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One Health Approach for Prevention and Control of Zoonotic Diseases: A Review

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Abstract: Increased interactions among people, animals and the environment continue to change. The expansion of human and animal populations, change in climate and land use and increased international travel and trade provide opportunities for disease spread. A substantial majority of these diseases are zoonotic in origin, that is, transmissible from animals to humans. Traditional approaches to this zoonotic disease management were fragmented and focused on interventions such as human-based clinical treatment, emergency response, or vaccines. Meanwhile, separate groups work on disease management and disease eradication. Recently there are increasing risks of zoonosis on economy and health globally which need collaborative efforts to be taken into action. This leads to the establishment of one health approach which embraces the idea that complex problems at the human-animal-environmental interface can best be solved through multidisciplinary communication, collaboration and cooperation, partnership as well as awareness creation education and training. One health needs the involvement of competent health professionals, wildlife specialists, environmentalists and other professionals who are competent in knowledge, skills, behaviors and attitudes to tackle the health threats. Apart from improving animal and human health globally and meeting new global challenges through interdisciplinary interactions appear. One Health approach interventions are cost effective and have the potential to be more effective and generate more equitable benefits for human health and livelihoods than approaches that rely exclusively on treatment of human cases. One Health interventions will help to build trust, community engagement and cross sectoral collaboration, which will in turn strengthen the capacity of fragile health systems to respond to the threat of zoonosis and other future health challenges. As the implementation of one health is impeded by many challenges like, lack of intersectoral collaboration, a lack of mutual understanding and trust between sectors and shortage of resource, its successful adoption requires overcoming these and other barriers.

Key words: Awareness Creation · Intersectoral Collaboration · One Health · Zoonotic Diseases

INTRODUCTION

Zoonosis can be defined as transmission of disease between human and animals that happens due to interaction between these two populations [1] and are caused by all types of pathogenic agents, including bacteria, parasites, fungi, viruses and prions [2]. They can be transferred from animals to humans through consumption of contaminated food and water, exposure to the pathogen during processing, direct contact with infected animals and by pets' scratches or bite [3].

Zoonotic diseases are emerging into human populations as the result of human being activities, such as, explosive human population growth, trade and travel that contributed to increased interactions between animals, humans and wildlife species [4]. Environmental and climatic changes also play a critical role in zoonoses spread and evolution [5, 6].

The appearance and re-emergence of novel pathogens of humans with both epidemic potential and high mortality rates have threatened global health security for centuries [6]. In the past few decades, there has been a rise in the outbreaks of zoonotic diseases which have an enormous socioeconomic impact worldwide [7].

Approaches to zoonotic disease management were fragmented by which most of health concerned sectors are working separately [8] and have focused on interventions such as human-based clinical treatment,

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emergency response, or vaccines which would not be effective in prevention and control of the disease battles of the 21st century [9]. Ineffectiveness of these traditional approaches associated with health and economic impacts of global pandemics of severe acute respiratory syndrome (SARS), avian influenza (AI) H5N1 and other emerging zoonotic diseases in the first decade of the new millennium [10] made the international community came across the "concept of one health" in solving health problems [11].

The One Health idea is a paradigm shift in the way we think about human and animal health in the world [12]. It has gained momentum and encompasses zoonotic infections, food safety and even health delivery systems [13]. In recent times the concept has been expanded to encompass the health and sustainability of the world's ecosystem [14]. Therefore this review paper was prepared with objectives to determine the status of the one health approach and ways of implementing, to assess the role of educational trainings and awareness creation in the prevention and control of zoonotic diseases and to highlight the ways in which the community can participate in improving animal, public and environmental health in one health approach.

Zoonotic Diseases: Zoonoses is the word derived from Greek word "zoo" means animals and "noses" means diseases, the term was coined and was first used by Rudolf Wirchow who defined it for communicable diseases [15]. Zoonotic diseases has been emerged in association with some livestock production practices and trade in livestock and livestock products [16] and they are a significant and growing threat to global health and global economy [17].

Impacts of Zoonotic Diseases: Zoonotic diseases are major concerns of public health in many countries because they inflict substantial global burden on the health of humans [18]. In developing countries, about 2.4 billion human infections that originate from animals occurs every year, this causes widespread infection resulting to about 2.2 million human deaths [19].

