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Prospects and Evaluation of an Integrated Extension Model designed for Anthrax-free Area Development

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Prospects and Evaluation of an Integrated Extension Model designed for Anthrax-free Area Development

Abstract

The main purpose of this study wasto assess and evaluate anIntegrated Extension Modelto improve the overall knowledge, attitude and practice habits of community people over a sustained period.The survey questionnaire results have indicated that the various sources of anthrax message dissemination had played a significant role in the study. Among those responsible for disseminating the information, it was realized that studentsserving in the role of message disseminators played the most significant role (15%) indelivering the anthrax-related key information to the community. Majority community members (97.5%) were made aware of the nature, occurrence, public health importance, and management of the disease. Theirdangerous habits and attitudes toward slaughtering of sick animals were reduced (<30%). The attention of local administration and the law enforcement agency focused distinctively on the issue of animal slaughter. Vaccination and clinical records reveal that the percentage of vaccination coverage was increased from 40% to 85% andthe percentage of farmers who can diagnose anthrax has been increased from 30% to 40%.On the other hand, their poor economic background together with the dispersed settlement nature of the farmers was the main gaps identified that continued to force them to slaughter infected animals, sell their products and to consequently concealthat information, all issues that are required to be addressed in the future. Based on the research findings, it can be concluded that this modelis an efficient, effective and suitable method to raise awareness levels in a large communitywith regards to a zoonotic disease like anthrax.

Keywords

anthrax, One Health, awareness, Integrated Extension Model, community.

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Introduction

Before the development of the vaccine in the 1930s, anthrax was regarded as a disease of major health or economic importance and was the foremost cause of uncontrolled mortality in cattle, sheep, goats, horses, and pigs worldwide. Humans contract the disease directly or indirectly from animals or animal products. Anthrax (popularly known as "*Torka*" in Bangladesh) is an acute infectious zoonotic disease caused by *Bacillus anthracis*, a soil-borne, spore-forming bacterium (OIE, 2008). The anthrax spore (*i.e.*, in its dormant stage) is resistant to heat and chemical disinfectants, and this dormant stage may persist and remain viable for several decades in the soil (Dragon et al., 2001; Hirsh & Zee, 1999; OIE, 2004). The disease is still enzootic worldwide and *Bacillus anthracis* has always been high on the list of subversive agents for potential use in biological warfare and bioterrorism.

Anthrax naturally occurs in almost all countries in the world; however, the disease is most prevalent in tropical and sub-tropical countries (Biswas et al., 2011). Sporadic occurrence and epizootics of anthrax occur among livestock and wild herbivores in the United States, southern and eastern Europe, and Canada. Outbreaks at the animal-human interface are reported from countries in Africa, the Middle East, and Asia (Islam et al., 2018). In southern Asia, anthrax is considered as highly enzootic – this is the case especially in India and Bangladesh where continual outbreaks occur in both animals and humans (Siddiqui et al., 2012).

In Bangladesh, anthrax has been reported in cattle and humans since 1980, and cases may be reported during any month of the year (FAO/OIE, 2010). In 2008 and 2009, animal anthrax outbreaks were reported from 58 of the 64 districts in the country, and while some districts have outbreaks almost every year, in others the outbreaks may occur only once every five or more years (FAO, 2016). Though animal anthrax has been presumed to be enzootic for long period earlier, in Bangladesh it was recognized as a zoonotic disease during the year 2009–2010 (Ahmed et al., 2010). According to the Department of Livestock Services (DLS), from 2010 to 2016 there was 17,139 anthrax cases reported and 1,268 animals died due to anthrax. Anthrax outbreak is mostly prevalent in Sirajganj and nearby districts (Ahmed et al., 2010; Biswas et al., 2011). Along with animal infections, more than 600 people have been diagnosed with anthrax in Bangladesh until the year 2011 (Fasanella et al., 2012). Favorable environmental conditions such as soil pH, calcium content, moisture, soil type, high ambient temperature and rainfall and topography positively correlated with the persistence of anthrax spores and the subsequent outbreaks of anthrax (Ahsan et al., 2013; Hugh-Jones, 2002; Van Ness, 1971).

After the analysis of every previous human anthrax outbreak in Bangladesh, it was observed that the outbreaksoccurred due to the slaughtering of sick or moribund animals, presence at the slaughtering site, and the handling of raw meat and meat products (HSB, 2009; Samad & Hoque, 1986). Studies identified that most of the people inan anthrax prone area were not well informed about the potential transmission ofinfections from sick animals to humans. Poor awareness level, lack of efficacy of anthrax treatment of humans, and inadequate vaccination program in livestock, improper washing of grass before feeding of animals, slaughtering of moribund cattle, and selling flesh of cattle that died of unknown causes to the community were found to be major reasons for repeated outbreak of anthrax (Hassan et al., 2015).

