Communication for Health Project –

Global Health Security Agenda (GHSA)-Risk Communication Activity

Landscape Analysis on Zoonotic diseases: Anthrax, Avian Flu and Brucellosis in Ethiopia

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List of Abbreviations

CCP	The Johns Hopkins Center for Communication Programs
CFT	Complement Fixation Test
EBS	Event Based Surveillance
EDHS	Ethiopian Demographic Health Survey
EPHI	Ethiopian Public Health Institute
EWCA	Ethiopian Wildlife Conservation Agency
FAO	Food and Agriculture Organization of the United Nations
FMOH	Federal Ministry of Health
GDP	Gross Domestic Product
GHSA	Global Health Security Agenda
HPAI	Highly Pathogenic Avian Influenza
HEW	Health Extension Worker
HF	Health Facility
IDSR	Integrated Disease Surveillance and Response
MEF	Ministry of Environment and Forestry
MoA&L	Ministry of Agriculture and Livestock
MoLFR	Ministry of Livestock and Fisheries Resources
NADIC	National Animal Diagnosis and Investigation Center
ND	Newcastle Disease
OIE	World Organization of Animal Health
OR	Odds Ratio
PHEM	Public Health Emergency Management
RBPT	Rose Bengal Plate Test
SBCC	Social and Behavior Change Communication
SNNP	Southern Nations, Nationalities and Peoples' Region
WHO	World Health Organization
USAID	United States Agency for International Development

Executive Summary

Global Health Security Agenda (GHSA) risk communication activity aims to support the public sector stakeholders: Ethiopian Public Health Institute (EPHI), Federal Ministry of Health (FMOH), Ministry of Environment and Forestry (MEF), Ministry of Agriculture and Livestock (MoAL), Ethiopian Wildlife Conservation Agency (EWCA) and other partners working on Zoonotic diseases prevention and control in the area of risk communication. This Landscape analysis is conducted to identify programmatic and geographic focus areas and linkages that inform the design and implementation of risk communication activities. The analysis used stakeholder mapping, geographic mapping and literature review focusing on the three zoonotic diseases: Anthrax, Avian Influenza and Brucellosis. A total of 19 stakeholders (mix of public and private sectors) were mapped at federal and regional level and key informant interviews were completed with respective representatives using a predesigned checklist. Surveillance data were collected and used to prioritize woredas. In addition, more than 63 published and unpublished literature searched using search engines and journals were reviewed and findings synthesized.

Magnitude of Anthrax, Avian Influenza and Brucellosis in Ethiopia

The national human anthrax case prevalence was found to be 1.3 per 100,000 populations per five years from 2009 to 2013, while it was 6.7, 2.3, 1.5 and 0.2 in Tigray, Amhara, SNNP and Oromia regions respectively. Zero human case was reported from pastoralist regions with 55-216 animal cases (Afar, Somali and Benshangul Gumuz). A study done on Avian related parasitic diseases in Ethiopia found an overall detection prevalence of 17%, 56%, and 34% for Ascaridida, Eimeriaspp and lice, respectively. Similarly, findings indicate that there is significant individual and herd prevalence of Brucellosis in Ethiopia estimated 0.4-33.3 and 12-68 respectively. The prevalence of zoonotic diseases has shown variation across regions and woredas. The assessment identified a total of 24 priority woredas based on surveillance data and history of outbreak in the woredas. Of which 11 woredas are from Amhara, eight in Oromia, two in Tigray and three woredas in SNNP regions.

Knowledge, attitude and practice on the three zoonotic diseases

Anthrax: Studies indicate that the most known zoonotic diseases is rabies, in which knowledge of rabies ranges from 68.8% to 97.1% followed by taeniasis[1] (53.1% to 83.4%), Anthrax (50.8% to 79.6%), bovine tuberculosis (29.1% to 49.5%), brucellosis (22.7%) among different studies across regions in Ethiopia. Anthrax was known as a zoonotic disease by 51% of farmers, 51% small holders, 67.6% butchers, and 79.6% city residents, respectively. A study conducted in Oromia indicates that only half of the respondents (48.2%) claimed to avoid contact with infected animals. 68.5% consumed raw meat, while 52.3% respondents revealed consumption of unpasteurized milk.

1 Taeniasis is a parasitic disease due to infection with tapeworms belonging to the genus Taenia

Moreover, about 34.4% of respondents shared the same house with different species of animals while 97.4% used backyard slaughter. Low awareness of the community on mode of transmission of Anthrax; and highly prevalent risky practices- such as consumption of raw meat, sharing of houses with animals and backyard slaughter could be priority for the risk communication activity in Ethiopia.

Avian Flu (AI): Avian influenza (AI) is a highly contagious viral infection, primarily affecting avian species. A highly pathogenic avian influenza (HPAI) virus causes severe disease and death of poultry. HPAI causes serious economic consequences in the agricultural sector through mass destruction of poultry. Ethiopia has not yet experienced an outbreak of HPAI. But the country is at high-risk for the avian human influenza pandemic threat due to the presence of similar species of Avian Influenza diseases in neighboring countries, seasonal migration of birds from affected areas, the effect of globalization (where people are able to move to the country from various endemic areas), and the importation of highly productive poultry. Ethiopia is one of the destination countries in Africa for migratory birds from affected countries. The country also imports annually considerable amounts of poultry and poultry products from a number of countries. There is an existing tradition of unsafe and unhygienic live poultry markets, which provide favorable conditions for transmission of infection among poultry and increased risk of infection to humans. In Ethiopia, poultry are kept by about 60% of households. Average households own a flock comprised of 6-10 birds. Low awareness of the community on AI; risky practices during transportation, unsafe contact with droppings, handling of poultry meat and handling sick birds are priority areas for the risk communication intervention.

Brucellosis: A study conducted in Southeastern Tigray region in Ethiopia indicates that among 120 camel owners, most of the respondents (88.33%) did not have knowledge about camel brucellosis and zoonotic diseases. Another study in Arsi Negele in Oromia region indicates that among 98 livestock keepers surveyed, a relatively high proportion of the respondents acquired the knowledge about zoonotic diseases from elders (34.7%) and from their personal observation (32.7%). A large proportion of respondents (96.3%) indicated meat as a vehicle for disease transmission to humans. Only a few people responded that zoonotic pathogens could be acquired through direct contact and inhalation. About one- third of the respondents cook meat and boil milk to minimize disease transmission. Low knowledge on brucellosis, together with existing habits consumption of raw animal product, backyard slaughtering, and close contact with animals can serve as means of Brucella infection in Ethiopia.

Collaboration and coordination

Out of 19 stakeholders mapped, nine have national, five regional and the remaining four zonal and woreda level geographic coverage (see Annex1: summary of stakeholder mapping). With the exception of the poultry association and private farms, almost all focus on different zoonotic diseases mainly rabies, anthrax, brucellosis and avian flu. Rabies is the most commonly mentioned zoonotic disease that the stakeholders are working on. EPHI, FAO, and Ministry of Livestock and Fisheries) experience on behavioral change communication on zoonotic diseases. These organizations designed SBCC materials (leaflets, posters, brochures) and distributed to the community; and provided health education on early warning of highly pathogenic influenza (HPAI), Ebola and Rabies.

Opportunities and challenges for prevention and control of zoonotic diseases were also assessed. Key informants indicated that the establishment of a flexible support system in government offices; existence of One health steering committee at national level; private sector interest to corporate in the area of zoonotic disease prevention, control and elimination; and a multi-hazard warning and response system within EPHI are the opportunities. On the other hand, limited organizational capacity to address risk communication needs; weak early warning and rumor tracing system; lack of coordination between the government and the private sector in sharing of information and alignment of responses from the federal to kebele level; inadequate data on prevalence of zoonotic diseases; and shortage of vaccines (anthrax) were mentioned as challenges. The findings indicated that there is a huge capacity gap on risk communication among organizations working on zoonotic diseases in Ethiopia. Only a few organizations are working on risk communication with a light engagement in material design development and distribution. In most of the cases the Social and Behavior Change Communication (SBCC) materials are emergency driven. Further, there is weak collaboration and coordination among the various actors working on zoonotic diseases.

Conclusions and recommendations

Cultural practices such as living with livestock in the same house, consumption of raw meat, and raw milk, and high contact with animals and animal carcasses, backyard slaughtering contributes to spread of zoonosis. Low awareness of the community on zoonotic disease and their transmission mechanisms, inadequate behavior change intervention (little or no communication materials on the subject); health workers little knowledge and experience to diagnose cases, and weak preparedness and early warning plans in endemic areas also contribute to the increasing risk of zoonosis. The assessment also identified weak coordination and information sharing system among the various actors working in zoonotic diseases prevention and control.

Based on findings of this assessment, the following recommendations were proposed with special emphasis to priority geographic areas indicated in the "Geography mapping" and high-risk targets pointed in the Table5 "Audience analysis" on Page 28.

Social and behavioral change communication (SBCC)

- The project in collaboration with different sectors shall support the design, production and distribution of tailored SBCC materials on zoonotic diseases and intervene priority target groups (Table5) with appropriate approach and channels. The SBCC materials shall focus on
  - Avoid consumption of raw meat, milk, and cheese;
  - Proper removal and disposal of dead animals and their carcasses
  - Avoid contact with infected animals; promote separate shelter for animals
  - Promote proper handwashing (with soap and clean water) whenever come in contact with animals
  - Educate the benefit of cleaning and disinfecting the poultry farm surroundings,
  - Promote timely vaccination,
  - Promote early treatment seeking for sick animals and human
  - Check food labels for expire date and related information and
  - Maintain good records of flock history and separating poultry by age and species or only raising one species instead of several to minimize HPAIA/H5N1 virus transmission.
- Design strategy and strengthen routine health education focusing on risk of zoonotic diseases, prevention and control strategies, educating farmers, butchers, tanners and other industrial workers to reduce their risk

Collaboration and coordination

- Early warning and rumor tracing system for zoonotic diseases was found weak in Ethiopia. The project shall in place a rumor tracking system and strengthen information sharing and alignment of responses among the various stakeholders from the federal to kebele level
- There is weak coordination between the government animal and public health sectors. The project shall work with partners through strengthening existing One health coordination mechanism and also establishing similar regional and woreda level coordination mechanisms
- Stakeholder mapping findings indicated there is shortage of training on zoonotic disease prevention and control for frontline health service providers at health facilities. The project with One health team shall provide the training.
- There is limited data generation and available data are not timely and/or geographically complete. The project shall identify real data need and conduct operational research to narrow the gap; and also shall work to improve data use for decision making on zoonotic diseases prevention and control

- There is limited organizational capacity among organizations working on zoonotic diseases to address risk communication needs. The risk communication activity shall prepare training on leadership on strategic communication and risk communication and provide for partners.

