Knowledge, Attitude and Practice towards Anthrax in Northern Ethiopia: a mixed approach study

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Abstract

Background Anthrax is prioritized as the second diseases in Ethiopia based on its negative impacts at the household level by causing disease or production losses in livestock and sever disease in human. This study aimed at assessing the knowledge, attitude and practices (KAPs) of anthrax in the communities of Eastern Tigray, Northern Ethiopia.

Methods A cross-sectional survey was concurrently conducted with focus group discussions (FGD) and key informant interviews (KII) from May 2019 to April 2020. A total of 862 respondents have participated in the questionnaire survey. Of which, 800 were local community members. While 62 were professionals working at animal and human health service institutions. Likewise, qualitative data were collected using six FGDs and 11 KIIs. Results sixty two percent (496/800) of the respondents said that they knew the disease anthrax while 38% (304/800) of them did not it. Only 9.3% (74/800) of the respondents reported germ as the causative agent of anthrax. About 56.5% (35/62) of the professional respondents said that the causative agent of the disease was bacteria while 33.9% (21/62) of them did not know it. More than sixty percent (64.1%, 513/800) did not know whether the disease was zoonotic or not. Among the listed clinical signs, 26.3% (210/800) and 36.8% (294/800) of the respondent knew at least one signs in animal and human, respectively while 21.3% (170/800) and 20.1% (161/800) knew one or more transmission routes in animal and human respectively. Moreover, 43.4% (347/800) and 45.6% (365/800) of the respondents mentioned one or more control/prevention method in animal and human, respectively. Fifty two (416/800) and 32.4% (259/800) of the questionnaire participants believed that vaccination of animals could prevent anthrax in animal and human, respectively. But although 4% (32/800) said that they had anthrax (Megerem) infected animals, more than 28% (9/32) of them used traditional medication for their animals. Regarding qualitative results, some of the participants knew the disease (in animals) in their own local names, Lalish and Tafia (splenomegaly), and Gulbus (abdominal cramp and shivering). Some had perceived the disease only as human disease while others recognized after they were told its clinical signs in animals and humans.

Conclusion The KAP of the participants towards anthrax was low. Moreover, there was no similar understanding of the disease among the participants. The study also revealed that the participants did not get consistent, adequate and continuous health messages regarding the disease. Traditional belief and socio-economic factors impacted the KAP of the community towards the disease.

Background

Anthrax is a neglected tropical zoonotic disease of economic and public health importance [1]. It is estimated that 20,000-100,000 incidence of human anthrax occur per year globally [2] with significant number of cases from Chad, Ethiopia, Zambia, Zimbabwe and India [1]. However, the true disease burden is likely unknown as there are poor surveillance systems and unreliable reporting [3]. The causative agent of anthrax is, *Bacillus anthracis* (*B. anthracis*), which primarily infects herbivores and secondarily afflicts humans [4, 5]. The most common source of infection for ruminants is ingestion of spores during grazing in contaminated pastures, or through grass and water contaminated with anthrax spores [6-8]. Animals also become infected through concentrated feed include bone meal [9].

The occurrence of anthrax outbreaks in a particular location mostly depends on the existence of interacting factors, which include unique characteristics of the bacterium, environmentally related features, animal densities and human activities [10, 11]. It was also found that outbreak of anthrax had been associated with ecological, demographic, and sociocultural factors [12, 13]. Seasonal variation of livestock and human anthrax has been reported because occurrence of human cases was highly correlated with animal anthrax outbreaks [14]. Anthrax epidemics are frequent in the dry season and are generally associated with onset of the first rains [15, 16]. During the dry season, the grass is short and animals are, thereby, forced to graze very close to the ground, and animals have chances of picking up anthrax spores [17] as anthrax-infected carcasses and butchering waste have disposed in environments where ruminants live and graze [18]. Spores may be spread in the environment through scavenging birds, animals, and water

[6, 19]. Repeated anthrax outbreaks in animals without vaccination have reported [18] since ongoing vaccination programs can break the cycle of transmission in domestic animals [7, 18].

Human infection is often, associated with eating meat of ill animals [20, 21] and, a result of coming into contact with infected animals or contaminated animal materials during agricultural activities including the butchering of livestock or industrial exposures through the processing of hair and bone [5, 20-24]. One of the drivers that may contribute to the persistence of anthrax is human behavior [25]. For instance, in Kenya, it was reported that human anthrax cases most often occur linked to animal anthrax. In most cases, human behaviors, especially slaughter and consumption of meat from animal anthrax cases, has been implicated [26]. In Zambia, Popular cultural practices that involved exchange of animals between herds contributed to uncontrolled cattle movements between herds facilitate subsequent transmission of anthrax [13]. In Tanzania, it has been documented that demographic characteristics, sleeping on animal's skins, contacting with infected carcasses through skinning and butchering, and not having formal education were linked to exposure for anthrax infection [20]. Because animals are an important asset to the communities affected, death of an animal may result in consumption of infected meat and use of animal products, potentially leading to infections. In Bangladesh, it was identified that skinners removed and sold the hides from discarded carcasses even though Islamic law forbids eating animals that die from natural causes [18]. This is worsened by the fact that a family may consume and sell some of the meat in order to salvage some losses from the death of the animal [17, 18, 25, 27].

According to Pieracci et al. [28], the United States center of disease control (US-CDC) and other concerned Ethiopian and North American organizations, have prioritized five zoonotic diseases in Ethiopia based on 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. Accordingly, anthrax ranked second based on its negative impacts at the household level by causing disease or production losses in livestock and severe disease in human in the country. In Ethiopia, government reports indicated that a total of 5197 and 26737 cases and 86 and 8523 deaths of human and animal anthrax respectively were documented from 2009 to 2013 [29]. Nonetheless, deficiencies in diagnostic testing services and the non-specific presentation of many zoonoses can lead to failure to confirm diagnosis as well as a failure to reinforce awareness of cases [30]. So also, another study reported that lack of awareness on zoonotic diseases was due to poor communication between veterinarian and human health-care professionals and lack of involvement of educated family members in farming activities [31]. Specifically, in Zambia it had been reported that the persistence of anthrax outbreak was linked to perceptions, beliefs and practices of farmers, which meant that cattle farmers were reluctant to have their livestock vaccinated against anthrax because of perceived low efficacy of the vaccine, and besides, farmers did not trust professional staff and their technical interventions [13].

Establishing a bond of trust between responsible authorities and those who are potentially affected communities through effective communication would create sensitive control strategy [32]. This might contribute to improved compliance to control measures and application of empirical evidence based on both technical and locally acceptable interventions [27]. It has been acknowledged that cultural issues are always an important component of health, especially in agrarian communities [33]. Human behavior [25] and socio-demographic factors [20] could affect the KAP of a given communities towards anthrax. Having evidence of KAP regarding anthrax can be used to set the prevention strategy against the disease. Hence, this study aimed at assessing the knowledge, attitude and practice of anthrax at Adigrat town, Ganta Afeshum and Gulomkada districts.

