

# Zoonotic Disease Prioritization for Inter-sectoral Engagement in Ethiopia

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## BACKGROUND

Zoonotic diseases are diseases that are spread between animals and people. Most known human infectious diseases and about three-quarters of newly emerging infections come from animals. Ethiopia is particularly vulnerable to the effect of zoonotic diseases because the economy is largely dependent on agriculture. It has the largest animal population in Africa and a vast majority of households have direct contact with domestic animals, creating an opportunity for infection and spread of disease. Ethiopia ranks very high in the health burden of zoonotic diseases and in having a large population of low income livestock farmers.<sup>1</sup>

Zoonotic diseases that occur in Ethiopia in large numbers impact the society in three main ways:

1. Threaten the health of animals resulting in illness, loss of productivity, and death.
2. Threaten the livelihood of a large segment of the population dependent on livestock as a major source of food and income.
3. Cause a large number of illness and death in people, which is associated with significant economic and societal loss.



**Figure 1.** Domestic animals are kept in close proximity to houses, a typical arrangement for a large segment of Ethiopian subsistence farmers.

<sup>1</sup> Mapping of Poverty and Likely Zoonoses Hotspots, Zoonoses Project 4, Report to Department for International Development, UK. International research Institute, July 2012.

The Growth and Transformation Plan of the government of Ethiopia intends to further increase the livestock population and maximize their productivity. This requires a parallel national strategy to prevent and control the most significant zoonotic diseases. If these are not properly addressed, they may dampen the full

impact of the Growth and Transformation Plan. To begin addressing some of these challenges, a zoonotic disease prioritization workshop was held on September 29–30, 2015, at the Ethiopian Public Health Institute (EPHI). The effort was supported by the Global Health Security Agenda (GHS) of the United States of America government.



**Figure 2.** Ethiopian boy surrounded by local dogs. To prevent cases of rabies in people, it is crucial to vaccinate the dog population. Vaccination coverage around 70% will stop rabies from spreading.

## OUTCOME OF THE PRIORITIZATION

The goal of the workshop was to identify the top five zoonotic diseases of major public health concern in Ethiopia that need to be jointly addressed by animal and human health agencies to have maximum impact on the health of people and animals. This effort was undertaken as part of the zoonotic diseases action package of the Global Health Security Agenda (GHSa). GHSa was launched in Ethiopia at a planning meeting held on June 17, 2015, between the Ethiopian government and United States government representatives.

To make sure that effective prevention and control programs are implemented for the prioritized diseases, a platform to strengthen collaborations among animal and human health agencies needs to be created. GHSa's zoonotic diseases action package is designed to assist the government of Ethiopia to address the challenges associated with prioritized zoonotic diseases.

### The primary objectives for the selection of significant zoonotic diseases are to:

1. Develop laboratory capacity at the national and regional levels in both human and animal health sectors
2. Strengthen surveillance and perform targeted surveys in humans and animals to determine disease burden, and create a mechanism for sharing data between the human and animal sectors
3. Develop disease prevention and control strategies in people and animals (available interventions primarily target animals)
4. Strengthen and operationalize cooperative inter-sectoral outbreak response capacity



**Figure 3.** Different animals share their living spaces with people—an arrangement that may further contribute to the spread of disease if proper safety and health precautions are not applied.

Five zoonotic diseases were prioritized by the workshop participants using a semi-quantitative selection tool developed by the US Centers for Disease Control and Prevention (CDC). The five selected zoonotic diseases were rabies, anthrax, brucellosis, leptospirosis, and echinococcosis (Table 1). A brief description of the diseases can be found on page 8.

Proven prevention and control strategies (such as vaccines) are available for four of these diseases, but putting them into practice effectively requires sustained level of collaboration among the animal and human health sectors. To facilitate this, the workshop participants recommended the creation of a One Health-focused Zoonotic Disease Unit, which would include staff from EPHI and Ministry of Livestock and Fishery Resources (formerly part of Ministry of Agriculture) or other appropriate animal health agencies. This unit will develop a national zoonotic disease strategy and coordinate the efforts between the human and animal health sectors to jointly address the selected zoonotic diseases and respond to outbreaks in people and animals. Similar collaborative units created in other East African countries such as Kenya and Tanzania have helped to advance zoonotic disease prevention and control activities.

