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Review of One Health Approach to Prevent and Control Zoonotic Diseases and Status in Ethiopia

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Abstract: Zoonotic diseases, infections transmitted between animals and humans, manifest in various forms. Endemic zoonoses persistently afflict specific populations or regions, such as malaria in sub-Saharan Africa. Epidemic zoonoses, characterized by sudden outbreaks with high transmission rates, include diseases like Ebola and COVID-19. Emerging zoonoses, like avian influenza, are newly identified pathogens, while re-emerging ones, such as tuberculosis, resurface after being controlled. Foodborne and waterborne zoonoses, like Salmonella and cholera, spread through contaminated food or water sources. The consequences of zoonotic diseases range from mild illness to severe morbidity and mortality, impacting public health and economies worldwide. The One Health approach addresses the interconnectedness of human, animal and environmental health to combat zoonotic diseases comprehensively. It emphasizes interdisciplinary collaboration and integrated strategies. One Health applications for zoonotic disease control involve interdisciplinary research, surveillance systems and policy interventions. This holistic approach considers the health of humans, animals and ecosystems, recognizing their interdependence. One Health's uniqueness lies in its collaborative nature and comprehensive scope, differentiating it from other techniques. Implementing the One Health approach necessitates coordinated efforts and resource mobilization from various sectors. Overcoming obstacles such as funding constraints and institutional barriers requires concerted action and stakeholder collaboration. Solutions include prioritizing investments in One Health initiatives and fostering coordination among governments, international organizations, academia and the private sector.

Key words: One Health · Zoonosis · Prevention And Control · Multisectorial · Collaboration

INTRODUCTION

The World Health Organization (WHO) defines "One Health" as an interdisciplinary approach aimed at addressing public health issues across humans, animals and their surrounding environments. This holistic strategy entails the implementation of meticulously designed programs and research activities involving various sectors [1]. At its core, One Health acknowledges the inherent interconnectedness of human well-being, animal health welfare and environmental integrity. The Action framework for One Health delineates five key pillars: food safety, the symbiotic relationship between humans and animals, antimicrobial resistance, water contamination and zoonoses. Establishing a robust One Health Platform necessitates the formation of an interdisciplinary team comprising public health experts such as medical doctors, veterinarians, biologists, ecologists and public health administrative officers. Regarding zoonoses, these experts play a pivotal role in immediate response, intervention during zoonotic epidemics, surveillance and mitigation of public health threats [1].

Zoonoses, diseases naturally transmissible between vertebrate animals and humans, encompass a spectrum of causative agents including fungi, bacteria, viruses, parasites and prions, each posing unique challenges to global health security. These zoonoses are classified into three categories: endemic; zoonotic diseases persist within specific geographic regions and affect both human

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and animal populations[2] for example, brucellosis and rabies, epidemic; zoonotic diseases are characterized by sporadic outbreaks with variable temporal and spatial patterns [3] like 2009 H1N1 influenza and emerging zoonotic diseases those present ongoing threats to public health, as they evolve or resurface over time and reflecting their varying patterns of prevalence and impact [4].

Applying the One Health approach to zoonotic disease control involves integrating expertise from diverse disciplines, including medicine, veterinary science, ecology and public health [5]. The holistic nature of the One Health approach acknowledges the complex interactions between humans, animals and the environment in disease transmission [6]. One Health distinguishes itself from traditional disease control approaches by emphasizing interdisciplinary collaboration and a systems-thinking perspective [7].

There is a significant gap in the literature regarding the importance of the One Health approach to preventing zoonotic diseases. While there is a growing body of research highlighting the interconnected nature of human, animal and environmental health, there is limited emphasis on the role of kindness and compassion in promoting collaboration and equity within the One Health framework. Additionally, there is a lack of studies exploring the impact of sustainable practices on preventing zoonotic diseases and improving overall well-being across species. Future research should focus on the ethical and moral dimensions of the One Health approach, as well as the practical implications of kindness in addressing zoonotic disease outbreaks and promoting health equity among diverse populations.