Zoonotic diseases inflict substantial global economic losses, in terms of the cost of treating infected people or animals, cost on agriculture, human and veterinary medicine and low livestock production [18]. The global economic impact of zoonoses was estimated to be above $120 billion between 1995 and 2008 [20]. The economic burden of zoonoses varies from one country to the other depending on type of zoonotic diseases. For example, about $3 trillion in global economic losses would be entailed for a severe flu pandemic [11] and the economic impact of bovine spongiform outbreak in UK was above $5 billion 112 [20].

Situation of Zoonotic Diseases: According to Halsby *et al*. [21] report, out of about 1415 species as pathogenic to humans recorded in 2001, about 61% (868) may possibly be categorized as zoonotic and 75% of the diseases known to have emerged can be considered as zoonotic.

In the recent years, there have been the emergence of many human infectious diseases that were unknown before and these are from animal host. Some of these pathogens that are of substantial global burden and major public health concerns [22] are: Ebola virus, human immunodeficiency virus (HIV), Nipah virus, West Nile virus, Hanta virus, Anthrax, rabies, Bovine Spongiform, Bovine tuberculosis, Highly Pathogenic Avian Influenza (HPAI) virus, Severe Acute Respiratory Syndrome (SARS), toxoplasmosis, leptospirosis, salmonellosis, brucellosis, campylobacteriosis, cryptosoridiosis, dengue fever, Lyme disease and Hemorrhagic fever just to mention a few [23, 24].

One Health Approach: According to Hinchliffe et al. [25] result, one Health, the concept of structured collaboration and coordination between human, animal and Eco health systems, has, in recent years, become an emerging focus among public health, veterinary and ecological sectors. The concept of One Health seeks to transition from the traditional management of individual sectors towards an interdisciplinary approach of addressing zoonotic diseases at the human-animal interface [26, 27].

Definition and Genesis of One Health: Although there is not an agreed One Health definition, a useful one is; "the collaborative effort of multiple disciplines working locally, nationally and globally to attain optimal health for people, animals and our environment" [12]. One health is an integrated strategy which involves the cumulative works of Veterinary medicine, human medicine, environmental science and public health [28, 29].

The idea of an integrated approach to human, animal and environmental health is not new [30, 31]. The concept has been with us for many years, yet it is only recently that it is actively being discussed as a way of mitigating risks in society [32].

Its practice can be traced as far back as to the mid-1700s when Edward Jenner (1749–1823), honored as the father of immunology, contributed innovatively to immunization and the ultimate eradication of smallpox

using cowpox to confer specific immunity to smallpox [33]. The German physician and pathologist Rudolf Virchow (1821–1902) effectively launched the One Health concept in the 19th century. His assertion that "between animal and human medicine there are no dividing lines nor should there be" holds true to this day [34]. The American veterinarian, Calvin W. Schwabe (1927-2006) also coined the term 'One Medicine' as recognition of the interdependence between animal health and human health [35, 36].

Based on Nabarro [37], the 20th century one health movement arose because of increasing concern of disease emergence at the interface between animals, humans and ecosystems. But it was only with the outbreak of avian influenza in the first half of the 2000s and the development of an international response (led by international organizations, notably the WHO, FAO and OIE, with oversight from the UN System Influenza Coordination Office (UNSIC)) that the term, one health gained international strength [38].

Through the One Health approach, scientists and health professionals of the 21st century have the opportunity to reshape and advance the future of health care for humans and animals worldwide [39]. At present the theme is taken into account by many national and international agencies across the globe [36].

The Need of One Health Approach: Humanity faces many challenges that require global solutions and one of these challenges is the spread of infectious diseases that emerge and reemerge from the interfaces between animals, humans and the ecosystems in which they live [40].

Structural separation between jurisdictions, as well as a historical lack of collaboration between human health and veterinary medical disciplines [41] and the convergence of human, animal and environment has made the routine disease prevention and control process difficult and unsuccessful. This condition created a new concept, one health, in which the health of each group is interconnected and dependent [42]. For example, the use of antibiotics results in AMR bacteria which initiates all stakeholders to work together and provide science-based solutions [43].