**Main roles of One Health-focused Zoonotic Disease Unit:**

- Enhance inter-sectoral linkages
- Facilitate efficient utilization of scarce resources
- Take advantage of various sectors' capabilities to improve prevention and control of zoonotic diseases

**Table 1.** Final zoonotic diseases selected during the prioritization workshop.

Disease	Causative agent	Human Disease Burden	Animal Disease Burden	Treatment and Preventive measures
<b>Rabies</b>	Virus	Each year, thousands of people are infected with rabies in Ethiopia, estimated at 1.6/100,000—one of the highest rates in the world. <sup>2</sup>	Exact number for Ethiopia unknown, but rabies confirmed in thousands of dogs in Addis Ababa Region alone. <sup>3</sup>	Effective animal vaccine exists. Post-bite treatment for people is very effective. Once symptoms start, all patients die.
<b>Anthrax</b>	Bacteria	Skin and intestinal form reported in various regions where outbreaks in livestock occur. <sup>4</sup>	Each year, many outbreaks continue to occur in livestock and wildlife. <sup>5</sup>	Effective animal vaccine and treatment for people exist.
<b>Brucellosis</b>	Bacteria	Exact number unknown, but cases commonly reported among herdsmen. <sup>6</sup>	Up to 50% infected animals reported in some regions. <sup>7</sup>	Effective animal vaccine and treatment for people exist.
<b>Leptospirosis</b>	Bacteria	Exact burden unknown. A small study in Wonji Hospital found about half of patients studied to be positive. <sup>8</sup>	Worldwide, 2–46% of animals depending on animal type. <sup>9</sup> Abortions and loss of meat and milk are major concerns.	Effective animal vaccine and treatment for people exist.
<b>Echinococcosis</b>	Parasite	Widespread in sub-Saharan Africa, with up to 5% of people infected in some regions of Ethiopia. <sup>10</sup>	35% cattle, 17% camels, 12% sheep infected; causes 10% reduction in animal productivity and performance. <sup>11</sup>	No vaccine available. Surgery most effective treatment for people. Drugs to support treatment exist.

<sup>2</sup> Deressa, A et al. *Ethiop J Health Dev.* 2010; 24(2): 127–132. Ramos, J.M. et al. *Ann Agr Env Med.* 2015; 22(1): 76–79. Yibrah, M. & Damtie, D. *Infectious Diseases of Poverty.* 2015; 4(3).

<sup>3</sup> Deressa, A et al. *Ethiop J Health Dev.* 2010; 24(2): 127–132.

<sup>4</sup> Seboxa, T. et al. *Trop Geogr Med.* 1989 Apr;41(2):108–12.

<sup>5</sup> Shiferaw, F. et al. *Vet Rec.* 2002; 150: 318–320. Shiferaw, G et al. *Rev sci tech Off Int Epiz.* 2004; 23(3):951–956.

<sup>6</sup> Haileselassie, M. et al. *Veterinary Medicine International.* 2011; 2011: doi:10.4061/2011/354943.

<sup>7</sup> Asmare, K. et al. *Trop Anim Health Prod.* 2013; 45:555–560. Haileselassie, 2011; Tschopp, R. et al. *Prev Vet Med.* 2015; 120 (2015): 187–194.

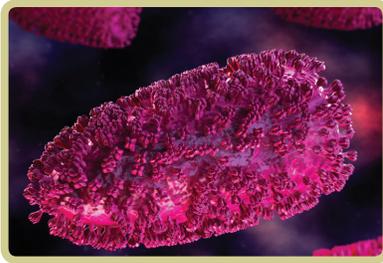
<sup>8</sup> Yimer, E. et al. *Ethiop J Health Dev.* 2004; 18(1): 48–52.

<sup>9</sup> Tilahun, Z. et al. *International Journal of Microbiological Research.* 2013; 4(1): 09–15.

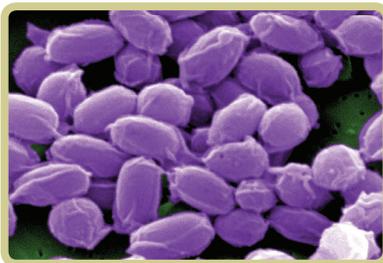
<sup>10</sup> Wahlers, K. et al. *Lancet Infect Dis* 2012; 12: 871–80.

<sup>11</sup> Fromsa, A. & Jobre, Y. et al. *Ethiop Vet J.* 2011; 15(2): 11–33. Dawit, G. & Shishay, K. et al. *World Journal of Medical Sciences.* 2014; 10(2): 94–102.