Therefore the objectives of this review mainly focused on:

- To introduce the concept of one health approach and zoonosis.
- To review on holistic approach of one health in zoonotic disease prevention and control

Understanding of Zoonotic Diseases: Zoonotic diseases, also known as zoonoses, are infectious diseases that can be transmitted between animals and humans. These diseases are caused by a variety of pathogens, including viruses, bacteria, parasites and fungi. Zoonotic diseases can be spread through various mechanisms, such as direct contact with animals, contact with animal products or waste, ingestion of contaminated food or water and transmission by vectors like insects [8]. Several risk factors associated with zoonotic disease infections have been described, but close contact with animals, including pets, livestock and wild animals is a crucial feature for zoonotic disease transmission. Both direct contact with infected animals but also indirect contacts in areas where animals live pose a risk to human health.

Endemic Zoonotic Diseases: Endemic zoonotic diseases are those that are consistently present in a particular geographic area or population. Research on endemic zoonotic diseases is crucial for understanding their epidemiology, transmission dynamics and impact on human and animal health. Here are some examples of endemic zoonotic diseases and relevant research studies:

Leptospirosis: Leptospirosis is a bacterial zoonotic disease transmitted through contact with urine from infected animals. Research by Costa *et al.* [10] in Brazil investigated the prevalence of leptospirosis in humans and animals in endemic areas, highlighting the importance of One Health approaches for disease control.

Rabies: Rabies is a viral zoonotic disease transmitted through the bite of infected animals. A study by Hampson *et al.* [11] examined the burden of rabies in endemic regions and evaluated the effectiveness of mass dog vaccination campaigns in reducing human rabies cases.

Brucellosis: Brucellosis is a bacterial zoonotic disease transmitted through consumption of contaminated animal products. A research study by Dean *et al.* [12] in Mongolia investigated the prevalence of brucellosis in humans and livestock, highlighting the need for integrated surveillance and control measures .

Q Fever: Q fever is a bacterial zoonotic disease transmitted through inhalation of contaminated aerosols. A study by van der Hoek *et al.* [13] in the Netherlands assessed the risk factors for Q fever transmission from livestock to humans in endemic areas.

Epidemic Zoonotic Diseases: Epidemic zoonotic diseases are infectious diseases caused by pathogens that can be transmitted between animals and humans. These diseases typically occur when a pathogen jumps from an animal host to a human host, leading to outbreaks or epidemics of illness in human populations. Zoonotic diseases can be caused by a variety of pathogens, including bacteria, viruses, parasites and fungi.

The transmission of zoonotic diseases can occur through direct contact with infected animals or their bodily fluids, through consumption of contaminated food or water, contact with contaminated environments. Some zoonotic diseases can also be transmitted through vectors such as mosquitoes, ticks, or fleas. Examples are those listed following:

Ebola Virus Disease: Ebola virus disease is a viral zoonotic disease with epidemic potential, causing severe illness in humans. A study by Gire *et al.* [14] investigated the genomic epidemiology of the 2014 Ebola outbreak in West Africa, providing insights into the transmission dynamics and evolution of the virus .

Zika Virus Infection: Zika virus is a mosquito-borne zoonotic disease that can cause birth defects in infants born to infected mothers. A research study by Faria *et al*. [15] analyzed the spread of the Zika virus in the Americas and identified the role of human mobility in driving the epidemic .

Middle East Respiratory Syndrome (MERS): MERS is a viral zoonotic disease caused by the Middle East Respiratory Syndrome Coronavirus (MERS-CoV). A study by Alraddadi *et al*. [16] investigated the clinical characteristics and outcomes of MERS patients during an outbreak in Saudi Arabia .

H5N1 Avian Influenza: H5N1 avian influenza is a zoonotic disease that can cause severe respiratory illness in humans. A research study by Wang *et al*. [17] examined the genetic diversity and transmission dynamics of H5N1 viruses during outbreaks in poultry and humans.

Emerging Zoonotic Diseases Re-Emerging Zoonotic Diseases: Understanding the mechanisms that underlie newly emerging and re-emerging infectious diseases (EID) is one of the most difficult scientific problems facing society today. EIDs are diseases that have recently increased in incidence or in geographic or host range (e.g., tuberculosis, cholera, malaria, dengue fever, Japanese encephalitis, West Nile fever and yellow fever), diseases caused by new variants assigned to known pathogens (e.g., HIV, new strains of influenza virus, SARS, drug resistant strains of bacteria, Nipah virus, Ebola virus, hantavirus pulmonary syndrome and avian influenza virus) and bacteria newly resistant to antibiotics, notably the multiple resistant strains that render the armamentarium of antibiotics useless [18].

