BHUTAN JOURNAL OF ANIMAL SCIENCE
Dorjee et al. 2017 Bhutan Journal of Animal Science 1 (1): 42-46; http://www.moaf.gov.bt

Animal Health article

Anthrax in East-Central Bhutan: knowledge, perceptions and practices of rural communities

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ARTICLE HISTORY

Received: 11/12/16
Peer reviewed:12-25/12/16
Received in revised form:
Accepted:

KEYWORDS

Anthrax
Community
Disease
Livestock
Participatory Epidemiology

ABSTRACT

The objectives of the study were to assess the communities' knowledge, perceptions and practices on anthrax and identify preferred channel of information or communication by the communities about anthrax in east-central Bhutan. The participatory epidemiological (PE) tools were used and a total of 18 villages were selected for the study. PE techniques used with the communities included participatory mapping, simple ranking, seasonal calendars, proportional piling, matrix scoring, transect walks, and probing. At least one semi-structured interview involving 6 to 16 respondents was held in each village. In addition, the key informants were interviewed after every group session. The results showed that cattle were the most important livestock species reared. Foot and Mouth Disease and anthrax were perceived to be the most important livestock diseases in the communities. The proportional piling scores indicated that the median scores (with range) for the sick, recovered and death due to anthrax were 17 (5-22), 2 (0-5) and 14 (5-20), respectively. Communities perceived anthrax as a fatal disease but had limited knowledge on the disease epidemiology and risks to animals and humans. The most preferred channel of communication for awareness was mobile phone while social mobilization including TV and radio were the most preferred source for information. The study finding suggests the need to reinforce community knowledge about anthrax through awareness education.

INTRODUCTION

Anthrax is primarily a disease of herbivorous animals, although all mammals, including humans, and some avian species can get the disease (OIE 2008). The disease is caused by bacterium *Bacillus anthracis* and has a world-wide distribution (OIE 2008). Anthrax can cause uncontrolled mortality in animals leading to huge economic losses. For instance, about 10,000 livestock died during 1979-1982 anthrax epidemic in Zimbabwe (Hubálek et al. 2011). Similarly, about 70 cattle, horses and pigs died during an anthrax outbreak in Romanian Danube Delta in 2000 (Hubálek et al. 2011). Anthrax epidemic has also been reported in bisons in the USA in 2007 (Hubálek et al. 2011).

Anthrax is a zoonotic disease and outbreaks and epidemics also occur in humans (WHO 2008). The most notable was the epidemic in Zimbabwe, which affected more than 10,000 people with a case fatality rate of 1-2% between 1979 and 1985 (WHO 2008). During an epidemic in Gambia, 448 cases of human cutaneous anthrax were diagnosed with 12 known deaths (WHO 2008). Case fatality rates due to anthrax are occasionally substantial, such as in the Sverdlovsk incident that occurred in 1979 in the former Soviet Union, with 66 known deaths (WHO 2008). In the 2001 bioterrorist anthrax letter events in the USA, 22 clinical cases were reported with 5 deaths (Hubálek et al. 2011). However, the number of anthrax cases in the world varies from 5 to 100,000 annually, with a considerable mortality of 25-100% in non-cutaneous forms and 5-20% fatality rate in cutaneous forms of anthrax (Hubálek et al. 2011).

In Bhutan, sporadic anthrax outbreaks occur annually among animals, posing health risks to persons who come into contact with the infected animals. Human exposures are attributed to handling and consumption of meat derived from anthrax infected carcasses due to lack of awareness and education on the public health importance of disease. Anthrax is endemic in Bhutan with an average of two outbreaks occurring every year in the country. Between 1998 and 2012, a total of 34 outbreaks of anthrax had been reported in animals at the village level, affecting 24 sub-districts in 14 districts in Bhutan and causing deaths to 145 animals (Tenzin et al. 2012). A major anthrax outbreak occurred in 2010 in Ngangla sub-district under Zhemgang district in east-central Bhutan, affecting 9 villages and causing deaths to 43 animals i.e. 25 cattle, 4 horses, 4 pigs and 6 cats (Thapa et. al. 2014). The outbreak in animals resulted in transmission to humans causing cutaneous form of anthrax in nine people including one death. The death was possibly due to gastrointestinal form of anthrax as a result of consuming meat of anthrax infected carcass (Thapa et. al. 2014). Although anthrax is a notifiable disease in Bhutan, the livestock para-veterinarians and general public lack knowledge on the disease, thus, many cases may have gone unreported. Moreover, the involvement of different species

in most outbreaks and occasional human exposures indicate lack of knowledge on the public health importance of the disease (Thapa et al. 2014). Therefore, a better understanding of communities' knowledge, attitude and practices (KAP) by using Participatory Epidemiology (PE) tools may help to improve our understanding about anthrax in rural communities of Bhutan.