## DESCRIPTIONS OF THE SELECTED DISEASES



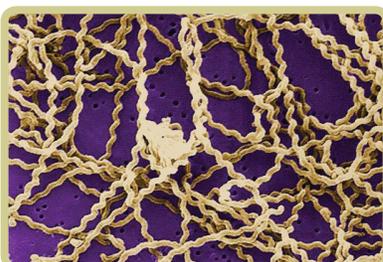
**Rabies** is a disease that attacks the brain, mainly spread to people by bites from dogs that have the disease. Ethiopia has one of the largest rabies infection rates in the world. Prompt treatment after a bite by rabies-infected animals can protect people from the illness and death. All infected people die after symptom onset, if proper treatment is not given soon after the bite.



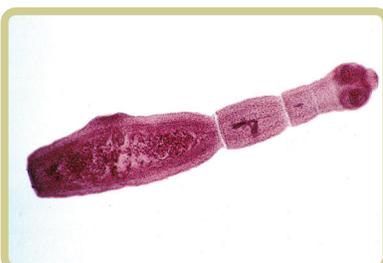
**Anthrax** causes a range of serious illnesses in people. It can lead to a severe infection of skin, infection of the gut, or severe infection of the lungs. It mainly affects animals used for food such as cattle, sheep, and goats. People can get the disease when they eat raw or undercooked meat from infected animals or have close contact with them. Routine vaccination of livestock can protect animals and people from illness and death.



**Brucellosis** is a disease usually seen in cattle, sheep, and goats. People can get sick when they are in contact with infected animals or eat undercooked meat or drink raw milk from an infected animal. Vaccination of animals can prevent illness in people, as well as illness, loss of productivity, and death in animals.



**Leptospirosis** is a disease that affects people and animals. People can get sick through contact with urine or with water, soil, or food contaminated with the urine of infected animals. These can be cattle, horses, dogs, and rodents. In people, it can cause a wide range of symptoms that can be mistaken for other diseases. Leptospirosis is treated with antibiotics, such as doxycycline or penicillin, which should be given early in the course of the disease. Without treatment, it can lead to kidney damage, brain infection, liver failure, respiratory problems, and even death.



**Echinococcosis** is a parasitic disease caused by tiny tapeworms. It can spread to people from dogs, cattle, sheep, and goats. In people, the disease can manifest as growing cysts or parasitic tumors in the liver, lungs, brain, and other tissues. The more common form (cystic) affects the intestines and can be treated with surgery and medication. The lung (alveolar) form of the disease, however, can be fatal if left untreated.

## PRIORITIZATION PROCESS

The prioritization process involved a semi-quantitative tool developed at CDC. The methods have been described in detail by Rist et al. The first step of the process was to identify a country-specific list of potential zoonotic diseases of concern. A list of 43 zoonotic diseases, shown in Table 2 in Appendix A, was considered during the prioritization workshop. Next, the workshop participants jointly identified five criteria for quantitative ranking of these 43 diseases. Once the five criteria were chosen, each member of the selection committee individually indicated their preferences for the relative importance of each criterion to help generate a final group of weights for each criterion. The criteria and weights assigned to each are listed in Appendix B.

One categorical question for each criterion was selected through group discussion. The questions had binomial (yes/no) or ordinal multinomial (1–5%, 5–10%, 10–20%, etc.) answers. The ordinal nature is necessary for the scoring process, and was determined by the participants and the available data. Data were identified through an extensive literature search, as well as information from the WHO, OIE, and CDC websites. Data on incidence, prevalence, morbidity, disability-adjusted life years (DALYs), and mortality were collected for the 43 zoonotic diseases. If disease information for a particular zoonotic disease was not available for Ethiopia, data for other East African countries were used. If regional data were not available, global disease data on prevalence, incidence, morbidity, mortality, and DALYs were used. Over 300 articles were collected with disease specific information on prevalence, morbidity, mortality, and DALYs for Ethiopia or the East Africa region. These articles were saved as PDFs, loaded onto an external storage device (thumb drive), and given to the workshop participants for reference.

A decision tree was designed using Microsoft Excel and used for determining the final disease ranking. Weighted criterion was applied for each disease, and scores assigned based on the response to each question. Country-specific, regional, and global data compiled previously for all zoonotic diseases under consideration were used to determine appropriate responses for each question. The scores for all five questions were summed and then normalized such that the highest final score was “1.” See Table 2 in Appendix A for a complete listing of normalized scores for all zoonotic diseases that were considered in the workshop.



<sup>12</sup> Rist CL, Arriola CS, Rubin C. Prioritizing zoonoses: a proposed one health tool for collaborative decision-making. *PLoS One* 2014;9(10):e109986.