Methods

Description of study area

Eastern zone is among the seven zonal administrative units of Tigray regional state which consists of 9 districts. Of which two are town districts while the remaining 7 are rural districts. Adigrat is the capital town of the zone. The zone is located at 14°16'N 39°27'E longitude and 14°16'N 39°27'E latitude; with an altitude ranges from 2000-3000 meter above sea level. The average annual rainfall is 552 mm and that of temperature is 16°C. The study was conducted in three districts of Eastern zone, namely, Adigrat town, Ganta Afeshum and Gulomkada (Fig 1).

Definitions

1. Zone is a large political administrative unit next to regional state.
2. Ketena and Kushet (urban and rural, respectively) are the smallest administrative units in the study region, Tigray – both are synonymous with parish.
3. Tabia is an administrative units larger than Ketena and Kushet but smaller than districts.
4. Community member: in this paper, community member used only to differentiate respondents who are not professional/experts, FGD participants and key informants.

Study design

The study used a mixed-method design employing both quantitative and qualitative methods. A cross-sectional survey was concurrently conducted with FGD and KII from May 2019 to April 2020.

Sample selection and healthcare sector description

The study districts were selected purposively. In total, 10 tabias were included in the study. Three from each district, were randomly selected: Adigrat (01, 03 and 05 tabias), Gan-afeshum (Bizet, Bahraseshita and Hagereselam) and Gulomkada (Fatsi, Kokobtsibah, Anbesetefikada). One tabia (Sebeya) from Gulomkada which had anthrax outbreak in 2018 was purposively included. All parishes under the selected tabias were included. Inclusion criteria were logistic feasibility and history of anthrax outbreak. Initial survey was conducted to collect the number of households and populations from each selected tabia and parish. Besides, animal and human healthcare sectors were identified. In animal healthcare sector, there were three clinics, one for each district. They provided veterinary service based on clinical signs with few broad spectrum medicaments. Rural tabias had no permanent veterinary facilities. They were reached from the respective district center/clinic for vaccination and sometimes for case management. Healthcare coverage is better in human than animal sector. Formal clinical services were provided through health posts, clinics/health centers and hospitals. Our rural study tabias had one health center each except Bahraseshita and Anbesetefikada which got healthcare from the neighbor tabias. Adigrat town had one general hospital and two health centers. Lists of households were not available. Hence, Respondent households were selected using systematic random sampling while all health professionals available at the time of visiting were included.

Data collection

Quantitative

Structured-questionnaire with mostly close-ended questions was prepared. It was translated into local language, *Tigrigna*, and translation was done back into English to keep the consistency. Enumerators, with University degree whose mother tongue and currently spoke Tigrigna, were selected. Training for enumerators was given. In addition to the content of the questionnaire, enumerators were tutored about the disease by using some supportive pictures which showed some clinical signs including cutaneous lesion in human and bleeding from natural orifices from dead animals. The authors themselves participated in data collection. Data collection format was prepared for individual

case. The questionnaire was tested in both rural and urban residents. In this study, a total of 862 respondents were interviewed. Of which, 800 were urban and rural dwellers. While 62 were professionals/experts working at animal and human health service institutions: 49 human health practitioners (HHPs) and 13 animal health experts (AHEs). For the community, one person per household with age of ≥ 18 years old was interviewed - Interview was held face to face by the enumerators. While health workers were given the questionnaire and allowed to answer the questions by themselves.

The questionnaires were of two types: one for the community members (Additional file: Questionnaire A) and another one for professionals (Additional file: Questionnaire B) with slight differences for animal and human professionals. The first questionnaire comprised: socio-demographic information of the respondent (age, sex, educational status, occupation, religion), animal ownership, questions related to knowledge (e.g. knowledge on the disease, source/cause of the disease, signs of the disease in animal and human, transmission routes to animal and human, prevention methods in animal and human), attitude (e.g. seriousness of the disease in animals and humans and the importance of vaccination) and practice related questions (e.g. animal vaccination and frequency and medication of animal and humans). The second questionnaire aimed at assessing the knowledge of the disease amongst health professionals. Majority of the questionnaires' components were the same with the first one. However, some additional questions were incorporated: questions related to knowledge (e.g. etiology of the disease, form of anthrax, transmission route form each form), questions related to outbreak and case admission to animal and human healthcare centers (e.g. occurrence of outbreak in animal and human, number of cases admitted in animal and human healthcare center, number of recovery and death in animal and human).

Qualitative

Six FGD and 11 KII were conducted. The FGD participants were individuals who did not take part in the questionnaire survey. Each group was composed of both sexes, farmers and local leaders. The FGDs meetings were modulated by both the researchers and each discussion was held until it reached saturation point, an average of ≈ 40 minutes. The mean age of the FGDs participants was 44 (range: 24-78). The FGDs were consisting of 7-15 (total of 58) participants. Focus group discussions were held in six tabias: three from Gulomkada (Fatsi, Anbesetefikada and Sebeya), one from Adigrat town and two from Ganta-afeshum (Hageresalam and Bizet). The FGDs were always begun with the animal health coordinators highlighted the purpose of the discussion. The participants were encouraged to speak their opinions. And they were left for sometimes to make side talk (help each other) in order to explore the question/matter being asked/raised until brought back their attention (handing their idea) to the stage by the researchers.

Eleven KII were held with concerned officers responsible for anthrax control/prevention: Amongst the 11 officers interviewed, 7 were human health officers (HHOs) and 4 were animal health officers (AHOs): five from Gulomkada (human health officers, $n=3$; animal health officers, $n=2$), Ganta-afeshum, (human health officers, $n=2$; animal health officers, $n=1$) and Adigrat (human health officers, $n=2$; animal health officers, $n=1$). One (1/11) of them was female while the remaining interviewees (10/11) were males.

Interview with key informants and focus group discussions were held with the local language, *Tigrigna*. Both the FGDs and the KII were conducted using interview guides with open ended questions/themes (Additional file: Questionnaire C) to allow the participants to express freely their views and thoughts in their own words on the subject matter, and were recorded on a digital recorder after getting verbal consent from the participants. During interview, the interviewer was taking responsibility, not to leave the themes.

Data management and statistical analysis

Quantitative data were run using STATA statistical software (version 14.0, Stata Corp, college station, Texas 77845 USA) for analysis. To ensure quality, data were crosschecked independently by the researchers. The effects of socio-demographic factors (such as age, sex, educational level, district, occupation, religion and animal ownership) on knowledge of the disease, and its causative agent, zoonotic nature, symptoms, transmission and control/prevention methods were analyzed using descriptive statistics. Moreover, with 95% confidence intervals, logistic regression model was used to evaluate the association between the outcome (e.g., knowledge on the disease its zoonotic nature) and the aforementioned socio-demographic variables. A P-value <0.05 was considered statistically significant.