The "one medicine concept" involving a convergence of animal, human and environmental science professionals for prevention, control and eradication of cross-species disease transmission is gaining momentum, where zoonoses has assumed central position [44] to tackle infectious diseases of animals and their increasing zoonotic and pandemic risk [45, 46]. 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 [47].

Recent drifts taking place in the globalized world include emerging infectious diseases (avian influenza, swine flu, zoonotic enterohaemorrhagic E. coli, severe acute respiratory syndrome) need to tighten the concept of 'one health' with a high degree of collaboration to tackle the issues smoothly [48]. However, it has only been in recent years that the one health concept has gained momentum, with SARS outbreak acting as an important catalyst [49].

Systems of Implementing One Health: The animal and human health can be improved and enhanced within 'One Health' concept using innovative partnerships and collaborations [50, 51]. The five C's for implementing the one health includes consensus among stakeholders, collaboration among professionals, co– operation among inter disciplinary groups, coordination among partner agencies and commitment (political and financial) by donors, partners, organizations and governments [52]. Research and education is also very important for the successful implementation of One Health approaches [53].

Collaboration and Cooperation: It is clear that no one discipline or sector of society alone has enough knowledge and resources to prevent the emergence or resurgence of diseases in today's globalized world [16]. A conjoint effort from part of medical practitioners, veterinarians as well as ecologists and environmentalists is requisite in implementing the concept [27].

For the development and implementation of new One Health policies and approaches being advocated by the international organizations necessitate the inclusion of ministries, organizations and disciplines that may not have been traditionally considered to be related to health at all [54]. Zoonoses require improved collaboration between these sectors to develop control strategies [2]. The collaboration between medical and veterinary scientists as well as public health practitioners and laboratory scientists is essential in helping to detect disease outbreaks and characterizing transmission routes [55].

Trainings and Awareness Creation: Majority of the general public are not aware of the fatality of zoonotic diseases and the importance of personal protection, food and personal hygiene, vaccination and infection

prevention and control [56]. A broader perspective on zoonoses should be deployed, particularly to change the local knowledge in both traditional and smallholder livestock keeping systems which might be limited to a restricted number of zoonoses such as anthrax, rabies and tuberculosis [57].

To prevent and control zoonotic diseases, there is a need to create awareness and educate the general public concerning the risk factors and the potential reservoir of the identified emerging zoonotic disease. Also, there is need for emergency training for professionals in the field of zoonotic diseases that will help for better understanding of the pathogen diversity and create ability to prevent and control for the diseases [58].

The health education envisages making community aware of the cause and mode of disease transmission, prevention and treatment of disease and the role of community in combating diseases. Health education through mass media such as newspapers, radio, cinema, wall slogans, television can be very effective [15].

Educational training programmes on zoonotic diseases awareness are great benefit to infection control activities to the general public. veterinary public health officers, policy makers and all health professionals needs to be trained because infection control policies and procedures maintenance may be difficult without adequate trained professionals [59]. The following health trainings are recommended to be included in the educational Programme [60]: Safety techniques like disinfection, cleaning, food preservation and pasteurization, personal hygiene at home and at work, zoonotic diseases that may be contracted in the place of work, foods that is potentially risky, the usefulness and importance of de-worming and animal vaccination.

Professional Competences in One Health: Competence is considered to be an ability to make decisions in order to solve problems, perform profession in different situations, fulfill social role according to knowledge, experiences, values and attitudes [61]. Competence, on the contrary, should use habitual and judicious communication, knowledge, technical abilities, clinical reasoning, emotions, values and the capacity to reflect upon daily practice for the individual and collective benefit [62]. Thus, in order to act in a competent manner it is necessary to assume an active posture in face of work situations, as well as using and transforming knowledge with the aim to apply it in practice [63].

The multidisciplinary nature of the one health approach requires that one health professionals are proficient in knowledge, skills, behaviors and attitudes that go beyond the discipline-specific knowledge gained through traditional training programs. Identifying a set of one health core competencies is critical to prepare professionals to tackle the health threats of the twenty-first century by working collaboratively with peers in other areas of expertise using a one health approach [64, 65].

Identifying the core competencies is necessary to develop relevant training programs for one health professionals [66]. The One health training is to impart trainees with the non-technical skills and attitudes that all one health practitioners need, regardless of discipline or work level and used to equip public health professionals with a breadth of skills to complement their own specific areas of expertise [67].

