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Applications and Challenges of One Health Approach in Relation to Ethiopian Context

Temesgen Tadesse Yitayih
Addis Ababa University College of Veterinary Medicine and Agriculture PO box 34, Bishoftu, Ethiopia

Abstract
As the human population continues to increase and expand across our world, the interconnection of people, animals and our environment becomes more significant and impactful. On the other hand, issues of global environmental change, global health, antibiotics resistant pathogens, food safety and emerging and re-emerging zoonotic diseases present some of the most complex challenges to the health of world population. As individual disciplines cannot address these issues in isolation, and the potential economic, health and environmental consequences of inaction are enormous. This review aimed at exploring some of the applications and challenges of one health approach. One Health offers a logical solution by recognizing the interconnected nature of human, animal and ecosystem health in an attempt to improve health and environmental policy, expand scientific knowledge, improve health care training and delivery, identify and address upstream solutions to public health challenges. This concept is founded on an awareness of the major opportunities that exist to protect public health through policies aimed at preventing and controlling pathogens at the interface between humans, animals and the environment. One Health can also enhance strategies for sustainable development, especially in areas, where health issues are relevant to threatened wildlife populations, people, and domestic animals. Despite its role in healthcare, operationalizing the concept of One Health requires overcoming many barriers including; difficulty in changing the mindset of health care providers from one of disease care to one of preventive medicine, general lack of awareness and need of education of physicians about one health. In developing nations, the lack of resources and informed personnel creates difficulty in establishing networks between animal, human and environmental health professionals. Although challenges to realization of one health certainly like financial constraints and lack of easy information exchange exist, it is critically important to develop this collaborative, cross-sectoral approach through focusing on specific investment in governance, particularly with regard to the allocation of public and private resources.
Keywords: Challenges, Food safety, One health, Zoonotic disease

1. Introduction

The global human population has now exceeded 7 billion, with estimated 30 billion food animals needed to help feed this population and meet its growing demand for protein from animal sources. This results in an impressive global food system that is both a major agricultural and business accomplishment and an unparalleled challenge that is creating major societal issues that, to some extent, threaten human, animal and environmental health (FAO, 2006). In addition, we live in a world that is rapidly changing, complex and progressively more interconnected (FAO, 2006). This convergence of people, animals and our environment has created a new dynamic concept in which the health of each group is profoundly and inextricably linked and elaborately connected (AVMA, 2008). Inherent in this new dynamic is the changing interface between people and animals, including animal products.

According to WHO, one or more new infectious diseases have been emerged each year since the 1970s (WHO, 2007). The majority of these have been Zoonoses; diseases caused by pathogens that can be transmitted between animals and humans with more than three-quarters originating from wildlife (Jones *et al*., 2008). Such diseases represent over 60% of all infectious organisms known to be pathogenic to humans (FAO, 2011). Global disease events have highlighted the increasing effects of zoonotic pathogens on human and animal health (Taylor *et al*., 2001). It has also become evident that changes in the environment including; agricultural intensification, population growth, climate change and human encroachment into wildlife habitats are drivers for such zoonotic disease emergence (Daszak *et al*., 2013) and that environmental contamination with toxic chemicals and other hazards threaten human and animal populations (Rabinowitz *et al*., 2009).

The human population growth combined with economic development has resulted in increased demand for livestock-derived food products; which has led to larger livestock populations, increased production intensity and changes in trade volumes and patterns. This in turn has provided an environment that facilitates the evolution and spread of infectious zoonotic pathogens, including those with antibiotic resistant genes (Jones *et al*., 2008). These trends have led to support for a more integrated and holistic approach to human, animal and environmental health Known as One Health (Davis, 2008).

One Health represents an approach for developing and sustaining broad trans-disciplinary collaboration for the early identification, prevention and mitigation of health risks in human, animals and the environment. While there are slightly varying definitions of One Health, most are similar to this European Union definition:

One health is an integrated approach to health that focuses on the interactions between animals, humans and their diverse environments. It encourages collaborations, synergies and cross-fertilization of all professional sectors and actors in general whose activities may have an impact on health (European Union, 2015). One health recognizes that understanding these interactions and interdependencies necessitates an integrated perspective (Zinsstag, 2011). This concept promotes a whole of society approach by incorporating human medicine, veterinary medicine, public health and environmental information when developing policy and determining interventions to address current challenges threatening today's globalized world (HPED, 2011).

Since the late 1990s, this core idea has been given additional impetus in the wake of many emerging and re-emerging Zoonoses including; *Human Immunodeficiency Virus*, *SARS*, *West Nile virus*, *Nipah virus*, *Ebola*, *Dengue hemorrhagic fever*, *Q-fever* and, most notably, Highly Pathogenic *Avian Influenza (HPAI)*. Endemic and/or neglected zoonoses (e.g. *Rabies*, *Brucellosis* and *Leishmaniasis*) are additional concerns in developing nations. Growing evidence suggests that globalization (the increased circulate on of people, other life forms, goods and services, finance and capital, and knowledge and ideas across the world since the late 20th century) is creating new conditions where disease could spread geographically and across species (Saker *et al*., 2006).

