

The roles of veterinary, medical and environmental professionals to achieve *ONE HEALTH*

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ABSTRACT

According to the WHO- "*Health is a state of complete physical, mental and social well-being and not merely an absence of disease or infirmity*". The good health is the fundamental right of all the people on earth. The concept of 'One Medicine' coined by Calvin W. Schwabe evolves towards 'One Health' which comprises collaborative efforts of multiple disciplines to achieve perfect health of people, animals, and our environment. 'One Health' deals with the challenges at the intersection of animal, human and environment health including the infectious diseases, the global food crises, and climate change due to global warming. The cordial and active association of various disciplines such as medicine, veterinary, public health, environment, wildlife, ecology, and food hygiene is highly emphasized in order to achieve the goal of 'One Health'. This mini-review describes brief history of 'one health', the roles of veterinary, medical and environmental professionals, and developing collaboration with various concern professionals to achieve 'one health'. In addition, the selected achievements of 'one health' in the past 10 years have been described along with the challenges ahead for the successful implementation of such concept.

Keywords

Emerging zoonoses, Environment, One Health, Physician, Veterinarian

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INTRODUCTION

The term 'One Health' could be defined as the interdisciplinary approaches and actions involving strong cooperation primarily between physician and veterinarian so that health of people and animals could be ensured including the safety of the environments through with improved cooperation between physicians and veterinarians. The concept of 'One Health' represents a unique and significant opportunity for veterinary medicine to be in a leadership role and to work collaboratively for ecosystem health (a community of humans, animals, and plants interacting with one another and with their physical environment) for the greater good of society (Chaddock, 2012). According to the American Veterinary Medical Associate (<http://www.avma.org>), about 75% of the emerging human infectious diseases are directly or indirectly linked to animal *e.g.*, zoonotic in nature. This phenomenon highlighted the importance of health scientists (veterinarians, physicians, etc.) working together as co-equal teams. Dealing with the implications of this information requires nothing less than a holistic, collaborative approach among all scientific disciplines involved.

Due to urbanization, globalization, deforestation, changes in human ecology and behavior, animal has come more closely and close to people resulting transmission and emergence of infections in both directions. Faced with these complexes, it is crucial for two health professions (Physicians and Veterinarians) to work more closely together for better animal and human health, Better education should be provided to the next generation veterinarians and physicians to improve knowledge of ecosystem health and an understanding of the intricate and sometimes delicate relationship between animals, humans, and the environment. In addition, leadership training for veterinarians and physicians is needed to prepare both professions for greater roles in influencing policy development and fulfilling the needs of society (Zinsstag et al., 2011).

BRIEF HISTORY OF 'ONE HEALTH'

'One Health' is a new phrase, but the concept was originated as far back as to the time of Aristotle in 500 BC and Hippocrates of Cos in 340 BC. Aristotle wrote the 'Historia Animalium' to elaborate on the natural zoonotic history of animals. Effect of environmental factors on human health could be traced by the Greek physician Hippocrates (c. 460 BCE - c. 370 BCE) in his text 'On Airs, Waters and Places'. Hippocrates provided insight on other possible causations for disease in the human body, not just from 'humor' imbalances.

The Italian Physician Giovanni Maria Lancisi (1654-1720) also talked on the role the environment in the spread of disease in animals and humans. Lancisi is one of those few people who first suggested on the mosquito nets for prevention malaria in humans (Drake, 1832) but was also a pioneer in the control of rinderpest in cattle. Later on, Louis-René Villerme (1782-1863) and Alexandre Parent-Duchatelet (1790-1835) talked about linkages of human and animal health with environment and developed the specialty of concept of public hygiene (LaBerge, 1992). Although human medicine developed many years back, the veterinary medicine appeared as a distinct discipline in China during the dynasty of Zhou between 11th to 13th century (Driesch and Peters, 2003). However, in 1762, the first veterinary school was established in Lyon, France. The term 'zoonosis' was first used by the German physician and pathologist Rudolf Virchow (1821-1902) in 19th century. Canadian physician Sir William Osler (1849-1919) was one of the pioneers appointed as faculty combindly to work in the

Montreal Veterinary College and the Medical School of McGill University (Kahn et al., 2007).