Advantages of One Health Approach in Zoonotic Disease Prevention: One health seeks to replace the disease centered approach to zoonoses with a system based one. It accelerates research discoveries, enhance the efficacy of response and prevention efforts, improve education and care [8] and increase cost effectiveness by reducing overlap among public health, animal health and ecosystem health sectors [68].

The concept of 'One health' mainly aims at reviving the integration of human health, animal health and environmental health for mutual benefit [69] and improving animal and human health globally through the collaboration. This is in turn enable collaborators to more effectively address and reduce the burden of zoonotic infectious diseases worldwide [70].

One health interventions advocate close intersect oral cooperation, interdisciplinary expertise and the involvement and empowerment (and not simply, engagement) of multiple stakeholders [71]. It initiates civil engagement (participation of the public and the community) and community preparedness [40]: enhance community trust and engagement [72]. It is beneficial for developing centers of excellence for education and training in specific areas, increasing professional opportunities and gaining scientific knowledge to create innovative programmes to improve health [34, 73].

Implementing one health Approaches induces the potential economic benefits. For example, the World Bank has argued that the global benefits of adopting a one health approach amount to US$ 6.7 billion per year 48 [11]. One health can add value and reduce costs in five ways: sharing health resources between the medical and veterinary sectors, controlling zoonosis' in animal

reservoirs, early detection and response to emerging diseases, prevention of pandemics and generating insights and adding value to health research development [74].

Challenges of Implementing One Health Approach: Even though one health approaches in human and animal health programmes are much desired, their implementation is impeded by some factors (barriers) [33] mainly due to difficulty of collaboration between sectors having different objectives and requirements and lack of budget or fund [75].

The complexity of this 'coming together' in one health frequently becomes difficult to manage [42] as the human health sector invariably views human well-being as the intended outcome of all social activities. This necessarily brings it into conflict with other sectors that focus on relatively prosaic concerns, such as economic development or industry policies [76, 77]. The insular approach of the human health sector in the discourse around zoonoses has resulted in a limited understanding among human-health researchers of the socio-political context of zoonoses and their risk factors, making attempts for One health collaboration between sectors even more tortuous [78].

The leading factors that impeded collaboration among various health experts were the following: lack of consensus on priority-settings, lack of policy statements to enforce collaboration among health experts, lack of networking partners, lack of knowledge of animal health expertise, lack of plans for collaboration. inadequate resources for dissemination of results and raising public awareness [79].

It is challenging to encourage collaboration between sectors where a financial cost is involved and this presents as a barrier of collaboration. Funding could become a sensitive issue, as financial investment would need to be justified and benefit the sector to which it was allocated [75]. The limits and costs of agency interaction cannot be underestimated: cash-strapped bureaucracies have different priorities and there are frequently inter-ministerial rivalries over budget allocations [80]. Lack of funding will pose the most serious obstacles to the integration of one health into education [64].

CONCLUSIONS AND RECOMMENDATIONS

Humanity faces many challenges that require global solutions for the prevention and control of the spread of zoonotic diseases between animals, humans and the ecosystem. Globalization, increased human population and dissatisfaction with existing health care system enforce the world to seek new health care options (One health program). By which each professional must tends to revolve around the question "What am I responsible for?" rather than "What needs to be done? for substantial reorientation along horizontal lines in which regular communication takes place between practitioners at work in different disciplines and sectors to ensure global health. Moreover; the future implication of the program will secure public health problems through designing of effective prevention and control methods of the disease. Success in adopting the one health concept will require overcoming many barriers, including difficulty in changing the mindset of health care providers from one of "disease care" to one of preventive medicine, lack of awareness and education of local community, lack of mutual understanding and trust between sectors, that may challenge the implementation of the integrative approach. Thus, a communication plan that could effectively influence public awareness, multidisciplinary cooperation, partnership, commitment and effective communication skills should be encouraged in the globe. According to the above conclusion, the following recommendations are forwarded: One health should be included in academic curriculum in schools of human medicine, veterinary medicine and public health, ccontinuous awareness creations and educations focused on the integrative approach should be given for the responsible bodies in; animal, human and environmental health sectors and the government should assess the national burden of zoonotic diseases and develop a common multisectoral national plan for zoonoses prevention and control in humans and animals.

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