One Health approach and policy documents, outlining the framework for one health intervention, attem pt to mitigate and prevent emerging disease. However, trans-disciplinary principles and unification of human, animal and ecosystem health can be applied to additional sectors such as food safety, antimicrobial resistance and addressing implications of climate change (VSF(Veterinarians without borders), 2010). The collaborative approach of One Health has even been suggested to alleviate poverty in the developing world through diminishing burden of illness associated with under-reported zoonotic disease and strengthening access to social services in rural settings (Okello, 2011). In Ethiopia, even though the collaboration between disciplines was not new, One Health was officially launched in 2013. But, there is no still well documented information regarding one health program (Gebreyes *et al*., 2014).

Therefore, the objectives of this paper are:

- To review the principles of One Health program, its practice, challenges and future implications.
- To review the applications of One Health approach in integrating the work of veterinarians, human and environmental health professionals mainly for better animal, public and environmental health as a whole in developing countries.

2. Origin and History of One Health Approach

Ever growing human populations, reaching 7 billion in 2011 (UNFPA, 2011), and the resulting environmental degradation from expanding land use, intensified agricultural and animal husbandry methods, and closer habitation between humans and both domesticated and wild animal species are recognized as key factors increasing shared risk across the animal-human-ecosystem interfaces (Sherman, 2010).

Generally, in the 20th century, three major movements were seen, all of which contributed largely to current thinking on one health approach. The first was the concept of 'One Medicine' which arose out of the work of Calvin Schwabe with Dinka in Sudan (Zinsstag *et al*., 2011). Calvin Schwabe; the 'father of veterinary epidemiology' coined and reintroduced the concept of 'One Medicine' in his book Veterinary Medicine and Human Health in 1984, which argued that 'the critical needs of man include; the combating of diseases, ensuring enough food, adequate environmental quality and a society in which human values prevail'(Schwabe, 1984). His core idea echoed the 19th century physician Rudolf Virchow who believed that, 'between animal and human medicine there are no dividing lines nor should there be' (Saunders, 2000). Schwabe renewed the basic principle that a more holistic approach to human, animal and environmental health was needed to better protect the health of all (Schwabe, 1984).

The second movement was 'Ecosystem Health' or 'Eco-Health' which was adapted from ecology and environmental management to the improvement of human health and wellbeing. The third movement, which took the title of One Health, arose because of increasing concern of disease emergence at the interface between animals, humans and ecosystems. Among a series of disease emergences of global importance in the 1990s triggering one health approach, *Severe Acute Respiratory Syndrome (SARS), Avian influenza* and *West Nile virus* had strong participation from veterinary and, to a lesser extent, human public health (Nabarro, 2012).

In 1999, a series of themed conferences were organized by the Society for Tropical Veterinary Medicine and the Wildlife Diseases Association under the banner 'Working together to promote global health'. The second of these conferences held in 2001 in Pilanesberg, South Africa, addressed issues at the domestic animal/wildlife interface relating to disease control, conservation, sustainable food production and emerging diseases (Gibbs and Bokma, 2002). This meeting is considered as key to the early development of One Health (Lee and Brumme, 2013).

In 2007, a vision supporting the concept of OH was adopted by The American Veterinary Medical Association and the American Medical Association that ended with formation of the One Health Initiative task

force. This brought together USA human and animal health agencies, Medical doctors and Veterinarians. Within the same year, the National Strategy for Pandemic Influenza and its Implementation Plan resulted in several International Ministerial Conferences that involved the United Nations' Food and Agriculture Organization (FAO), the World Organization for Animal Health (OIE), and the WHO. It has also gained ground throughout the USA government, led by the president's new initiatives for coordination and collaboration on national security and global development policy (USDA, 2015).

3. Principles of One Health Approach

One Health recognizes the inextricable linkage of human, livestock, companion animal, wildlife and environmental health implying an added value to the health and wellbeing of humans, animals and environment (Zinsstag *et al*., 2011). This concept is more expanded compared to One Medicine that stated 'human and veterinary medicine share a common body of knowledge in anatomy, physiology, pathology and the origins of diseases in all species' (Schwabe, 1984) and thereby recognizing the mutual benefits available through the connection of veterinary medicine and human health. So, One Health is different from One Medicine in that ecosystem health is added into the animal-human interface to incorporate the environment, as well as wildlife populations, and recognize that sustainable development and continued human and animal health are dependent on healthy surrounding ecosystems (Zinsstag, 2011).

This new concept is the function of the collaborative efforts and communication of multiple disciplines working to attain optimal health of people, animals and the environment. One Health is an integrated strategy which involves the cumulative works of veterinary medicine, human medicine, environmental science and public health (Samuel *et al*., 2013). More recently, it is defined as 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, wild life, plants and our environments (One Health Commission, 2015).

Improving the health and well-being through the prevention of risks and the mitigation of effects of crises that originate at the interface of humans, animals and their various environments is the aim of One Health Approach. To promote this multi-sectoral and collaborative approach and a whole society approach to health hazards, a systemic change of perspective in the management of risks is crucial (One Health Global Network, 2015). Meeting new global challenges head-on through collaboration among multiple professions: Veterinary Medicine, human medicine, environmental health, wildlife and public health (AVMA, 2008).