Introduction

Communication for Health is a five-year social and behavior change communication (SBCC) project in Ethiopia that began in July 2015. Funded by the United States Agency for International Development, the project is managed by the Johns Hopkins Center for Communication Programs (CCP) in partnership with John Snow International. The Project's overall vision is an Ethiopia where all families have the knowledge, desire, and ability to practice healthy behaviors at home and to seek health services when they need them. The project activities focus on Amhara, Oromia, SNNP and Tigray regions while supporting systems to improve quality, capacity, and coordination of SBCC nationally.

Ethiopia has the second largest human population in Africa and the largest livestock population in the continent. About 80% of Ethiopians are dependent on agriculture and have direct contact with livestock or other domestic animals(1). The livestock sub sector contributes about 16.5% of the national Gross Domestic Product (GDP) and 35.6% of the agricultural GDP, 15% of export earnings and 30% of agricultural employment (2). Agricultural sample survey estimates put the number of cattle around 54 million and around similar number of shoats (sheep and goats)(3). Agriculture in Ethiopia is mostly mixed. As a result, the country is vulnerable to the spread of zoonotic diseases. For example in Ethiopia, it is estimated that up to 2,700 human deaths occur annually due to rabies. Zoonotic diseases have the potential to impact society in three main ways: (a) they threaten the health of animals resulting in illness, loss of productivity, and death; (b) they threaten the livelihood of people dependent on livestock as a major source of income; and (c) they cause illness and death in people, which in turn causes additional economic and societal loss (3).

To tackle the human and animal health risks as well as the environmental impact of zoonosis, a multi-sector approach involving biomedical initiatives, social and behavior change actions, and policy level interventions were proposed. The Global Health Security Agenda (GHSA) was launched in February 2014 and is a growing partnership of over 64 nations, international organizations, and non-governmental stakeholders to help build countries' capacity to help create a world safe and secure from infectious disease threats and elevate global health security as a national and global priority. An important step for work on the Zoonotic Disease Action Package, a zoonotic disease prioritization workshop was held to identify significant zoonotic diseases of mutual concern for animal and human health agencies in Ethiopia. The workshop involved the Ethiopian Public Health Institute (EPHI), the Ministry of Livestock and Fishery Resources (MoLFR), and the Ethiopian Ministry of Environment and Forestry (MEF) and other partners including UN agencies such as the Food and Agricultural Organization (FAO) in ONE Health approach. One Health (OH) implies that the health of humans, animals and ecosystems are interconnected. It involves applying a coordinated, collaborative, multidisciplinary and cross-sectoral approach to address potential or

existing risks that originate at the animal-human-ecosystems interface. The workshop prioritized the most critical zoonotic diseases, which impact the health of people and animals. As a result, five zoonotic diseases were identified as high priorities in Ethiopia (Rabies, Anthrax, Brucellosis, Leptospirosis and Echinococcus).

The Joint External Evaluation Tool, which is an International Health Regulations (2005) intended to assess country capacity to prevent, detect, and rapidly respond to public health threats independently of whether they are naturally occurring, deliberate, or accidental. According to JEE, states and parties should have risk communication capacity which is multi-level and multi-faced, real time exchange of information, advice and opinion between experts and officials or people who face a threat or hazard to their survival, health or economic or social well-being so that they can take informed decisions to mitigate the effects of the threat or hazard and take protective and preventive action. Risk communication includes a mix of communication and engagement strategies like media and social media communication, mass awareness campaigns, health promotion, social mobilization, stakeholder engagement and community engagement(4).

A multi-sectoral team of experts and advisors (representing international organizations including the WHO, the World Bank and the Food and Agriculture Organization (FAO) of the United Nations) participated in a weeklong evaluation from 29 February 2016 through 4 March 2016 in Addis Ababa, Ethiopia. The evaluation results indicated risk communication systems (plans, mechanisms, etc.), has got 3pt; internal and partner communication and coordination, 3pt; public communication, 4pt; communication engagement with affected communities, 3pt; and dynamic listening and rumour management, 3pt out of the maximum 5pt. The evaluation team recommended significant improvements on coordination with other sectors at all levels of government in the area of social mobilization and risk communication (5).

In Ethiopia, social and behavior change communication (SBCC) activities for zoonotic diseases are limited in scope. Current in-country SBCC efforts mainly focus on rabies prevention. To address this gap, the United States Agency for International Development (USAID/Ethiopia) has approached the Johns Hopkins Center for Communication Programs (CCP) Communication for Health project with a request to support public sector stakeholders working on zoonotic diseases risk communication (EPHI, FMOH, MEF, MoLFR, EWCA) with in-country emergency preparedness efforts and risk avoidance communication during outbreaks, with a special focus on Brucellosis, Anthrax and Avian Influenza.

In response to this initiative, the Communication for Health project uses a risk communication perspective involving the creation of sustainable mechanisms to coordinate the multi-sector social and behavior change communication actions. This includes the development of a widely shared

strategy and action plan, capacity strengthening of key actors in responding to risk communication needs, supporting grassroots social mobilization, and media engagement efforts in selected interventions. The risk communication activity of the Communication for Health Project, has four major elements for strategic health communication on zoonotic diseases,

1. Advocacy on the need to establish and strengthen OH coordination mechanism at regional, zonal, and woreda levels that helps to strengthen the platform to prevent and control zoonotic diseases in Ethiopia

2. Improve community risk perception and increase knowledge on prevention and control of zoonotic diseases using community wide campaigns such as market place campaign, mass media campaign; school based campaigns, and community dialogues.

3. Strengthen the capacity of mass media so that media play its role in alerting, educating, and mobilizing the community towards the prevention and control of the risk

4. Train front line human health and veterinarians on their role in alerting, educating, mobilizing the community, and sharing information each other to prevent and control the risk

The purpose of this landscape analysis is to identify programmatic and geographic focus areas and linkages that inform the design and implementation of risk communication activities

Objectives of the landscape analysis

General Objective

The overall objective of the landscape analysis is to identify programmatic and geographic focus areas and linkages that serve to lay the groundwork for understanding how the risk communication activity will impact the local context.

Specific objectives

1. Identify geographic areas (woredas/districts) with a high burden of the three zoonotic diseases (Anthrax, Avian flu & Brucellosis)
2. Identify stakeholders working on the three diseases (Geographic scope of their intervention, target population, approach & capacity)
3. Identify risky behaviors and their determinants that contribute to the spread of the diseases
4. Identify primary and secondary target audiences for risk communication intervention including federal, regional, community-level audiences

Methodology

The landscape analysis employed stakeholder mapping, geographic mapping and literature review techniques to collect relevant data.

Literature Review

The literature review covered both published and unpublished literatures, including journal articles, books, reports, and policy and strategy guidelines. The following journals and databases were searched: PubMed, HINARI, and BMC a publication date between 2009 to 2018GC. A Google search was conducted to identify additional web-based resources. Relevant policy, strategy and plan documents, draft strategy documents on Anthrax, and various reports were also part of the review. Endnote was used to manage reviewed articles.

A team of three people including the risk communication SBCC specialist and the Communication for Health two Research and Monitoring and Evaluation staffs conducted the review. The Communication for Health Research, Monitoring and Evaluation Director provided overall guidance to implement the analysis. The team first agreed on appraisal criteria to identify valuable materials for review. The criteria included timeliness of the study, the scope of the study (sample size, geography-national/regional/district level), the plausibility of the method used for data collection, and relevance to zoonosis risk communication. Then, pieces of literature were categorized into three areas (Avian Flu, Anthrax, and Brucellosis) and shared with the review team members. In the first round review, the team identified and reviewed more than 195 documents; of which 63 more valuable documents were selected and thoroughly reviewed. The magnitude of the diseases, risk behaviors including knowledge, attitude, practice, gender, and risk group were considered to organize the findings. A spreadsheet was used to summarize the findings.

Stakeholder and geographic mapping

As part of the landscape analysis, the study team visited 19 stakeholders (associations, a private business involved in the poultry farm, FAO, MOH, MoA&L, and regional agriculture and health bureau in Amhara and Oromia). Key informant interviews were conducted with representatives from each office using a semi-structured checklist. In addition, the team collected available surveillance and monitoring data about prevalence of zoonotic diseases in order to prioritize woredas.

Study limitations:

- Most of the available literatures are animal health oriented. The review couldn't include sufficient information on some aspects of zoonotic diseases in humans, particularly in Ethiopia
- Shortage of pieces of literature and lack of sufficient information on risk communication
- Scarcity and incomplete surveillance data both on animal and public health and limited studies or data that show prevalence of zoonotic disease in humans

Results

I. Anthrax

Epidemiology of Anthrax in Human:

Zoonoses are diseases transmissible between animals (domestic and wildlife) and humans. It has been estimated that 60% of all human diseases and around 75% of emerging infectious diseases are zoonotic, among which Anthrax is a serious disease that can affect most mammals and several species of birds. Anthrax is caused by the bacterium *Bacillus anthracis*. It is primarily a disease of herbivores. Humans almost invariably contract the natural disease directly or indirectly from animals or animal products. *Bacillus anthracis* has always been high on the list of potential agents with respect to biological warfare and bioterrorism. It has been used in that context on at least two occasions, prepared for use on several other occasions, and has been the named agent in many threats and hoaxes. Anthrax letter events that happened in the United States of America (USA) in 2001 is one of several examples (6). In the African Region, the Integrated Disease Surveillance and Response (IDSR) framework define human diseases priorities, where anthrax is the only bacterial zoonosis featured(7).

Naturally occurring anthrax disproportionately affects the health and economic welfare of poor, rural communities in anthrax-endemic countries. However, many of these countries have limited anthrax prevention and control programs. *Bacillus anthracis* spores can survive in the soil for many years and are distributed worldwide, although the disease is endemic to Africa, Central Asia, the Middle East, and South America(8).

Accidental ingestion of contaminated bone meal or pastures contaminated by tanner effluent are common sources of infection for Anthrax to humans. There are different factors, which influence the acquirer of infection. The first one is the host factor- the disease is more common in cattle and sheep and less frequent in goats and horses. Humans occupy an intermediate position between this group and the relatively resistant pigs, dogs and cats. In farm animals, the disease is almost invariably fatal, except in pig, and even in this species the case fatality rate is high. The second factor is, the agent of the disease. The third factor is the environmental factor. In tropical and subtropical climate with high annual rainfalls, the infection persists in soil, so that frequent, serious outbreak of anthrax, are commonly encountered(9, 10). The seasonality of anthrax outbreaks varies among locations, making it difficult to develop a single consistent ecological description of this disease(11).