The Global Health Security Agenda (GHSA) recommends a multi-sectoral, One Health (OH) approach to be adopted towards strengthening both the global and nation's capacity to prevent, detect, and respond to human and animal infectious disease threats,occurring naturally, accidentally or intentionally, to contain the spread of a disease of zoonotic importance (WHO,

2016). The approach requires educating the local community on anthrax transmission and prevention, control phases such as real-time surveillance, animal vaccination including mass awareness creation and motivation that will help and thereby facilitate early detection, control, and prevention of anthrax outbreaks (Chakraborty et al., 2012). The issues like improvement of vaccination rate, proper knowledge for early diagnosis of anthrax disease by livestock farmers and optimum awareness level of the community members about anthrax disease are prerequisites to establish an anthrax free area.

Purpose and Research Objective

Proper knowledge and optimum awareness level of the community people about anthrax disease are prerequisites to establishing an anthrax-free area. To realize this goal, an Integrated Extension Model (Model) was introduced in the study area to improve the anthrax awareness level. The objective of this study was to assess and evaluate our Model to improve the overall knowledge, attitude, and practice level of the people in concerned area over a sustained period.

Methods

Description of the Integrated Extension Model through the Project

The Model was designed by the research team for a project titled *An Integrated Approach to Establish an Anthrax-free Model Area in Bangladesh* funded by the Ministry of Education, Government of the People's Republic of Bangladesh. The Model is based on the recommendation ofthe Global Health Security Agenda (GHSA).The OH approach, a multi-sectoral involvement approach was used to enhance the key information components of anthrax disease among the community members. In this Model, Bangladesh Agricultural University's (the Agricultural University in Bangladesh that has many research scholars and working experience on technology extension and research) and the DLS jointly developed tools and materials of anthrax disease control measures conversant with the local context, geographic location, socio-economic status, risk factors, agent, host and environment factors, and their interaction. The vaccination status and community members' awareness level increased through the integration of all potential sectors changing upon the community as shown in Figure 1.

How the Model Works

Firstly, key information and necessary measures pass through the first (outer) circle of different stakeholders like the local governmental health department, law enforcement agencies, livestock office, local administrative government offices (*Upazila Parishad*, *Union Parishad*), farmers' club, religious institutions, educational institutions, to sensitize and activate them in their respective fields. Then, these stakeholders takethe necessary initiative to influence key persons of the second (inner) circle, like individual households, religious leaders, students, livestock traders, volunteers, meat buyers, and sellers. These key persons have a positive influence on the overall community. The community is our ultimate target for the implementation of overall control strategies.Anthrax control measuresin the community appropriately reached would make it possible to build an anthrax-free area, our final goal.

The prime difference of our model from other extension approaches is that with this model we involved all influential groups, and not only the local governmental LDS and/or the Health departments to engagetheir role at the community level. This method included not only the circulation of information about anthrax but also raising awarenessof the role and responsibilities of all groups involved in reaching the targeted goal of development of an

anthrax-free area. Thus the involvement of all the agencies such as local government administration, law enforcement agencies, and mass community awareness is needed.

*Figure 1. I*ntegrated extension model. Bangladesh Agricultural University & Livestock Department jointly develops extension tool and materials. Key information passes among agents in the first outer circle, then disseminates to second circle that ultimately impacting upon the community.

Study Area, Design and Populations

The study was conducted in the Kamarknandha *Upazila* (sub-district) of Sirajganj district, north-western Bangladesh, as shown in Figure 2. The diameter of that area is 4.68 sq. a kilometer, longitude and latitude between 24° 21.933′ to 24° 23.189′ to 24.23.189 and 89° 39.635′ to 89° 38.821′ respectively. Criteria for the area choice were based on the repeated outbreak of anthrax in both animal and human, geographical location, the openness of livestock department, communication, livestock density and awareness levels among the community members.

