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Risk Factors Assessment of Zoonotic Anthrax among the People at Risk (PAR) in Selected Areas of Bangladesh

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Authors' contributions

This work was carried out in collaboration between all authors. Author MAI designed the study. Authors MAI, MMM and SY wrote the protocol, searched review of literatures and conducted the field works. Authors MAI, MMI and MSAS analyzed the data and wrote the first draft of the manuscript. Author KHMNHN guided the research group, managed fund for research and corrected the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

Aim: A cross-sectional survey was conducted to assess the risk factors among the people at risk in selected areas of Bangladesh, considering awareness, attitudes and management practices towards anthrax.
Methodology: Administrative areas of Bangladesh had been classified into high-, medium-, and low-risk anthrax areas by assessing the risk of anthrax based on the reports published in daily newspapers and scientific journals. The selected high-, medium- and low-risk areas were Kushtia, Pabna and Mymensingh districts. The animal owners and family members, butchers, and the affected people by cutaneous anthrax were considered as the key informants. Data on management practices including feeding, awareness to zoonosis, vaccination and institutional education were collected using interview-questionnaire method. A total of 622 data were

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collected and uploaded to the data collection tools “Magpi”, and the data were analyzed using Epi Info™.

Results: In the study areas, about half of the people had no institutional formal education (46.46%; n=289/622). The farmers at high-risk districts were significantly (p=0.000) aware to anthrax as compared to those from medium- and low-risk districts. The level of knowledge about zoonosis of anthrax and vaccination of anthrax were poor among the people from both medium- and low-risk areas. For treatment of animals, most of the farmers (about 98%) at high- and low-risk areas depended on village doctors. In our study, improper washing of grass and occurrence of flood in the study areas were significantly (p=0.000) correlated with anthrax outbreak.

Conclusion: Increasing awareness towards zoonosis of anthrax, proper vaccination, treatment of diseased animal by registered veterinarians, and washing of grasses before serving to animals may help to reduce the anthrax outbreak in Bangladesh.

Keywords: Anthrax; epidemiology; zoonosis; knowledge; awareness; Bangladesh.

1. INTRODUCTION

Anthrax (popularly known as - *Torka, Duckmina, Duckshal, Dhash* or *Dharash* in Bangladesh) is an acute disease caused by a soil-borne, aerobic, gram-positive, spore forming, non-motile and non-hemolytic bacterium, *Bacillus anthracis*. As a common problem, the disease naturally occurs around the globe; however, nowaday, anthrax is mostly found in tropical and sub-tropical countries [1-2]. In many African and Asian countries, anthrax outbreak occurs periodically in animals, and subsequently transmits to human [3]. Until 2009, the disease was periodically reported in animals and humans in Bangladesh [4]. From 2010, outbreaks of anthrax occurred enzootically. In 2010, there were 687 human cutaneous anthrax cases were recorded. According to the report of the Institute of Epidemiology, Disease Control & Research (IEDCR), Dhaka, 1320 cutaneous anthrax cases were found until July 2016. Human anthrax in Bangladesh is intrinsically related to enzootic anthrax affecting livestock population. This is because of low vaccination coverage despite the country's routine anthrax vaccination program for livestock [5-6].

On the country-side, people and their farm animals live in close vicinity, and direct or indirect human contact with sick and diseased animals is frequent. In previous years, inadequate livestock vaccination coverage, butchering sick animals, disposing butchering wastes and carcass in the environment where animals graze, handling raw meat, social and environmental factor, scarcity and limitation contributed to the outbreaks of anthrax in Bangladesh [7-9].

In Bangladesh, the disease is more prevalent in the Pabna, Sirajganj, Tangail and Kushtia districts which contained the country's largest cattle populations [4].

B. anthracis forms spore in unfavorable conditions, which is resistant to heat and most chemical disinfectants, and this spore may persist in soil as viable for several decades [10-12]. Favorable environmental conditions such as soil pH, Ca content, moisture, soil type, high ambient temperature and rainfall and topography are positively correlated with the persistence of anthrax spores and subsequent outbreaks [7-8,13].