In USA, James H. Steele, a veterinarian with DVM (Doctor of Veterinary Medicine) degree first established the veterinary public health section at the CDC (Waddy, 2009) in 1947. The term 'One Medicine' was developed and promoted by veterinary epidemiologist and parasitologist Calvin W. Schwabe (1927-2006) in 1984. The work of visionaries like Steele and Schwabe began to slowly influence veterinary medical and medical school curricula and public policy, as well as the approach to research of both groups. Among the many 'One Health' research models in the early 21st century, veterinarian orthopedist Dr. James L. Cook and physician orthopedist Dr. Sonny Bal at the University of Missouri have collaborated for over eight years on efforts to develop knee and hip replacements for humans and animals. Indeed, Dr. Cook's original development of using laboratory-grown cartilage for knee and joint replacement in dogs is being studied by Cook and Bal for adaptation to humans.

In 2003, the term 'One Health' draw the attention across the globe since it was mentioned in Washington Post by Dr. William Karesh to describe the outbreaks of Ebola hemorrhagic fever in Africa. He said, 'Human or livestock or wildlife health can't be discussed in isolation anymore. There is just *One Health*. And the solutions require everyone working together on all the different levels' (Weiss, 2003). This was followed by a series of conferences across the globe with the theme of 'One World - One Health'. The milestones in the recognition of 'One Health' across the globe is presented in **Table 1**.

THE ROLE OF VETERINARY PROFESSIONALS TO ACHIEVE "ONE HEALTH"

In the last 30 years, the prevalence of infectious disease has increased such that 75% of the emerging infectious diseases in humans are of animal origin (Taylor et al., 2001; Torrey and Yolken, 2005; Pal, 2013). The increasing occurrence of emerging infectious diseases indicates that bridging animal, human and environmental health through the 'One Health' concept is becoming even more critical. Veterinarians can ideally provide this bridge with their in-depth understanding of biological systems, knowledge of disease processes and epidemiology, experiences with diagnosing and managing diseases in large populations of animals, and success in eliminating and preventing

Table 1: The milestones in the global recognition of *One Health*

Year	Events
2004	a) The Wildlife Conservation Society publishes the 12 Manhattan Principles
2007	a) The American Medical Association passes the One Health resolution promoting partnership between human and veterinary medicine b) The One Health approach is recommended for pandemic preparedness
2008	a) FAO, OIE, and WHO collaborate with UNICEF, UNSIC, and the World Bank to develop a joint strategic framework in response to the evolving risk of emerging and re-emerging infectious diseases b) One Health becomes a recommended approach and a political reality
2009	a) The One Health Office is established at CDC b) USAID establishes the Emerging Pandemic Threats program c) Key recommendations for One World, One Health™ are developed
2010	a) The Hanoi Declaration, which recommends broad implementation of One Health, is adopted unanimously b) The Tripartite Concept Note is published c) Experts identify clear and concrete actions to move the concept of One Health from vision to implementation d) The United Nations and the World Bank recommend adoption of One Health approaches e) The European Union reaffirms its commitment to operate under a One Health umbrella
2011	a) The 1 st International One Health Congress is held in Melbourne, Australia b) The 1 st One Health Conference in Africa is held c) The High Level Technical Meeting to Address Health Risks at the Human-Animal-Ecosystem Interface builds political will for the One Health movement
2012	a) The Global Risk Forum sponsors the first One Health Summit
2013	a) The 2 nd International One Health Congress is held in conjunction with the Prince Mahidol Award Conference

The table has been generated from- www.cdc.gov/onehealth/people-events.html

infectious diseases (Pal, 2007). Veterinarians can be, and often are, the first line of defense for zoonotic diseases as well as for various toxicants that occur naturally or by intentional terrorist attack. Veterinarians are in contact with a wide variety of domestic and free-ranging animals, effective and efficient diagnostic systems, and local and national regulatory systems for animal health, food safety, and public health (Osburn et al., 2009).

Besides the role of veterinarians to control zoonotic diseases, a more integrated approach would identify the factors that promote infectious disease emergence as well as non-infectious diseases like cancer, cardiovascular disease, obesity, orthopedic conditions like osteoarthritis; more specifically, human joint prostheses developed primarily by veterinarians in animals continue to serve as significant models for human surgical replacements of knees, hips and other joints. Also, the first flexible coil balloon expandable intracoronary stent was developed for humans by a research team including an interventional physician cardiologist (a former veterinarian) and a pathologist veterinarian in the early 1990s. Nearly 100 percent of patients undergoing balloon angioplasty for 'heart attacks' from heart vessel blockages receive stents (Kahn et al., 2007).

One Health approach provides the opportunity for the veterinarian to collaborate intimately with the physician, public health officials, wildlife and environmental health professionals for better understanding of diseases affection human being and animals. Pal (2005)

in a review article published at the Platinum Jubilee issue of Indian Journal of animal Sciences strongly recommended the need of permanent placement of the 'Public Health Veterinarian' in the process of global health program.