Human infection is by contact with infected animals or spore-contaminated animal products through skin lesions (most common), ingestion, and inhalation (10). Inhalation anthrax develops

when anthrax spores enter the lungs through the airways. It is most commonly contracted when workers breathe in airborne anthrax spores during processes such as tanning hides and processing wool. Breathing in spores means a person has been exposed to anthrax. But it does not mean the person will have symptoms. The bacterial spores must germinate or sprout (the same way a seed sprouts before a plant grows) before the actual disease occurs. This process usually takes 1 to 6 days. Once the spores germinate, they release several toxic substances. These substances cause internal bleeding, swelling, and tissue death. Gastrointestinal anthrax occurs when someone eats anthrax-tainted meat. Injection anthrax can occur in someone who injects heroin. (12). A skin infection may be transmitted from person to person by direct contact or fomites. Ingestion and inhalation anthrax is not transmitted from person to person. The lesions (eschars) are generally found on exposed regions of the body almost invariably accompanied by marked edema extending some distance from the lesion. (6). Percutaneous transmission from biting tabanid flies is possible, but of unknown significance. Inhalation anthrax exposure is rare under natural conditions(11).

Symptoms of anthrax differ depending on the type of anthrax. Symptoms of cutaneous anthrax start 1 to 7 days after exposure: An itchy sore develops that is similar to an insect bite. This sore may blister and form a black ulcer (sore or eschar). The sore is usually painless, but it is often surrounded by swelling. A scab often forms, and then dries and falls off within 2 weeks. Complete healing can take longer. Symptoms of inhalation anthrax: Begins with fever, malaise, headache, cough, shortness of breath, and chest pain Fever and shock may occur later. Symptoms of gastrointestinal anthrax usually occur within 1 week and may include: Abdominal pain, Bloody diarrhea, Diarrhea, Fever, Mouth sores, Nausea and vomiting (the vomit may contain blood), Symptoms of injection anthrax are similar to those of cutaneous anthrax. In addition, the skin or muscle beneath the injection site may get infected (12).

Failure of blood to clot is the most sensitive carcass characteristic of anthrax across all species(11). Anthrax is responsive to antibiotic therapy provided this is administered early in the course of the infection. Penicillin, ciprofloxacin, and doxycycline for more serious intravenous penicillin are common treatments for Anthrax (6). Different studies across the country, show there are traditional medicines produced from many species of plants to treat Animal and human Anthrax in Ethiopia. Anthrax has different local names in Ethiopia; some of the local names include 'Shem-itere', in Gurage and Silite Zones of SNNP; 'Megerem' in Northwestern Tigray (13-16).

Of the various types of anthrax, cutaneous anthrax accounts for > 95% of human cases worldwide. This mostly occurs on areas of exposed skin, with the face, neck, eyelid, and forearms(9). Frequently, the infection can be traced back to contact with a specific, diseased grazing herbivorous animal,

and it is seen to occur within families. It is a disease associated with biological terrorism in western countries, it is common and underreported in the rural areas of Africa. There is low uptake of medical care for cutaneous Anthrax in Africa. It can be lethal in some cases, especially when the oropharyngeal area is affected after ingesting meat from contaminated sources(17).

In the case of an outbreak occurring in livestock control measures consist of correct disposal of the carcass, decontamination of the site(s) and of items used to test and dispose of the carcass(es), and initiation of treatment and/or vaccination of other animals as appropriate. The best disposal method is incineration. Livestock vaccines are available in most countries. Vaccines for humans, in contrast, are not widely available (6). Field visit findings in Oromia region in Ethiopia also indicate there is a shortage of vaccines in Anthrax endemic areas. The diagnosis of the disease in humans is usually by clinical sign and symptoms and no confirmatory laboratory test was conducted.

Characteristics of anthrax in Ethiopia include a known exposure to diseased animals, occurrence within families, frequent treatment by local healers and high morbidity and mortality. Twenty-seven patients with cutaneous anthrax were identified over a three-year period (2013-2015) at Gonder College of Medical Sciences. Nine patients who delayed seeking medical care presented with severe symptoms and three patients died. Eighteen patients were clustered with four families in which an attack rate of 32% occurred. 93% of patients could trace their disease to exposure to the product of a specific diseased animal (9). The section indicates risk of human infection for Anthrax is highly related with ingestion and inhalation next to cutaneous.

Magnitude of Anthrax

Globally, 10,000-100,000 human anthrax incidences occur annually with significant number of cases from Chad, Ethiopia, Zambia, Zimbabwe, and India. Even though anthrax is a reportable disease in Ethiopia, data have not been analyzed and interpreted for public health intervention purposes. Studies indicate lack of consistency in the regularly gathered information, and that can make it challenging to estimate the incidence and prevalence of zoonotic diseases including anthrax in Ethiopia. In addition, when information on zoonosis is available, it is not necessarily accurate, complete, and/or on-time(18).

Human and animal anthrax surveillance data collected between 2009-2013 from the Ethiopian Public Health Institute and the Ministry of Agriculture has been analyzed. A total of 5,197 human and 26,737 animal anthrax cases (human to animal ratio 1:5) were reported from 2009 to 2013 with 86 human anthrax deaths (Case Fatality Rate: 1.7%). The national human anthrax case prevalence was found to be 1.3 per 100,000 populations per five years, while it was 6.7, 2.3, 1.5 and 0.2 in Tigray, Amhara, SNNP and Oromia regions respectively. Zero human cases were reported from pastoralist regions with 55-216 animal cases (Afar, Somali and Benshangul Gumuz). The human

prevalence was highest in May followed by February (0.20 and 0.15 per 100,000 populations per year respectively). Both suspected human and animal anthrax cases were reported in larger number in the month of May and also larger numbers of animal cases were reported in October. This is dry season, during this time the grass is short and animals are, forced to graze very close to the ground. This increases chances of animals picking up anthrax spores in areas whose soils and pastures are contaminated with the spores. Therefore, case of anthrax in animals is very common during this time increasing risk of human anthrax exposure.(19, 20).

In a study conducted in Amhara region, the event based surveillance (EBS) showed the routine surveillance is not effective in catching Anthrax cases. The most commonly reported rumors were about measles (n = 90/126, 71%) followed by rabies (n = 14/126, 11%). The third most reported rumors were about anthrax (n = 5/5, 100%). Five verified anthrax rumors were reported by EBS; however, only two cases were captured in the routine surveillance in the same period(21). Emplacing strong rumor tracing mechanism could help the risk communication activity to identify and manage Anthrax cases. In addition SBCC intervention need to consider seasonality of the Anthrax outbreak in view rainy seasons.

Anthrax is among the reportable diseases under routine surveillance in the Agricultural and Health sector in Ethiopia, however, the reports are manifested by report break ups and under reporting across all regions. There is no report sharing between sectors which are responsible for Animals and public health.

Knowledge, Attitude and Practice on Anthrax

According to the study conducted among students and residents of Dodola town and surrounding farmers in Oromia region, the majority of respondents (76.8%) heard about zoonosis. Rabies (68.8%), taeniasis (53.1%), anthrax (50.8%), bovine tuberculosis (49.5%), and brucellosis (22.7%) were commonly listed zoonotic diseases by the respondents, while animal bites, contact, ingestion, and inhalation were indicated as modes of zoonotic transmission(22). A study on 100 dairy farmers in Bishoft Oromia region found out that the farmers were aware of tuberculosis (38.9%), mastitis (33.3%), anthrax (19.8%), brucellosis (6.3%), and salmonellosis (1.6%)(23). Similar study in Jimma indicates that anthrax was known as a zoonotic disease transmitted to humans by 51, 51, 67.6, and 79.6% of farmers, small holders, butchers, and city residents, respectively(24). In a study conducted among 384 elementary and high school students in Addis Ababa and surrounding areas, knowledge of zoonotic diseases indicates that the most frequently mentioned zoonotic disease was rabies (100%), followed by anthrax (94.3%), and brucellosis (49.5%)(25). The most frequently known zoonotic diseases among the respondents in the study area were rabies (97.1%), followed by taeniasis (83.4%), anthrax (55.4%), bovine tuberculosis (29.1%), and hydatidosis (4%) (24). Knowledge of zoonosis was recorded as being significantly higher in urban areas than among peri-urban settlers ($P<0.05$)(22).

Knowledge on transmission mechanisms of zoonotic diseases indicate that about 67.2% of respondents had a perceived zoonotic disease transmission as being from animal to human; while 32.8% didn't have knowledge about the role of animals in zoonotic disease transmission (22). In a separate study, transmission through the consumption of raw meat was mentioned by 54.9% of the respondents, whereas contact and inhalational transmission routes were only mentioned by 14.3 and 2.3% of respondents, respectively (26).

Most of the respondents reported that consumption of meat from infected animals was the major source of infection for humans. However, a study conducted in Oromia indicates that only half of the respondents (48.2%) claimed to avoid contact with infected animals. 68.5% consumed raw meat while 52.3% respondents revealed consumption of unpasteurized milk. Moreover, about 34.4% of respondents shared the same house with different species of animals while 97.4% used backyard slaughter(27). Another study indicated majority of the respondents (62%) discards milk of sick animals, 27.6% gave milk from sick animals to their pets, 7.8% used the milk of sick animals after processing it, and 2.6% gave the milk of sick animals to their calves(23). The findings indicate that there is knowledge gap about mode of transmission of Anthrax and majority of the population practiced risky behaviors such as consumption of raw meat, milk and unsafe contact with sick animals.

Risky behaviors/High Risk Groups for Anthrax

Humans get infected almost exclusively through contact with infected animals or animal products. People work for industrial products such as contaminated hair, hides, wool, bone meal, etc., have a higher chance of resulting in pulmonary infection as a result of inhalation of spore-laden dust. Non-industrial source of infection can affect a person who works with animals or animal carcasses such as vets, farmers, and butchers and the infection is almost always coetaneous(9). In poorer countries and regions of the world, there are reports of people consuming carcasses with anthrax and dying (28). People who consumed raw meat and milk are also at a higher risk.