Qualitative data collected through audio recorder first were transcribed into computer files and then were translated from the local language *Tigrigna* into English. Thematic analysis was used as described in Graneheim and Lundman [34]. The narratives were read several times to understand the whole sense of the text. After setting the major themes, texts were extracted and brought under each theme. Illustrative quotations that clearly represented the themes were used in the results.

Results

Quantitative

Socio-demographic characteristics

Of the 800 rural and urban residents, 54.9% (439/800) and 45.1% (361/800) were males and females, respectively. Mean age of the respondents was 46.7 (95% CI: 45.6-47.9) with a range of 18 – 90 years. About 38.8% (310/800), 31.6% (253/800) and 29.6% (237/800) were from Gulomkada, Gant-afeshum and Adigrat districts, respectively. Regarding the professionals, 49.2% (30/61) were males while 50.8% (31/61) were females. More than sixty percent (61.7%, 37/62) were diploma graduated while 33.3% (20/62) and 5% (3/62) were respectively first and second degree holders. About 85.5% (53/62) had been working in urban settings and remaining (14.5%, 9/62) was in rural areas (Table 1).

Knowledge on the disease, its causative agent and zoonotic nature

Community members: sixty two percent (496/800) of the respondents said that they knew the disease anthrax, locally (in *Tigrigna*) called *Megerem*. However, 38% (304/800) of them said that they did not know the disease. The proportion who knew anthrax was greater in female (63.4%, 229/361) than in male (60.8%, 267/439) respondents. Greater number (77.6%, 621/800) of the respondents reported that they did not know the cause of the disease (Table 2). However, of the respondents (22.4%, 179/800) who believed to have known the cause of the disease: Only 9.3% (74/800) said that the disease was caused by germ. About 8.9% (71/800) believed that the disease was God given, and 4.3% (34/800) mentioned other entities (heredity, witchcraft, lack of sanitation, hunger, insects and thirst) as causative agent of the disease. Of the respondents who claimed knowing the disease, majority (63.9%, 317/496) of them responded as they did not know the causative agent of the disease (Table 2). Regarding the zoonotic importance of the disease, more than sixty percent (64.1, 513/800) did not know whether the disease was zoonotic or not. About 20.1% (161/800) of respondents claimed that anthrax had zoonotic nature while 15.8% (126/800) said that the disease was not zoonotic (Table 2). Knowledge of respondents on anthrax increased with age. As age of respondent increases, knowledge on anthrax increases (Additional file: Fig A). Socio-demographic factors in relation to knowledge of anthrax, and its causative agent and zoonotic nature were presented in Table 2.

Logistic regression model was used to determine the effect of socio-demographic factors (age, sex, district, level of education, occupation and animal ownership) on knowledge and zoonotic nature of anthrax. Accordingly, age, sex,

district, occupation and animal ownership had statistical significant association with knowledge of the disease anthrax. Age group of 58-65 were found 7 times knowledgeable about the disease (OR: 6.7; 95% CI: 2.80-16.01; $p<0.001$) than age group of 18-25 years old. Male (OR: 0.6; 95% CI: 0.40-0.85; $p<0.005$) and merchants (OR: 0.3; 95% CI: 0.12-0.80; $p=0.016$) respondents, and participants from Gulomkada (OR: 0.3; 95% CI: 0.19-0.53; $p<0.001$) had significantly lower level of knowledge on anthrax than female, civil servants and participants from Adigrat, respectively. Respondents who owned animals (OR: 1.8; 95% CI: 1.10-2.83; $p=0.02$) had better knowledge on anthrax than respondents who did not have animals. However, only district had statistical significant association with awareness of zoonotic nature of the disease. Respondents from Ganta-afeshum (OR: 0.4; 95% CI: 0.19-0.65; $p<0.001$) had low level of awareness on the zoonotic nature of the disease than respondents from Adigrat.

Professionals: About 56.6% of the respondents said that the causative agent of the disease was bacteria while 33.9% of them did not know it. However, 9.7% claimed that the causative agent of anthrax was other organisms (Leishmania and fly). Cutaneous form (67.2%) was the most known form of the disease. More than ninety percent (90.1%) of the professional respondents knew that anthrax was zoonotic (Table 3). Socio-demographic factors such as age, sex, Profession (animal and human experts) and level of education were analysed using logistic regression model whether there was statistical association with the knowledge of the causative agent and zoonotic nature of anthrax or not. None of them found statistically significant.

The respondents of the community members learned about anthrax: 55.8% (446/800) from family, friends and neighbours/colleagues, 2.8% (22/800) from health experts, 2.1% (17/800) from radio and 2% (16/800) from veterinary experts (Additional file: Table A and Fig B).

Knowledge on symptoms, transmission, and control/prevention methods in animals

Community members: The number of community member respondents who knew one or more symptoms, transmission and control/prevention methods of anthrax in animals was 26.3 (210/800), 21.3 (170/800) and 43.4% (347/800), respectively. Respondents who did not know symptoms, transmission and control/prevention methods of anthrax were 73.8 (590/800), 78.8 (630/800) and 56.6% (453/800), respectively. The most known symptom, transmission route and prevention methods by the communities were sudden death in cattle (14.4%), ingesting of blood contaminated grass (13%) and isolation of anthrax infected animals (7.6%), respectively (Table 4).

Professionals: The number of professional respondents who reported for each one or more symptoms, transmission and control/prevention methods of animal anthrax was 74.2 (46/62), 79 (49/62) and 80.7% (50/62), respectively. Sudden death (53.2%) and contaminated soil (56.5%) were the most common symptom and transmission route, respectively, while they reported that vaccination (67.7%) of animals were the most effective control/prevention methods (Table 4).

Knowledge on symptoms, transmission, and control/prevention methods in humans

Community members: The number of respondents who knew at least one anthrax symptom in humans was 36.8% (294/800) which was greater than in animals (26.3%, 210/800), and the most recognized symptom by the respondents was fever (22.4%). Moreover, respondents who mentioned one or more transmission routes and control/prevention methods of human anthrax were 20.1 (161/800) and 45.6% (365/800), respectively. The respondent considered that consumption of infected animal products (raw meat & milk) was the common transmission route (15.9%) while vaccination of animals (34.5%) was effective mechanisms of control/prevention methods (Table 6).

Professionals: More than ninety percent of the professional respondents knew for each one or more anthrax symptoms, transmission routes and prevention methods. The most recognized symptom, transmission route and

control and prevention methods were skin rash (cutaneous wound) (66.1%, 41/62), consumption of infected animal products (raw meat and milk) (83.9%, 52/62) and vaccination of animals (67.7%, 42/62), respectively (Table 6).

