et al., 2010). Recent decades of modernization and industrialization, along with adoption of policies like liberalization and globalization, the characteristics of human demographics have been affected considerably (Nolen and Kahler, 2007). Increase in international trade and travel, global climate change, habitat destruction, ecotourism, changes in ecosystem and biodiversity have resulted in exposure of humans as well as animals to new pathogens to which they were never exposed, requiring proper veterinary attention (Morse, 1995; Taylor et al., 2001; Patz et al., 2003; Rogers and Randolph, 2006; Myers and Patz, 2009; Osburn et al., 2009; Pawaya et al., 2009; Bloom, 2011; Dhama et al., 2012a; Mahima et al., 2012; Dhama et al., 2013a). Besides the preceding situations, certain other circumstances like civil unrest, political instability, communal
riots, etc have also led to the uneven demographic changes in human population in most of the developing countries.

Certainly, global warming is unequivocal, and is primarily caused by increasing concentrations of greenhouse gases produced by deforestation and burning of fossil fuels (Battisti and Naylor, 2009; Knight et al., 2009; United Nations Framework Convention on Climate Change, 2011). Rapid population growth has several impacts which may be immediate or short-lived, comprising of poverty, lower living conditions or older populations living longer during the period of stagnant birth rates (Wittmer, et al., 2008). Research and health education when combined with social marketing as well as community development, along with legislative and public policy approaches are prerequisites to determine healthy lifestyle of people (McKeown, 1972; The Maclean’s Health Report, 1999).

There is a continuous increase in migration of people from rural to urban/peri-urban areas; also there has been a considerably increase in human population along with increase in consumption of animal proteins, which has necessitated changes in traditional livestock rearing-production systems to meet the demands. In addition, budgetary restrictions in developing countries especially in the last two decades have led to a decline in the quality of public services provided. All these changes constitute important risk factors for maintaining and developing diseases in such population resulting in the emergence and re-emergence of infectious, including zoonoses (Taylor et al., 2001; Patz et al., 2003; Rogers and Randolph, 2006; Myers and Patz., 2009; Bloom, 2011; Dhama et al., 2012a,b). Some of the zoonotic diseases that seem to attract less public awareness viz. brucellosis, rabies, cisticercosis and hydatidosis are re-emerging in some regions nowadays (Jones et al., 2008; Kumar et al., 2009). Again, vector borne zoonoses form the most complex group of infectious diseases that are difficult to prevent and control due to difficulty in predicting the habits of the vectors; striking diseases are West Nile, Lyme disease, plague (caused by Yersinia pestis) tick transmitted diseases caused by rickettsials like Rocky mountain spotted fever, Ehrlichiosis and anaplasmosis, Q fever and mosquito-borne diseases such as dengue and chikungunya, all having fatal outcome, responsible for sufferings of millions in US, Africa and Asia (U.S General Accounting Office, 2000; Kahn et al., 2007; Wolfe et al., 2007). It is also indicative that avian influenza (H5N1) viruses are now being transmitted between migratory/wild birds and may pose a threat to poultry and human health (Webster et al., 1997; Dhama et al., 2003; Sengupta et al., 2007; Dhama et al., 2008a; Dhama et al., 2012 a,b,c; Ahmed et al., 2012; Sakoda et al., 2012; Dhama et al., 2012b).

EMERGING AND RE-EMERGING ZOONOSSES

The urgent need of various partnerships and collaboration lies in the critical need in response to emergence and re-emergence of zoonotic diseases that illustrate a new dependency, governed by the complexity of human-animal relationships, including wildlife (Garrett, 1994; Dazak et al., 2000; Bengis et al., 2004; Zinsstag et al., 2007; Zinsstag et al., 2008; Jones et al., 2008; Cascio et al., 2011).

New infection evolving due to change of an existing pathogen or spread of a known infection to a new geographic area or population, and diagnosing infection caused by an agent previously unrecognized, all contribute to the occurrence of emerging disease. Zoonotic diseases are those that animals use to transmit/ birds to humans under natural conditions (Office des International Epizootics, 2004). Out of 1415 species of pathogens in human, 868 (61%) are zoonotically important. The prevalence of infectious diseases have increased in last three decades with 175 pathogens causing emerging diseases with most of them [132 (75%)] to be of zoonotic nature (Statistics Division, United Nations, 2003; World Health Organization, 2009; Osburn et al., 2009; Dhama et al., 2012a). Surveillance data between public health and animal health organizations indicate an ever increasing emergence of zoonotic diseases caused by pathogens resistant to antimicrobial substances viz., tuberculosus, campylobacteriosis, salmonellosis, E. coli and Staphylococcus aureus infections (Cosivi et al., 1998; Eberhart-Philips, 2000; Gupta, 2001; Hamburg et al., 2003; Verma et al., 2007; Dhama et al., 2011; Kumar et al., 2012).