Prioritization of messages for Anthrax

Geographic areas with history of epidemics should be given priority and the message should include the signs and symptoms of the disease (for example, non-clotting of blood) to prevent the consumption of infected livestock. Public education on prevention measures for cutaneous Anthrax and awareness creation on sign and symptoms is necessary. As indicated in the stakeholders' analysis and former outbreaks in Oromia, people contract such diseases by eating sick animals, simply assuming the animals are sick from other non-communicable diseases. Messages to raise awareness about Anthrax transmission mechanisms, and risky practices such as consumption of raw meat and milk need to be addressed. Anthrax outbreaks commonly happen in May and June and a seasonal early warning message should address that too. Proper disposal of animals died

of Anthrax should be promoted. The recommended measures for disposal of animals that die of anthrax are incineration and deep burying with limestone covered. However, literature and stakeholders' interviews reveal that farmers just shallowly bury animals which in turn allows: Scavengers like hyenas to bring them out and contaminate the topsoil and grazing grass; heavy rain to erode the topsoil and bring out the spores, such that all the areas reached by floodwaters are exposed to the disease-causing agent.

Table1 Audiences Analysis (Target)

Risk groups	Reasons
• People who have exposure to industrial products (contaminated hair, hides, wool, bone meal, etc.) have a higher chance of resulting in pulmonary infection as a result of the inhalation of spore-laden dust. • Exposure to non-industrial (affects a person who works with animals or animal carcasses such as vets, farmers, butchers, etc.) is almost always coetaneous in nature. • Consumption of infected animals or their carcasses • People who remove dead cattle may be at higher risk of anthrax exposure. • People who share houses with animals • Males generally have higher occupational risk rates	High contact with infected animals or animal products that increase risk of contamination

II Avian Flu

Epidemiology of Avian Flu

With increasing globalization and urbanization, epidemics caused by new influenza viruses are likely to spread rapidly around the world. Avian influenza (AI) is a highly contagious viral infection, primarily affecting avian species. A highly pathogenic avian influenza (HPAI) virus causes severe disease and death of poultry. HPAI causes serious economic consequences in the agricultural sector through mass destruction of poultry. The virus poses a threat to human health as well as economic security. The highly pathogenic avian influenza (HPAI) H5N1 has been described as a highly contagious viral disease in several avian species. The disease is characterized by high morbidity and mortality and could be potentially contracted by humans and other warm-blooded animals thus making it an emerging pandemic of zoonotic importance (29). Infected birds can shed influenza virus in their saliva, nasal secretions and feces (30). Human influenza is transmitted by inhalation of infectious droplets and droplet nuclei, by direct contact and perhaps, by indirect (Fomite) contact, with self-inoculation onto the upper respiratory tract or conjunctival mucosa (31).

The spread of avian influenza A viruses from one ill person to another has been reported very rarely, and when it has been reported it has been limited, inefficient and not sustained. However, because of the possibility that avian influenza A viruses could change and gain the ability to spread easily between people, monitoring for human infection and person-to-person spread is extremely important for public health (32). The subtype H5N1 virus that is threatening to cause a similar type of human influenza pandemic in humans belongs to this group of influenza viruses that cause severe form of influenza among the bird population (33). In addition, HPAI has captured the attention of the international community over the years, with outbreaks in poultry having serious consequences on both livelihoods and international trade in many countries. Since 2014, HPAI clade 2.3.4.4 viruses (H5N1) have spread rapidly via migratory wild aquatic birds and have evolved through re-assortment with prevailing local low pathogenicity avian influenza viruses(34).

HPAI has seriously affected poultry farmers whenever and wherever it has appeared. The recent avian influenza epidemic, caused principally by the H5N1 strain, has been continuing since it was first recognized in Vietnam in December 2003. The zoonotic nature of the H5N1 avian influenza virus has resulted in a rapidly rising number of humans infected with the disease. As of November 13, 2006, the total number of human infections reported was 258, of which 153 people died7, representing a case-fatality rate of 59.3%. In Africa, Egypt has recorded 15 human cases with 7 fatalities (35).

Influenza pandemics (worldwide epidemics) have occurred at irregular and unpredictable intervals, and the diversity of zoonotic influenza viruses that have caused human infections are

increasing in alarming rate. Under normal conditions people are affected by human influenza virus, which often is not life threatening. However, if animal influenza virus or influenza virus containing genes from animal influenza virus spread among human population the effect could be devastating with high mortality rates. It is this situation that is threatening the world now (33). Since 2015/2016, various countries in Africa, Asia, Europe, and Middle East have detected infections in wild birds and/or domestic poultry with various strains of HPAI viruses including the newly emerged and potentially pandemic H5N8. HPAI virus, which is highly fatal to poultry, requires a high density of, and frequent movement between, susceptible flocks, which are more commonly associated with intensive production (36)

An AI epidemic is threatening Africa mainly because the flyways of migratory birds link the endemic and newly infected countries with disease-free areas in this continent, and because of the risk of introduction through trade(37). The first outbreak of HPAI in Africa was noted in Nigeria in February 2006. Subsequently, the disease was detected in Niger, Cameroon, Ivory Coast, Burkina Faso, Egypt, Sudan, Djibouti, and Ghana. After the declaration of HPAI outbreaks in Djibouti and Sudan, the risk of introduction of avian influenza to Ethiopia has become more pronounced.

The incidence AI informally known as “bird flu,” has been a worldwide cause for concern since the 1960s. Poultry farmers of poor households in developing countries, especially in Sub-Saharan Africa, have received the greatest shocks of the incidence of this disease(38)

Ethiopia has not yet experienced an outbreak of HPAI(39) . But the country is at high-risk country for the avian human influenza pandemic threat due to the presence of similar species of Avian Influenza diseases in neighboring countries, seasonal migration of birds from affected areas, the effect of globalization (where people are able to move to the country from various endemic areas), and the importation of highly productive poultry. Ethiopia is one of the destination countries in Africa for migratory birds from affected countries. The country also imports, annually, considerable amounts of poultry and poultry products from a number of countries (40).

False reporting of HPAI prevalence on site following a poultry disease outbreak at Gubre (PMDC) in 2006 – which resulted in all the chickens being culled - caused considerable public panic and debate, and severely depressed demand for poultry and poultry products in the country. The outbreak of Gumboro(is an acute, highly contagious viral infection in chickens) disease devastated production activities on many commercial farms (41). However, there have been two cases of Gumboro disease, which were initially thought to be HPAI. In 2007 there was a suspected case of HPAI in Assossa in Benishangul GumuZ Region of Ethiopia, in one of the government poultry multiplication centers, which led to the culling of all the birds at the multiplication center (42).

To prevent and control the effects of AI, Ethiopia has developed different strategic guides, manuals, and plans such as "Standard Operating Procedure for Avian Influenza", "Emergency Preparedness Plan for Highly Pathogenic Avian Influenza", "National Risk-Based Surveillance Plan for Highly Pathogenic Avian Influenza", and a three-year national strategic preparedness and response plan for the human Influenza pandemic in Ethiopia. However, HPAI was not prioritized as one of the five diseases (Rabies, Echinococcosis, Anthrax, Brucellosis, and Leptospirosis), even though its pandemic nature makes it high importance (3, 43). Human infections with highly pathogenic avian influenza A (H5N1) viruses continue to present a serious and highly complex public health challenge where they occur. Since late 2003, there have been 385 human cases recorded, with more than 245 deaths in 15 countries in Africa, Asia and Europe. In 2008 there have been 36 cases and 28 deaths (predominantly in Indonesia although Egypt, China and Vietnam continue to experience cases and deaths). HPAI H5N1 affects poultry and human populations, with Egypt having highest human cases (346) globally. Nigeria had a reinfection from 2014 to 2015, with outbreaks in Côte d'Ivoire, Ghana, Niger, Nigeria, and Burkina Faso throughout 2016. Risk of HPAI outbreak is high in Ethiopia, and an outbreak would cause a supply and demand shock in the poultry sector. Economy wide effects of an HPAI outbreak are expected to be minimal because of the poultry sector's small size and weak inter-sectoral linkages (44).

A review of influenza-related articles from sub-Saharan Africa indicated that most countries in the region did not have sufficient data on influenza to prioritize strategies for influenza prevention and control and called for more data on the epidemiology, risk factors, and burden of influenza in the region (45). Weak coordination structure for the response of AI with different reach and bureaucratic requirements (42). Highly Pathogenic Avian Influenza has not yet happened in Ethiopia, with existing weak surveillance system and immigration of trans boundary birds, however, there exist high-risk situation for HPAI transmission in Ethiopia. There is a need for advocacy, social mobilization, and community engagement SBC activities to strengthen prevention and control and biosecurity system strengthening with government sectors, private poultry industry, and the community at large.

Magnitude of Avian Flu in Ethiopia

Most commercial and small-scale poultry farms are located around the town of Debre Zeit in the Oromia region and Addis Ababa. According to the Central Statistical Agency (CSA 2007) report, high land areas of Ethiopia are with high density of poultry population compared to the low land areas, and vulnerable areas for transmission of Avian Influenza are located around rift valley lakes and other wetland areas where migrating bird prevail (see below map). However, HPAI has not yet happened in Ethiopia. The Rift valley and selected wet land areas are regular survey sites for HPAI and other related bird flus. The other risk areas for HPAI are commercial and small-scale poultry farms and chicken multiplication centers. Most of the commercial and small-scale

poultry farms are located around the towns of Debre Zeit, Hawasa, Mojo and Addis Ababa. While majority of the multiplication sites are located in different sites of Oromiya, Amhara, SNNPR and Tigray regions. Multiplication centers are sites, which incubate egg for to distribute a day old chicken to small-scale poultry farms and to family/individual back yard farms.