4. Applications of One Health Approach

Deteriorating government public health services and stagnating public health and veterinary budgets in many countries have seriously limited disease surveillance and other preventive operations (World Bank, 2009). Global emerging livestock markets and rapidly changing socio-economic conditions, especially in parts of Asia and Africa (Herrero *et al.*, 2010), have led to the worrying development of 'hotspots' of zoonotic disease emergence. These regions are increasingly compromised when it comes to public health. Their populations are already challenged by a host of endemic zoonosis that contribute to poverty both directly, through their impact on human and livestock health, and indirectly, through their cumulative effects on food and economic security (WHO, 2009).

Traditional farming practices continue alongside innovative methods to increase livestock productivity, but weak regional regulatory systems and national disease control responses often mean that rapidly changing systems have the potential to not only cause the emergence and re-emergence of zoonotic infections, but also, more importantly, to further alienate already marginalized smallholder populations, as seen in the *Avian influenza* outbreaks in Asia (Scooness, 2010). Humans living in close proximity to and/or having frequent contact with wild animals and livestock, and sharing the same ecosystem with them, all contribute to the emergence of zoonotic disease. A lack of community awareness, the absence of effective surveillance in humans and animals and limited access to human health care and veterinary services serve to exacerbate the risk (Maudlin, 2009).

One Health approach that enables the management of both emerging and endemic zoonotic diseases may offer a practical and cost-effective route to poverty alleviation, by simultaneously addressing ecosystems management, animal and human health surveillance and community participation in disease risk mitigation (Godfroid *et al*., 2013).

4.1. Zoonosis control

The concept of One Health mainly focuses on control of various infectious diseases that can be transmitted among and between animals, human and the environment. There are different indications that show the occurrence of infectious diseases in different forms will continue to be significant global events (Graham *et al*., 2008). A large majority of these infectious diseases are caused by microbes which have zoonotic importance. At

the same time, the ever changing environmental conditions will continue to create favorable conditions for the development of new infectious diseases as well as an expanding number of non-infectious and chronic diseases and disorders (Kahn, 2006).

Complex interactions of epidemiological, ecological, social and technological processes shape zoonotic disease emergence, transmission, risks and vulnerabilities, shaped by wider socio-economic and environmental drivers. Zoonotic diseases transmitted from animals to people present urgent scientific and policy challenges (Jones *et al*., 2008). The epidemic of *Ebola virus* in West Africa in 2014 and the 2009 *Influenza A (H1N1)* pandemic serve as stark reminders of the unpredictable nature of pathogens and the importance of animals in the ecology and emergence of viral strain (Gebreyes *et al*., 2014).

Zoonotic and communicable diseases common to human and animals continue to have high incidence rates and to cause significant morbidity and mortality worldwide (Kahn, 2006). Such diseases have important impacts on public health and livestock economies representing over 60% of all infectious organisms known to be pathogenic to humans. This gives significant credence to the importance of examining health effects across species, in order to fully understand the public health and economic impact of such diseases and to help implement treatment and preventive programs (FAO, 2011).

Emerging infectious diseases (EIDs) are diseases of infectious origin whose incidence has increased within the recent past or threatens to increase in the near future. These include; new, previously undefined diseases as well as old diseases with new features. These new features may include the introduction of a disease to a new location or a new population (e.g.it may present in youth where previously it was only seen in the elderly); new clinical features, including resistance to available treatments; or a rapid increase in the incidence and spread of the disease. Reappearance of a disease which was once endemic but had since been eradicated or controlled, would classify it as a re-emerging infectious disease (Emerging & re-emerging infections in India, 2013).

The emergence and re-emergence of pathogens due to various factors threatens the health and wellbeing of people and animals throughout the globe (Coker *et al*., 2011). The causes for the occurrence of such newly emerging and re-emerging diseases are due to simultaneously happening multi-factorial causes that may be associated with the behavior of the pathogens such as adaptation and resistance or host susceptibility. The other most contributing factors include; climate change, global travel and transportation, economic development, over growing human population and feeding behavior, interaction with wild life, and absence of public and animal health infrastructures, poverty and illiteracy (Patel and Burke, 2009).

Most of these factors have contributed in establishing a suitable condition and possibilities to the microbes to flare up every time and create new niches. These microbial, environmental, natural and manmade changes are occurring very quickly worldwide and establish new beachheads in the populations of people, animals and are also invading our environment where they are inducing new pathogenic conditions (Coker *et al*., 2011) as indicated in figure 1 bellow. Health of the animals, hygiene and safety of food of animal origin represent growing and difficult challenges which clearly fall into a new global health agenda for animal production and food supply (Gebreyes *et al*., 2014).