Emerging and re-emerging diseases involve numerous mechanisms. Particularly, RNA viruses show extreme variations that act as a key factor for population of quasi-species to cross species barrier. Evolution of viruses is much quicker as they use mechanisms like point mutation and deletion; recombination and re-assortment along with acquisition of cellular genes. Also, the increase in widespread antimicrobial resistance among zoonotic bacteria limits the use of antibiotic treatments in animals. Emerging diseases may be the outcome of involvement of invasive/migratory species or release of foreign species accidentally in a new environment. Also, recent infectious disease events (Severe Acute Respiratory Syndrome / SARS; avian influenza, H1N1; swine origin influenza virus H1N1, SOIV) have uncovered vulnerabilities of the global health community in its preparedness and response to diseases emerging on the human-animal interface (Slingenbergh et al., 2004; Dhama et al., 2005; Amonsin et al., 2008; Pawaiya et al., 2009; Ali et al., 2012; Dhama et al., 2012a; Dhama et al., 2012b).

Poultry meat is the major source of animal protein worldwide. So people need to work or live with birds daily, exposing themselves to numerous microorganisms having the potential of zoonotic disease like Avian Influenza (AI), tuberculosis, salmonellosis, campylobacteriosis, colibacillosis and chlamydiosis. In addition, listeriosis, Newcastle disease (ND), eastern equine encephalitis (EEE), West Nile virus, cryptosporidiosis, erysipelas, clostridial infections, arizonosis, cryptococciosis, histoplasmosis and allergic alveolitis also contribute to human infections (Leslie, 2000; Saif, 2003; Dhama et al., 2005; Dhama et al., 2008a; Dhama et al., 2011; Manual of Diagnostic Tests and Vaccines for Terrestrial Animals, 2010; Grunkemeyer, 2011; Dhama et al., 2012c; Tiwari and Dhama, 2012).

WILDLIFE AND EMERGING/RE-EMERGING ZOONOTIC DISEASES

Wildlife acts as a potential but unknown reservoir for diseases that emerge or re-emerge possessing zoonotic threat and include vector-borne viral diseases (75%) (Taylor et al., 2001) viz., Hendra and Nipah viruses, Menangle, West Nile virus, Monkey pox (Dazak et al., 2000; Centers for Disease Control and Prevention, 2003; Bengis et al., 2004; Dazak et al., 2004; King, 2004; Dhama et al., 2010; Chakraborty, 2012). This ultimately poses threat to biodiversity, and human and animal health. Leading causes for the occurrence of the zoonosis from wildlife pool are:

a) Growth of human population exponentially and invasion of wildlife habitats. For example, vampire bat rabies has re-emerged in people living in Amazon basin due to deforestation caused by human activities for the progress of civilization (Schneider et al., 2003); natural foci of Kyasanur Forest disease (KFD) i.e. adult tick Haemaphysalis spinigera
(of cattle) flare up due to deforestation and agricultural development (Varma, 2001).

b) Changes in agricultural practices like domestication of species of wild animals leading to reemerging zoonoses such as bovine tuberculosis in deer populations kept in captivity (Wilson, 2002) and brucellosis in wild bear (Godfray et al., 2005). During 1998–1999, removal of forests and expansion of non-industrial pig farming along with production of fruiting trees has led to Nipah virus outbreak in Malaysia (Daszak et al., 2001).

c) Rabies can spread due to movement of wild animals for example repopulation of hunting pens with raccoons trapped in endemic zones of the Southern United States have led to introduction of the disease during 1970s in the mid-Atlantic states (Woodford and Rossiter, 1993); Crested hawk eagles carried a highly pathogenic avian influenza A H5NI virus in Europe (Van Borm et al., 2005).

d) Ecotourism also plays crucial role e.g. Rickettsia africae (causes African tick bite fever) (Jensenius et al., 2004); Cercopithecine herpes-virus-1 (herpes B virus) (Huff and Barry, 2003).

e) Petting zoos and exotic birds have been linked to several zoonotic outbreaks viz., Escherichia coli O157:H7 and Salmonellae as well as rickettsiales like Coxiella burnetii (Bender and Shulman, 2004).