Fundamental questions persist concerning molecular mechanisms and specific cellular processes involved in pathogenesis, as well as transmission dynamics and epidemiology, of pathogens that cause some of the most studied of the reemerging infectious diseases, such as tuberculosis, malaria and cholera.

Newly emerging diseases caused by entirely novel or previously unrecognized pathogens, such as HIV/AIDS, SARS and hantavirus, or those whose modes of transmission are currently under study, as in the case of Ebola and Nipah, represent yet another significant challenge. Certainly the mechanisms or processes of disease emergence involve factors in addition to those at molecular and cellular levels. These include climate, rainfall, ocean and air circulation patterns and extreme weather events, as well as the ecology of the pathogens' reservoirs and vectors, namely those factors associated with larger-scale mechanisms and the dynamic behavior of ecosystems in which parasite (pathogen) and host relationships are embedded [19].

Still other factors are involved and must be identified, if a truly holistic framework is to be constructed that incorporates factors related to human and societal mechanisms. Demographic and social changes, along with associated environmental alterations and even the efforts to control disease, have contributed to the severity of the problem of EIDs [20]. The use of antimicrobials, pesticides and biological controls predictably are effecting changes in pathogens, hosts and ecological systems and often unwittingly facilitating disease emergence or reemergence [18, 21-23]. Antibiotic resistant Strepococcus A and *E. coli* 0:157 are prime examples.

Pathogens and their hosts, including humans, reproduce, grow and adapt in an environmental context, devastatingly exemplified by the avian influenza threat (chickens, ducks, pigs and humans in close confines). This context is most accurately captured using a holistic or systems perspective, considering sub-systems at different levels of organization—those at lower levels embedded within those at successively higher levels, including social as well as physical, chemical and biological components. 'Ecological changes' embrace a number of very different processes under the same umbrella: changes in agricultural practices, urbanization, globalization or climate change. The latter is a factor of growing concern as it may affect the areas where primary agricultural production takes place, alter vector distribution and abundance, change the migration patterns of birds and other wildlife and affect the survival time of pathogens outside the host [24].

The reason that most emerging diseases are reported to be related to ecological changes rather than evolution may also be a matter of time-scale: environmental change may have been the main factor influencing disease emergence over the last few decades because such changes have been fast, whilst evolution has played a major role in the emergence of diseases over the longer term. This does not, however, prevent evolution from playing a role in the short-term adaptations of pathogens to human hosts [25, 26] and assessing the respective roles of environment and evolution separately is therefore unwarranted, as they are closely intertwined. One can simply view emerging diseases as an evolutionary response to (anthropogenic) environmental change. Sporothricosis is an example of an emerging disease that spreads by scratches of cats infected with the dimorphic fungus Sporothrix brasiliensis. Zoonotic scabies (pseudoscabies) is caused by burrowing mite Sarcoptes scabiei, which can infect humans through contact with affected animals [27].

Foodborne and Waterborne Zoonotic Diseases: Another chapter includes the foodborne and waterborne zoonotic diseases caused by the consumption of food or water contaminated by pathogenic microorganisms. With regard to food, the risk of contamination occurs at any point along the chain “from farm to fork”. The most common foodborne diseases are caused by Campylobacter, Salmonella, Yersinia, Shiga toxin-producing Escherichia coli (STEC) and Listeria monocytogenes [28].

Among bacterial zoonoses, the consumption of unpasteurized milk is implicated in the human transmission of Mycobacterium bovis and *Brucella* spp., which are the etiological agents of tuberculosis and brucellosis, respectively. Recently, pigs and pork products were implicated in zoonotic transmission of Hepatitis E Virus to humans and the incrimination of also other foods was suspected. Food-borne parasites include nematodes Anisakis spp. in marine fish and Trichinella spp. in pigs, horses and wild mammals, cestodes Taenia saginata in cattle and Taenia solium in pigs and trematodes Opisthorchis spp. in fish and Paragonimus spp. in crustaceans, but also protozoa, in particular Toxoplasma gondii, infecting one-third of the human population worldwide. Concerning water, cryptosporidiosis and giardiasis are acute gastrointestinal infections caused by the protozoa Cryptosporidium and Giardia species, spread to humans via drinking, food processing and recreational use of contaminated water [29].

