



## Prioritizing zoonotic diseases in Ethiopia using a one health approach



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### ABSTRACT

**Background:** Ethiopia has the second largest human population in Africa and the largest livestock population on the continent. About 80% of Ethiopians are dependent on agriculture and have direct contact with livestock or other domestic animals. As a result, the country is vulnerable to the spread of zoonotic diseases. As the first step of the country's engagement in the Global Health Security Agenda, a zoonotic disease prioritization workshop was held to identify significant zoonotic diseases of mutual concern for animal and human health agencies. **Methods:** A semi-quantitative tool developed by the US CDC was used for prioritization of zoonotic diseases. Workshop participants representing human, animal, and environmental health ministries were selected as core decision-making participants. Over 300 articles describing the zoonotic diseases considered at the workshop were reviewed for disease specific information on prevalence, morbidity, mortality, and DALYs for Ethiopia or the East Africa region.

Committee members individually ranked the importance of each criterion to generate a final group weight for each criterion.

**Results:** Forty-three zoonotic diseases were evaluated. Criteria selected in order of importance were: 1) severity of disease in humans, 2) proportion of human disease attributed to animal exposure, 3) burden of animal disease, 4) availability of interventions, and 5) existing inter-sectoral collaboration. Based on the results from the decision tree analysis and subsequent discussion, participants identified the following five priority zoonotic diseases: rabies, anthrax, brucellosis, leptospirosis, and echinococcosis.

**Discussion:** Multi-sectoral collaborations strengthen disease surveillance system development in humans and animals, enhance laboratory capacity, and support implementation of prevention and control strategies. To facilitate this, the creation of a One Health-focused Zoonotic Disease Unit is recommended. Enhancement of public health and veterinary laboratories, joint outbreak and surveillance activities, and intersectoral linkages created to tackle the prioritized zoonotic diseases will undoubtedly prepare the country to effectively address newly emerging zoonotic diseases.

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### 1. Introduction

Most known human infectious diseases and approximately three-quarters of newly emerging infections come from animals [1,2]. Zoonotic diseases have the potential to impact society in three main ways: (1) they threaten the health of animals resulting in illness, loss of productivity, and death; (2) they threaten the livelihood of people dependent on livestock as a major source of income; and (3) they cause illness and

death in people, which in turn causes additional economic and societal loss.

Ethiopia has the second largest human population in Africa and the largest livestock population on the continent [3–6]. Ethiopia is particularly vulnerable to the effect of zoonotic diseases because the economy is largely dependent on agriculture [7,8] and roughly 80% of households have direct contact with domestic animals, creating an opportunity for infection and spread of disease [2,9]. Ethiopia also ranks very high in the health burden of zoonotic diseases and in having a large population of poor livestock keepers [10]. Meanwhile, the lack of coordination among human and animal health sectors coupled with inadequate resources for public health systems have been prominent factors that have contributed to weak surveillance systems and less efficient and

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ineffective response to public health threats in the country. Therefore, having a mutually agreed and prioritized agenda among key sectors is crucial for resource allocation and strengthening zoonotic disease surveillance systems in the country.

Ethiopia's Growth and Transformation Plan, developed under the guidance of the United Nations, 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, which is also a component of the Global Health Securities Agenda (GHSa). GHSa is an initiative developed by the US government with other international collaborators to address the gaps that exist in many countries in meeting the International Health Regulations and the Performance of Veterinary Services (PVS) pathway. GHSa has three strategies — Predict, Respond, and Prevent — and eleven packages were developed to achieve the strategies [11]. One of these action packages is addressing the burden of zoonotic diseases. Because a large number of zoonotic diseases endemically occur in Ethiopia, a prioritization process was necessary to identify the most critical zoonotic diseases that should be jointly addressed by animal and human health agencies to maximize impact on the health of people and animals in Ethiopia. The present article describes the first semi-quantitative, multi-sectoral process used for prioritization of zoonotic diseases in Ethiopia.