**IMPACT OF TRANSBOUNDARY DISEASES ON ONE HEALTH**

Transboundary diseases include the epidemic diseases of highly contagious nature, which can spread very rapidly, irrespective of national borders, and are of much serious socio-economic and possibly public health concerns. These are the emerging and re-emerging diseases which can cross borders between animals (domestic and wildlife) and human, and thus threaten both livestock and human health. This is another reason to combine all the latest research on economically important infectious animal diseases worldwide. No country whether rich or poor is immune from the risk of these diseases, especially South Asian countries, which have been identified as a global ‘hotspot’ for emergence of infectious diseases of animal origin. The conditions that encourage the emergence of disease may be different, but the challenge of managing disease spread is almost the same for a given disease condition (National Research Council, 2003; Dhama et al., 2012a). Improvement of health of man, animal and environment through One Health concept with special reference to control of emerging and zoonotic diseases at national, regional and global level becomes more critical with increased emergence of infectious diseases (Karesh et al., 2005). Also, as these diseases can cross the animals-human-environment interface, studying in detail about the disease in one host species or environment alone may not be applicable for others; more researches are required on this area (Foreign Agriculture Service, 2003; Wolle et al., 2005).

**BIOTERRORISM**

One Health concept plays a crucial role in case of growing threats like bioterrorism (comprising of 80% self-replicating zoonotic pathogens). Biological agents are organisms or toxins produced by organisms (natural), which when used deliberately against humans, animals or crops, can cause illnesses even in a small concentration, in contrast to chemical agents, which are man-made (Block, 2001). They can be spread through the air, through water, or in food and are resistant to current medicines. The botulinum toxin produced by Clostridium botulinum, and ricin extracted from the castor seeds are amongst the most potent toxins. The lethality of many toxins is much more than several lethal chemical agents. The 50% lethal dose (LD₅₀) of VX, most lethal chemical agent is ~15,000 times more than that of botulinum toxin. The political, religious or other ideological factors may motivate the terrorists to use these biological agents, as the detection of these agents is not easy due to the time lapse between their use and the production of illnesses. The threat of person to person spread is present in some bioterrorism agents, like the smallpox virus, which is not present in other agents like anthrax. During the past few years, the threat of bioterrorism has evoked widespread concern and brain-storming putting additional responsibilities on governmental agencies to ensure biosecurity. Bio-surveillance is the detection of disease outbreaks in real-time in which data from different sources, various places and categories are collected and analysed. It can be effectively applied in the fight against bioterrorism (Wagner et al., 2006). Pioneer work conducted in US has lead to the deployment of the first automated bioterrorism detection system, called RODS (Real-Time Outbreak Disease Surveillance), which can detect a probable bioterrorism event within the shortest possible time. The RODS system has now been replicated in all the States of the USA. The Global Emerging Infections Surveillance and Response System along with many other programmes have been put in place by the Defence department of USA for worldwide bio-surveillance. Similarly, surveillance for any bioterrorism event/activity is not done at country level, but on the continent-wide scale in the Europe. Therefore, the “One World, One Health” has an important role to play in the fight against the bioterrorism at the global level. The CDC has classified the bioterrorism agents into three categories, depending on ease of spread and severity of illness or death they cause.

a) **Category A:** Organisms or toxins such as Anthrax (Bacillus anthracis); Plague (Yersinia pestis); Tularemia (Francisella tularensis); Viral Hemorrhagic Fever Viruses (Ebola, Marburg, Lassa, Machupo) that pose the highest risk to the public and national security are included in this category. The easy person to person spread or transition results in high death rates and have the potential for major public health impact causing panic and social disruption, thus requires special public health preparedness.

b) **Category B:** These agents are the second highest priority as they are moderately easy to spread resulting in moderate illness rates and low death rates, and require enhanced disease monitoring.

c) **Category C:** Emerging pathogens that could be engineered for mass spread in the future are included in the C category, whose acquisition, production and dissemination is easier. They have potential for high morbidity and mortality rates and posses the ability to cause pronounced health impact.