The Consequences of Zoonotic Diseases: The most important impact of zoonoses is on human health and, almost a decade ago, it was shown that they are responsible for almost 2.5 billion cases of human infection and approximately 2.7 million human deaths globally, every year [30]. Apart from the cost of human lives and the problems caused to public health, zoonoses have significant socioeconomic consequences on everyday life, both in terms of direct costs associated with treating infected individuals and indirect costs associated with lost productivity, reduced trade and increased public health measures. This is the case with highly pathogenic avian influenza strains, which can kill up to 90–100% of the flock, immediately causing economic losses. It can also lead to trade restrictions on animals and animal products, which can reduce the profitability of the agricultural sector. Also, in livestock, illness may cause a reduction in productivity, as well as in meat and milk production [31]

A loss of productivity also occurs when people who are infected by zoonotic diseases are not able to work or perform their usual activities. This, in turn, results in lost income and reduced economic output. Zoonotic diseases often require expensive medical treatments, which can be a significant burden on individuals, families and healthcare systems. In a piece of research conducted in six African countries in 2016, the economic burden on human health due to cysticercosis, a tissue infection caused by a young form of the pork tapeworm [32], was estimated to be approximately USD 241 million purchasing power parities [33].

Public health measures need to be implemented by governments, to control the spread of zoonotic diseases, such as quarantines, travel restrictions and vaccination campaigns. New York City, for example, invested nearly USD 2.44 billion in direct costs into the vaccine campaign against COVID-19 between 14 December 2020 and 31 January 2022 [34].

Zoonotic diseases can also affect the tourism industry by reducing the number of visitors to affected areas and causing financial damage to businesses that rely on tourism. It was shown in the past how tourism was reduced in countries with zoonotic infections, as in the case of Singapore in 2004 due to SARS [35] and Mexico at the beginning of the H1N1 Influenza pandemic [36]. Overall, zoonotic diseases can have significant economic consequences, which can be reduced by investing in surveillance, early detection and rapid response systems to prevent the spread of these diseases Concept and application of one health.

Concept of One Health: One Health includes the health professions [37]. But, it also includes wildlife specialists, anthropologists, economists, environmentalists, behavioural scientists and sociologists, among others [38]. One Health embraces the idea that complex problems at the human-animal-environmental interface can best be solved through multidisciplinary communication, cooperation and collaboration. One Health is increasingly being acknowledged by national and international institutions as the most constructive approach to address complex issues at the animal-human-environmental interface. The multi-disciplinary nature of one health makes it very important to solve many problems facing nature [39].

The importance of one health is very vast. OH, is a preventive approach that focuses on minimizing risk factors that cause a series of problems and crises. One Health approach can achieve the best health outcomes for people, animals and plants in a shared environment. OH supports the global health system by improving coordination, collaboration and communication between human-animal-environment to address shared health threats such as zoonotic diseases, antimicrobial resistance, food safety, climate change and others [40]. Over the recent past decade, countries understand the importance of this concept and have implemented the One Health approach and demonstrated recognized benefits. Whenever to build sustainability of One Health in these efforts, One Health implementers need to collect and provide government decision-makers [41].

The one health importance is not neglect able due to the problems and crises that we are facing at this time. The current pandemic of COVID-19 showed us practically how much it is very important to collaborate with human health, animal health and environmental health to build a sustainable health care system. COVID-19 is a current pandemic that is considered one of the emerging zoonotic diseases thus the interaction between humans and animals with their surrounding environment should be healthily and hygienically [42].

The One Health Uniqueness and Differentiations from the Other Techniques: One of the unique aspects of the One Health approach is its interdisciplinary nature, which integrates expertise from various fields such as human health, animal health and environmental science. This comprehensive approach allows for a holistic understanding of complex health issues that affect both humans and animals [43]. Additionally, One Health emphasizes collaboration between different sectors, including government agencies, academia and non-governmental organizations [44]. This collaborative effort enables more effective disease surveillance and control strategies [43]. Furthermore, the One Health approach recognizes the interconnectedness of human, animal and environmental health, highlighting the importance of addressing health issues at the interface of these domains. This interconnected perspective promotes a more sustainable and resilient approach to addressing global health challenges [45].