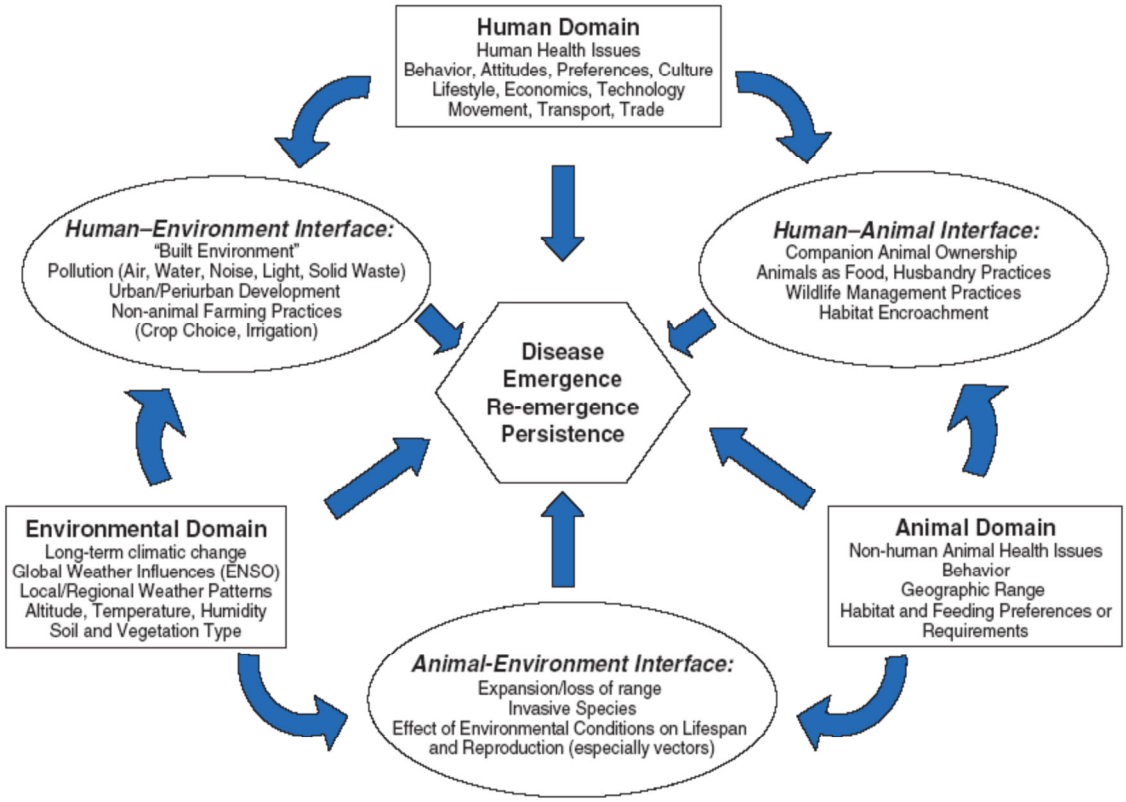

Figure 1. Major contributing factors for the emergence of emerging and re-emerging zoonotic diseases. **Source**: (Treadwell, 2008).

4.2. Antibiotic resistance

Antibiotics are used widely to prevent or treat disease in food animals. The major part of the usage is for prevention of disease, and their use has become an integral part of modern industrialized food animal production, to the extent where nearly all feed for growing animals is supplemented with antimicrobials in various doses, ranging from so-called "sub-therapeutic concentrations" to full therapeutic doses. It is estimated that the volumes of antimicrobials used in food animals exceeds the use in humans worldwide, and nearly all the classes of antimicrobials that are used for humans are also being used in food animals, including the newest classes of drugs such as third- and fourth-generation cephalosporins, fluoroquinolones, glycopeptides and streptogramins (Aarestrup *et al*., 2008).

Despite its curative and preventive value, the cause of treatment failure in animals and humans attributable to antibiotic resistance arising from the use of antimicrobial agents in food-producing animals or companion animals is a serious concern for public health (Australian Commission on Safety and Quality in Health Care, 2013). The amounts and patterns of antimicrobials used in food animals is the major determinant for the propagation of resistant bacteria in the animal reservoir. Thus, the levels and patterns of resistance observed in food animals to a wide extent reflect the patterns of drug usage. However, other determinants also play a part, such as spread of bacterial clones between animals, in particular vertical spread between the generations (e.g., the spread of resistant *Salmonella* in the poultry and swine breeding pyramids), and successful adaptation of clones resistant to the animal reservoir (e.g., MRSA CC398) (Aarestrup *et al*., 2008).

The public health consequences of zoonotic antibiotic resistant pathogens is invariably difficult to assess for a number of reasons: the epidemiology is highly complex because it involves complex production and distribution systems of animals and food, it involves the spread of bacterial clones as well as resistant genes, and, finally, the impact on public health includes increased morbidity and mortality and higher costs of treatment of disease. Evidence shows that the amount and pattern of non-human usage of antimicrobials impacts on the occurrence of resistant bacteria in animals and on food commodities and thereby human exposure to these resistant bacteria. The food borne route is the major transmission pathway for resistant bacteria and resistant genes from food animals to humans, but other routes of transmission also exist (FAO *et al*., 2003).

4.3. Food safety

Food safety is the assurance that food will not cause any harm to the consumer when it is prepared and/or

consumed according to its intended use (FAO/WHO, 1997). Food safety is a growing global concern, not only for its continuing importance to public health, but also because of its impact on international trade (Burros, 1997). The convergence of people, animals, and our environment has created a new dynamic one in which the health of each group is inextricably interconnected. While the demand for animal-based protein is expected to increase by 50% by 2020, animal populations are under heightened pressure to survive, and further loss of biodiversity is highly probable (Delgado *et al*., 1999).