Primarily, herbivores like cattle, sheep, goat, horse and pig are affected with anthrax [7], and the disease is usually fatal for ruminants [14]. It has been reported that occurrence of anthrax in animals and humans partly influenced by lack of awareness [15], improper perceptions, reluctant attitude [16-18], and/or misconceptions [17] about zoonotic nature of the disease. Hence, it is crucial for animal particularly cattle owners and the consumers to acquire a certain level of awareness about livestock diseases in their areas, the risks they pose, and possible transmission routes to humans. Although a few relevant studies in communal areas have focused on risk factors relating to human anthrax outbreaks [19-20], few reports are available describing the detail risk factors particularly among the people at rural areas. The objective of this study was to assess the risk factors of anthrax outbreak among cattle owners and consumers at high-, medium- and low-risk areas in Bangladesh.

2. MATERIALS AND METHODS

2.1 Geography of the Study Area

Administrative areas in Bangladesh have been classified into high-, medium-, and low-risk anthrax areas considering the human anthrax cases published in daily newspapers and scientific journals. The selected high-risk area was Kushtia district, whereas Pabna district was selected as medium risk area, and Mymensingh district was selected as low risk area (Fig. 1). Although anthrax of cattle occurred as endemic nature in different parts of Bangladesh, official document is not clearly available describing the total number of animal cases due to weakness in reporting system. As all human cases originated from animal anthrax during the period of 2010 to July 2015, we considered human cases for assessing risk areas in Bangladesh. We visited the reported areas and collected information by android data collection tools (Magpi version 5.4.1) and susceptible samples for subsequent analysis. Primarily, we visited the human and livestock officials of the particular areas. The animal owners and their family members, people associated with slaughtering, butchering, handling and eating meat of affected animals, people who developed lesions of cutaneous anthrax were considered as the key informants.

2.2 Data Collection and Survey Methods

A cross-sectional survey was employed to collect data from the respondents. A semi structured, open-ended questionnaire was developed to gather information on the awareness, perceptions, and attitudes towards zoonosis by farmers and management practices, feeding habit, environmental conditions such as heavy rainfall and flooding. The questionnaire was uploaded to the data collection tools (http://Magpi.com), and the data were collected by Magpi android data collection application. The questionnaire was completed by two trained veterinarians during the interviews with the farm owners and uploaded instantly from the place where interview was performed through internet. Population statistics of the farms were collected, and Global Positioning System (GPS) coordinates were recorded.

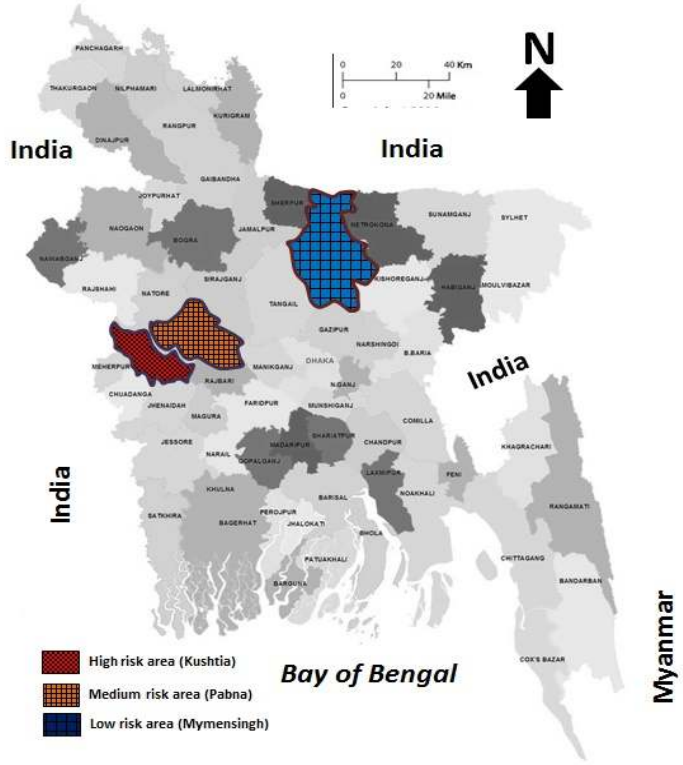

Fig. 1. Study areas in Bangladesh. The figure indicates high, medium and low risk areas of anthrax in Bangladesh