A Holistic Approach to Safeguarding Against Zoonotic Diseases: The One Health approach plays a crucial role in preventing zoonotic diseases by recognizing the interconnectedness between human, animal and environmental health[45]. Through collaboration between human and veterinary health professionals, as well as environmental scientists, One Health facilitates early detection and response to emerging zoonotic threats[44]. By addressing the root causes of disease transmission at the human-animal-environment interface, such as deforestation and habitat destruction, One Health helps mitigate the risk of zoonotic spillover events. Furthermore, the holistic perspective of One Health encourages the implementation of integrated surveillance systems that monitor disease trends in both animal and human populations[43]. This proactive approach enhances preparedness and response capabilities, ultimately reducing the impact of zoonotic diseases on public health [43].

One Health Status in Ethiopia

Establishment of Different Technical Working Groups: The National One Health Steering Committee has established different national Technical Working Groups (TWGs) including Rabies, Anthrax, Brucellosis, Emerging Pandemic Threats (EPT), Antimicrobial Resistance (AMR) and National One Health Communication Task Force to promote multi-sectorial coordination and collaboration on One Health related activities. Each TWG represents a specific zoonotic disease with particular emphasis on prioritized ones (such as anthrax, rabies and brucellosis) and main pandemic threats like highly pathogenic avian influenza, Rift Valley Fever (RVF). The technical working groups are composed of veterinary and medical experts in virology, bacteriology, microbiology and epidemiology and provide a platform for strategic discussions. The working group members include government and non-government stakeholders and are officially nominated from line ministries to the National One Health Steering Committee [46].

Extension of One Health Schemes to the Regional Governments: So far, the national One Health coordination structures have already been extended to 7 Regions (Amhara, Oromia, Southern Nations Nationalities People Region (SNNPR), Tigray, Somali, Benishangul-Gumuz and Gambella). In addition to this, the structure has further extended to 7 Zones and 17 districts in different regions of the country[47].

The Development of National One Health Strategic Plan (2018-2022): The NOHSC developed a National One Health Strategic Plan (2018–2022) for the overall guidance of one health approach in Ethiopia. The strategic plan is the roadmap for the country to achieve the long-term goal of prevention, detection and response to "negligible risks and impacts of endemic, emerging and re-emerging health threats at the animal-environment-human interface". Moreover, the strategic plan includes an organizational framework with detailed guidance on how the NOHSC will address One Health engagement across disciplines and sectors in its tasks [38]. Ethiopia aims to achieve this goal through the five key pillars and objectives which include: coordination and collaboration to ensure effective one health schemes, preparedness and response to emerging and re-emerging priority threats, multi-sectoral surveillance and reporting system, advocacy and communication as well as research and capacity building. The National One Health Steering Committee has also developed and implemented a Risk Communication and Community Engagement (RCCE) strategy document which provide a comprehensive guidance for response zoonotic diseases including COVID-19 outbreak and to mitigate the impact of emerging and reemerging diseases [46].

The Development of Control and Prevention Strategic Documents for Different Prioritized Zoonotic Diseases: Several strategic documents for prioritized zoonotic diseases have also been developed and validated by each National Technical Working Group together with partners and other stakeholders and finally endorsed by the National One Health Steering Committee. With the overall leadership of the members of each National Technical Working Group in drafting their strategic document, key responsible ministries, regional health and livestock and/or animal health bureaus, research institutions, universities and development partners have engaged during the development of the document. Each strategic document is a joint plan of key ministries(Ministry of Health, Ministry of Agriculture, Ministry of Culture and Tourism and Ministry of Environment, Forest and Climate Change which has been endorsed by NOHSC. International partners and other stalk holders were also represented and actively participated during the development and validation of the documents. Each strategic document has its own framework (developed based on OIE, WHO, FAO principles), stepwise approach and implementation Phases [46].