## CRITERIA SELECTED FOR RANKING ZOO NOTIC DISEASES

Criteria selected by the Ethiopian multi-sectoral working group are listed in order of importance in Appendix B.

### 1. Severity of human disease in Ethiopia

Diseases having the highest death rate in humans were deemed to have priority and this criterion was given the highest weight. However, data on deaths in Ethiopia for each of the 43 zoonotic diseases of concern were not available. A proxy was established in which the diseases were ranked based on their known presence in Ethiopia and the global case-fatality rate (CFR, proportion of cases that result in death). A disease was given full weight for this criterion if there was any data indicating its presence in Ethiopia and the disease had a high case fatality rate ( $\geq 5\%$ ). The next highest credit was given for diseases which were known to be present in Ethiopia, but had a low case-fatality rate ( $< 5\%$ ). The lowest credit was given for diseases not present, or not known to be present, in Ethiopia, but had a high case-fatality rate ( $\geq 5\%$ ). No credit was given to diseases not present or not known to be present in Ethiopia and with a low case-fatality rate ( $< 5\%$ ).

### 2. Proportion of human disease attributed to animal exposure

Diseases that are not known to spread from person to person (and thus all cases result from animal exposure) were assigned the full weight of this criterion. Diseases which can spread from person to person but not easily enough to become serious epidemics received partial credit. And finally, diseases known to spread mainly between people (cases rarely originating from animal exposure) received no credit.

### 3. Burden of animal disease

This criterion involves diseases that have negative impacts at the household level in Ethiopia by causing disease or production losses in livestock. Assessing the burden of disease in animals in Ethiopia was challenging because data were available for relatively few of the 43 diseases considered. In addition, even for those diseases with some data available, the data was not consistent across regions and species. At last, diseases were ranked and assigned weights based on whether the disease was present or not present (or not known to be present) in Ethiopia, and whether the disease causes production losses. If the effect on livestock production was unknown, the final weight was assigned based on whether or not the disease was an OIE reportable disease.

### 4. Availability of interventions

A full weight was assigned to diseases for which vaccines targeting animals existed. Partial credit was given to diseases that had vaccines or medical intervention available for people, but not an animal vaccine. No credit was assigned when interventions for animals or people were not available.

### 5. Existing inter-sectoral collaboration

Finally, the group prioritized diseases in which inter-sectoral collaboration is already present within Ethiopia. Partial credit was given to diseases with prior collaboration or weak collaborations, and no credit for those with no collaboration.

## PLANS AND RECOMMENDATIONS



Workshop participants reviewed the numerical scores generated (see Table 2, Appendix A) and engaged in further discussion to determine the final five prioritized diseases. The discussion was collaborative, and representatives from each sector were encouraged to discuss their recommendations for the top five diseases. Finally, the selection committee members voted on the top five zoonotic diseases for Ethiopia. The final outcome was a list of diseases that animal and human health sectors in Ethiopia, international organizations, and other donor agencies can support for strengthening of surveillance in humans and animals, enhancement of laboratory capacity, development of prevention and control strategies, and participation in joint outbreak investigations. GHSA can be leveraged to support some of these activities in specific regions of the country.

To facilitate inter-sectoral collaboration and effectively address the impact of prioritized zoonotic diseases, workshop participants recommended the following next steps.

- Establish One Health-focused Zoonotic Disease Unit with representation from the animal and human health agencies.
  - ▶ The unit can be physically located at EPHI and potentially combine or link EPHI's existing zoonotic disease research team with that of the Ministry of Livestock and Fishery Resources' veterinary public health unit.
  - ▶ It should have staff representing relevant ministries with well-defined roles and responsibilities such as joint planning, coordinated outbreak response, and information sharing.
  - ▶ Defense Threat Reduction Agency (DTRA) and other US government agencies can support with funding and technical assistance to stand up the unit once high-level decisions to establish such a unit are made.
- Develop a national strategy to jointly address the five prioritized zoonotic diseases. This could be one of the primary tasks for the joint Zoonotic Disease Unit.
- Engage leadership across different ministries for further support of program platform and coordination to address the prioritized zoonotic diseases.
- Strengthen veterinary public health workforce development in collaboration with Field Epidemiology Training Program (FETP).

## APPENDIX A

**Table 2.** Zoonotic diseases considered for prioritization in Ethiopia: Final results of prioritization and normalized weights for all zoonotic diseases.