2.3 Data Analysis

The data was extracted from Magpi server as Microsoft Excel database. Data analysis was carried out using Epi Info™ (a trademark of the CDC used version 7.1.5.2) for Windows to generate descriptive statistics (frequencies/ proportions) related to the cattle owners' awareness of zoonosis, management practice, feeding habit, environmental conditions, time of occurrence of anthrax, routes of transmission of the disease, food consumption habits, family and community-based activities, treatment-seeking behavior, and prevention of anthrax. In addition to questionnaire information, data on anthrax outbreaks and cases in cattle and humans in the studied areas were also extracted from the monthly reports of the Division of Livestock Production and Veterinary Services in respective area and reports of newspapers and scientific articles.

3. RESULTS

3.1 Outbreak Occurrence among People during 2010-2015

Table 1 summarizes the number of participants involved in the survey in the studied area for the period January 2010 to July 2015. During this period, the high-risk anthrax districts accounted for 64.4% (n=67/104) of the human outbreaks, followed by the medium-risk districts (35.6%; n=37/104); the low-risk district, no human outbreak was recorded. 22.35% (n=139/622) of the farmers were from anthrax high-risk area, while 40.03% (n=249/622) were from medium-risk area and 37.62% (n=234/622) were from low-risk areas, respectively (Table 1). Out of the 622 farmers, 610 (98.07%) were males and 12 (1.93%) were females. 30% of the farmers were between 20 to 34 years of age (considered as young), 67% were between 35 to 50 years of age (middle age), and the rest 3% were above 50 years (considered as old).

Among the interviewers, about half of the people (51.81%; n=124/249) had no institutional formal education in Pabna district, whereas in Kushtia, 60.43% (n=84/139) had no formal education. In Mymensingh, the overall situation was better than other two districts, where less than 34% (n=81/234) people were illiterate. In general, the interviewed farmers had small herds in size; majority (>70%) of them had 2-3 cattle per family.

3.2 General Awareness about Knowledge on Anthrax and Zoonosis

Overall, farmers from anthrax high-risk district were significantly aware of anthrax as compared to those from medium- (χ^2=32.261, df=1, p=0.000) and low- (χ^2=84.826, df=1, p=0.000) risk districts (Table 2). Similarly, knowledge of zoonosis of anthrax was significantly poor among people from medium (χ^2=30.818, df=1, p=0.000) and low (χ^2=82.221, df=1, p=0.000) risk districts as compared to high-risk area (Table 2).

3.3 Awareness of Vaccination

We assessed the knowledge level on vaccination of the farmers in the selected areas. In high-risk area, more than 70% (n=101/139) farmers knew about availability of anthrax vaccine. In most

Table 1. Number of people interviewed with number of case in these respective areas

Risk level	Area	No. of interviewer (%)	Human case number						Total (%)
			2015	2014	2013	2012	2011	2010	
High-risk	Kushtia	139 (22.35)	13	0	0	5	0	49	67 (64.4)
Medium-risk	Pabna	249 (40.03)	0	0	0	0	2	35	37 (35.6)
Low-risk	Mymensingh	234 (37.62)	0	0	0	0	0	0	0 (0)
Total		622 (100)	13	0	0	5	2	84	104 (100)