Issues and problems connected with food safety, food security, sustainable production systems that ensure environmental protections and the capacity to help feed more than 7 billion people collectively qualify as a societal and wicked dilemma. Food safety challenges differ by region, due to differences in income level, diets, local conditions and government infrastructures (WHO, 2004). Even though considerable progress to strengthen food safety systems has been achieved in many countries, highlighting the opportunities to reduce and prevent food-borne disease, up to one third of the population of developed countries is affected by food-borne diseases each year, and the problem is likely to be even more widespread in developing countries (Royal Society of Chemistry, 2001). So, ensuring food safety in today's complex world is a daunting task and is possible only with a concerted effort of all sectors including government, consumer organizations and industry (Motarjemi and Mortimore, 2005).

In sub Saharan Africa, millions of small-scale farmers efficiently supply the great majority of the meat, milk and fish market. Even though such animal products have a high nutritional value which enhances public health, they are also the single most important sources of food borne diseases. This is because food borne infection and intoxication due to exposure of food of animal origin to different physical, chemical and biological contaminants is creating a serious problem in the health of human being. The food hygiene and safety problems occurring along the whole food chain are producing food borne zoonotic diseases (Newell *et al*., 2010). Health of the animals, hygiene and safety of food of animal origin represent growing and difficult challenges which clearly fall into a new global health agenda for animal production and food supply (Gebreyes *et al*., 2014).

4.4. Environmental health

The environment includes "all of the physical, chemical and biological factors and processes that determine the growth and survival of an organism or a community of organisms". Another concept, Ecosystem, is "comprised of all of the organisms and their physical and chemical environment within a specific area" (Christensen, 2012). Fundamentally, the environment affects how organisms live, thrive, and interact and must be considered in order to achieve optimal health for people and animals (Maller *et al*., 2008). In general, human and animal well-being relies on the integrity of ecosystems. Ecosystems underpin processes essential to our survival, known as ecosystem services. These services include supporting services (nutrient cycling, soil formation, primary production); regulating services (climate and flood regulation, disease buffering, water purification); provisioning services (food, water, fuel); and cultural services (aesthetic, spiritual, mental health) that make the persistence of human and animal life possible (United Nations Millennium Ecosystem Assessment, 2005).

Even though, Ecosystems can maintain healthy populations, mismanagement or rapid alteration due to human pressure leads to increasing challenges to the maintenance of healthy ecosystems, including climate change, deforestation and intensification of agricultural systems, freshwater depletion, and resultant biodiversity loss which can also be associated with disease emergence (Myers and Patz, 2009).

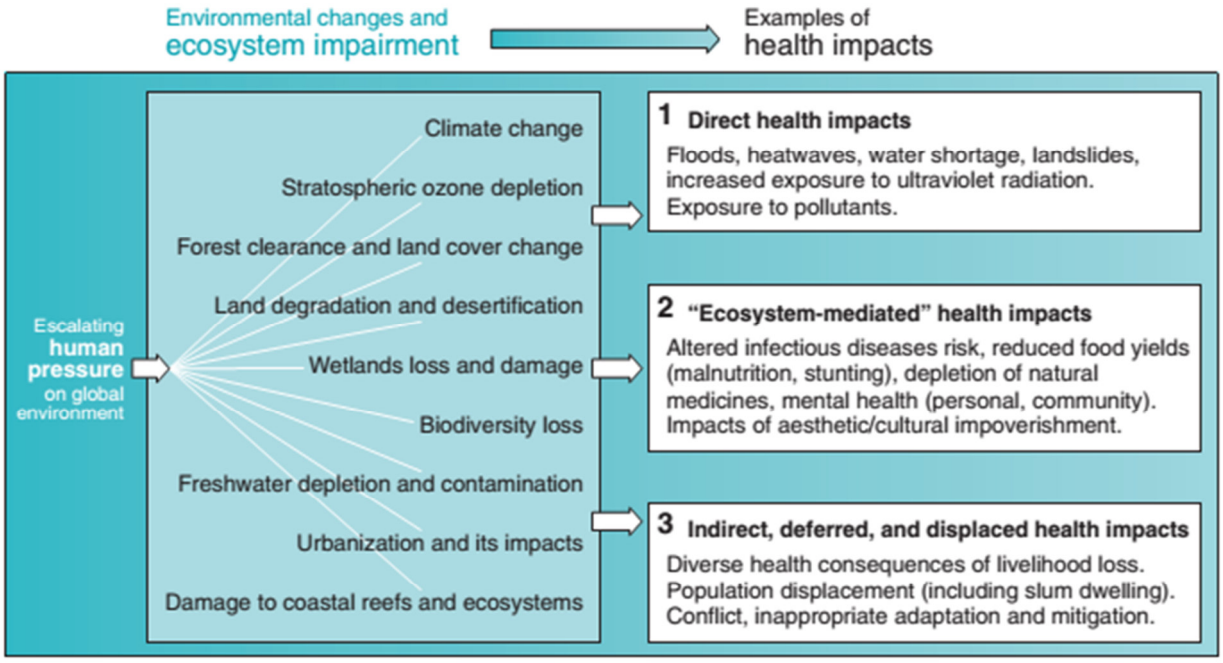

Figure 2. Environmental change can degrade ecosystems and negatively affect health.
Source: (Corvalan, 2005)

Changes in temperature, precipitation, and seasonality can also influence infectious disease incidence, and spread (Tanser, 2003). This is because of their effect on pathogen reproduction, abundance, environmental tolerance, virulence, and distributions (Froeschke *et al*, 2010). In addition to disease, the potential health impacts of climate change will be broad and significant in terms of the heat and cold effects; wind, storms, and floods; drought, malnutrition, and food security; food safety; water quality; air quality; occupational health; and ultraviolet radiation (Solomon *et al*, 2007).