Attitude and practice towards anthrax

Fifty two (416/800) and 32.4% (259/800) of the questionnaire participants believed that vaccination of animals could prevent anthrax in animal and human, respectively. But although 4% (32/800) said that they had anthrax (*Megerem*) infected animals, more than 28% (9/32) of them used traditional medication for their animals. Moreover, of the 10.5% (84/800) respondents who had anthrax infected family member, 71.4% (60/84) visited local healers (Table 6).

Qualitative

Knowledge on anthrax/*Megerem*

Different local name of the disease in animals in different locality: The researchers approached the participants by using the local name *Megerem* which is commonly known in Tigray. However, the researchers gave opportunities to the participants to name their own local name of the disease by telling the clinical signs of the disease in animals and humans when they failed to recognize the name *Megerem*. Because farmers usually named diseases based on their clinical signs and lesion/pathology they found in animals.

... I do not know the disease Megerem, but I have heard about it. But I know Lalish and Gulbus in animals (male participant, Sebeya). This participant called another person for help, a deacon male participant. The second participant had given similar opinion with some clarifications.

...I do not know Megerem in animals. Perhaps we can learn from you. But in cattle, there are other diseases I know. One is "Lalish", enlargement of the spleen. Moreover, there is another fatal disease called "Gulbus" showing cramp like symptoms and shivering. This disease may sometimes be confined around the head (neck swelling), in this case animal may not die soon (the deacon male participant, Sebeya). This idea was supported by most of this FGD (Sebeya) participants. The FGDs participants from Ganta-afeshum district had similar understanding about the disease. A 78 age male participant named the disease in animals *Tafia* (enlargement of spleen) (Hageresela tabia, Ganta-afeshum district). Similar suggestions had been given in Bizet tabia of the same district. Especially, a female participant told that *Lalish* was a severe disease of cattle (Bizet tabia, Ganta-afeshum district).

Anthrax/*Megerem* perceived only as human disease: The deacon participant from Sebeya said that *Megerem* appears in the neck/face of humans and could not be cured without treatment (modern medication). Another female participant from the same area shared her knowledge about human *Megerem*. *...My daughter (one year old) was sick (swelling in the wrist). My daughter was waiting without medication for few days. When the swelling has become bigger and bigger, I took my daughter to health center. After medication, she cured but she was suffered.*

The researcher asked: What look likes the swelling? The same female participant responded: *the swelling starts with small size. Then it increases in size with depressed black eschar in the center.*

The researcher added another question: Do you think that this disease can attack animals? *I do not know.* Where your daughter acquired the disease from? *...I did not know its origin or from where it came. If I had known that I could have prevented and/or taken quick measure for my daughter during her suffering.*

Indeed, the second female participant from the same group partially supported the idea of the first female participant but she had different view in the characteristics of the disease. This participant did not agree with the first female participant, especially with the nature of the lesion (depressed black eschar) in the center of the swelling. She said that

the swelling had no depressed black eschar (Sebeya tabia, Gulomkada district). A female participant from Bizet tabia fanatically said that it should not be talking about *Lalish* in front of animals because animals could be panic when they heard the word *Lalish* – indeed; she reflected the belief of the community. However, she failed to relate with human *Megerem* (Bizet tabia, Ganta-afeshum district).

Anthrax perceived by the participants after they had been told its clinical signs: Most FGD participants from Fatsi and Anbesetefikada tabias (both from Gulomkada district) told that they did not know the disease *Megerem*/anthrax, and the disease has not occurred in their locality. However, after the researchers had explained the nature/signs of the disease in animals and humans, few individuals tried to share what they have heard/known about the disease.

...I have seen bleeding from natural orifices of dead animals. But I do not know the name of the disease (male participant, Fatsi). Other participants said that they have seen bleeding through natural orifices and absence of rigor mortis of dead animals but they did not relate to *Megerem* (Hagereselam and Bizet, Ganta-afeshum district).

Knowledge on the causative agent, transmission and control/prevention methods on anthrax/*Megerem*

Most FGDs participants did not know the causative agent, transmission and control/prevention methods of anthrax/*Megerem* in animals and humans. Some of the participants associated *Megerem* in animals with the local belief, Weqh'e (unidentified cause but they told that it caused sudden death): but the participants believed that it can be transmitted to humans through consumption of meat. Some of the participants also believed that the disease could occur in humans when there was stress (e.g. thirst, starvation), and consumption of meat and alcohol might exacerbate the disease. According to these participants, the disease was commonly seen in poor body condition animals, and exacerbated when diseased animals had consumed water. Few participants mentioned that the disease was caused by germs. Regarding the control/prevention methods, FGDs participants agreed that though the disease had been treated using traditional medicine, nowadays modern medication has become their best option in animals and humans. However, some of the participants still believed in traditional medicine – heating, the spleen using hot iron or, around the bottom part of the neck if there was swelling and bloodletting in animals were commonly used. All the FGDs participants did not recognize the GIT and pulmonary forms of the disease in human.

Attitude and practice

Some of the participants knew the disease (in animals) in other names, *Lalish* and *Tafia* (splenomegaly) and *Gulbus* (abdominal cramp and shivering). Some had perceived the disease only as human disease while others recognized after they were told its clinical signs in animals and humans. Most of the participants failed to know the transmission routes of the disease among animals as well as its zoonotic importance. But during the discussion, they remembered that the general health education given by the experts, i.e. not to eat carcass of dead animals. Some of the participants said that they were told not to eat animals died from anthrax/*Megerem*.

...I have heard that if animals died of Megerem, they should have not been eaten their meat and touched their blood. But the community did not perform it (male participant, Fatsi). In Sebeya, the researchers raised the issues of the outbreak occurred in 2018, and asked the participants regarding the transmission routes and control/prevention measure to be taken: *... We had been informed that a girl (tenth grade student) has died of eating dead animal meat. And experts told us that animal died of such kind of disease should have not been eaten...* (Participants from Sebeya).

According to the key informants, eating habit and living style of the communities would risky to contract anthrax. *... Indeed, there were no animals died from anthrax. But if animals died of any cases (for example rabies), individuals would resist burying the carcass; they need to consume it* (Meida Agame health center director, Adigrat town district). Other key informants said that the communities had lived with their livestock in the same house (indeed poverty is our

main challenge) (Tekhli Siwuat health center director (Adigrat), and they slaughtered animals for meat purpose at home (never use abattoir) (Bizet health center director, Ganta-afeshum district). Another challenge reported by officers is that the negative attitude of the community towards animal vaccination against infectious diseases (including anthrax) (Gulomkada district animal health and Adigrat Veterinary clinic coordinators). Instead, they prefer visiting the local healers to modern treatment and vaccination (Gulomkada District Health coordinator).