Table 2. Zoonotic knowledge of anthrax among the study people

Area	Total	Number of people know about anthrax (%)	Number of people know about zoonosis of anthrax (%)	p-value
Kushtia	139	103 (74.10)	91 (65.47)	0.000
Pabna	249	110 (44.18)	90 (36.14)	
Mymensingh	234	59 (25.21)	44 (18.80)	
Total	622	272 (43.73)	225 (36.17)	

cases, vaccine was given by government vaccinator (94.96%; n=132/139). But, farmers claimed that vaccinator performed mass vaccination to the areas only when outbreak had occurred. There had few (30.2% agreed) vaccination society in high-risk area where mass vaccination was done by farmers with their own efforts, but this was not sufficient. On the other hand, in medium-risk area, few farmers (21.29%; n=53/249) knew about anthrax vaccine. Only 10% (n=25/249) farmers performed vaccination by government vaccinator, and there had no such vaccination society. In low-risk area, the number of farmers knew about anthrax vaccine was negligible (0.85%; n=2/234), and there had no vaccination society as well.

3.4 Management Practices

For treatment purpose, most of the farmers at high- and low-risk areas depended on village doctors (97.12%, n=135/139 in Kushtia; 98.80%, n=246/249 in Pabna). However, in Mymensingh, the scenario was different, where about 52.14% people took their animals to registered veterinary surgeons. In high-risk area, most people provided both grass and concentrate (91.37%; n=127/139) to their animals, but washing of grass with safe water was not practiced properly (75.53%; n=105/139); in medium- and low-risk areas, this figures were 50.60% (n=126/249) and 26.07% (n=61/234), respectively. Improper washing of grass was one of the other factors of anthrax transmission. For improving feed value, most farmers used feed supplement with cattle feed; usually, the farmers used rice straw (88.46%), rice husk (85.04%), wheat bran (72.22%) and oil cake (14.95%). Vulture which is known as a natural cleaner was not seen by the farmers (91.44%; n=575/622) in these areas. Some other management practices are illustrated in Table 3.

4. DISCUSSION

The results of this study demonstrated that anthrax awareness among the cattle owners and consumers was higher in Kushtia district (a high-risk area) as compared to Pabna and Mymensingh districts, indicating that the level of awareness differed depending on the incidences of the disease in a particular area. Similar result was reported from Zambia, where awareness to bovine tuberculosis was observed to be lower in low-prevalence areas as compared to high-prevalence areas [21]. Similarly, Brook and McLachlan [22] indicated that the level of awareness among farmers in North America was related to the prevalence of the disease. Increasing of awareness towards anthrax in high outbreak areas could be due to mass implementation of vaccination program by the government authorities. The other possible reason of increasing awareness could be due to the experiences of the people that gained after exposing to anthrax once.

Despite high awareness among people on anthrax disease and its zoonotic nature, occurrence of anthrax outbreak cannot be reduced [8]. Poor people are compelled in most cases to sell or consume meat of anthrax suspected cattle due to their intention of compensating economic losses. Poor people are the main consumers of the anthrax affected meat because the meat is found as cheap.

Table 3. Management practices by the people considering anthrax outbreak

Factors	Areas	Total	Number of people said 'Yes' (%)
Bathing in fresh	Kushtia	139	87 (62.59)
Water	Pabna	249	126 (50.60)
	Mymensingh	234	224 (95.73)
Floor type: Concrete	Kushtia	139	87 (62.59)
	Pabna	249	167 (67.06)
	Mymensingh	234	127 (54.27)
Use of bedding	Kushtia	139	39 (27.86)
	Pabna	249	186 (74.70)
	Mymensingh	234	182 (77.78)
Occurrence of flood	Kushtia	139	99 (71.22)
	Pabna	249	86 (90.53)
	Mymensingh	234	0 (-)
Frequency of grazing	Kushtia	139	6 (4.32)
	Pabna	249	11 (4.41)
	Mymensingh	234	132 (56.41)

As a result, cutaneous anthrax mostly happens to them. As observed earlier in Ghana [16] and Zimbabwe [20], another reason for eating meat from anthrax-suspected carcasses was the belief that drying, overcooking, and cooking the meat with herbs would prevent anthrax.