4.5. Wild life conservation

Among existing and emerging pathogens affecting humans, over 60% originates from animals; of those, 75% comes from wildlife (FAO, 2011). Human encroachment into wild life habitats invites these infectious agents to become pathogen for human populations. It is important to identify the routes by which these agents find their way to the human host and to understand their impact on the animals that serve as the primary and intermediate hosts. Veterinarians are in a unique position to deploy their back grounds and understanding of animal diseases to identify, manage and control these diseases (Jones, 2009).

While human and domestic animal diseases do sometimes affect wildlife, pathogens that are transmitted from wildlife to humans, often through domestic animals, are considerably more numerous. These include *HIV*, *Ebola*, *SARS*, *H5N1 Avian influenza*, *Nipah* and *Hanta viruses*, *Lyme* disease, *Crimean-Congo hemorrhagic fever*, *Tick encephalitis* and *West Nile virus* (Cleaveland *et al*., 2001).

5. Benefits of One Health Approach

The benefits of a One Health approach include: Improving animal and human health globally through collaboration among all the health sciences, especially between the veterinary and human medical professions to address critical needs, meeting new global challenges head-on through collaboration among multiple professions (veterinary medicine, human medicine, environmental, wildlife and public health), developing centers of excellence for education and training in specific areas through enhanced collaboration among colleges and schools of veterinary medicine, human medicine and public health, increasing professional opportunities for veterinarians and adding to our scientific knowledge to create innovative programs to improve health (American Veterinary Medical Association, 2008). Closer cooperation of human and animal health care provision can also lead to financial savings in different sectors (Zinsstag *et al*. 2005).

The importance of one health is increasing as the expansion of human and animal populations, ecological changes due to human impact and climate variations, and technological advancements facilitating global human, animal, and product movements have resulted in an increased risk of disease transmission between animals and people. It embraces the idea that a disease problem impacting the health of humans, animals, and the environment can only be solved through improved communication, cooperation, and

collaboration across disciplines and institutions (USDA, 2015).

5.1. Joining up health resources

One Health is synergistic, as it aims to shift the focus from single diseases to strengthening public and animal health systems, while also recognizing the environmental and social drivers of health (Laboeuf, 2011). To achieve this synergy, there must be a delicate balance between improving collaboration and cooperation while also acknowledging the distinct objectives and management principles of each discipline involved. If One Health is successfully implemented, there should be improved achievement and efficiency in logistics, the enhanced provisioning of services globally, and the strengthening of health systems (WHO, 2010).

Sharing health resources across human and veterinary health sectors would appear to be an easy win. This is especially the case for laboratory facilities as the majority of pathogens and chemical hazards are common to both humans and animals. Joint laboratory facilities are particularly important in developing countries where scarcity of human and financial resources challenge the sustained operation of laboratory resources. A second area is shared education resources; much of the pre-clinical curriculum is common to both human and veterinary medicine and there are overlaps in many paraveterinary and paramedical curricula. Disciplines which work at a scale much higher than the individual patient (e.g. epidemiology) or much lower (e.g. molecular biology) use essentially the same methods for both humans and animals and can easily combine forces. Surveillance is a third area where there are obvious advantages to systems which are at least joined up and possibly integrated. A fourth possible area for joining forces is disease control, especially in remote, livestock-keeping communities. Linking livestock vaccination with vaccination of children has been piloted in Chad in communities where the majorities of livestock, but no children, were vaccinated (Schelling *et al*., 2007).

In developing countries, human health expenditure was estimated at US$521 billion in 2012 (IHME, 2012) and veterinary health expenditures is less solid, but combining data from a number of studies suggests an expenditure of US$1bn – US$2bn on public animal health services (Bonnet *et al*., 2011). Best available evidence suggests that shared laboratories, education and management of zoonosis can constitute 5% of the human health budget and 40% of the veterinary health budget implying that the total savings of joined-up services could be US$2.68bn per year (Eurostat, 2012).

5.2. Controlling zoonosis in animal reservoirs

The convergence of human, animal and environment has made the routine disease prevention and control process difficult and unsuccessful creating a new concept, One Health, in which the health of each group is interconnected and dependent (Coker *et al*., 2011). Studies estimate that around 14% of livestock in developing countries each year are infected with one or more zoonosis and that each infection reduces their productivity by around 10% (Grace, 2013). In addition to morbidity, mortality is an important cause of loss for livestock. The annual mortality rate of livestock is high in developing countries particularly in Africa (Otte and Chilonda, 2002). The human health costs of zoonosis are typically equal to or greater than the livestock sector losses, a trend which is becoming more pronounced with time (World Bank, 2012). To reduce such losses, One Health approach plays a significant role in the prevention and control of Zoonoses (WHO, 2005).