Table2: High and medium risk woredas for avian influenza, National Risk-Based Surveillance Plan for Highly Pathogenic Avian Influenza, Ministry of Livestock and Fishery, Addis Ababa Ethiopia April 2017:

Region	Woreda
Afar	Buromodaitu, Gewane
Amhara	Dera, Fogera, Womberma Merawi Town Admin., Bahir Dar Town Ad, Haike Town Admin, Dangila, Tehulederie, South Achefer, Bahir Dar Zuria, North Achefer, Bure, Bure Town Admin
Oromiya	Libo,Kemkem, , Mecha, Kalu, Alefa, Takusa, Dembeya, Gondar zuria, Debre Elias, Dangila Town Admin, Mana Sibu, AzbayChomen, Horro, Abe Dongoro, Begi, Guduru, Babo-Gembel "BaboGembel ", GudatuKondole, JimmaGenete, GudeyaBila, GawoKebe, Jimma Rare, Ejere, JimmaHoro, Gidami, Fentale, Dawo,Ilu, Becho, Adami Tulu JidoKombolcha, Lome, Gelana, Dugda, Shala, Shashemene, ArsiNegele, ZiwayDugda, Bora, Adama, Dodota, Teltele, Dilo, Abaya, Ofla (18)
SNNPR	Shashago, Hawasa Zuriya, Loko Abaya, Wendo Genet, Humbo, Selamago, Hamer, Dasenech, Gnangatom, Mirab Abaya, AribaMinichiZuriya, Amaro, Silite, Lanifaro, Hawassa Town, BenaTsemay, Derashe,)

Table3: List of high-risk areas by existence of commercial poultry farms and poultry multiplication centers in Ethiopia

Area of Commercial Poultry farms	Multiplication centers
All Regional capitals	Kombolcha
Bishoftu	Andassa
Addis Ababa	Bedelle
Mojo	Adelle
Hawassa	Sodo
	Bonga
	Gubre
	Mekelle
	Legetafo
	Ambo
	Fiche
	Kersa
	Nekemte

Knowledge, Attitude and Practice on Avian Flu

There are limited studies that clearly show the knowledge, attitude, and practice of the community with regard to HPAI in Ethiopia. A participatory evaluation study done on chicken health and production constraints in Ethiopia found that none of the chicken keepers who reported using tetracycline were aware of appropriate dose rates and many reported adjusting the dose according to their perception of the severity of the illness (46). A study in Addis Ababa Ethiopia among pastoralists found out that a majority of pastoralists neither possessed adequate knowledge about avian influenza nor applied adequate biosecurity measures against it. Sedentary pastoralists were more likely to have significant knowledge on HPAI/H5N1 compared to nomadic pastoralists (OR: 1.76; 95% CI: 1.19–2.61)(47). Only a few respondents had awareness about hazardous diseases associated with poultry(48).
(48). None of the poultry traders sought veterinary services when their chickens were sick (50).

Unsafe movement of staff, live poultry sales, equipment exchange, and visitors are important risk factors in the transmission of the virus. A study made in Nigeria revealed that most of the visitors are gate buyers who have higher chance of visiting several farms per day; and farms with farm workers that live outside the farm are less likely to observe biosecurity principles, and guidelines set by the farms had higher odds of infection, compared with farms where workers live within the premises. Poultry farms that purchased live poultry and poultry products in the course of the outbreak had higher odds of being infected with HPAI H5N1 virus, compared to farms that did not. Such workers raise poultry in their own homes, offered services to other farms, exchange items with workers from other farm premises, and rarely change their clothes and shoes when they come for work. Specialist slaughter facilities that meet the minimum level of bio-security are not available apart from those owned by Alema and Elfora Agro-Industries in Ethiopia (41). Nearly half (52.8%) of the poultry traders reported using a type of public transport (that transports people). The materials reported as being used for packing the poultry were sacks (47.1%), bamboo cages (46.2%) and wooden cages (6.7%). It was discovered that these materials were poor from a biosecurity point-of-view, as they are neither easily washable nor disinfectable (48). 71.2% of the respondents claimed that sick poultry was either sold to hotels or simply thrown anywhere rendering high potential for dissemination of diseases to both poultry and human beings.

There is an existing tradition of unsafe and unhygienic live poultry markets, which provide favorable conditions for transmission of infection among poultry and increased risk of infection to humans. Various traditions and religious ceremonies involve live poultry, which can expose people to diseases including the potentially deadly H5N1 strain of the HPAI virus (51). A review of peer reviewed literature revealed that keeping flocks indoors without knowing the basic principles of biosecurity could actually expose humans to flocks, resulting in a higher risk of HPAI/H5N1 infection. There is no veterinary check and follow-up with respect to the wild bird trade transit and there is an absence of appropriate holding facilities for keeping wild birds in transit in airports in Ethiopia (46).

A study done on the characterization of Newcastle virus and disease in Ethiopia revealed that birds from different origins are placed in the same cages (mixed) and sold either to traders in other live poultry markets in the city or to the consumers on spot. All the traders responded that they dispose of manure and dead birds either within the markets or on the roadside. None of them seek veterinary services when chickens are sick (50).

In Ethiopia, poultry are kept by about 60% of households. Average households own a flock comprised of 6-10 birds(3). Based on the scale of poultry farming, poultry keepers can generally be categorized in to village or backyard pouters, small-scale pouters, and commercial pouters. The section indicates that the community has little/no awareness on HPAI in Ethiopia.

Risky behaviors/High Risk Groups for Avian Flu

Unsafe movement of staff, sales of live poultry, equipment exchange for slaughtering and visitors are important risk factors in the transmission of viruses(39). Backyard (family/household) production methods imply low biosecurity measures and high risk of infectious diseases, such as Newcastle disease or Highly Pathogenic Avian influenza. Studies confirmed the potential risk of small backyard flocks roaming in or near waterlands and thus being exposed to Avian Influenza. The presence of ponds or canals was identified as increasing the risk of HPAI outbreaks in the village and the risk of spread to neighboring villages (52).

Village or backyard pouters: This is mainly a family level farm and family members, especially housewives and children, are responsible for handling the chicken. 98 to 99% of the poultry population consists of local breed types. Typically, flocks are small with an average of 7-10 mature birds in each household, consisting of 2 to 4 adult hens, a male bird, and a number of growers of various ages. Minimal levels of biosecurity and birds without appropriate housing put family poultry farms at greater risk of being exposed to diseases (39).

Small-scale production pouters: These are owned by small-scale enterprises, where adult females and males are involved in keeping the chicken, with a low level of training on handling the chicken. 500 to 10,000 birds are kept indoors and/or outdoors with a low level of biosecurity.

Commercial poultry production pouters: These are large scale farms where there are trained staff responsible for an average of 10000 birds kept indoors with a medium to high biosecurity level (53).

Another audience group closely related to poultry are chicken traders. These include mainly adult men who collect chickens from individual sellers in small market and sell in larger markets. This group, as mentioned above, generally has low awareness on how to keep their chickens and practice poor levels of bio-security.

About 95% of poultry in Ethiopia are overwhelmingly domestic fowl, kept in villages, mainly under scavenging systems, and only 5% are in industrial systems.

Most of the dressed carcasses from the small-scale sector are prepared and packaged without the recommended veterinary/healthcare inspection, which further raises issues for delivery of unsafe foods into the food chain. Sanitary facilities and measures available to these larger importers have not always been (and remain) largely inadequate, and biosecurity measures have sometimes been less than satisfactory(41).

A study done on poultry for virus identity from live market sites of Merkato and Kotebe were found to be identical to viruses from Saris, Shola, and Meri, which revealed that, identical isolates are circulating in live bird markets in Addis Ababa. This could be associated with the poor biosecurity practices and the use of similar marketing channels in these market sites(50).

Table4 Audiences Analysis (Target)

• Poultry keepers (household, large and small scale), • Household poultry keepers (mostly women & children), • Chicken traders, • People who share house with poultry, • Live around waterfowl with very high density of birds, market sites,	High contact with poultry, chickens & their products

Prioritization of messages on Avian Flu

In Ethiopia, poultry are kept by about 60% of households and an average household owns a flock comprised of 6-10 birds (34). The household-level messages should highlight the signs and symptoms of HPAI, management of infected cases, precautionary measures, and the importance of vaccination and seeking veterinary support. In addition communication messages for chicken traders need to focus on raising their risk perception towards Avian Flu through the process of keeping at houses, transportation and market place. Increase awareness of small and large-scale poultry keepers about standard biosecurity measures.

III Brucellosis

Epidemiology of Brucellosis

Brucellosis is an infectious bacterial zoonotic disease caused by member of genus *Brucella*. *Brucella abortus*, *Brucella melitensis*, and *Brucella suis* infect cattle, small ruminants, and swine, respectively, making these species of particular importance in human and livestock infections worldwide. Other species of concern include *Brucella canis*, infecting dogs, and *Brucella ovis*, infecting sheep (54, 55). Brucellosis is among the most widely distributed zoonosis of economic importance in developing countries. Most of the zoonotic diseases including brucellosis are poorly controlled, and endanger economically disadvantaged communities(43).

In animals, brucellosis is highly contagious and cross species transmission of certain Brucella species can occur (42). Mucosal contact with aborted fetuses and fetal membranes, which contain large amounts of the bacteria, is an important means of transmission in livestock (56). Infected livestock exhibit clinical signs of great economic significance to stakeholders (i.e., small scale livestock farmers, the meat and milk industry, human communities, etc.), including reduced fertility, spontaneous abortion, and a substantial decline in milk production over an animal's lifespan (42).

Brucellosis is a bacterial disease transmitted to humans by consumption of infected, unpasteurized animal milk or through direct contact with infected animals, particularly aborted fetuses. The livestock production losses resulting from these abortions have a major economic impact on individuals and communities. Infected people often suffer from a chronic, debilitating illness. Human brucellosis represents one of the most widespread zoonotic diseases in the world, and is caused by the bacteria of the genus *Brucella.* Among the ten species recently recognized in the genus Brucella, *B. melitensis*, *B. abortus*, *B. suis* biovars 1, 3, and 4 and *B. canis* are pathogenic for humans, and the rest of the species are either not pathogenic or their pathogenicity should be determined additionally(3).

The human disease usually manifests itself as an acute febrile illness, which may persist and progress to a chronically incapacitating disease with severe complications. It is nearly always acquired directly or indirectly from animal sources, of which cattle, sheep, goats and pigs are by far the most important. In these natural hosts, the infection usually establishes itself in the reproductive tract, often resulting in abortion. Excretion in genital discharges and milk is common and is a major source of human infection(3).

Expansion of animal industries and urbanization, and the lack of hygienic measures in animal husbandry and in food handling partly account for brucellosis remaining a public health hazard. Expansion of international travel which stimulates the taste for exotic dairy goods such as fresh

cheeses which may be contaminated, and the importation of such foods into Brucella-free regions, also contribute to the ever-increasing concern over human brucellosis (3). In humans, sexual transmission has rarely been reported. In one case, 2 couples in which food-borne Brucella infection in the husband was followed several weeks later by brucellosis in the wife and in which the sexual route was the only possible mode of transmission (43). Brucella is also a potential agent for bioterrorism because of its propensity for airborne transmission and induction of a chronic debilitating disease that requires combined and lengthy antibiotic therapies (44).

In humans, brucellosis typically manifests as a range of non-specific clinical signs including malaise, fatigue, arthritis, and fever. Chronicity and recurring febrile conditions with joint pain are common sequelae (57). The symptoms of brucellosis are often vague and similar to the flu. They may include: fever (the most common symptom, with high "spikes" that usually occur in the afternoon), back pain, body-wide aches and pains, poor appetite and weight loss, headache, night sweats, weakness, abdominal pain, cough. Those symptoms may be confused with malaria, especially in sub-Saharan Africa. This may result in the misuse of drugs and lead to the development of complicated brucellosis (44).