Lack of efficacy of human anthrax treatment, inadequate vaccination program, improper washing of grass before feeding, lack of awareness of anthrax and transmission, slaughtering of moribund cattle, selling meat from cattle that died of unknown causes to the community were found to be major reasons for repeated outbreak of anthrax [8,23], which supports the findings of the present study. In many developed countries, human anthrax has been virtually eliminated because of effective control measures, including mass animal vaccination, governmental law and veterinary supervision of animal slaughter and quality control of animal products [24]. Also consumption of meat from animals that died of unknown causes as a discouragement from veterinary officials, introducing veterinary-supervised meat inspection services [23] was likely to help in preventing human anthrax outbreaks. Also increasing awareness of animal vaccination and burial of anthrax-infected carcasses by proper method, human anthrax could be preventable in the studied areas [8]. Education, awareness and collaboration between human and animal health workers were considered to be important in combating the disease [25]. In addition, strict and powerful guidelines for the slaughter, disposal, and quarantine of domestic animals suspected to have anthrax would be beneficial. Furthermore, slaughtering and butchering livestock, careful monitoring should be beneficial for reducing cutaneous anthrax outbreak among community people.

5. CONCLUSION

From the analyzed factors in this study that are associated with repeated outbreak of anthrax, we suggest proper washing of grass before serving to animal, increasing awareness towards zoonosis of anthrax and vaccination, providing treatment of animals by registered veterinarian and improved management practices are to be ensured to reduce anthrax outbreak in Bangladesh.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Biswas PK, Islam MJ, Shil SK, Chakraborty RK, Ahmed SSU, Christensen JP. Risk factors associated with anthrax in cattle on small holdings. Epidemiol. Infect. 2011;140:1888-1895.
2. Nagarajan K, Selvaraj J, Balakrishnan G, Manimaran K, Padmanath K, Senthil NR, Parimal R. Confirmation of acute nitrate poisoning differentiating from anthrax in three Indian indigenous cattle. J. Adv. Vet. Anim. Res. 2015;2(1):30-33.
3. WHO. Anthrax guideline 2008. Anthrax in Humans and Animals, 4th Edition. 2008;1.
4. Ahmed BN, Sultana Y, Fatema DSM, Ara K, Begum N, Mostanzid SM, Jubayer S. Anthrax: An emerging zoonotic disease in Bangladesh. Bangl. J. Med. Microbiol. 2010;4:46-50.
5. Chakraborty A, Khan SU, Hasnat MA, Parveen S, Islam MS, Mikolon A, Chakraborty RK, Ahmed BN, Ara K, Haider N, Zaki SR, Hoffmaster AR, Rahman M, Luby SP, Hossain MJ. Anthrax outbreaks in Bangladesh, 2009-2010. Am. J. Trop. Med. Hyg. 2012;86:703-710.
6. Siddiqui MA, Khan MA, Ahmed SS, Anwar KS, Akhtaruzzaman SM, Salam MA. Recent outbreak of cutaneous anthrax in Bangladesh: Clinico-demographic profile and treatment outcome of cases attended at Rajshahi Medical College Hospital. BMC Res. Notes. 2012;5:464.
7. Ahsan MM, Khan MFR, Rahman, Hassan J, Chowdhury SMZH, Parvej MS, Jahan H, Nazir KHMNH. Investigation into

Bacillus anthracis spore in soil and analysis of environmental parameters related to repeated anthrax outbreak in Sirajganj, Bangladesh. Thai J. Vet. Med. 2013;43: 449-454.