5.3. Adding value to health research and development

OH leads to better research and disease control program as well as ecosystems better able to provide health as a regulatory service. Evidence for the value of OH has been presented at major conferences with the most recent including: Addis Ababa (2011), Arusha (2013), Bangkok (2013), Davos (2012), Johannesburg (2011), Kunming (2012), London (2010) and Melbourne (2011). Important meetings have also been held where global health leaders endorsed the approach: these include gatherings in New York (2004), Winnipeg (2009), Bellagio (2010), London (2009), and Stone Mountain (2010). A recent review identified 41 major OH initiatives (Rockefeller Foundation, 2011), another review showcased 31 OH projects (VSF, 2010) and a recent book sets out ecosystem health and practice (Charron, 2012).

5.4. Early disease outbreak detection

It is estimated that outbreaks have cost on average US$6.7bn from 1997–2009 (World Bank 2011). Human and animal health being investigated as a single social system makes control of diseases more cost effective (e.g. *Rabies*, *Brucellosis*; in comparison to looking at economic efficiency in one sector only) (Jonas, 2012).

An integrated One Health system improves global health surveillance and preparedness. For example, it could ultimately reduce the lag time for detecting emerging diseases, as well as improve response and, importantly, prevention (Zinsstag *et al*., 2011).

5.5. Pandemic prevention

In addition to the ongoing losses from disease outbreaks, there is considerable concern over the possibility of a

civilization-altering pandemic or plague. These have occurred regularly but infrequently throughout history and pre-history. In a landmark study, the World Bank considers the possible impacts and costs of averting high impact but low probability pandemics. A severe pandemic costing US$3 trillion may occur, on average, once in a hundred years. If the investments in One Health systems are made and such a pandemic is prevented, the global expected benefits are US$30 billion per year. Every year, an investment of US$3.4 billion would produce an expected benefit of US$30 billion for the international community (Burns *et al*., 2008).

6. Practices of One Health Approach in Developing Countries

Even though there are challenges and limitations to come to the mind set of One Health, various opportunities have emerged to promote health in the continuously changing human, animal and environment interface (Gebreyes *et al*., 2014). For example, ICONZ, which involves 21 European and African universities and research institutes, is working on case studies of zoonotic disease clusters in seven African countries: Morocco, Mali, Nigeria, Uganda, Tanzania, Mozambique and Zambia. The need for organizational control programmes to consider both human and animal health factors, along with monetary and other benefits to society, can encourage participation from public health services in interventions that may otherwise never be cost-effective from a health sector point of view alone. This large collaborative project, targeting the neglected zoonotic diseases, is filling vital knowledge gaps, particularly on the burden of neglected zoonosis, and provides a strong evidence base to support policy decisions at the international, regional and national levels in developing countries (Okello and others, 2011).

During the launch of One Health approach in Ethiopia, representatives from governmental and private organizations appreciated OHCEA activities in Ethiopia so far and emphasized the need to consider the following points: focusing on advocacy of OH approach through creating more awareness forums to bring attitude change and get buy-in of policy makers, working on way of registering OHCEA in Ethiopia and formulating short and long term goals at national level, strengthening national committee and revising the existing membership to include all relevant OH stakeholders, soliciting funds or grants to make the prevailing project sustainable after the funding period expires, preparation of national strategic plan based on organized and well-designed assessment tool to know the gaps in various institutions/ organizations, documenting and sharing the lessons learnt from previous ways of fighting pandemic threats in the form of success stories, working on gender issue to address zoonotic diseases (OHCEA, 2014).

7. Challenges of One Health

The commonalities of human and veterinary medicine, and the financial constraints that many governments presently facing, are arguments in favor of One Health-One Medicine approach; while status of thinking, education system, administrative structures and legislation hinder its implementations (Marsha and Tewodros, 2012). The challenge to be better prepared for natural and man-made disasters is a huge concern for all, but veterinarians are in a unique position to appreciate the implication of disasters on both human and animal communities (Jones, 2009).

7.1. Budgetary constraints

Sharing finances is constrained by low and unequal budget allocations. The human health sector generally has significantly more human and financial resources available for disease control activities than environmental or animal health agencies. Moreover, the relation between staff salaries and recurrent costs to enable the services to operate has deteriorated, leaving limited discretionary spending for all services. This has been well documented for the veterinary services; in particular for sub-Saharan Africa (World Bank, 2009). The challenge of capacity can be an issue for government bodies as not all countries have the ability to support a One Health agenda. This lack of resources and informed personnel may prove difficult in establishing networks between animal, human, and environmental health professionals (FAO *et al*, 2008).

7.2. Inefficient information sharing

National public health authorities often use different disease reporting procedures and communication channels than the veterinary services. Despite the importance of understanding the life cycle of pathogens in humans, and in both domestic and wild animals, most national and international health organizations monitor, and can only generate information on, human or domestic animal disease but not both together (Kuehn, 2006). Professionals within the One Health field argue that there is a disconnection between professions working within the framework, specifically those from veterinary and medical communities. The inability to effectively coordinate professional services could jeopardize communication and surveillance regarding emerging zoonotic disease and curb the opportunity for collaboration in other interconnected matters of public health concern (Zinsstag *et al*, 2011).