## 2. Methods

The prioritization process involved a semi-quantitative tool developed at the U.S. Centers for Disease Control and Prevention (CDC). The methods have been described in detail by Rist et al. [12]. An in-country workshop was held that included representatives from the key stakeholder agencies (Table 1). Although multiple agencies were invited to participate in the workshop, key decisions including selection of criteria, questions to address the criteria, and the final selection of top five zoonotic diseases was made by five pre-selected committee members. The committee members were identified prior to the workshop and included individuals from the Ethiopian Public Health Institute (EPHI), the Ministry of Livestock and Fishery Resources (MoLFR), and the Ethiopian Ministry of Environment and Forestry (MEF).

### 2.1. Selection of zoonotic diseases for prioritization

The first step of the process was to identify a country-specific list of zoonotic diseases of potential concern. Subject matter experts from the Ministries, as well as local WHO and CDC staff provided expert opinion on the proposed list of diseases for consideration in Ethiopia. EPHI, MoLFR and CDC circulated the list of potential diseases for inclusion and final selection was based on input from subject matters experts and a literature review.

**Table 1**  
The Ethiopia One Health Zoonotic Disease Prioritization Participating Organizations – Addis Ababa, Ethiopia, 2015.

Participating organizations	Abbreviation
Federal Ministry of Health, Ethiopia	FMOH
Ethiopian Public Health Institute	EPHI
Ministry of Livestock and Fishery Resources, Ethiopia	MoLFR
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
Food and Agriculture Organization of the United Nations	FAO
Armauer Hansen Research Institute/Swiss Tropical and Public Health Institute	AHRI/STPHI

### 2.2. Literature review

Data on the burden of zoonotic diseases in Ethiopia were identified through an extensive literature search. Forty-three zoonotic diseases were included in the literature review: 18 zoonotic diseases were associated with viral infection, 18 with bacterial infection, and 7 with parasitic pathogens. Peer-reviewed literature citing disease incidence, prevalence, morbidity, disability-adjusted life years (DALYs), and mortality were collected. If information for a particular zoonotic disease was not available for Ethiopia, data for other East African countries was used. If regional data was not available, global disease data were used. Over 300 articles were reviewed with disease-specific information for Ethiopia or the East Africa region.

NCBI PubMed was used to conduct the initial search. Information regarding human disease severity (e.g. morbidity, mortality, and DALYs), economic burden in animals, and prevention and control strategies (e.g. local wildlife reservoirs and vaccine availability) was compiled. The search used the country name (Ethiopia), disease name, and one of the following terms: “morbidity,” “mortality,” “DALYs,” “cases,” “animals,” “vaccine,” and “wildlife,” combined using the Boolean operator “AND.”

Authors reviewed references from retrieved articles to identify additional relevant publications for inclusion in the literature review. Non-English articles were excluded. Articles published during 1965–2015 were included. All articles were collated and shared electronically with workshop participants.

In addition to literature found via PubMed, data publicly available on websites of the World Health Organization (WHO), the United Nations Food and Agriculture Organization (FAO), and the Institute for Health Metrics and Evaluation's 2010 Global Burden of Disease (GBD) Survey were also included.

### 2.3. Criteria selection

Through group discussion and consensus, the workshop participants identified five criteria for quantitative ranking of the 43 zoonotic 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 one of them are listed in Appendix A.

### 2.4. Question selection for each criterion

A categorical question for each criterion was selected through group discussion. The questions were designed to address the criteria using data generated from the literature review for each of the 43 zoonotic diseases. 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 guided by participant preference and the available data.

### 2.5. Disease weighting and final ranking

A decision tree was designed using Microsoft Excel and was used to determine the final disease ranking. Each weighted criterion was applied across all diseases, and scores were assigned based on the response to each question. Data compiled during the literature review were used to determine appropriate responses for each question for all zoonotic diseases under consideration. The scores for all five questions were summed and then normalized such that the highest final score was 1.

Workshop participants reviewed the numerical scores generated and engaged in further discussion to determine the final five prioritized diseases. Finally, the selection committee members voted on the top five zoonotic diseases for Ethiopia.

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