Reasons of low KAP of the community towards anthrax

In general, the low KAP towards anthrax was arisen from three different reasons:

1) Animal and human health officers

Anthrax as a forgotten disease: Key informants already admitted that their respective communities had low KAP towards anthrax and they said that the disease was not their priority to be prevented:

...Our community has low awareness towards anthrax because we do not deliver adequate health education specific to anthrax. Since the disease is not common, it is not in our top lists. Rather we do inform the community the general impacts about zoonotic diseases like tuberculosis and rabies (Fatsi health center director). Likewise, the director of Tekli Siwuat health center of Adigrat said: *...we have no scheduled separate prevention program against anthrax. But we try to associate with rabies prevention program* (according to the director, rabies outbreak was common in the town).

Similar suggestions have been given by other human health officers (Adi-aynom and Meida Agame health center officers from Ganta-afeshum and Adigrat town districts, respectively). They said that anthrax cases were not admitted to their health centers. Moreover, they told that the disease had not occurred in their surroundings and that is why health education given specifically against anthrax was poor. One of the key informant described anthrax as a “forgotten” disease. *...long time ago there were rare anthrax cases but nowadays it is being forgotten* (Meida Agame health center director, Adigrat town district).

Irregular health education: Some of the key informants said that health educations were conducted in Sebeya and Bizet where anthrax outbreaks had occurred in their locality. The director of Sebeya health center said: *...there was an outbreak that killed a girl and left diseased others in a village called Adibeteksian* (Adibeteksian found in Sebeya tabia). *The source of the case was a cow died from anthrax. The girl was presented to our clinic with high abdominal cramp and fever. ...though finally the cause was role out as anthrax (by Aider specialized hospital), we failed to save the life of that innocent girl. The then time, we have begun health education together with the veterinarians in the area. We started teaching the community during the funeral of the girl that it was because of the delay that she lost her life so that they must immediately bring their children when they observe such signs, and should avoid consuming animals that are sick and even carcass of apparently healthy animals which are not properly inspected.*

The animal science and health district (of Gulomkada) coordinators confirmed the above suggestions, i.e. after the outbreak of anthrax occurred in Sebeya (in 2018), awareness creation education towards anthrax has been started in Sebeya and its surroundings. However, from the interviews held, we found that though health educations were concentrated in areas where there were anthrax outbreaks, health educations could not continue when the outbreak has been controlled: *...During the anthrax outbreak (to control the disease) we were doing with the human health professionals in an integrated way. However, after controlling the disease we did not continue to work together for prevention purpose* (Animal science district coordinator- Gulomkada).

2) Government

Since anthrax is a neglected tropical disease, the government of Ethiopia has not given priority for anthrax. Government has not been funding specifically for anthrax prevention program. Neither health education specific to anthrax nor human anthrax vaccine was given.

...So far, we do have more than 15 vaccines but there is no human anthrax vaccine independently or in combination with others (Fatsi health center director, Gulomkada district). Moreover, though anthrax can be prevented using ante- and postmortem inspections, it was indicated that there was no proper abattoir and slaughtering method (Bizet health center director, Ganta-afeshum district). The officer added that there was no even a single investor that could invest on abattoir. Other officers reported that there was inadequate veterinary clinics and drugs in (Animal science district coordinator- Gulomkada), and man power (Adigrat Veterinary clinic coordinator) to tackle the disease. *... There were also remote areas where we cannot access it via vehicles even during the epidemics of anthrax. ...Nowadays the community is reluctant to the local delivering (by gathering people) way of health education; the community may need modern mass Medias staying at home which the government ought to have afforded* (Gulomkada District Health coordinator).

3) Community

The negative attitude of the community towards anthrax contributed its own challenge to the prevention of anthrax. Focus group discussions and KIs revealed that the community has still stuck to local beliefs. Even though the communities were not given adequate educations, they also resist implementing what they have been told, and fix themselves to the traditional way of living style.

Discussion

Anthrax is a neglected tropical disease, and it is hardly studied in Ethiopia. Pieracci et al. [28] have prioritized that anthrax as the second disease in Ethiopia based on its negative impacts at the household level by causing disease or production losses in livestock and severe disease in human. However, this study showed that anthrax has not been given yet any priority in Ethiopia. Key informants from Gulomkada said that anthrax has been a problem in the community which caused human death and socio-economic crisis. But another key informant from Adigrat said that anthrax was a forgotten disease. This indicated that there was no anthrax control/prevention program coordinated by the central government. In our study, socio-demographic/social differences of the study community (age, sex, animal ownership, and district) were significantly associated with the knowledge of the disease.

Link and Phelan [35] indicated that social conditions (e.g. race, socioeconomic status, gender, and other stressful life events of a social nature) are going to be fundamental causes of diseases. Moreover, In West Africa, during the epidemic of Ebola, the traditions of local communities frequently challenged the control program of the disease [36]. These problems could be solved by education. The Health Belief Model posits that messages will achieve optimal behavioral change if they successfully target perceived barriers, benefits, self-efficacy, and threat [37].

Even though 62% of respondents said that they knew the disease anthrax/ *Megerem*, only 9.3% of them explained its causative agent, i.e. the germ. About 9% and 4.3% believed that as if the disease were God given and caused by other entities (heredity, witchcraft, lack of sanitation, hunger, insects, thirst), respectively while 77.6% did not know the causative agent of the disease. Among the listed clinical signs, only 26.3% and 36.8% of the respondent name at least one signs in animal and human, respectively. During the questionnaire survey data collection, we observed that some respondent perceived staphylococcal skin infection, locally (in *Tigrigna*) called *Migli Chiwa*, as cutaneous anthrax in humans. We had also been encountered similar condition in animals. According the FGDs, in animals, the swelling was developed around the lower neck which was not fatal, locally called *Zigag*. This might be mistaken with the throat

swelling caused by subacute form of anthrax [1]. The poor understanding of the study community on the overall of the disease was revealed by qualitative results. In fact, similar findings were reported from Zambia: quantitative results showed good awareness among respondents while qualitative results indicated poor knowledge of the same communities on the disease [27].

More than 38% of the respondents had no formal education. It was also reported by the key informants that except in Sebeya (education was given during the outbreak), health education was not given. Hence, it was not expected that the study community could have been aware regarding the disease. This scenario is similar with Sitali et al. [27] who suggested that education influences one's access to information and ability to comprehend health messages. Even involvement of educated family members in farming practices can create awareness and improve knowledge toward zoonotic disease [31]. Indeed, the present study community did not find adequate public health messages. Among the survey respondents who claimed to have known anthrax (496/800), about 90% (446/496) of them acquired information regarding the disease from family, friends and neighbours/colleagues, which might expose the community members to seek misconceptions and myths surrounding the disease [27].