In Ethiopia, brucellosis in animals and humans has been reported from different localities of the country, particularly associated with cattle in different agro-ecology and production systems (27). These prevalence studies in animals and humans were largely confined to serological surveys and commonly targeted bovine brucellosis, occasionally sheep and goats, and rarely camels. So far, attempts to identify Brucella species in the country were unsuccessful; the distribution and proportion of their natural hosts was also not studied exhaustively (44). This is largely attributed to the degree of laboratory development and lack of consumables for laboratory tests (54).

Magnitude of Brucellosis in Ethiopia

Table4 indicates that the highest prevalence of animal brucellosis was found in Oromia, followed by SNNP. Cattle, camel, goats, sheep and pig were the animals infected with the disease as per their order of importance.

Table4: Brucellosis sero-prevalence report on animal in different locations in Ethiopia, 2008-2016.

S/n	Region	Zone	Woreda	Type of animal	Prevalence %		Source
					Individual	Herd	
1	Oromia		Wuchale-Jida	Cattle	11		(T. KEBEDE, 2008)
2	Oromia		Arsi-Negele	Cattle	2.6	12	(K. Amenu, 2010)
3	Tigray	S. East	Mehoni	Camel	3.4		(Habtamu T. , 2015)
4	Somali		Babile	Camel	2.4		(Berhanu Tilahun, 2013)

S/n	Region	Zone	Woreda	Type of animal	Prevalence %		Source
					Individual	Herd	
5	Oromia		Borana	Cattle	4.7	68.5	(Bekele Megersa, 2011)
	Somali		Jijiga		3.0	50	
	Somali		Shinle		6.6	40	
	SNNPR	S. Omo	S.omo		3.4	33.3	
	SNNPR	Gedeo	Gedeo		0.5	5.9	
	SNNPR	Hadiya	Hadiya		3.5	30	
	SNNPR	Sidama	Sidama		1.8	13.5	
6	Oromia		Borana	Cattle	8		(B. MEGERSA, 2011)
				Camel	1.8		
				Goats	1.6		
7	Afar			Camel	4.1		(Angesom Hadush, 2013)
8	Oromia		Debre ziet & Modjo expo	Goat & Sheep	1.76		(Amanuel Tsegay Getachew Tuli, 2015)
9	Oromia		Adami Tulu		4.3		(Gebawo Tibesso, 2014)
10	Oromia & SNNP		E.harage &Alaba		2.4	45.9	(Hagos Asgedom, 2016)
11	Oromia	Jimma		Cattle	3.1	15	(Bekana, 2010)
12	Oromia & Somali		Liben and Filtu	Cattle	1.4		(Balako Gumi, 2013)
				Camel	0.9		
				Goats	9.6		
13	Central Ethiopia			Pigs	4.5		(Mulisa Megersa Kebeta, 2015)
14	Amhara	S. Wollo	Kalu & Harbu	Sheep	1.5		(Mohammed Yesuf, 2010)
15	SNNP	S. Omo		Goats	4.21		(Tigist Ashagrie, 2011)
16	DireDawa	Diredawa	DireDawa	Goats &Sheep	9.11		(Efa Negash, 2012)
17	Amhara	Bahirdar	Bahirdar	Goats &Sheep	0.4		(Yeshwas Ferede1, 2011)
18	SNNPR	Sidam	six Woredas	Cattle	1.66	13.7	(Kassahun Asmare, 2010)

Knowledge, Attitude and Practice on Brucellosis

There is a shortage of published data on the status of human brucellosis in Ethiopia. Among the few reports available, one study conducted to determine the sero-prevalence of camel brucellosis in Mehoni Woreda, Southeastern Tigray, Ethiopia and identified potential risk factors associated with animal and human infection. The study revealed that from the owners interviewed, about 91% drank fresh raw milk regularly, and 11% of them owned sero-positive camels and the risk of Brucella infection was found to be high - 88% in owners with close contact to their animals. The same study indicates that among 120 camel owners most of the respondents (88.33%) did not have knowledge about camel brucellosis and zoonotic diseases. 79.2% of the respondents reported touching the afterbirth with bare hands. Those with close contact with animals (handling

aborted foetus, delivery assistance and contact to vaginal discharges of infected camels) were eight times more likely at risk to be infected by Brucella as compared to those who do not have (OR = 8.07, CI 95%; 0.476, 137.014)(58). The logistic regression analysis showed that 86% of the respondents previously having malaria like symptoms were found to be significantly associated with owning a seropositive animal.

Similarly, a study in Arsi Negele in Oromia region indicates that among 98 livestock keepers surveyed, a relatively high proportion of the respondents acquired the knowledge about zoonotic diseases from elders (34.7%) and from their personal observation (32.7%). A large proportion of respondents (96.3%) indicated meat as a vehicle for disease transmission to humans. Only a few people responded that zoonotic pathogens could be acquired through direct contact and inhalation. About one- third of the respondents cook meat and boil milk to minimize disease transmission. About three-quarters of the interviewed household members in the study population reported practicing at least one activity considered at risk for transmission of zoonotic diseases. These activities were mainly related to handling animals and their products (milking, slaughtering, skinning and chopping meat) and consumption of raw animal products (59). Lack of awareness about zoonotic diseases, together with existing habits of consumption of raw animal product, backyard slaughtering, and close contact with animals can serve as means of Brucella infection to human beings (58, 59).

Another cross-sectional study carried out to investigate the prevalence and risk factors of bovine (cattle) and human brucellosis in and around Adami Tulu, Ethiopia, revealed that 2.2% human sera were found to be positive (60). A study conducted for seroprevalence of human brucellosis among 254 blood donors in Gamogofa Zone, Southern Ethiopia revealed 10.6% through complementary fixation test (CFT) (61). A study was conducted in the towns of Debre Ziet and Modjo to determine the seroprevalence of human brucellosis and assess the potential risk factors of brucellosis among 149 abattoir workers indicate human sera samples (from five export abattoirs) screened with Rose Bengal Plate Test (RBPT), 4.70% were found positive. Samples screened positive for RBP were further confirmed with CFT where 2 (1.34%) were confirmed positive. Relatively high Brucella seropositivity was observed in female respondents and within the age group of 21–30 years old in comparison to male respondents and other age groups (62). The other risk factors are: Camel keeping and rearing practices (50,84), traditional livestock husbandry practices (63), intensive cattle production systems (64), animal slaughter, the handling and preparing of food of animal origin, the consumption of such food when raw or undercooked (65), and traditional food processing practices (61). Poor awareness of the zoonotic importance of brucellosis and the practices of consuming raw milk and meat and handling potentially infectious materials using bare hands (small ruminant owners)(66, 67) are also risk factors.

In some areas, the animals are kept in the yards of houses and may even be brought inside, especially in severe weather. In the case of recently aborted animals, this has resulted in infection of entire households. The use of dried dung as fuel may also import infection into households. It should be noted that brucellosis often presents as clusters of cases in a family or tribal group, usually relating to a common infected food source, and often follows an outbreak in animals. The habit of children playing with sick animals as pets can put children at particular at risk for infection(57). Age, parity, abortion, and herd size and composition across different agro-ecologies and production systems are also risk factors. Adult age, larger flock size, presence of other livestock (cattle, sheep or camel) in the flock and agro-pastoral and pastoral production systems were found to predispose goats to a higher risk of acquiring Brucella infection (68). Over the age of two years animals have a higher seroprevalence compared to younger animals. History of abortion and retained fetal membrane and cross-breeding were found to be significantly associated with occurrence of bovine brucellosis (69).

Risky behaviors/High Risk Groups for Brucellosis

The animals most exposed to Brucellosis infection are: cattle, camels, goats, sheep, and humans (certain occupations are associated with a high risk of infection). These include people who work with farm animals, especially cattle, sheep, goats and pigs. Farmers, farm laborers, animal attendants, stockmen, shepherds, sheep shearers, goatherds, pig keepers, veterinarians, and inseminators are at risk through direct contact with infected animals or through exposure to a heavily contaminated environment. Children can be particularly at risk as they may adopt newborn or sick animals as pets (57).

Persons involved in the processing of animal products may be at high risk of exposure to brucellosis. These include slaughter men, butchers, meat packers, collectors of fetal calf serum, processors of hides, skins, and wool, renderers, and dairy workers. Direct and environmental contamination may present hazards through inhalation, ingestion, mucousal contamination, and skin contact or penetration. Staff employed in the maintenance of farm premises, factories, or plants used for processing animal products are often overlooked as occupationally exposed groups but may be at considerable risk from environmental contamination (57).

Laboratory staffs involved in culturing *Brucella* are at particular risk. In some countries in which brucellosis is no longer endemic, this potential hazard may be overlooked or considered to be no longer relevant. Nevertheless, the performance of diagnostic procedures on patients with unsuspected imported disease may lead to the culture of organisms which are not correctly identified until laboratory-acquired infection raises the level of suspicion (57).

Table5 Audiences Analysis (Target for Brucellosis)

Farmers, farm laborers, animal attendants, stockmen, shepherds, sheep shearers, goatherds, pig keepers, veterinarians, and inseminators; slaughter men, butchers, meat packers, collectors of fetal calf serum, processors of hides, skins, and wool, renderers, and dairy workers. Laboratory staff involved in culturing *Brucella* are at particular risk.	High contact with infected animals or animal products

Prioritization of messages on Brucellosis

The main source of brucellosis infection was livestock animals; a well-designed message should be prepared for use in the process for animal control and disease prevention from brucellosis infection. This may include the vaccination of the herd, segregation of the sick animals, composition of the herd, and isolation of the animal from the household.

For human health, messages should focus on lowering risk of contracting brucellosis from natural sources. The message should highlight precautionary behaviors around food consumption and utilization. Messages should tell populations to avoid eating or drinking unpasteurized milk, cheese, or ice cream (including queso - fresco), check food labels to make sure it says "pasteurized" (and avoid consumption if unsure), do not handle sick or dead animal bodies, (but if you must, then use gloves plus face and eye protection), cook meat thoroughly, wash hands regularly, avoid touching your eyes, nose, and mouth, and disinfect areas where animals are living.