THE ROLE OF MEDICAL PROFESSIONALS TO ACHIEVE 'ONE HEALTH'

In the past, a number of collaborative projects namely *e.g.*, the Eden Project and Rockefeller Foundation Virus Program (1951-71) took efforts to control various infectious diseases that involved the activities of both veterinarians and physicians. Although there are cooperations between veterinarians and physicians, isolated thinking persists; specifically in the public health sector, for example, in the disputed case of human to pig transmission of H1N1 in Alberta, Canada in early 2009, an official of the Canadian Food Safety Agency (CFIA) complained about the lack of cooperation between public and veterinary profession. In few cases, some medical physicians have seen 'One Health' as a veterinary 'land-grab' (Gibbs, 2014).

Medical experts tend to be more focused on their own and public health needs than on other species. Medical professionals are good at building areas of specialization which certainly has its benefits, but narrows their scope so much that they stop seeing the forest for the trees. Now they are focusing on things that were overlooked earlier, particularly concerned with

veterinary public health and food hygiene, zoonoses etc. Schools of public health could now be the Centre for more collaborative works to improve public health situation of a locality. Medical schools need to incorporate more courses on zoonotic diseases and zoonoses. In fact, it will be good to share courses and practical exposures between these two professions and could be achieved through comparative medicine approach (Kahn et al., 2007).

THE ROLE OF ENVIRONMENTAL PROFESSIONALS TO ACHIEVE 'ONE HEALTH'

The term 'ecosystem approaches to health' or 'eco-health' refers to inextricable linkages between ecosystems, society and health of animals and humans (Rapport et al., 1998). Environment impacts the emergence of several diseases. In the case of the emergence of Hantavirus, a particularly wet season in the southwestern United States in 1993 led to increased vegetation, and normally brown desert areas turned green. The increased vegetation supported increases in arthropod and rodent populations- arthropods as well as vegetation are food sources for rodents. Eleven Hantaviruses known to cause Hantavirus pulmonary syndrome (HPS) are carried by the New World rats and mice. The virus sheds in the urine and feces of carrier rat and mice without infecting them. Humans get the infection from dust contaminated with urine and feces of carrier animals (Pal, 2007). Several recent studies indicated that El Niño-Southern Oscillation (ENSO), a major source of climate variability from year to year, influences cycles of cholera. El Niño events could be monitored by satellite sensors and used to make predictions about the severity of disease outbreaks and to predict when and where major cholera epidemics are likely to occur (Atlas et al., 2010; Olabode et al., 2014).

Similarly, the climate variability has influenced on the other diseases such as malaria and dengue. The prevalence of these diseases could be under the influence of El Niño. It could be speculated that the outbreak of plague in central Africa during the 2004 to 2009 might also be related to El Niño cycles. Since the human activities plays a major role in the climate change, the environmental professionals could play a vital role along with other health professionals in adopting measures to reduce the effect of human activities on climate change so that *One Health* approaches could be easily adopted.

DEVELOPING COLLABORATION

The emerging of various infectious diseases worldwide resulting from the changing in ecology, agriculture practice, climatic conditions, animal migration, virulence, host resistance etc. poses an increasing threat to people, livestock and wildlife (Pal, 2013). Most of these pathogens are bacteria or virus that over the period of time somehow gets more virulence to trigger such diseases. Many of these are moreover zoonotic in nature. A strong collaboration between the veterinarians and physicians are essential along with other expertise to combat such emerging infections under the umbrella of 'One Health'.

Various organizations organized meetings, conferences and workshops to promote such collaboration among the concerned veterinarian, physician, environmental professionals and so on. For example, in 1999, the Wildlife Diseases Association and the Society for Tropical Veterinary Medicine and organized a series of conferences under the banner 'Working Together to Promote Global Health'. Later on, in 2001, the second series of these conferences were organized at Pilanesberg, South Africa on animal disease control, conservation, sustainable food production and emerging diseases (Gibbs and Bokma, 2002). The resolutions of the conferences were known as 'Pilanesberg Resolution'. The details of the resolutions published by Kaersh et al. (2002) are available now.