During the FGDs, some participants said that they did not know *Megerem* in animals but *Lalish* and *Tafia* (splenomegaly) and *Gulbus* (abdominal cramp and shivering), and others described the clinical signs like bleeding in dead animals. These circumstances indicated the absence/lack of consistent health education in the study area. Consistent with this study, Opare et al. [25] showed that most respondents did not know the causes of anthrax but recognized the signs of the disease. Moreover, in the questionnaire survey, the number of respondents who knew the clinical signs was better than respondents who knew the cause of the disease. Although 74.2 and 90.3% of the professional respondents name at least one sign of the disease, only 55.7% of them knew the causative agent of the disease.

About 10 and 11% of the respondents had felt that anthrax was a serious disease of animals and humans, respectively. And 52 and 32.4% of them believed that vaccination could prevent the disease in animals and humans. However, only 4.4% (35/800) of them have vaccinated their animals. In general, we observed the KAP of the respondents on anthrax: knowledge was better than attitude, and attitude was better than practice. This is supported by a study conducted in Ghana which indicated that high levels of knowledge of the farmers on vaccination had not been realized into practices [25].

In fact, practice might be influenced by culture and socio-economic factors. The deep-rooted belief could not be changed unless the Health Belief model variables successfully inculcated in the community. This model suggested that individuals who perceive a risk which can cause low health problem are unlikely to engage in behaviors to reduce their risk of developing that particular health problem; hence, optimal behavioral change is achieved if the Health Belief Model successfully target perceived barriers, benefits, self-efficacy, and threat [37].

Participants from Sebeya tabia said that they had been informed that the meat of an infected animal was the cause for the death of the girl. But the participant uncovered his reluctance to the public health messages given. In the Ebola period of West Africa, some of the local people not only detached themselves off from help but also they were fighting the prevention program delegations and killed eight members. Finally, control and prevention program was successful when the community was made part of the program using social mobilization action [36]. Other reports indicated that how notions of 'the community' can be problematic if used uncritically [38, 39].

On the other hand, socio-economic factors could affect a practice made to avoid a given risk. One of the key informants pointed out "indeed poverty is our main challenge". This was to claim that the community had lived with their livestock in the same house. According to other key informants, the community resisted to bury the carcass of

dead animals. Consumption and selling of animal carcass died from anthrax was reported by other studies: this is not only to make financial return but also as a source of protein [14, 25, 27, 40]. Key informants also said that there were remote and inaccessible areas which could not get veterinary services. Sitali et al. [13, 27] reported that practices that can be used to prevent anthrax have been impacted by infrastructure. Bruce and Phelan (1995) postulated the essential feature of fundamental social causes which involve access to resources (e.g. money, knowledge, power, prestige) that can be used to avoid risks or to minimize the consequences of disease once it occurs. Likewise, similar theory was formulated by Phelan et al. [41] which states differences in socio-economic status brings inequality in health.

The study has its own limitations. There was no common local name for anthrax in the study areas. During our quick survey, we identified that anthrax was commonly called Megerem. This local name is widely known in Tgray. But some of our study village residents called the disease with different local names. During interview, the respondents could not understand the disease, their response might be “No or I did not know”, or they understood the disease differently (mostly *Megli Chiwa* in human and *Zigag* in animals - both are non-fatal swellings). Having felt this problem, we trained our enumerators how to approach the respondents who had different understanding about the disease. The presence of local veterinarian during the discussion might also bias the response of the FGDs participants.

Conclusion

In general, the KAP of the participants towards anthrax was low. Moreover, there was no similar understanding of the disease among the participants. The study also revealed that the participants did not get consistent, adequate and continuous health messages regarding the disease. Traditional belief and socio-economic factors impacted the KAP of the community towards the disease. During the epidemic of Ebola in West Africa, the communities of the respective countries not only resisted the health messages but also challenged the control program [36]. Hence, to hold health risky tradition by the community is not uncommon. It is the responsibility of the government and the experts to uproot this tradition. This can effectively be done through community-centered programs.

Declarations

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Availability of data and materials

Data will not be made public to keep the confidentiality of the participants but can be obtained from authors on reasonable request.

Authors' contributions

GR and WG designed the study and developed the questionnaire, collected the qualitative data, supervise and participated in the questionnaire survey data collection; GR analyzed and interpreted the data; GR and WG have drafted, critically reviewed and approved the manuscript.

Ethics approval and consent to participate

Ethical approval was obtained from Adigrat University, Deans and directors Committee (DDC) which was responsible for Research and Ethical issues. Moreover, oral informed consent was obtained from all interviewees.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Tables

Table 1: Socio-demographic characteristics of the respondents

Variable		Professionals (n=62)		Community (n=800)	
		Number	%	Number	%
Sex	Female	31	50.8	361	45.1
	Male	30	49.1	439	54.9
Age	18-25	10	23.3	68	8.6
	26-33	22	51.2	124	15.7
	34-41	5	11.6	146	18.4
	42-49	3	7.0	116	14.7
	50-57	3	7.0	115	14.5
	58-65	0	0	101	12.8
	>65	0	0	122	15.4
Education	No formal education	-	-	309	38.6
	1-4	-	-	110	13.8
	5-8	-	-	160	20
	9-10	-	-	136	17
	11-12	-	-	38	4.8
	Diploma	37	61.7	27	3.4
	Degree	20	33.3	18	2.3
	MSc	3	5	2	0.3
Occupation	Civil servant	-	-	39	4.9
	Merchant	-	-	145	18.1
	Farmer	-	-	449	56.1
	Daily worker	-	-	44	5.5
	Students	-	-	18	1.6
	Other	-	-	12	1.5
	Unemployed	-	-	98	12.3
Animal ownership	Have	13	21	452	56.5
	Have not	49	79	348	43.5
District	Adigrat	25	40.3	237	29.6
	Gulomkada	17	27.4	310	38.8
	Ganta-afeshum	20	32.3	253	31.6
Religion	Orthodox	54	94.7	770	96.7
	Catholic	2	3.5	6	0.8
	Muslim	1	1.8	19	2.4
	Protestant	-	-	1	0.1
Profession	Human health	49	79	-	-
	Veterinarian	13	21	-	-

Table 2: Knowledge on the disease, its cause and zoonotic nature by the community member respondents