IV Cross-cutting Issues

Collaboration and Coordination

Nineteen stakeholders (see Annex 1) were mapped including governmental and non-governmental organizations and associations, a private business involved in the poultry farm, FAO, MOH, MoA&L, and regional agriculture and health bureau in Amhara and Oromia. Of the 19 stakeholders, nine have national coverage, five have regional coverage, and the remaining four have zonal and woreda level geographic coverage. With the exception of the poultry association and private farms, almost all the stakeholders focus on different zoonotic diseases; mainly rabies, anthrax, brucellosis and avian flu. Rabies is the most mentioned zoonotic disease that stakeholders are working on. Only three of the stakeholders (EPHI, FAO, and Ministry of Livestock and Fisheries) work on zoonotic disease-related behavioral change communication. These organizations produced communication materials such as brochures and leaflets on early warning signs of Highly Pathogenic Avian Influenza (HPAI), brochures and radio spots on the sign and symptoms of rabies. In almost all cases stakeholders tend to focus efforts on dealing with emergencies rather than sustained prevention and control of zoonosis.

Stakeholders working at the multinational and national levels are involved actively in GHSA One health steering committee, which MoA&L, FAO, WHO, NADIC, EPHI are members. FAO, in particular, has a strong collaboration with national and regional laboratories (animal health) and has established a close relationship with government structures (MoA&L, EWCA, & EPH), public universities, veterinary associations, and the private sector (producers, processers, and exporter associations of different animal products).

Opportunities and challenges were also assessed with respect to prevention and control of zoonotic diseases in Ethiopia. According to key informants, the opportunities include: establishment of a flexible support system in government offices, existence of a functional one health steering committee, strong government partners, private sector interest in the area of zoonotic disease prevention, control and elimination, a multi-hazard warning and response system within EPHI. Since, the growing market demand for Ethiopian livestock from middle east Asia and Northern African countries is attracting investors to the sector, other potential actions include publishing a weekly bulletin produced by Public Health Emergency Management (PHEM) at zonal level on cholera and others, developing a structure to improve animal health up to the kebele level, the presence of universities which can support the investigation of public health threats of zoonotic diseases, and involving active professional and business owners in improving standards of veterinary services and structures. Similarly key informants mentioned the following as common challenges in the prevention of zoonotic diseases include:

- Limited organizational capacity to address risk communication needs
- Limited data generation and tracking of specific zoonotic diseases (Brucellosis, Avian Flu)
- Available data are not timely and/or geographically complete
- Weak diagnostic capacity in diagnosing Brucellosis (both in terms of professional knowledge and equipment)
- Shortage of reagents particularly at regional and woreda level vet clinics
- Shortage of vaccines (anthrax)
- Weak early warning and rumor tracing system
- Lack of coordination between government sectors involved in animal and public health,
- Lack of coordination between the government and the private sector in sharing information and alignment of responses from the federal to kebele level
- Limited attention given to the quality of animal feed from the producers and no relevant communication materials for customers
- There is a shortage of communication materials on zoonotic diseases and the ones produced are not properly sent to local woredas and communities (the real audience) and there is no follow up mechanism of distributed communication materials,
- Use of limited communication channels (only poster and brochures)

- Shortage of staff trained on zoonotic disease prevention and control at health facilities

In addition, the assessment team visited Dire Inchini Woreda (Anthrax outbreak site), West Shewa zone of Oromia region from June 19-23, 2018. The aim of the visit was to see how practically the different sectors responded to the outbreak and if there is collaboration in the process. The team observed that, at zonal level, the two departments (Health and Agriculture) do not respond to outbreaks in coordinated fashion. The Agriculture sector responded early following the death of animals. They sent experts from Jimma University to provide vaccinations to cattle in the catchment area and study the outbreak. The health sector responded to the outbreak after diagnosing the first Anthrax human case in nearby primary health care unit (Dir Inchini). The Zonal Agriculture sector didn't share information to the health sector about the animal Anthrax outbreak until the helath sector diagnosed the first human case. The lack of coordination between Agriculture and health offices in responding to the outbreak goes down to the woreda sector offices; health facilities and veterinary clinics; kebele level health extension workers and Agricultural development agents.

- The outbreak happened in one kebele, nine people treated for Anthrax, 17 animals killed (10 cow and 7 donkeys).
- The disease was not confirmed by laboratory, only diagnosis by history, sign and symptoms.
- Dire Inchini woreda has a known history for anthrax cases and Jimma University used to do research in the locality.
- More than 200 animals vaccinated after the attack.
- The management of the carcasses was done by both burning and burring. Even if the recommendation is burning.
- After the two sectors were aware of the outbreak, they provided instructions to the agriculture and health extension workers to do awareness raising activities to the community in the specific area.

The result in this section clearly indicates that there is weak collaboration and coordination between the animal and agricultural sector in prevention and control of zoonosis. Weak early rumor tracing system, among the different actors; organization's capacity gaps in design and implementation of SBCC interventions should be priority areas for the risk communication activity.

Communication channels

Many communication materials/channels for zoonotic prevention do not exist. However, according to study conducted in Addis Ababa and surrounding areas among graduates, non-health professionals, health professionals, and students, mass media is a key source of information reported by 30.73%, 52.08, 10.42% and 12.5%, respectively. 85.42% students get information

on zoonotic diseases from their family in the form of advice, whereas there is a lack of updated information for health professionals once graduated, 68% of health professionals are working on the possibly outdated information they acquired from schools/college they attended (70). As indicated by the study at Arsi Negele among livestock keepers, a relatively high proportion of the respondents acquired the knowledge about zoonotic diseases from elders (34.7%) and from their personal observation (32.7%). Considering heterogeneity of the target populations in line with the different zoonotic diseases, a mix of communication channels (print, interpersonal and mass media) were proposed to reach key messages for target population.

Gender Norms

Most rural households have poultry cared for by women, children, and vulnerable people (the aged and physically challenged)(13). In countries where village poultry production predominates, women, especially those from female-headed households, frequently derive a significant percentage of their income from poultry production. Women, who are frequently the primary owners and managers of village chickens, were considered most adversely affected by HPAI outbreaks and associated control programs (8).

Throughout the African continent, women and children are often responsible for rearing family poultry. Most poultry in Ethiopia is managed by women in smallholder farms, and is often a rural woman's dominant source of income(19). Female pastoralists were also more likely to practice significant biosecurity measures (handwashing) against HPAI H5N1 than the males (OR: 1.99; 95% CI: 1.28–3.09)(41). On the other hand, studies indicate men have more occupational risk to Anthrax than women.

Conclusions and Recommendations

Cultural practices such as living with livestock in the same house, consumption of raw meat, and raw milk, drinking animal blood, and high contact with animals and animal carcasses, backyard slaughtering contributes to spread of zoonosis. Low awareness of the community on zoonotic disease and their transmission mechanisms, inadequate behavior change intervention (little or no communication materials on the subject); shortage of vaccines and laboratory reagents, inadequate case diagnostic knowledge and experience of health workers, and weak preparedness and early warning plans also contribute to the increasing risk of zoonosis. The assessment also identified weak coordination and information sharing system among the various actors working in zoonotic diseases prevention and control.

Based on the findings the following recommendations were proposed with special emphasis to priority geographic area and high-risk targets:

Structural intervention

- There is weak coordination between the government animal and public health sectors. The project shall support the establishment and strengthening of collaboration mechanism between veterinarians, public health authorities, and other community leaders to control the disease in animals and to manage the risk of human exposure.
- Early warning and rumor tracing system for zoonotic diseases was found weak in Ethiopia. The project shall assist putting in place rumor tracking system and strengthen information sharing and alignment of responses among the various stakeholders from the federal to kebele level
- The stakeholder mapping indicated there is no or little in-service training for health professionals on zoonotic disease prevention and control at health facilities. The project shall prepare training on risk communication and provide for partners.
- The quality of animal feed play significant role in transmission of toxins and other diseases to human beings through the food chain, and there is limited attention given to the quality of animal feed from the producers and no relevant communication materials for customers. The project shall work with animal feed sector (private association) and support the design strategy on how to support (training, message and material production) the sector and the community.
- There is a shortage of messages and communication materials on zoonotic diseases at different level. The project in collaboration with different sectors shall support the design, production and distribution of tailored SBCC materials on zoonotic diseases and intervene the priority target groups with appropriate approach and channels
- Advocate the importance of vaccination of animals in reducing the risks of abortion and raising herd immunity to the community
- Advocate with partners on the benefits of improving animal husbandry working conditions and infrastructural upgrades (including separation of animal living from humans) and reduce infection transmission among the animal and human. Assist individual, small and large scale animal husbandry to adapt standard biosecurity measures
- Mainstream gender issue in animal husbandry industry and promote adequate intervention as behavior towards biosecurity varies in men and women at household level and as women are more responsible to care poultry in the household.

Behavior change communication

General to all zoonotic diseases

- Design public awareness increase strategies (such as mass campaigns at market place, schools and community discussion forms) in communities to improve knowledge and

decrease the risk of exposure as well as to control the spread of infection from animal to human and infection transmission within the animal population.

- Promote the need to include the issue of zoonotic diseases, prevention and control in routine health education to farmers, butchers, tanners and other industrial workers on industrial hygiene
- Design and develop messages and communication materials on appropriate disposal of dead animals and their carcasses such as burying or burning to prevent further infection transmission and environmental contamination.
- Develop messages and materials on early/timely care seeking and treatment for exposed, infected and sick animals and individuals
- Develop messages and materials to promote regular disinfection and vaccination of animals

Anthrax

- Design and develop messages and communication materials on the sign and symptoms of Anthrax disease in animal and human so that the community seek care early and at take preventive measures such as (Avoid contact with infected animals, proper handwashing (with soap and clean water) whenever come in contact
- Develop and distribute messages on the health and economic loss attribute to Anthrax on human and animal population
- Develop messages and communication material on the special precaution that must be taken such as disposal of dead animal body including the skin, contaminated utensils, and cleaning of environment contaminated with bool due to Anthrax

Avian Flu

- Risk communication project develop messages and communication materials on HPAI and other avian influenza viruses to improve knowledge of the community on sources of contamination (i.e. transport, bio-security measures, and hygienic practice after contact with droppings, handling poultry meat and handling sick birds etc)
- Provide technical support (sensitization workshops, such as capacity building training, SBC messages and materials production and distribution) to Improve community and relevant sectors knowledge on transmission and application of preventive measures such as:
  - Keeping a good record of flock history and separate poultry by age and species or Consider raising one species instead of several, given that mixing species increases HPAIA/H5N1 virus transmission.
  - Educate the benefit of cleaning, disinfecting, and restricting people movement within the husbandry practice the poultry farm surroundings, which proves particularly effective in interrupting potential HPAI A/H5N1.

- Education communities and employees at poultry industry on the benefits of proper Hand washing and wearing gloves when handling poultry.