PE is the systematic use of participatory approaches and methods to improve understanding of diseases and options for animal disease control (Catley et al. 2012). It refers to the essential involvement of communities in defining and prioritizing veterinary-related problems, and in the development of solutions to service delivery, disease control or surveillance (Catley et al. 2012). Semi-structured interviews (SSI), visualization methods, ranking, and scoring methods are three main groups of participatory methods used in PE. Various PE tools have been used in the field of veterinary sciences to understand the epidemiology of livestock diseases, disease ranking, control programs, impact of livestock diseases (e.g. Catley, et al. 2002 a,b; Catley et al. 2012; Ameri et al. 2009; Bett et al. 2009; Adrawa et al. 2010). However, no such tools have been applied to understand the epidemiology of anthrax or other animal diseases in Bhutan. Therefore, a study was conducted with two main objectives. The first objective was to assess the communities' knowledge, perceptions and practices (KAP) about anthrax in selected communities of Ngangla sub-district, Zhemgang district in east-central Bhutan. The second objective was to identify the preferred channel of information or communication on anthrax by the communities.

MATERIALS AND METHOD

Study site and method

The study was conducted in November 2012 in Ngangla sub-district under Zhemgang district in east-central Bhutan. A village was a sampling unit and a total of 18 villages were purposively selected for the study. The selected villages were stratified into "at-risk" and "not at-risk" villages based on their proximity to the area of anthrax outbreaks that occurred in 2010.

The PE techniques used were participatory mapping, simple ranking, seasonal calendars, proportional piling for morbidity and mortality, matrix scoring, and transect walks (Catley et al. 2002(a); Catley et al. 2002(b); Ameri et al. 2009; Bett et al. 2009; Adrawa et al. 2010; Catley et al. 2012). Simple ranking tool was used to obtain information on the preferred source of communication and health information about anthrax. Seasonal calendars were used to understand local perceptions on the seasonal variation of key livestock diseases, risk factors such as climate and location, rainfall pattern, vaccination schedules and their impact on the control measures. The community knowledge on anthrax and other key diseases was assessed with matrix scoring tool. All scoring exercises were conducted using 100 beans and followed procedures described by Ameri et al. (2009) and Catley et al. (2012). The PE tools used in this study were pre-tested in three anthrax affected villages under Trongsa district (adjoining to Zhemgang district) but were not included in this study.

A total of 108 participants from 18 villages were involved during the study. Participants comprised of 53 males and 55 females. Participants were probed on health and treatment seeking behavior and traditional practices prevalent in the communities to manage anthrax in animals and humans. Ten semi-structured interviews were carried out in 18 villages. At least one interview involving 6-16 participants was conducted in each village. Triangulations were done through transect walks and independent interviews of key informants after every group session.

Data analysis

Data generated from this PE exercise were processed in Microsoft Excel 2007 (Microsoft Windows, USA) and were analyzed using Epi Info™ 7 (CDC, Atlanta) and statistics add-in for Microsoft Excel - PHStat2 version 2.7. The mean scores of each clinical sign for anthrax analyzed by matrix scoring technique for lower Ngangla and upper Ngangla communities were compared using two-sample t-test.

RESULTS

Livestock species ranking

Participants listed cattle, horses, pigs, chicken, cats and dogs as the common livestock species reared by the communities. The standardized analysis of simple ranking showed that cattle was the most important livestock species followed by chicken, horses, pigs and goats. Chicken was perceived to be the second most important livestock species in lower Ngangla communities while horse was the second ranked species in upper Ngangla.

Livestock disease ranking

Participants listed Foot and Mouth Disease (FMD), Anthrax, Black Quarter (BQ), Bovine Enzootic Hematuria (BEH), Non-specified Gastroenteritis, Mastitis, and Fascioliasis as the most common livestock diseases in the communities. The standardized analysis of simple ranking showed that FMD was the most important livestock disease followed by anthrax, BEH, BQ and non-specified gastroenteritis (Table 1). Chronic Obstructive Pulmonary Disease (COPD) and colic in horses were perceived to be the least important diseases based on morbidity and mortality rates in the study areas.