Disease	Raw Score	Normalized Final Score	Disease	Raw Score	Normalized Final Score
Rabies	0.90	1.00	Trichinellosis	0.37	0.42
Echinococcosis	0.74	0.82	West Nile Virus	0.36	0.41
Anthrax	0.73	0.81	Eastern Equine Encephalitis	0.35	0.40
Brucellosis	0.65	0.73	Hendra Virus Disease	0.35	0.40
Leptospirosis	0.65	0.73	Yellow Fever	0.35	0.40
Q fever	0.65	0.73	Ehrlichiosis	0.31	0.34
Salmonellosis	0.65	0.73	Lyme disease	0.30	0.34
Bovine tuberculosis ( <i>M. bovis</i> )	0.64	0.71	Hanta virus	0.29	0.32
Tularemia	0.58	0.65	Scrub typhus ( <i>Orientia tsutsugamushi</i> )	0.29	0.32
Leishmaniasis	0.57	0.63	Plague ( <i>Yersinia pestis</i> )	0.28	0.31
Cysticercosis/ <i>Taenia</i>	0.56	0.62	Rickettsial disease	0.28	0.31
Toxoplasmosis	0.56	0.62	MERS-CoV	0.26	0.30
Listeriosis	0.54	0.60	Hepatitis E	0.26	0.29
Schistosomiasis	0.53	0.59	Western Equine Encephalitis	0.25	0.28
Avian Influenza	0.52	0.58	Dengue	0.21	0.23
Campylobacteriosis	0.49	0.55	Venezuelan Equine Encephalitis	0.17	0.19
<i>E. Coli</i>	0.49	0.55	Crimean Congo Hemorrhagic Fever virus	0.14	0.16
Trypanosomiasis	0.48	0.54	Nipah	0.14	0.16
<i>Streptococcus suis</i>	0.45	0.50	Lassa Fever	0.10	0.11
Rift Valley Fever	0.45	0.50	Ebola Virus Disease	0.08	0.09
Cat Scratch Disease ( <i>Bartonella</i> )	0.44	0.49			
Japanese Encephalitis	0.44	0.49			
MRSA ( <i>Staphylococcus aureus</i> )	0.38	0.43			

## APPENDIX B

The numerical weights for the criteria selected for ranking zoonotic diseases in Ethiopia

### 1. Severity of human disease in Ethiopia (weight = 0.23)

- a. Disease present, high ( $\geq 5\%$ ) CFR (weight = 3)
- b. Disease present, low ( $< 5\%$ ) CFR (weight = 2)
- c. Disease not known to present, high ( $\geq 5\%$ ) CFR (weight = 1)
- d. Disease not known to be present, low ( $< 5\%$ ) CFR (weight = 0)

### 2. Proportion of human disease attributable to animal exposure (weight = 0.21)

- a. Sustained animal to human transmission (no human to human) (weight = 2)
- b. Human to human transmission possible, but not sustained (weight = 1)
- c. Human to human sustained transmission (weight = 0)

### 3. Burden of animal disease (weight = 0.20)

- a. Disease present, loss of production yes (weight = 3)
- b. Disease present, loss of production unknown, OIE reportable yes (weight = 3)
- c. Disease present, loss of production no (weight = 2)
- d. Disease present, loss of production unknown, OIE reportable no (weight = 2)
- e. Disease not present, loss of production yes (weight = 1)
- f. Disease not present, loss of production unknown, OIE reportable yes (weight = 1)
- g. Disease not present, loss of production no (weight = 0)
- h. Disease not present, loss of production unknown, OIE reportable no (weight = 0)

### 4. Availability of interventions (weight = 0.19)

- a. Animal vaccine (weight = 2)
- b. Human intervention (vaccine or treatment) (weight = 1)
- c. Neither (weight = 0)

### 5. Existing inter-sectoral collaboration (weight = 0.17)

- a. Yes, current strong collaboration (weight = 2)
- b. Yes, previous or weak collaboration (weight = 1)
- c. No (weight=0)

## **PARTICIPATING ORGANIZATIONS**

Ethiopian Public Health Institute (EPHI)

Ministry of Livestock and Fishery Resources, Ethiopia (MoLFR, formerly part of the Ministry of Agriculture)

Ministry of Environment and Forestry, Ethiopia (MEF)

World Health Organization (WHO)

United States Department of Agriculture (USDA)

U.S. Centers for Disease Control and Prevention (CDC)

Defense Threat Reduction Agency/Cooperative Biological Engagement Program (DTRA/CBEP)

The Ohio State University (OSU)

United Nations Food and Agriculture Organization (FAO)

Armauer Hansen Research Institute (AHRI)/ Swiss Tropical and Public Health Institute (STPHI)

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