Brucellosis

- Design and develop messages and communication materials on the sign and symptoms of Brucellosis disease (such as blood through reproductive organ and blood socked tail of cows) in animal and human so that the community seeks care early and at take preventive measures such as (safe way of cleaning infectious blood from tail, proper handwashing whenever come in contact).
- Develop and distribute messages on the health, productivity and other economic risks and losses brought due to Brucellosis on human and animal population
- Develop messages and communication material on the special precaution that must be taken in disposal of dead animal and product of abortion due to Brucellosis
- Promote the need to check food labels for expire date and related information for packed foods
- Design and develop training guides, educational materials, and messages to improve awareness of farmers, extension services, and smallholders in the dairy industry on milking hygiene practices and post-harvest handling of milk to minimize losses due to rejection of spoiled milk reduce the risk of human infection due to consumption raw milk, meat and other animal products.

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Annex I: Summary findings of stakeholder mapping

Ser. No	Name of organization	Intervention (focus , geographic, and accomplishments)	Collaboration and co-ordination (partners, possible collaboration areas)	Opportunities
1	Ethiopian Public Health Association (Different Departments)	**FOCUS:** Brucellosis and other zoonotic diseases investigation and informing prevention and control programs **COVERAGE:** National **ACCOMPLISHMENTS**: • Brucellosis special attention to pastoralist communities • Sero surveillance study in collaboration with CDC and OSU preliminary finding drafted	• Partner with MoA&L; FAO; WHO; NADIC; • Participate in GHSA one health forum Member of disease specific task forces	• Flexible supportive system • Existence of functional one health steering committee • Strong partners interest support in the area of zoonotic disease prevention, control and elimination
		FOCUS: Emergency early warning and response coordination for all health emergency situations **COVERAGE**: National **ACCOMPLISHMENTS**: • In collaboration with WHO coordinated TOT on risk communication • Orientation and training on Anthrax and other emergency situations risk communication • System strengthening to strengthen early alarm/warning and response with in the MoH	• Establish TWGs and member of all disease specific task forces • Internal collaboration with in the Institution (Different section with in EPHI) • Participate in GHSA one health platform GHSA One GHSA One health Steering committee	• Establishment of multi-hazard warning and response system within EPHI • Flexible supportive system • Strong partners interest to support the health system in emergency situation response
		FOCUS: Anthrax & Avian flu • Human Anthrax cases follow up, supervision, outbreak investigating and response (early warning and response) • Avian flu identification of risks based on alert system, influenza sentinel survey **COVERAGE:** National **ACCOMPLISHMENTS**: • Anthrax Routine surveillance, lab capacity assessment, lab training and strategy document development • Avian flu risk assessment in corridor areas, routine surveillance, HPAI preparedness plan is under development	• By actively Participating in one health initiatives Involving in different technical working groups	• Existence of One health steering committee • Existing surveillance systems Establishment of well-organized and equipped Laboratories at regional level

Ser. No	Name of organization	Intervention (focus , geographic, and accomplishments)	Collaboration and co-ordination (partners, possible collaboration areas)	Opportunities
2	FAO	**FOCUS:** • Key project GHSA One Health Network to address prioritized zoonotic diseases (Rabies, Anthrax, Brucellosis, Leptospirosis, Echnococus.) and provide technical and financial support to prevention of other related diseases such as HPAI, salmonella • Support government and other partners in the area of food and agriculture including animal health • Laboratory capacity building training and other related support • Provide support for Anthrax, Rabies, Brucellosis, HPAI and other zoonotic diseases **COVERAGE:** Generally National, but specific focus area for Anthrax as specified in the strategy document , HPAI private poultry farms and wait land arears around rift valley area, **ACCOMPLISHMENTS:** • Capacity building training on improving zoonotic disease diagnosis for EPHI and regional laboratory experts • Assisted development of Anthrax prevention, control and elimination strategy document • Key player in GHSA One health initiative • Actively supported Rabies prevention, control and eradication strategy development and mass vaccination • Strong surveillance (animal diseases notification) system including mobile-up • Laboratory data management (collection and notification) system strengthened	• Actively participate in GHSA One health steering committee • Strongly collaborate with regional laboratories (animal health) • Establish close relation with Gov't (MoA&L, EWCA, EPHI…), private sector (producers, process associations, etc)	• Existence of functional one health steering committee

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3	Animal feed Association	**FOCUS:** Promote the production and use of good quality feed for animal to impact on the health of animal and food safely **COVERAGE**: National **TARGET GROUP**: - Animal feed produce industry owners and sellers **ACCOMPLISHMENTS**: Conducted various capacity building trainings for animal feed producers	• Participate in GHSA one health forum • Provide capacity building training for members • Annual progress review	• Partners(GO/NGO) interest to collaborate in the area • Growing animal feed industries
4	Ethiopian Livestock Association	**FOCUS**: Support members to link is potential reliable market **COVERAGE**: National coverage **ACCOMPLISHMENTS**: • Conducted training for animal feed producers • Produced Ethiopian livestock promotion and members address booklet	• Participate in GHSA one health forum • Market search and communication with external livestock importers	• Partners interest to collaborate in the area • Growing market demand for Ethiopian livestock from middle east Asia and Northern African countries
5	Ethiopian Poultry producers and processors Association	**FOCUS:** Capacity building to members and Policy issue identification and lobby **COVERAGE**: National coverage A**CCOMPLISHMENTS**: Organize foreign experience exchange opportunity for members Implementing INTAG project in collaboration with Netherlands Embassy	• Participate in GHSA one health forum • Organize trainings and experience sharing workshops • Establish partnership with Embassies and other development partners	• Existence highly committed board members • Government support for the industry • Growing poultry market

Ser. No	Name of organization	Intervention (focus , geographic, and accomplishments)	Collaboration and coordination (partners, possible collaboration areas)	Opportunities
6	Ethiopian Veterinarians association	**FOCUS**: • Animal health • Public health • Food safety (Inspection and certification) • Animal welfare (less worked on but recently due to export requirement getting attention) **COVERAGE**: National **TARGET GROUP**: Regional Agriculture Beauro and lower offices, private and government abattoirs, meat and milk producers, processers and distributers, universities, different associations working in animal production and processing A**CCOMPLISHMENTS:** • Involved in one health steering committee and working on development of strategies for Anthrax, etc • Working for revision of curriculum to address market demand (commercial farms) • Support in development of ethical guidelines • Lobbying to improve the benefits of veterinarians (considering the contribution and the number of years they spent studying)	• MoA&L, FAO, Associations, Universities	• Existence of One health steering committee Partners like FAO

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7	MoA &L (Veterinary public health Directorate)	**FOCUS**: • Zoonotic diseases (working on strategic document) • Food safety (abattoirs, poultry and dairy products processors) **COVERAGE**: National **TARGET:** The whole country/ All the people **ACCOMPLISHMENTS**: • Involved in one health steering committee and working on development of strategies for Anthrax, etc • Conducted national studies on Brucella • Assessments on Vet Clinics, abattoirs to butchers , milk and egg producers	• Participation in material/ communication/ production • Participation in technical and Financial support to initiatives • Participation in Assessments and trainings • Working with different Partners (CDC, FAO, Ohio University, USAID (preparedness and response project), Environment Ministry, National Animal Health Diagnosis lab, and National Veterinary institute)	• One health steering committee • Partners like FAO and others Responsible directorate (policy and political support)
8	Ministry of Environment Forestry Conservation (MEFCC)	**FOCUS:** • Bio-safety **Coverage**: National **TARGET**: General population **ACCOMPLISHMENTS**: • National bio-safety advisory committee established with membership from MEFCC, EPHI, MoA&L, Animal feed etc • Risk assessment conducted on the impact of bio-safety on the environment and human health	• Working with and through Biosafety advisory group • Participate in one health initiative TWG • Involve partners during assessment • Involved Bio-safety advisory group (TWG)	• Gov't commitment for environment protection and encouragement for multi-disciplinary approach • Partners support

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9	Amhara region PHEM office	**FOCUS**: Track and investigate public health threats (infectious and non-infectious disease causing pathogenic), and coordinate response when emergencies happen. **COVERAGE**: Regional **TARGET**: All the region population with special focus to endemic disease sites **ACCOMPLISHMENTS**: • Conducted regular surveillance and project specific investigation • Coordinated mass vaccination on rabies • Established PHEM teams at zonal level	• Collaborate with universities (Gonder and Bahir Dar), other government and non-government partner in the prevention and control of emergency situations	• The presence of universities which can support the investigation of public health threats • Establishment of PHEM teams at regional and zonal levels.
10	Amhara Livestock Agency	**FOCUS:** • Animal health and welfare • Surveillance and investigation of public health diseases • Coordinate and lead public health emergency issues • Lab investigation of animal diseases (Rabies, Anthrax, etc) **COVERAGE**: Regional **TARGET**: - Animal population • **ACCOMPLISHMENTS**: ▯ Development of guide for animal health professionals (Veterinarian guide) ▯ Season based vaccination for anthrax ▯ Development of Anthrax strategy (draft level)	• Partners : Agricultural Growth program(AGP), FAO, Organization for Rehabilitation and Development in Amhara (ORDA), Environmental protection, Feed z future	• Existence of animal health structure up to kebele level • Development of Anthrax strategy (draft level)

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11	Oromia Animal Health Agency	1. Public health Department **FOCUS**: Prevent and control animal health problems and contribute for economic growth and protect the health and safety of the public from health hazards and infection. **COVERAGE**: Regional **TARGET**: All Communities' raring cattle **ACCOMPLISHMENTS**: • Developed zoonotic disease prevention and control manual that help frontline workers • Conduct periodic season based mass vaccination to endemic areas of the region 2. Regulatory Department **FOCUS**: • Regulatory of abattoirs, diary and poultry institutions • Prevention of zoonotic diseases, give emphasis to areas with known history of the diseases (Disease map) • Surveillance	• Collaborate with FAO and other non-governmental partners and local administration	• Growing interest of government and non-government partners to work together • Enforcing vaccination throuth model farmers
12	Oromia Health Bureau	**FOCUS**: protect the safety of the public from health hazards and infection sources including infection from diseases of animal origin **COVERAGE**: Regional **TARGET:** targets for prevention of zoonotic diseases are all the public with due focus on geographic populations where zoonotic diseases (such as Anthrax and Rabies) are endemic **ACCOMPLISHMENTS**: • Established PHEM at regional and zonal level • Conducted surveillance across the region • Coordinate capacity development intervention to strengthen the team.	• Collaborate with partner non-governmental organizations during control of emergencies	• Establishment of PHEM teams at regional and zonal levels