**THE ONE HEALTH APPROACH**

Death of thousands of children and adults everyday worldwide due to underdiagnosed diseases arising at human-animal-environment interface, explosive human population growth, and environmental changes have created the urgent need for a One Health approach on a global basis (Taylor et al., 2001). One health approach requires the complex field of endeavor utilizing individual, organizational and cultural interventions, leading to improved morbidity patterns and health care use, behavior of defined populations (Kindig and Stoddart, 2003; Howe and Christopher, 2004).

The animal and human health can be improved and enhanced within ‘One Health’ concept using innovative partnerships, collaborations, and research/surveillance/control.
programmes. The novel advances in diagnostics and therapeutics need to be explored to their full potentials to safeguard health of humans as well as their companion animals (Schmitt and Henderson, 2005; Belak, 2007; Belak, 2007; Ratcliffe et al., 2007; Bergquist, R. 2011; Deb and Chakraborty, 2012; Dhamo et al., 2012 ad; Dhamo et al., 2013b). The concept of ‘One World One Health’, put forward during a conference of the Wildlife Conservation Society, 2004, helps in building the cooperative momentum to control and defeat emerging and reemerging diseases at the interface between man, animal and ecosystem (Ahmed et al., 2010). The foundation of One Health is a flexible global governance model. Therefore, existing resources are mobilized and smoothly redirected to respond to emerging issues, without any requirement for the creation of new norms or new institutions. Classical examples in this regard include deaths of wild and captive birds leading up to the West Nile human (confused for St. Louis encephalitis virus) outbreaks, monkey pox (confused for smallpox virus) in prairie dogs from West African rodents, or deaths of apes in the Congo forest due to Ebola epidemic. Until the discovery of horseshoe bats as the real hosts, the civet cat was initially wrongly thought to be the reservoir for SARS. Similarly, in the year 1998, in Malaysia, pigs were originally considered as hosts for Nipah virus, which are now found out to be intermediary hosts, while the actual hosts were fruit bats. The spill-over from wildlife reservoir to livestock and human is also represented by the Hendra virus that has killed both horses and human beings in Australia. Again, in this case also the fruit bats were found to be the reservoir hosts. Whole-hearted cooperation between public health and animal health services will be required for prompt and effective control of well-known emerging and re-emerging diseases as and when they occur, or else their control will be hard and difficult, resulting in disastrous consequences and great economical losses. This type of situation was seen in the past in bovine spongiform encephalopathy (BSE) [or Variant Creutzfeldt-Jakob disease (vCJD)] and is now observed in the case with Q-fever in the Netherlands; or in a recent outbreak of rabies in raccoons in New York City (FAO, 2010; FAO-OIE-WHO, 2010a).

The One Health approach can also be viewed in a different context away from the zoonotic diseases and human-animal interface, wherein global concerted efforts are directed to prevent, control and if possible, to eradicate the diseases from planet earth. This has been shown for the smallpox in human and rinderpest in bovines. A resolution put forth in 1958 by the Soviet Union for global eradication of smallpox was adopted by WHO, later on sponsored by many countries, had eradicated smallpox within ten years. Forty four countries were still reporting the disease during that time. The Smallpox Eradication Program (SEP), started in some of the poorest countries, was successful even under situations where health services were minimal. It was observed that every single individual needs not be vaccinated for the removal of disease. Improved technology also made delivering the vaccine more efficient leading to declaration of freedom from smallpox by many more new countries. The last naturally-occurring case of smallpox in the world was observed in October, 1977 in Somalia. However, smallpox last two victims were observed in 1978 in Birmingham, England, who tragically contracted the smallpox virus escaped from a research lab. The certification of the eradication of smallpox in 1979 by a global commission was officially accepted by the 33rd World Health Assembly in 1980 (Fenner et al., 1988; FAO, 2010).