The first national control and prevention strategy document which has been endorsed to be implemented from 2018–2030 and currently under enactment is the National Rabies Control and Elimination Strategic Document. It was developed with the goal to eliminate all human rabies deaths by 2030 through a strategic vaccination campaign that achieves and maintains a vaccination rate of at least 70% of the domestic dog population in the country. The second strategic document which was endorsed to be implemented from 2018 – 2030 is Anthrax Prevention and Control Strategic Plan. The overall mission of this plan is to significantly reduce and ultimately control the public health impact of anthrax in humans and animals, in Ethiopia, through sustained surveillance, laboratory diagnosis, prevention and control systems and community awareness. The other strategy document is the National Brucellosis Prevention and Control Strategic Plan (2020–2030). This has the mission of reducing the impact of brucellosis in livestock and humans in Ethiopia by 2030 through multi-sect oral and community engagement at all levels. The fourth important strategic documents, prepared by the key ministries having a role in the one health activities, are a Multi-sectoral Preparedness and Response Plan for Highly.

Pathogenic Avian Influenza. It was prepared with the financial support of Partners. The purpose of the preparedness and response plan is to prevent and/ or mitigate transmission of pandemic Avian Influenza virus strain and protect the health, social and economic well-being of the population. Rift Valley Fever Multisectoral Preparedness and Response Plan is also among the strategic documents. The plan is thought to address prevention and control of Rift Valley Fever in humans and animals through professionals and relevant institutions through involvement of professionals in the surveillance, detection and response to RVF outbreaks. The scope could extend to bilateral agreements with neighboring countries to jointly prevent and control the threat. Another important strategic document is Prevention and Containment of Antimicrobial Resistance. Its goal is to prevent, slow down and contain the spread

of antimicrobial resistance through the continuous availability of safe, effective and quality-assured antimicrobials and their effective use thereof. This can only be achieved through collaborative actions among partners in human health, animal health, the environment, agriculture, the food industry, teaching and research institutes, civil societies and associations, the pharmaceutical industry and global stakeholders to synergize efforts and resources.

Joint Disease Surveillance and Outbreak Investigation: The country with the Technical Working Groups (TWGs) has been coordinating and conducting joint disease surveillance and outbreak investigations activities following reports received from various locations in the territory of the country. It has conducted joint anthrax disease outbreak investigations in 2018 for suspected animal and human cases. The investigation team consisted of regional veterinarians, medical workers and national level laboratory and epidemiology experts were deployed for the investigation. Safe sample collection and transportation training was completed only days before the outbreak investigation mentioned above. As a result, the responders were better prepared and equipped to collect samples from both animal and human suspected cases. A joint investigation team composed of community animal and human health experts, local representatives and faculty members of College of Health sciences of Jimma University were engaged on another anthrax outbreak investigation in Oromia Regional State in 2018.

In the same year, Rabies joint outbreak investigation was led by the Ministry of Health and Ministry of Agriculture after having trained on animal sample collection and transportation. Furthermore, in mid-2018, Rift Valley Fever outbreak was reported across an extensive geographic range in East Africa, including areas bordering Ethiopia. Thus, in preparation for its possible spread to Ethiopia, the Ministry of Agriculture worked with the NOHSC to organize One Health preparedness planning, coordinating teams to conduct enhanced surveillance activities in at-risk border zones [48].

A multidisciplinary and multi-sectoral team was also organized and deployed by the Emergency Pandemic Threat-Technical Working Group for joint survey and potential outbreak investigation was conducted in the Borena zone of Oromia region. This was conducted following the Rift Valley Fever outbreak report in northern Kenya and mass wild birds (pigeons) mortality in the South Omo zone of Southern Nations Nationalities People Region. This multidisciplinary team also conducted anthrax outbreak investigation in Wag Himra and North Gondar zones of Amhara Region and Assosa zone of Benishangul-Gumuz region.

Vaccination Activities Against Zoonotic Diseases: The Ministry of Health represented by the Ethiopian Public Health Institute (EPHI) and Ministry of Agriculture with the support of global partners US CDC, Ohio State University Global One Health Initiative (GoHi) and the Global Alliance for Rabies Control and the European Union-Health of Ethiopian Animal for Rural Development (HEARD) project have been conducting mass dog vaccination campaign (MDVC) in collaboration with regional and city administrations. Since 2016, more than 50, 000 dogs have been vaccinated. The campaigns were achieved after providing training for veterinary, medical and public health staff regarding animal handling, vaccine safety, vaccination evaluation and dog population estimation methods. The vaccination activities were a reflection of how successful One Health collaborations among government partners were. It also showed how strategic support and mentoring from global experts can help in materializing and sustaining the goals of the TWGs and workforce [48].