Lee and Brumme (2013) later on mentioned as 'Pilanesberg Resolution' as one of the key events to the early development of 'One Health'. Around that time in New York, the WCS (Wildlife Conservation Society) organized another conference to focus the importance of understanding wildlife diseases and ecology to address the emergence of new diseases, and introduced the term 'One World-One Health' which embraced both the ecosystem health and medicine. The recommendation of this meeting to promote human and animal health is now known as the 'Manhattan Principles' because that the meeting was hosted by Rockefeller University in Manhattan area at New York (Gibbs, 2014). The scopes of 'One Health' are vast and there are opportunities to develop cooperations among many disciplines under the umbrella of 'One Health'. The scopes of one health as described by the One Health Initiative is presented in **Figure 1**.

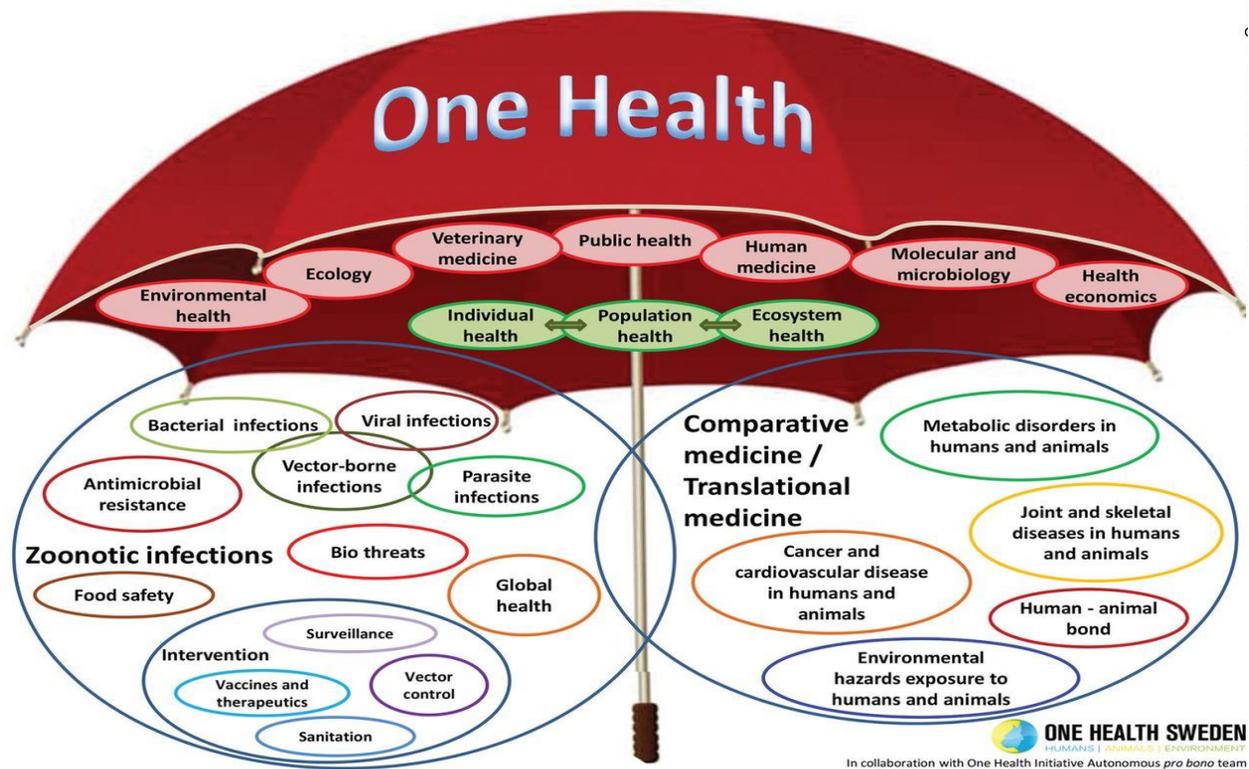


Figure 1. The scope of *One Health* according to the One Health Initiative (www.onehealthinitiative.com)

SELECTED ACHIEVEMENTS OF 'ONE HEALTH' IN THE PAST 10 YEARS

Control of infectious diseases

In 2004, highly pathogenic Avian Influenza (H5N1) outbreaks were occurred in many parts of the world. 'One Health' approach was been successfully adopted in control of highly pathogenic Avian Influenza outbreaks in some parts of the world. For example, the joint effort of FAO along with OIE/WHO/UNICEF/World Bank and the UN System Influenza Coordination published a framework that focused the 'One Health' approaches that helped to reduce the risks of infectious diseases *e.g.*, Influenza and zoonoses at the animal-human ecosystems interface (FAO, 2008). The framework also highlighted that the prevention and control of such diseases is of everyone's interest, and depends on long-term investment from both private and public sources.