The Global Rinderpest Eradication Programme (GREP) including many different regional campaigns such as Pan African Rinderpest Campaign (PARC), West Asia Rinderpest Eradication Campaign (WAREC), South Asia Rinderpest Eradication Campaign (SAREC), and India's National Programme for Rinderpest Eradication (NPRE) were involved in prevention and control of rinderpest. These regional campaigns incorporated common features in their campaigns along with the use of three OIE pathways and a common vaccine strain (Rweyemamu and Cheneau, 1995, Taylor et al., 1995, FAO-OIE-WHO, 2010a; The World Bank, 2010). These combined efforts have produced results to eradicate Rinderpest, the first one of veterinary importance to be eradicated. The decades-long, worldwide collective field activities to eradicate the disease were stopped in October 2010 by the United Nations Food and Agriculture Organization. In May 2011, the World Organization for Animal Health (OIE) announced the free status of the last eight countries not yet recognized, and announced freedom from the disease in a total of 198 countries. In August 2011, the United Nations declared rinderpest has been fully eradicated, making it only the second disease in history to be fully wiped out, the one being the smallpox. These two examples encourage the application of combined, concerted and simultaneous efforts and resources at the global level to achieve the One Health concept for human and animal diseases.

CLINICIANS AND ONE HEALTH PRACTICE

The human health and animal health practitioners should understand the concept of One Health, appreciate the complexities of the spread of zoonotic diseases between human and animals, and apply the One Health knowledge in their clinical practice. When human and animal health professionals collaborate and communicate can work for the benefit of human and animal health and this can be recognized through practicing One Health. Human health clinicians can better understand the contribution of household pets in the spread of zoonotic diseases and animal allergies in human by the interaction with a veterinarian, which would help in the diagnosis and prevention of infectious diseases and allergies. Geographical information System (GIS) based display of data on the detection of zoonotic diseases in human and animals in a given geographical area would help to alert the clinicians as well as public health specialists in the diagnosis and prevention of the disease. Practicing One Health is also important in the diagnosis and prevention of diseases associated with occupational health hazards.

JOINT VENTURE - SEEKS ATTENTION FOR ONE HEALTH

Collaborative efforts of veterinary and human medicine, environmental, wildlife and public health, result in establishing or identifying Centers of Excellence for Education, Research and Training, thereby lead to the success of the One Health approach. A collaborative approach from experts of various fields, laboratories and countries will be helpful with division of labor and creating the Centers of Excellence (Osburn et al., 2009). Regional consultations of government officials, agricultural, and conservation scientists, entomologists, epidemiologists, anthropologists, microbiologists and nutritionists, economists and educators, engineers, hydrologists, physicians, public health professionals, sociologists, and veterinarians necessitate the understanding of emerging diseases with special reference to their region. These meetings should also involve stake holders and policy makers (Leonardi et al., 2006; Madigan and Dacre, 2009; Dhamo et al., 2012a). This cooperative approach on health will facilitate easy control and prevention of emerging zoonotic diseases. This approach needs an efficient national surveillance and monitoring system capable of rapidly detecting emerging zoonoses, generating reliable information on the disease situation, and justifying them to all
the collaborating countries. This should also suggest the disease management measures by collaborating with international organizations like World Organization for Animal Health, (WOAH), Food and Agricultural Organization (FAO) and World Health Organization (WHO). All the international organizations should have the regional referral diagnostic laboratories, local emergency plans, priorities and autonomy from the political bias (United Nations, 2008). These networks should make use of the highly sensitive and specific methods like molecular based as well as serological methods in diagnosing pathogens at the earliest. They should develop the cost effective and pen-side diagnostic methods (Coughlin et al., 2006; John et al., 2008; Dehove, 2010; FAO-OIE-WHO 2010b).