Table 1 Simple ranking of livestock diseases (n=10) in Ngangla, Zhemgang district, Bhutan, 2012

Livestock Diseases	Total Score	Rank
FMD[£]	53	1
Anthrax	35	2
BEH[¥]	29	3
BQ[β]	25	4
Non-specified Gastroenteritis	22	5
Mastitis	21	6
Fascioliasis	15	7
Bloat	10	8
Coccidiosis	8	9
Phototoxicity	8	9

[£]Foot and Mouth Disease, [¥]Bovine Enzootic Haematuria, [β]Black Quarter

Relative morbidity, mortality and case fatality rates

The median score and range for the sick, recovered and death due to anthrax were 17 (5-22), 2 (0-5) and 14 (5-20), respectively, compared to 24 (9-43), 7 (3-34) and 6.5 (4-26) for FMD (Table 2). The mean relative morbidity, mortality and case fatality rates for anthrax in the study areas were 15.6 ± 6.5, 13.4 ± 5.4, and 88.2 ± 12.6, respectively. Table 2 also describes the median score and range for sick, recovered, and dead, using proportional piling for relative

morbidity and mortality for common livestock diseases including anthrax.

The 95% confidence intervals (CI) calculated from the sample mean for relative morbidity, mortality and case fatality rates for anthrax were 7.6 – 23.6, 6.7 – 20.1 and 72.6 –103.8 respectively (Table 3).

Community knowledge, perceptions and practices about anthrax

The matrix scores indicated relatively strong association between the disease and clinical signs such as off-feed, dullness, weakness, abdominal distension and sudden death with median scores of 3.0, 0.5, 0.0, 14.5, and 24.5 respectively (Table 4). There was no significant difference in the level of understanding about anthrax between upper and lower Nangla communities (Table 5).

Communities perceived anthrax as a fatal disease but had limited knowledge on the disease epidemiology and the risks to animals and humans. However, they perceived women and pregnant women as the vulnerable group followed by children, old aged and disabled people. Communities also had a practice of consuming meat of the animals that die suddenly. This is because they believed that these animals die of some natural curse and not due to any diseases.

The result of seasonal calendars showed that anthrax occurred mostly during rainy season (June to August). However, anthrax vaccination by the government is usually scheduled during the months of August to November in the study areas (Figures 3 and 4). On the health and treatment of anthrax in animals and humans, it was evident that participants preferred modern animal and human health care services compared to traditional healing practices.

Table 2 Median score and range for sick, recovered, and dead by proportional piling for morbidity and mortality for common livestock diseases in Ngangla, Zhemgang district, Bhutan, 2012. Figures in parenthesis are range of scores.

	Median		
Disease	Sick	Recovered	Dead
FMD (n=8)	24.0 (9-43)	7.00 (3-34)	6.50 (4-26)
BEH (n=6)	7.50 (6-9)	4.00 (0-7)	4.00 (2-6)
BQ (n=5)	8.00 (5-14)	5.00 (2-7)	3.00 (3-7)
Gastroenteritis (n=4)	20.5 (5-32)	16.5 (3-28)	3.50 (2-5)
Mastitis (n=4)	11.5 (7-15)	10.5 (7-15)	0 (0-2)
Anthrax (n=5)	17 .0(5-22)	2.00 (0-5)	14.0 (5-20)
Fascioliasis (n=3)	14.0 (6-25)	6.00 (2-10)	4.00 (4-19)

Table 3 Confidence Interval (95%) for overall morbidity, mortality and case fatality rates for key livestock diseases and anthrax (n=10) in Ngangla, Zhemgang district, Bhutan, 2012. Figures in parenthesis show overall morbidity, mortality, case fatality rates and CI for anthrax.

Data	Morbidity	Mortality	Case fatality
Sample SD[β]	8.0 (6.5)	11.1 (5.4)	18.6 (12.6)
Sample Mean	63.7 (15.6)	30.6 (13.4)	49.2 (88.2)
Sample Size	10.0 (5.0)	10.0 (5.0)	10.0 (5.0)
Df[¥]	9.0 (4.0)	9.0 (4.0)	9.0 (4.0)
t-test value	2.3 (2.8)	2.3 (2.8)	2.3 (2.8)
CI[£]	57.9-69.4 (7.6-23.6)	22.7-38.5 (6.7-20.1)	35.9-62.5 (72.6-103.8)

[β]Standard deviation, [¥]Degree of freedom, [£]Confidence interval

Table 4 Community knowledge on anthrax (using matrix scoring technique) in Ngangla, Zhemgang district, Bhutan, 2012. Number of informant groups = 10. Numbers represent the scores (number of seeds) that were used during the matrix scoring. A high score indicates a relatively strong association between a sign and a disease. Other diseases include mastitis, bovine enzootic haematuria, bloat and gastroenteritis. Figures in parenthesis are median scores.