Prioritization of Zoonotic Diseases in Ethiopia: There are three strategies; predict, respond and prevent and eleven packages which were developed to achieve the strategies by GHSA. One of the main packages is addressing the burden of zoonotic diseases [40]. In Ethiopia, there are large numbers of zoonotic diseases which are endemic. Hence, prioritization of zoonotic diseases based on impacts on both humans and animals is of paramount importance to jointly address experts from both animal health agencies and public health authorities. Accordingly, two prioritization processes of zoonotic diseases were conducted; in 2016 and 2019.

The first prioritization of zoonotic diseases in Ethiopia: The first zoonotic diseases prioritization workshop in Ethiopia was held in 2015 by participating organizations form Federal Ministry of Health represented by Ethiopian Public Health Institute, the Ministry of Livestock and Fishery Resources, the Ministry of Environment and Forestry, WHO, United States Centres for Disease Control and Prevention, Defence Threat Reduction Agency/ Cooperative Biological Engagement Program, the Ohio State University, Food and Agriculture Organization of the United Nations and Armauer

Hansen Research Institute/ Swiss Tropical and Public Health Institute using a in Addis Ababa [46]. The workshop participants identified five criteria for ranking among 43 zoonotic diseases through group discussion. The criteria used to select the final five prioritized zoonotic diseases are unique to Ethiopia and includes: Severity of human disease in Ethiopia (diseases having the highest number of deaths rates per population in humans were deemed to have priority), proportion of human disease attributed to animal exposure, burden of animal disease (priority was given to diseases that have negative impacts at the household level in Ethiopia by causing production losses in Livestock), availability of interventions (vaccines targeting diseases in animal and medical intervention available for people) and existing inter-sectoral collaboration (disease which has focus of inter-sectoral collaboration gained full credit). Finally, five top zoonotic diseases (rabies, anthrax, brucellosis, leptospirosis and echinococcosis) were selected and ranked for inter-sectoral engagement by human and animal health agencies [39].

The second prioritization of zoonotic diseases in Ethiopia: Ethiopia is the first country in Africa to utilize the One Health Zoonotic Disease Prioritization Process (OHZDP) for the second time to update the priority zoonotic disease list. Because of the request from Ministry of Agriculture and other relevant stakeholders for the reprioritization of current country's public health and economic importance of diseases, the National One Health Steering Committee in collaboration with US CDC and Human Resource for Health -2030 (HRH2-030) organized national level zoonotic diseases re-prioritization workshop from September 24–25, 2019 in Addis Ababa. Experts from national and regional level and key stakeholders of the National One Health Steering Committee (Ministry of Health; Ministry of Agriculture; Environment, Forestry and Climate Change Commission; and the Ethiopian Wildlife Conservation Authority and partners such as USAID, CDC, FAO, WHO, Veterinary Sans Frontiers -Suisse, etc.…) were participated on the workshop. Accordingly, Galvani (2003). Zoonotic diseases were considered for prioritization and criteria utilized to determine the ranked outcomes of the One Health Zoonotic Disease Reprioritization process are epidemic or pandemic potential, availability of prevention and control strategies, severity in humans, socioeconomic impact and presence of disease in Ethiopia. After the two days exercise, a list of five top zoonotic diseases of greatest national concern was agreed upon by voting members. These are: Anthrax, Rabies, Brucellosis, Rift valley fever and Zoonotic Avian Influenza which are identified as the five national priority zoonotic diseases in Ethiopia [26].

Awareness Creation: The NOHSC established National One Health Communication Taskforce (OHCTF) in 2019 to facilitate planning and implementation of advocacy and communication interventions for One Health program in the country. The task force has been working aggressively since its establishment. The communication taskforce has developed One Health website and telegram channel, prepared, printed and distributed many copies of national zoonotic diseases message guide and National Rabies Control and Elimination Strategic Documents. At the global level, the World Health Organization WHO), OIE, FAO and the Global Alliance for Rabies Control (GARC) have launched 'World Rabies Day' (WRD) campaign in 2007 as a response to the call to raise global awareness and mobilize resources for rabies prevention and control and it has been celebrating annually every September 28 which is the largest unifying initiative on the prevention of the disease [48].