Although over the period of time, the epidemics of many diseases such as H5N1 influenza, Ebola hemorrhagic fever, SARS etc. has been receded, the coordination established across the globe under the principles of 'One Health' remains in place and active to combat emergence of new epidemics. For example,

with regard to pandemic influenza, the world is now better protected through 'One Health' in action. Similar coordination also existed to prevent and control endemic zoonoses in many countries or region; one such example is ICONZ (Integrated Control of Neglected Zoonoses in Africa). This is a research project coordinated by the University of Edinburgh and funded by the EU to examine a number of integrated animal interventions for the control of neglected zoonoses. In addition, ICONZ also involved strong coordinated work among the concerned professionals of 21 European and African universities and research institutes to study zoonotic disease in Africa.

Control of non-infectious diseases and conditions

In addition to deal with infectious disease, 'One Health' activities could be directed to deal with other issues that are linked with the promotion of human health, the human-animal bond and early cancer detection in people using dog, and as indicators of metabolic crises and so on (Gibbs, 2014).

Development of One Health Initiative website

One of the easy ways to let the others know about information is website. People having access to internet could easily visit the relevant websites to get access to

valuable information. To disseminate knowledge about 'One Health' among the interested people, several websites have been designed and made available to public by concerned agencies and/or people. For example, <http://www.onehealthinitiative.com> is an example of a good website for information about 'One Health' related events and publications. Similarly there are other websites related to 'One Health' e.g., <https://www.onehealthcommission.org> ; <http://www.cdc.gov/onehealth> ; <http://www.onehealthglobal.net> ; http://en.wikipedia.org/wiki/One_Health etc.

Research and funding

Since, 'One Health' is relatively a new area, more research and funding are needed to improve our understanding on 'One Health'. Donor agencies such as WHO, OIE, FAO, USDA, USAID, EU, DFID, BBSRC and DANIDA etc. have already funded substantial amount of money for the 'One Health' activities, but more fund is required. An outstanding example of proposed funding in 'One Health' was recently announced by the BBSRC. In association with DFID, the Economic and Social Research Council, the Medical Research Council and the National Environment Research Council, BBSRC issued a joint call for research proposals on Zoonoses and Emerging Livestock diseases. Similarly, contribution of private funding bodies like the Wellcome Trust and the Bill and Melinda Gates Foundation for 'One Health' within the 'Grand Challenges in Global Health' program is highly appreciated (Gibbs, 2014).

CHALLENGES AHEAD

There are several challenges ahead that need to be addressed carefully to ensure the implementation of 'One Health' concept. Several veterinary and related concerned professionals have already expressed their concerns over the effective implementation of 'One Health' (Okello et al., 2011; Zinsstag et al., 2011; Häslar et al., 2012; Rostal et al., 2012; Atlas et al., 2013; Gibs and Gibs, 2013; Preston et al., 2013) as 'One Health' is also discussed under direct or indirect influence of burning global issues e.g., climate change and poverty. 'One Health' has attracted the attentions of health policy analysts, social scientists, and humanities scholars (Lee and Brumme, 2013). In addition, joint collaboration among the various disciplines has been recognized as the core of 'One Health' concept. To overcome the challenges more close association among the veterinarians, physicians, other related professionals, and all the stakeholders are needed. In addition,

the complex interrelated ecosystem of animal and human also needs to be preserved in such a way that none of its components are disturbed. Moreover, it will also be necessary to develop improved tools and models to predict where and when outbreaks are most likely to occur (Atlas et al., 2010).

The aboves will require significant research activities that will involve microbiologists. It will be necessary to develop point-of-contact techniques for diagnosing and treating endemic diseases to ensure that the appropriate biologic samples are transferred to reference laboratories in a timely manner. Systems analysis will also need to be developed and applied to improve identification and movement of samples. Predictive models using human and animal biologic samples would have to be tested if we are to properly identify risk factors for zoonotic disease spread and ways to combat emerging infectious diseases (Atlas, 2010). But, all these challenges could be addressed for a better world if sufficient fund are made available from Government, Private, National, Regional and International organizations.

CONCLUSION

The main concept of 'One Health' is based on multi-dimensional integrated collaborative efforts involving various disciplines working locally, nationally, regionally and globally to generate optimal health for humans, animals, and the environment. Without an integrated approach involving humans, pet animals, livestock, wildlife and their social and ecological environment, it is not possible to ensure their optimum performance, Despite several achievements of 'One Health' for example control of Avian Influenza HPAI H5N1, more collaborations are crucial to connect subject matter experts from different disciplines originating from local, regional, national and global level for better 'One Health' activities to ensure safe health and a better world.

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