Clinical sign	Disease			
	FMD[£]	BQ[¥]	Other Diseases	Anthrax
Off-feed	11 (11.5)	3 (0.0)	11 (8.5)	5 (3.0)
Dullness	9 (8.0)	4 (0.0)	14 (7.0)	3 (0.5)
Weakness	11 (12.5)	2 (0.0)	16 (12.0)	1 (0.0)
Distension	1 (0.0)	3 (0.0)	11 (6.0)	15 (14.5)
Sudden death	1 (0.0)	1 (0.0)	5 (0.0)	23 (24.5)

[£]Foot and Mouth Disease, [¥]Black Quarter

Preferred source of communication and information about anthrax

Communities listed mobile contact as the most preferred source of communication, followed by personal visits to the Livestock Extension Centers, and reporting through village representatives. Communities also expressed that social mobilization (public gathering) is the most preferred source of information, followed by TV, radio broadcast and print media.

DISCUSSION

The PE tools to understand the disease outbreak pattern and epidemiological situations of livestock diseases are not employed so far in Bhutan. This is the first study conducted to understand the community knowledge, perceptions, and practices about anthrax in Bhutan.

Among the livestock diseases, FMD was perceived as the most important livestock disease followed by anthrax when compared to other diseases. This may be due to frequent outbreaks of FMD and anthrax in these communities causing high morbidity and mortality of animals and economic losses. In a similar KAP study in the communities of Kasese and Rubirizi districts in Western Uganda, anthrax was perceived to be the most important disease at animal-human interface, but FMD was ranked as the seventh important disease (Adrawa et al. 2010).

The study identified two major risks of spreading anthrax among livestock species in the study areas: (a) mid-March to mid-September due to both migration and herding of cattle among the communities during cropping season, and (b) mid-September to mid-March due to interaction among different species of livestock during non-cropping season. During cropping seasons, the migration and herding are usually practiced in common grazing lands, which contribute to the rapid spread of anthrax to other herds in the communities. In non-cropping seasons (after harvest), the animals are usually let out in the open grazing land, which result in mixing of animals. Such practice may be responsible for the occurrence of anthrax in different species of animals. Since there are continuous risks of anthrax transmission and spread in the communities throughout the year, it is important that the surveillance programs, preparedness plans, and control measures against anthrax

are reviewed and specifically designed to target during these risk periods.

Anthrax outbreaks occurred mostly during rainy seasons. This may be due to the fact that the anthrax spores which are abundantly present in the soils might have surfaced out during heavy rains. Thus, the spores might be ingested by the animals during grazing resulting in infections. This agrees with the finding of previous study that demonstrated anthrax outbreaks occurrence during rainy seasons (Thapa et al. 2014). However, the trends on the outbreaks of anthrax in other parts of Bhutan for the period 1998 to 2012 showed that 35% occurred during winter, 27% occurred during spring and autumn, and only 11% occurred during rainy season (Tenzin et al. 2012). But, the results of this study are based on passive surveillance data and may not provide true picture of the disease incidence. Anthrax is a seasonal disease and the primary conditions affecting the seasonality of anthrax are temperature, rains or drought and the associated humidity (WHO 2008). Moreover, many cases may have been unreported especially in sporadic cases due to lack of adequate knowledge to recognize the clinical signs and symptoms of anthrax in animals. Further studies are necessary to understand the epidemiology and establish the seasonality of anthrax outbreaks in the country.

The participants and the key informants revealed that many people in the communities are ignorant about the types and schedules of different vaccines and control measures implemented by livestock extension centers. The study also showed that anthrax vaccination was practiced annually during the months of August to November in the communities. However, the anthrax outbreaks in the communities are usually reported during the rainy seasons (June to August), which is consistent with the previous study findings (Thapa et al. 2014). Therefore, it is important to review the vaccination schedules of anthrax in animals in the

Although there is relatively a strong association between the clinical signs of anthrax and the disease, the study showed that there is discrepancy in level of knowledge about anthrax in the communities. Most of the participants were not familiar with the clinical signs and symptoms to recognize anthrax in animals and humans, the epidemiology of the disease, risk factors involved, and the public health importance of disease. This finding is similar to the study by Adrawa et al. (2010) in the communities of Kasese and Rubirizi districts in Western Uganda.

The participants in the communities also believed that the animals that died suddenly were not due to any disease consequences but due to some natural curse and thus the meats are usually consumed. As a result of this type of perception among people, the anthrax outbreak during 2010 in Ngangla sub-district had spread in many other communities and affected different species of animals. Further, the humans were also exposed to the disease due to the communities' lack of knowledge, poor perceptions, and orthodox practices about anthrax (Thapa et al. 2014).