Based on this, celebration of the World Rabies Day in Ethiopia promoting One Health has begun since 2017. The 2021 celebration day workshop was held on 28 September.

Opportunities, Challenges and Solutions of One Health Approach in Ethiopia: Opportunities and challenges: There are several achievements and opportunities to extend the One Health schemes and philosophies to deal with zoonotic diseases in Ethiopia. The opportunities include strong interest from technical people in the ministries, the establishment of the National One Health Steering Committee and prioritized zoonotic diseases Technical Working Groups and their active engagement and interest and support from various NGOs. However, there are still considerable challenges which stakeholders and responsible government bodies should be aware of Fasina and Fasanmi [49]. According to Fasina and Fasanmi [49], some of the challenges include:

- Poor integration among animal and human health sectors in data sharing and lack of awareness and continuous advocacy across the relevant sectors and community members.
- Leadership and commitment from higher government officials including budgeting is still not strong.

- Weak encouragement and collaboration between regional One health task forces
- Competing prioritized zoonotic diseases prevention and control strategic plans (Ethiopia has already planned more than three zoonotic diseases to control and eliminate them by 2030).
- Limited laboratory diagnostic capacity, resulted in poor detection of outbreaks/causative agents
- One Health-based course in the curriculum of human medicine, veterinary medicine and other related disciplines in most universities is still not included.
- Lack of clear legislation on the engagement of public-private partnerships pertinent to One Health.

Solutions: Possible solutions could be awareness of One Health and foster leaders who are uniquely skilled to work across disciplines and sectors and rapidly Institutionalize the One Health approach. The NOHSC with its TWGs should not only extend the One Health concept to the community level but also begin operation of prioritized zoonotic disease prevention and control measures based on urgent revision of competing priorities. Universities should include One Health philosophies and principles to academic curricula, including designated degree programs as well as incorporating the One Health research issues into their thematic areas. In addition to these, capacitating diagnostic laboratories, encouraging research activities and advising to increase leadership commitment are very important.

CONCLUSION AND RECOMMENDATION

The risk of spreading emerging and reemerging zoonotic diseases has been increasing due to the interactions of humans, animals and ecosystems and accounts for more than a billion cases, a million deaths and hundreds of billions of United States dollars of economic damage per year. The One Health approach is critical for solutions to prevent, prepare for and respond to these complex threats. Countries, like Ethiopia, in which their household income is dependent on livestock, are characterized by strong correlation between a high burden of zoonotic disease and poverty. Thus, reducing the zoonotic disease burden through OH approach is crucial to improve through the application of One Health principles, such as interdisciplinary research, surveillance systems and policy interventions, significant strides have been made in controlling zoonotic diseases. By integrating efforts across sectors, One Health offers a unique advantage in addressing complex health challenges that transcend species boundaries. However, implementing the One Health approach faces various obstacles, including limited funding, institutional barriers and lack of coordination among stakeholders. Overcoming these challenges requires concerted efforts from governments, international organizations, academia and the private sector to foster collaboration, resource mobilization and policy support.

In addition, the One Health approach offers a promising framework for preventing and controlling zoonotic diseases by addressing their multifaceted nature. By embracing the principles of interdisciplinary collaboration, shared responsibility and evidence-based decision-making, the global community can better safeguard public health and ecological integrity against the threats posed by zoonoses. stakeholders continue to prioritize investments in One Health initiatives to build resilient health systems and promote sustainable development for future generations.

From the above conclusion the following points were forwarded;

- One Health concept should be promoted from the grassroots level and/or community level but also begin the operation of prioritizing zoonotic diseases prevention and control measures.
- Although the one health approach is in an embryonic stage in developing countries like Ethiopia, many crosscutting policies and regulatory measures that are operating and conducive for further development.
- Universities should include One Health philosophies and governing principles in academic curricula, including designated degree programs as well as incorporating the One Health research issues into their thematic areas

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