PREVENTION AND CONTROL OF ZOONOSES – PART OF DISASTER MANAGEMENT

With respect to preventive and control measures for emerging diseases like the viral diseases of animals, no real alternative exists since there are no antiviral drugs suitable for widespread application in the field conditions (Jehara, 2004). Furthermore, with the increasing problem of antimicrobial resistance among zoonotic bacteria, use of antibiotics in the treatments in animals has been put under scanner. Also, the inadequate compensation provided by the government during adoption of stamping out policies to control epidemics has a clear negative social effect on the livelihood of smallholder, particularly with respect to the poultry industry (Grunkemeyer, 2011; Dhama et al., 2012a,c). All these suggest the possible way to control zoonotic disease in animals would be through the use of vaccines. With the recent molecular developments in vaccinology like recombinant subunit, di- deoxy nucleic acid (DNA) and non-pathogenic virus vectored vaccines including the reverse vaccinological approaches using expression library are to be explored fully so as to achieve most cost-effective methods of producing antigens that are free from the exogenous materials as associated with conventional vaccines (Gamble and Zarlenga, 1986; Casais et al., 2001; Fingerut et al., 2003; Dhama et al., 2008b; Weiner, 2008). The delivery systems like nanoparticle, liposome, viral vector and cell based vaccination procedures too need to be explored and applied to achieve effective and protective immune responses (Babiuk et al., 2003; Emerich and Thanos, 2003; Suri et al., 2007). Many pathogens causing infectious diseases gain entry through the mucosal sites (immune response being the first line of defence) and establish initial infection in these sites. Mucosal vaccines can offer lower costs, better accessibility, needle and medical waste-free delivery, and higher capacity of mass immunizations during pandemics (Dhama et al., 2013c). Such vaccination provides protective immunity against pathogenic entities both locally and systemically. However, majority of the licensed vaccines are administered parenterally, with the exception of poultry vaccines. Therefore, more efforts are required to design and develop effective and potent mucosal vaccines, mucosal adjuvants and their delivery systems for human, livestock, poultry, wild and aquatic animals (Chadwick et al., 2010, Fujikuyama et al., 2012, Pavot et al., 2012, Rhee et al., 2012, Woodrow et al., 2012; Dhama et al., 2013c.) Furthermore, regulations governing registration and marketing of vaccines for livestock or wildlife should become more flexible, so that these vaccines can meet the epidemiological requirements of field. However, animal disease control recommendations should take into account scientific and technological progress as well as the new vaccines available (Moran et al., 2009; WHO, 2006; Gargano et al., 2013).

Vaccination is without a doubt the best means of prevention, wherever possible. But good management practice and biosecurity can, however, never be replaced by vaccination as most emerging diseases pose the obstacles like residual virulence, variability in the strains, extensive safety precautions regarding personal and environmental contamination, difficulty in production, sometimes requirement of specific growth conditions, cost constraints or prohibitively expensive. In addition, there are fundamental biological differences that will influence vaccination protocols, between various species and even within each species particularly when there are numerous strains developed artificially like in poultry (Paul-Pierre et al., 2009; Dhama et al., 2012a). There is increase trend of controlling major poultry diseases through vaccination along with other measures. Attention should also be given to heighten biosecurity measures, disease surveillance and monitoring activities (Haﬁz, 2003). The new trends in veterinary vaccinology should not only focus the causative agent but also the host (Movahedi and Hampson, 2008). Research on selective breeding of animals resistant to certain diseases should also be given emphasis as it is being used in Marek's disease in poultry (Jacqueline et al., 1997; Linda, 1998; Dhama et al., 2007; Singh et al., 2012). It is also necessary that veterinary services consider animal welfare as large-scale emergencies and disasters affect both human and animals and most of the disease outbreaks either have animal origin or are associated with such conditions (Leonardi et al., 2006). Veterinary institutions must develop their training and curricula to allow veterinarians to effectively engage in missions envisaged by the OIE for participating in global animal welfare programmes. Provision for veterinary care of injured or sick animals along with plans to vacate animals and their shelters should reflect the normal standard care to animals in the society and thus is a result of regional socio-economic realities and geographic factors (Madigan and Dacre, 2009; OIE, 2010).

WILDLIFE AND EMERGING/REEMERGING ZOONOTIC DISEASES

Interaction of human with wildlife gives rise to various re-emerging global zoonotic pandemics viz., SARS corona virus as well as H5NI and H1N1 influenza viruses; Nipah and Hendra viruses; human immunodeficiency virus (HIV) (Day et al., 2011). Some of the holistic approach need to be adapted to prevent epidemic/epizootic diseases and to conserve integrity of ecosystem as is given below:

- Relationship between man and animals including wildlife needs to be understood.
- Judicious use of land and water.
- Wildlife health science is crucial for global disease management and requires attention.
- Generating approaches towards the management of emerging and re-emerging diseases accounting for the complex interconnections among species.
- Biodiversity conservation perspectives; human and domestic animals needs must be fully integrated when developing solutions to infectious disease threats.
- Wildlife population impose an important and urgent threat to humans and at the same time to food security for which multidisciplinary efforts and scientific concerns to restrict culling of wild species are required.
- Increased investment in the global human and animal health infrastructure.
- Collaborative efforts by both public and private sectors are needed to ensure conservation of global health and biodiversity.
- Common people need to be made aware and educated regarding the problems.
NUTRITION AND IMMUNITY

The innate and acquired immunity in humans and animals is significantly influenced and modulated by the nutrition and nutritional status. The knowledge and understanding of the molecular and cellular immunological mechanisms involved in nutrient-immune interactions will help in the discovery of new dietary factors, which may be included in the diet to augment immune defenses and increase the pathogen/disease resistance of the host (Harbige, 1996, Chandra, 1997, Cunningham-Rundles et al., 2003; Mahima et al., 2013).