The findings of a study in Western Uganda (Adrawa et al. 2010) demonstrated that the most preferred channels of communication and source of health information about anthrax were social mobilization, social institutions and radio. The majority of respondents in that study regarded phone and television as least important since they were expensive to acquire. However, our study showed that mobile phone is the most preferred channel of communication while the livestock extension centers, social gathering and mass media such as radio program as the source of information for diseases. Therefore, there is a need to reinforce the community knowledge about anthrax, its transmission, symptom recognition, prevention and control measures through social mobilization, and radio programs. In addition, to better predict, detect and respond to future outbreaks, the monitoring and reporting system needs to be

Table 5 Comparison of mean scores for clinical signs of anthrax between lower Ngangla and upper Ngangla communities using two-sample t-test, Zhemgang district, Bhutan, 2012

Clinical Signs	Lower Ngangla		Upper Ngangla		*t-test* Statistics	CI[β]	*p*-value
	M[£]	SD[¥]	M	SD[¥]			
Off feed	5.2	6.2	5.8	6.7	-0.15	-10.1 to 8.9	0.89
Dullness	3.0	6.0	3.8	3.9	-0.23	-8.7 to 7.1	0.82
Weakness	0.2	0.4	1.0	1.4	-1.36	-2.2 o 0.6	0.21
Bloat	12.0	11.4	19.5	12.8	-0.97	-25.3 to 10.3	0.36
Sudden death	23.2	7.7	23.5	7.5	0.06	-11.7 to 11.1	0.95

[£]Mean, [¥]Standard Deviation, [β]Confidence Interval (95%)

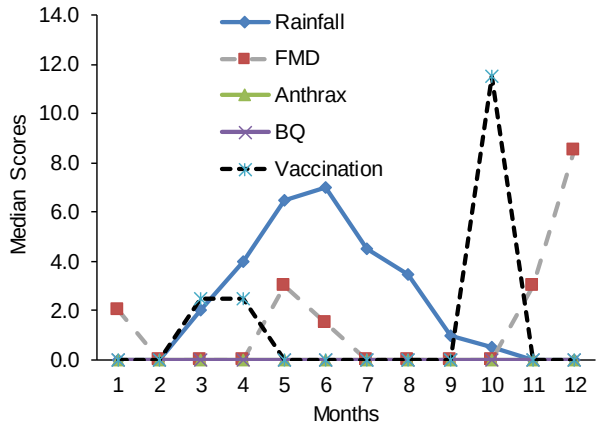

Figure 3 Seasonal variations of diseases and impact of vaccination in lower Ngangla communities.

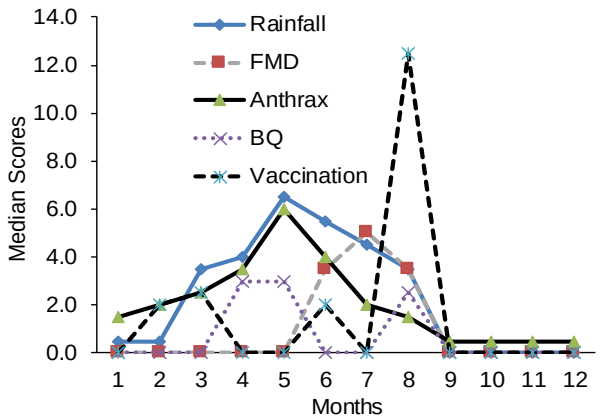

Figure 4 Seasonal variations of diseases and impact of vaccination in upper Ngangla

strengthened with establishment of community-based public health surveillance system for anthrax and other important zoonotic diseases in humans and animals.

Finally, the number of village selection and the semi-structured interviews conducted in this study was constrained by time availability for the field work and distances needed to be covered because of remoteness of the study areas. In addition, the findings of this study are based on community participation through participatory approach, which reflects the local preferences and priorities. However, the findings may not be extrapolated to other districts in Bhutan. Nevertheless, this study provided useful information to guide policy decision on anthrax prevention and control program in the communities and similar study is recommended in other anthrax outbreak areas in the country.

CONCLUSION

This study showed that anthrax is an important livestock disease which causes high morbidity and mortality in the study areas. Communities have low level of knowledge and understanding about anthrax, therefore, public awareness education is required. It is also important to review the existing vaccination schedules for some of the important notifiable diseases in livestock including anthrax based on the disease epidemiological pattern in the communities.

ACKNOWLEDGEMENTS

The authors would like to acknowledge Participatory Epidemiology Network for Animal and Public Health (PENAPH), International Livestock Research Institute (ILRI) and the Rockefeller Foundation for providing necessary technical and fund supports for the study. The communities in the study areas are also acknowledged for their active participation and for providing logistic support to the team during the study.

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