Variable		Knowledge on the disease		Knowledge on the cause of the disease				Zoonotic nature		
		Yes (n/%)	No (n/%)	Germ (n/%)	God given (n/%)	*Other (n/%)	Don't know (n/%)	Yes (n/%)	No (n/%)	Don't know (n/%)
Sex (n= 800)	Female	229/63.4	132/36.6	22/6.1	37/10.3	14/3.9	288/79.8	66/18.3	62/17.2	233/64.5
	Male	267/60.8	172/39.2	52/11.9	34/7.7	20/4.6	333/75.9	95/21.6	64/14.6	280/63.8
	Total	496/62	304/38	74/9.3	71/8.9	34/4.3	621/77.6	161/20.1	126/15.8	513/64.1
Age(n= 792)	18-25	23/33.8	45/66.2	3/4.4	4/5.9	1/1.5	60/ 88.2	12/17.7	5/7.4	51/75
	26-33	59/47.6	65/52.4	11/8.9	4/3.2	1/0.8	108/87.1	20/ 16.1	9/7.3	95/76.6
	34-41	88/60.3	58/39.7	12/8.2	16/11	5/3.4	113/77.4	34/23.3	20/13.7	92/63
	42-49	77/66.4	39/33.6	17/14.7	10/8.6	5/4.3	84/72.4	28/24.1	19/ 16.4	69/59.5
	50-57	80/69.6	35/30.4	16/13.9	13/11.3	3/2.6	83/72.2	26/22.6	21/18.3	68/59.1
	58-65	80/79.2	21/ 20.8	7/6.9	7/6.9	10/9.9	77/76.2	18/17.8	28/27.7	55/54.5
	>65	84/68.9	38/31.1	6/4.9	17/13.9	9/ 7.4	90/73.8	20/16.4	23/18.9	79/64.8
	Total	491/62	301/38	72/ 9.1	71/9	34/ 4.3	615/ 77.7	158/20	125/15.8	509/ 64.27
Education (n= 800)	No formal education	205/66.3	104/33.7	24/7.8	36/11.7	15/4.9	234/75.73	49/15.9	64/20.7	196/63.4
	1-4	78/70.9	32/29.1	13/11.8	11/10	4/3.6	82/74.6	29/26.4	12/10.9	69/62.7
	5-8	104/65	56/35	16/10	12/7.5	10/6.3	122/76.3	37/23.1	28/17.5	95/59.4
	9-10	64/47.1	72/52.9	7/5.2	9/6.6	3/2.2	11/86	17/12.5	13/9.6	106/77.9
	11-12	18/47.4	20/52.6	2/5.3	2/5.3	0	34/89.4	10/26.3	4/10.5	24/63.1
	Diploma	16/59.3	11/40.7	7/25.9	1/3.7	2/7.4	17/63	11/40.7	4/14.8	12/44.4
	1 st degree & above	11/55	9/45	5/25	0	0	15/75	8/40	1/5	11/55
Occupation (n= 800)	Total	496/62	304/38	74/9.3	71/8.9	34/4.3	621/77.6	161/20.1	126/15.8	513/64.1
	Civil servant	28/71.8	11/28.2	9/23.1	2/5.1	6/15.4	22 56.4	15/38.5	8/20.5	16/41
	Merchant	72/49.7	73/50.3	9/6.2	14/9.7	3/2.1	119/82.1	29/20	17/11.7	99/68.3
	Farmer	288/64.1	161/35.9	46/10.2	34/7.6	17/3.8	352/78.4	78/17.4	70/15.6	301/67
	Daily worker	28/63.6	16/36.4	3/6.8	4/9.1	2/4.6	35/79.6	14/31.8	9/20.5	21/47.7
	Students	4/30.7	9/69.2	1/7.7	0	0	12/92.3	1/7.7	2/15.4	10/76.9
	†Other	9/75	3/25	3/25	1/8.3	0	8/66.7	6/50	1/8.3	5/41.7
	Unemployed	67/68.7	31/31.6	3/3.1	16/16.3	6/6.1	73/4.5	18/18.4	19/19.4	61/62.2
Animal ownership (n= 800)	Total	496/62	304/38	74/9.3	71/8.9	34/4.3	621/77.6	161/20.1	126/15.8	513/64.1
	Have	298/65.9	154/34.1	52/11.5	42/9.3	19/4.2	339/75	87/19.3	82/18.1	283/62.6
	Have not	198/56.9	150/43.1	22/6.3	29/8.3	15/4.3	282/81	74/21.3	44 (12.6)	230/66.1
	Total	496/62	304/38	74/9.3	71/8.9	34/4.3	621/77.6	161/20.1	126/15.8	513/64.1
District (n=800)	Total	496/62	304/38	74/9.3	71/8.9	34/4.3	621/77.6	161/20.1	126/15.8	513/64.1
	Adigrat	152/64.1	85/35.9	20/8.4	24/ 10.1	15/6.3	178/75.1	69/29.1	53/22.4	115/48.5
	Gulomkada	155/50	155/50	44/14.2	8/ 2.6	9/2.9	249/80.3	53/17.1	20/6.5	237/76.5
	Ganta-afeshum	189/74.7	64/25.3	10/4	39/15.4	10/4	194/76.7	39/15.4	53/21	161/63.6
District (n=800)	Total	496/62	304/38	74/ 9.3	71/8.9	34/4.3	621/77.6	161/20.1	126/15.8	513/64.1

* Heredity, witchcraft, lack of sanitation, hunger, insects, thirst

†Private company worker, retired

Table 3: Knowledge on the disease, its cause and zoonotic nature by the professional respondents

Variable		Knowledge on the cause of the disease			Forms of the disease†			Zoonotic nature		
		Bacteria (n/%)	*Other (n/%)	Don't know (n/%)	Cutaneous (n/%)	GIT (n/%)	Respiratory (n/%)	Yes (n/%)	No (n/%)	Don't know (n/%)
Sex (n=61)	Female	9/30	5/16.7	16/53.3	23/76.7	11/36.7	11/36.7	26/86.7	2/6.7	2/6.7
	Male	25/80.6	1/3.2	5/16.1	18/58.1	10/32.3	11/35.5	29/93.6	2/6.5	0
	Total	34/55.7	6/9.8	21/34.4	41/67.2	21/34.4	22/36.1	55/90.1	4/6.6	2/3.3
Age (n=43)	18-25	6/80	0	4/40	7/70	4/40	3/30	7/70	2/20	1/10
	26-33	15/68.2	2/ 9.1	5/ 22.7	16/72.7	8/36.1	11/50	20/ 90.9	1/ 4.6	1/ 4.6
	34-41	1/20	1/20	3/ 33.3	4/80	1/20	1/20	5/100	0	0
	42-49	1/33.3	1/33.3	1/ 33.3	1/33.3	2/66.7	1/33.3	3/100	0	0
	>49	2/66.7	1/33.3	0	2/66.7	0	1/33.3	3/100	0	0
	Total	25/58.1	5/ 11.6	13/30.2	30/69.8	15/ 34.9	17/ 39.5	38/88.4	3/7	2/4.7
Education (n=60)	Diploma	19/51.4	4/10.8	14/37.8	24/64.7	9/24.3	12/32.4	35/94.6	1/2.7	1/2.7
	Degree	12/60	2/10	6/30	15/75	9/45	8/40	16/80	3/15	1/5
	MSc	3/100	0	0	2/66.7	3/100	2/66.7	3/100	0	0
	Total	34/56.7	6/10	20/33.3	41/68.3	21/35	22/36.7	54/90	4/6.7	2/3.3
District (n=62)	Adigrat	8/32	5/20	12/48	18/72	6/24	6/24	19/76	4/16	2/8
	Gulomkada	15/88.2	0	2/17.8	10/58.8	10/58.8	8/47.1	17/100	0	0
	Ganta-afeshum	12/60	1/5	7/35	14/70	5/25	8/40	20/100	0	0
	Total	35/56.5	6/9.7	21/33.9	42/67.7	21/33.9	22/35.5	56/90.3	4/6.5	2/3.2
Profession (n=62)	HHPs	22/44.9	6/12	21/42.9	34/69.4	17/34.7	16/32.6	43/87.8	4/8.1	2/4.1
	AHEs	13/100	0	0	8/61.5	4/30.8	6/46.1	13/100	0	0
	Total	35/56.5	6/9.7	21/33.9	42/67.7	21/33.9	22/35.5	56/90.3	4/6.5	2/3.2