In fact, malnutrition is the most common cause of immunodeficiency in the world, leading to inadequate intake of complex biochemical ingredients as well as selective micronutrient deficiencies. Unfortunately, immunosuppression and dysregulation of immune responses are the grave consequences. Protein-energy malnutrition can cause significant impairment of cell-mediated immunity mediated by phagocytes, complements and cytokines and secretory immunoglobulin A (IgA) concentrations. Impairment of these responses can compromise the integrated immunity and increases one’s susceptibility to infection (Harbige, 1996, Cunningham-Rundles et al., 2005). Many developing countries are putting in policies for addressing the problem of malnutrition, which can have a direct and indirect influence on the health. India for example is working on the Food Security Bill.

ISSUES IN THE IMPLEMENTATION OF ONE HEALTH

Research and education in this relatively new field of science is very important for the successful implementation of One Health approaches. Recently, a conference was organized to address the One Health issues, priorities, research, and education at the Southeastern Regional Center of Excellence for Emerging Infections and Biodose. The group focused on research aspects of the One Health approach as well as selected microbial aspects of One Health (Gargano et al., 2013): 1) the need to develop and evaluate interventions with the potential to provide economic benefits to human or animal health to demonstrate a return on investment and 2) the need to engage behavioral science researchers and social marketers in conducting research to better understand consumer perspectives on One Health issues. The another group in the conference emphasized on inclusion of One Health concept in courses of science classes in schools, colleges, and universities; involvement of professional societies; embedding training opportunities within industry; and using social media and networking tools. University of Florida and University of North Carolina have already started the educational programs in One Health (Gargano et al., 2013). One Health Central and East Africa (OHCEA) was established for connecting public health and veterinary medicine schools in Africa that ensured spontaneous improvement of health and well-being of human, animals and ecosystems through multi-dimensional research, training and community service. The One Health Alliance of South Asia (OHASA) was established to predict and prevent emerging infectious diseases on the Indian subcontinent. However, the One Health concept has not reached to all the people involved in the fields related to animal, human and public health, particularly in the developing countries and there should be more emphasis on this in the future.

CONCLUSION AND FUTURE PERSPECTIVES

It can be summarized that scientific and policy-focused presentations from leaders, public health and scientific communities covering topics on current global activities focusing on surveillance for emerging infectious diseases in the ecosystem are important. Moreover, round table discussions to effectively generate multi-sectoral, trans-boundary surveillance initiatives need to be regularly organized, bringing together participants from diverse scientific backgrounds. This will provide an environment for the free exchange of ideas among experts from various fields and between scientists and policymakers, at global, regional and National level. An overall emphasis should be on epidemiology, surveillance and networking, prevention and control policies of zoonoses focusing the current and future perspectives. Equitable coordination between the public and private sectors is advisable and needs of the hour, in order to make available high-quality, safe, effective and affordable diagnostic and prophylactic products. For this purpose, collaborative / coordinating mechanisms, and inter-departmental / multi-disciplinary activities and strategic priorities are required with effective preparedness and response to diseases emerging on the human-animal interface for benefit of individual country / region in particular and global health community in general. The One Health concept should not only be viewed as a new field of public health, but it should also be well integrated with the basic science research areas of human and animal health. Lessons learned from the pathogen/animal host interface should be applied to understand the pathogen-human interaction. While applying this, we also need to be cautious about the influence of environmental interaction. The concept of One Health is still in its infancy though it has been emphasized by several professional organizations and their members, still it has not reached the students, healthcare professionals in the field of human, animal and public health specialists and policy makers. A major emphasis needs to be given in the education and research of the One Health concept of ‘One World, One Medicine, and One Health’ and its message should reach everyone.

REFERENCES