7.3. Cultural and perception issues

To implement One Health, there may be cultural and perception issues to overcome. It often requires cultural shifts within agencies, and new systems and capacities to be built and changes in attitudinal relationships between professions (veterinarians, doctors, extension workers, biologists and workers in the area of the environment and natural resources) (FAO, 2008).

8. Practice and Challenges of One Health Approach in Ethiopian Context

In collaboration of Jimma University with OHCEA Secretariat manager and various delegates from local and international organizations, One Health was launched in Ethiopia on March, 2013 (OHCEA, 2014). Key note address was delivered through delegates of MOH and MOA and both expressed the need for OH approach in the control and understanding of emerging diseases. They also said that, the need for working together is timely approach not only to solve communicable diseases but also the non-communicable diseases which affect both livestock and human beings. In fact, the issue of collaboration was not new for the Ethiopian system since the two ministries in particular and other relevant disciplines were working together to address different health problems such as the case of unknown liver disease in Western part of Tigray region and the *Avian influenza* (Gebreyes *et al*., 2014).

8.1. Practice

The Ohio State University Health Science colleges established The Ohio State University Health Sciences-Ethiopia One Health Partnership task force in August, 2012 aiming to create and develop a sustainable and mutually beneficial partnership with Ethiopian academic and service agencies in teaching, research and outreach by embracing the principles of One Health. The task force has been conducting activities such as: service learning, clinical, outreach and research projects that involved more than 300 Ethiopian and 100 Ohio State students, delivered more than 40 courses for more than 300 Ethiopians in Annual Summer Institutes, engaged in high impact societal problems such as *Rabies* and *Cervical cancer*, developed novel and rapid field-deployable diagnostic systems against key infectious diseases such as *Bovine Tuberculosis*, developed novel approaches for training and research delivery using electronic approaches such as iTunesU based courses, MAGPI and iPAD based data collection system and others (One Health Summer Institute, 2014).

In 2011, One Health Central and Eastern Africa (OHCEA) network was established as a network of seven public health and seven veterinary Higher Education Institutions that are located in 6 countries in the Eastern and Central African regions to address current and future global health challenges through the One Health approach. Ethiopia, being a member of OHCEA, has been sharing experiences, challenges and lessons to date from countries: Rwanda, Kenya, Uganda, Tanzania and Cameroon that have established on-going national One Health structure or "platform". This is because a national One Health platform provides government and stakeholders with a mechanism to improve multi-sectoral coordination and collaboration to strengthen the prediction, prevention, detection and response to emerging pandemic threats (Second OHCEA International One Health Conference, 2015).

8.2. Challenges

The main focus of One Health is on the control of various infectious diseases that can be transmitted among and between animals, human and the environment (Graham *et al*., 2008). As Ethiopia has a great coverage of pastoral areas with inadequate veterinary and health infrastructures and facilities, low number of health professionals and less supply of medical inputs, the issue of OH is very critical. The livelihood of pastoral community of Ethiopia is mainly dependent on livestock production (Admasu, 2003). This condition made the people to have an intimate relationship with animals (Zinsstag *et al*., 2005). However, there is knowledge gap both in the community and health professionals about zoonotic infection in the rural areas. Apart from this, there is no trend of collaborative work between animal and human health professionals to create awareness about the zoonoses to the community which demands policies and strategies that motivate professionals and disciplines to unite for human, animal and ecosystem health (Angesom, 2015).

9. Conclusion and Recommendations

In general, One Health approach promotes collaborative approaches to the collection, analysis and interpretation of a wide range of data to anticipate and respond to the rapidly changing environment and its impacts on the health of human and animal communities. This approach can only be successful if it maintains partnerships across various professional sectors and engages stakeholders within the human, animal and environment categories. It stimulates more innovative collaborative intervention options for prevention and response to diseases. Despite the large and growing body of evidence supporting its usefulness, the great majority of medical education, clinical practice, development programmes and research continue to operate within disciplinary boundaries. This lack of uptake of OH approach attributes to insufficient evidence to convince practitioners and

decision makers. Moreover, it is apparent that complex public health challenges will continue to emerge which can only be tackled through application of One Health. Therefore, the following recommendations are forwarded to encourage successful implementation of One Health approach:

- Educational curriculum has to be developed, in particular at the university level that integrate human, animal, and ecosystem health and familiarize the principles of One Health.
- Legislation should be prepared and implemented to promote One Health approach through disease reporting and decision-making processes.
- Institutional frameworks that facilitate enhanced cooperation and communication among human, animal and ecosystem health agencies have to be established.
- Providing of an incentive framework, through the establishment of joint budgets of the services, and the provision of special grant mechanisms for One Health activities.
- Therefore, capacity building by training health professionals, awareness creation to the community through health extension workers and promoting collaborative health programs in One Health approach.
- Increase investment in the global human and animal health infrastructure commensurate with the serious nature of emerging and resurging disease threats to people, domestic animals and wildlife.

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