8. Hassan J, Ahsan MM, Rahman MB, Chowdhury SMZH, Parvej MS, Nazir KHMNH. Factors associated with repeated outbreak of anthrax in Bangladesh: qualitative and quantitative study. J. Adv. Vet. Anim. Res. 2015;2(2):158-164.
9. Nazir KHMNH, Hassan J, Chowdhury SMZH, Rahman MB. Novel multiplex-PCR for rapid detection of *Bacillus anthracis* spores present in soils of Sirajganj district in Bangladesh. Prog. Agric. 2015;26:67-70.
10. Hirsh DC, Zee YC. The Genus *Bacillus*. In: veterinary microbiology. Ernst L, Berstain B, Hirsh DC (ed.). Blackwell Science Inc. USA. 1999;246-249.
11. Dragon DC, Rennie RP. Evaluation of spore extraction and purification methods for selective recovery of viable *Bacillus anthracis* spores. Lett. Appl. Microbiol. 2001;33:100-105.
12. Manual of Standards for Diagnostic Tests and Vaccines (5th ed). Chapter 2.2.1, OIE, France. 2004;283-294.
13. Hugh-Jones ME, de Vos V. Anthrax and wildlife. Rev. Sci. Tech. 2002;21:359-383.
14. Islam MS, Hossain MJ, Mikolon A, Parveen S, Khan MSU, Haider N, Chakraborty A, Titu AMN, Rahman MW, Sazzad HMS, Rahman M, Gurley ES and Luby SP. Risk practices for animal and human anthrax in Bangladesh: An exploratory study. Infect. Ecol. Epidemiol. 2013;3:21356.
15. Mosalagae D, Pfukenyi DM, Matope G. Milk producers' awareness of milk-borne zoonoses in selected smallholder and commercial dairy farms of Zimbabwe. Trop. Anim. Health Prod. 2011;43:733-739.
16. Opare C, Nsiire A, Awumbilla B, Akanmori BD. Human behavioural factors in outbreaks of human anthrax in the Tamale municipality of northern Ghana. Acta Trop. 2000;76:49-52.
17. Shirima GM, Fitzpatrick J, Cleaveland S, Kambarage DM. Participatory survey on zoonotic diseases affecting livestock keeping communities in Tanzania. J. Anim. Vet. Adv. 2003;2:253-258.
18. John K, Kazwala R, Mfinanga GS. Knowledge of causes, clinical features and diagnosis of common zoonoses among medical practitioners in Tanzania. BMC Infect. Dis. 2008;8:162.
19. Mwenye KS, Siziya S, Peterson D. Factors associated with human anthrax outbreak in the Chikupo and Ngandu villages of Murewa District, Mashonaland East. Central Afr. J. Med. 1996;42:312-315.
20. Gombe NT, Nkomo BMM, Chadambuka A, Shambira G. Risk factors for contracting anthrax in Kuwirirana ward, Gokwe North, Zimbabwe. Afr. Health Sci. 2010;10:159-164.
21. Munyeme M, Muma JB, Munang'andu HM, Kankya C, et al. Cattle owners' awareness of bovine tuberculosis in high and low prevalence settings of the wildlife livestock interface areasin Zambia. BMC Vet. Res. 2010;6:21.
22. Brook RK, McLachlan SM. Factor's influencing farmers' concerns regarding bovine tuberculosis in wildlife and livestock around Riding Mountain National Park. J. Environ. Manage. 2006;80:156–166.
23. Chikerema SM, Matope G, Pfukenyi DM. Awareness and attitude toward zoonoses with particular reference to anthrax among cattle owners in selected rural communities of Zimbabwe. Vector Borne Zoonotic Dis. 2013;13:243-249.
24. Turnbull PC, Hugh-Jones ME, Cosivi O. World Health Organization activities on anthrax surveillance and control. J. Appl. Microbiol.1999;87:318-320.
25. Chikerema SM, Pfukenyi DM, Matope G, Bhebhe E. Temporal and spatial distribution of cattle anthrax outbreaks in Zimbabwe between 1967 and 2006. Trop. Anim. Health Prod. 2012;44:63-70.

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