†there were individuals who knew more than two form of the disease

* Leishmania, fly

Table 4: knowledge of the community members and professional respondents towards anthrax symptoms, transmission routes and control/prevention methods in animals

Variable	Professionals		Community	
	Frequency (n=62)	%	Frequency (n=800)	%
Number who did not knew anthrax symptoms (n/%)	16	25.8	590	73.8
Number who knew anthrax symptoms (n/%)	46	74.2	210	26.3
Sudden death	33	53.2	115	14.4
Un-clotted dark red blood	26	41.9	32	3
Bleeding from natural orifices	29	46.8	24	4
Incomplete rigor mortis	17	27.4	14	1.8
Other (swelling, wound, pain, fatigue, etc)	8*	12.9*	78	9.8
Number who did not knew anthrax transmission (n/%)	13	21	630	78.8
Number who knew anthrax transmission (n/%)	49	79	170	21.3
Ingesting of blood contaminated grass	33	53.2	104	13
Drinking contaminated water	30	48.4	76	9.5
Licking anthrax dead bones	24	38.7	33	4.1
Through contaminated soil	35	56.5	67	8.4
Believe its transmission but did not tell the method	7	11.3		
Other (inhalation, contact)	-	-	7	0.9
Number who did not knew anthrax control/prevention methods (n/%)	13	21	453	56.6
Number who knew anthrax control/prevention methods (n/%)	49	79	347	43.4
Isolate/separate anthrax infected animals	33	53.2	61	7.6
Avoid with anthrax infected people	-	-	37	4.6
Burn all suspected anthrax animal carcasses	27	43.6	33	4.1
Bury all suspected anthrax carcasses	32	51.6	22	2.8
Vaccinate animals	42	67.7	1	0.1
Bury and burn all suspected anthrax carcasses	22	35.5	1	0.1
Using Traditional medicine	-		36	4.5

*swelling, black wound, diarrhoea, bloat

Table 5: knowledge of the community member and professional respondents towards anthrax symptoms, transmission routes and control/prevention methods in humans

Variable	Professionals		Community	
	Frequency (n=62)	%	Frequency (n=800)	%
Number who did not knew anthrax symptoms (n/%)	6	9.7	506	63.3
Number who knew anthrax symptoms (n/%)	56	90.3	294	36.8
Fever	39	62.9	181	22.4
Chills	28	45.1	80	10
Fatigue	31	50	37	4.6
Skin rash/wounds	41	66.1	68	8.5
Coughing	22	35.5	16	2
Lack of appetite	29	45.2	25	3.1
Headache	25	40.3	15	1.9
Irritability	15	24.1	10	1.3
Diarrhea	17	27.4	7	0.8
Vomiting	21	33.9	8	1
Sweating	21	33.9	12	1.5
Other (swelling, wound, pain, itching, etc)	1*	1.6*	102	12.8
Number who did not knew anthrax transmission (n/%)	6	9.7	639	79.9
Number who knew anthrax transmission (n/%)	56	90.3	161	20.1
Eating infected animal product (raw meat & milk)	52	83.9	127	15.9
Handling infected animals and animal products without protective clothing	28	45.1	66	8.3
Through contaminated soil	24	38.7	28	3.5
Number who did not knew anthrax control/prevention methods (n/%)	5	8.1	435	54.4
Number who knew anthrax control/prevention methods (n/%)	57	91.9	365	45.6
Avoid contact with anthrax infected animals	32	51.6	59	7.4
Avoid contact with anthrax infected people	22	35.5	35	4.4
By avoiding eating anthrax infected animal products	44	71	63	7.9
Bury all suspected anthrax carcasses	34	54.8	28	3.5
Burn all suspected anthrax animal carcasses	28	45.1	20	2.5
Bury and burn all suspected anthrax carcasses	22	35.5	7	0.9
Vaccinate animals	42	67.7	276	34.5
Using traditional medicine	-	-	10	1.3
Other (Keeping good hygiene/sanitation and nutrition)	-	-	9	1.1

*itching

Table 6: Attitude and practice of community member respondents

Question	Response	Frequency	%
What animal husbandry do you practice? (n=452)	Free grazing	84	19
	Zero grazing	354	80.1
	Mixed (free and zero)	4	0.9
	No report	10	2
Have you ever had anthrax infected animal(s)? (n = 800)	Yes	32	4
	No	392	49
	Do not know	376	47
If yes, what action did you take? (n = 32)	Reported to the Veterinarian	8	25
	If died, buried the dead animal	5	15.6
	Consumed meat of the dead animal	0	0
	Remove away the dead animal	7	21.9
	Use Traditional medication (local medicine, bleeding and branded)	9	28.1
	No report	3	9.4
Has any member of your family infected with anthrax? (n = 800)	Yes	84	10.5
	No	404	50.5
	Do not know	312	39
If yes, what action did you take? (n = 84)	Took the person to health facility	3	3.6
	bought drug from pharmacy	0	0
	Took to a local healer	60	71.4
	We did nothing	2	2.4
	use both (took to health center and local healer)	2	2.4
	Do not know	1	1.2
	No report	16	19.1
Do you think that vaccination of animals can prevent anthrax in animals? (n = 800)	Yes	416	52
	No	44	5.5
	Do not know	340	42.5
Do you think that vaccination of animals can prevent anthrax in humans? (n = 800)	Yes	259	32.4
	No	134	16.8
	Do not know	407	50.9
Do you think that anthrax is a serious disease of animals? (n = 800)	Yes	78	9.8
	No	418	52.3
	Do not know	304	38
Do you think that anthrax is a serious disease of humans? (n = 800)	Yes	90	11.3
	No	406	50.8
	Do not know	304	38
Were your animals vaccinated against anthrax? (n = 800)	Yes	35	4.4
	No	28	3.5
	Do not know	737	92.1

Figures

Figure 1

Map of the study area

Supplementary Files

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