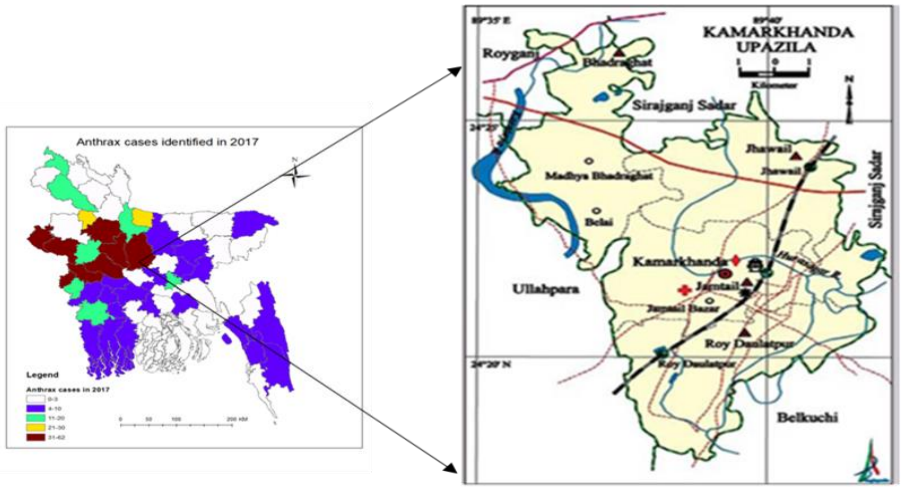

Figure 2. Map of Bangladesh indicating anthrax case occurrence, and the location of our integrated extension model implementation areas

A questionnaire was compiled to conduct the survey with a selected cross-section of the target population including livestock farmers, traders before starting the awareness extension program. The questionnaire served to gather baseline data of overall knowledge, attitude, and practice regarding anthrax disease in that community. After that, an awareness program was implemented through the Model for around 2 years. Then, the second survey (mid-term) was conducted using the same questionnaire and the findings were compared with the baseline survey data.

Sample Size Determination and Sampling Procedure

The sample size for the study was determined using a simple random method (Thrusfield, 2009). In mathematical notation: $n = Z2\ p\ (1 - p)/d2$, where n represented the required sample size; Z2, the Z-score at 95% confidence interval or 1.96; *p*, the expected percentage frequency of likely exposure to anthrax disease through the farmers; and *d*, the margin of error. From the study area'sestimated population size 4000, a hypothesized expected percentage frequency of 50% was used with 5% desired absolute precision, and a sample size of 351 was obtained. As the desired effect was not more than 1% for cross-sectional study at a single level probability sampling, a contingency of 5% was added to take care of no-response, and the size was adjusted to 372 participants.

Implementation Method of the Awareness Program through the Model

Educational tools were designed and developed by the Department of Agricultural Extension Education of Bangladesh Agricultural University. This model was implemented to reach the entire community. Regular announcements, leaflets, posters and disease brochure distributions, pictorial billboards, newspaper reports, broadcast of key messages using local cable channels were the informational toolsapplied to raise awareness about anthrax disease. Community members were categorized into different groups based on their exposure to the disease. Training programs were developed and conducted for schools (primary and high), butchers and farmers. Sensitization workshops and meat market inspections were added to improve knowledge, skill and practice levels. Messages by law enforcement agents, the local Imam (religious leader), and politically influential persons were other strategies used to raise awareness and strengthened the disease control mechanisms.

Data Collection and Management of Statistical Analysis

Two cross-sectional surveys were conducted - one before applying the model (baseline survey) and another after two years of work. A one-stage cluster sampling technique was employed to draw the required sample size of the participants, determined by using online resources like Epi Tools - Sample size calculations (Nielsen, 2012; Sergeant, 2019). The questionnaires for this study was comprised of 3-parts and contained 22 questions, mostly closed-ended, to simplify data processing, minimize variation and improve the precision of response. The 1st part was designed to determine demographic information, the 2nd part, exposure to livestock and the 3rd part, KAP (Knowledge, Attitudes, Practices) of anthrax**.** Collection, storage, and presentation of data were done by using KoboToolbox (Harvard Humanitarian Initiative) for easy and reliable use in difficult field settings, such as humanitarian emergencies or post-conflict environments. Recorded data of both baseline and evaluation surveys were transferred t oexcel worksheets format and descriptive statistics were carried out using Microsoft Excel® tools. Descriptive analysis was performed, and results expressed in frequencies and proportions. Categorical response variables were presented as proportions and their associations determined by chi-square tests.

Results

Tools Used for Dissemination of Anthrax Information in the Community

Bangladesh Agricultural University and the Livestock Department jointly developed information tools such as the vaccination card, disease information card, billboard publicity, information leaflet, publicity script for proclamation, training modules, session guide for community yard meeting and resourced-based area mapping. Networks with different stakeholder groups dependent upon the strategy and focus were built to deliver a key message to the community. The evaluation survey engaged respondents with questions regarding how and where they received information on anthrax. The wide variations of answers supported the effectiveness of the Model. All the sources of anthrax message dissemination played a significant role. Among all information disseminators, student disseminators had the largest impact (15%) to deliver the anthrax related key information to the community. Details of the imparting of different sources of message dissemination are provided in Figure 3.

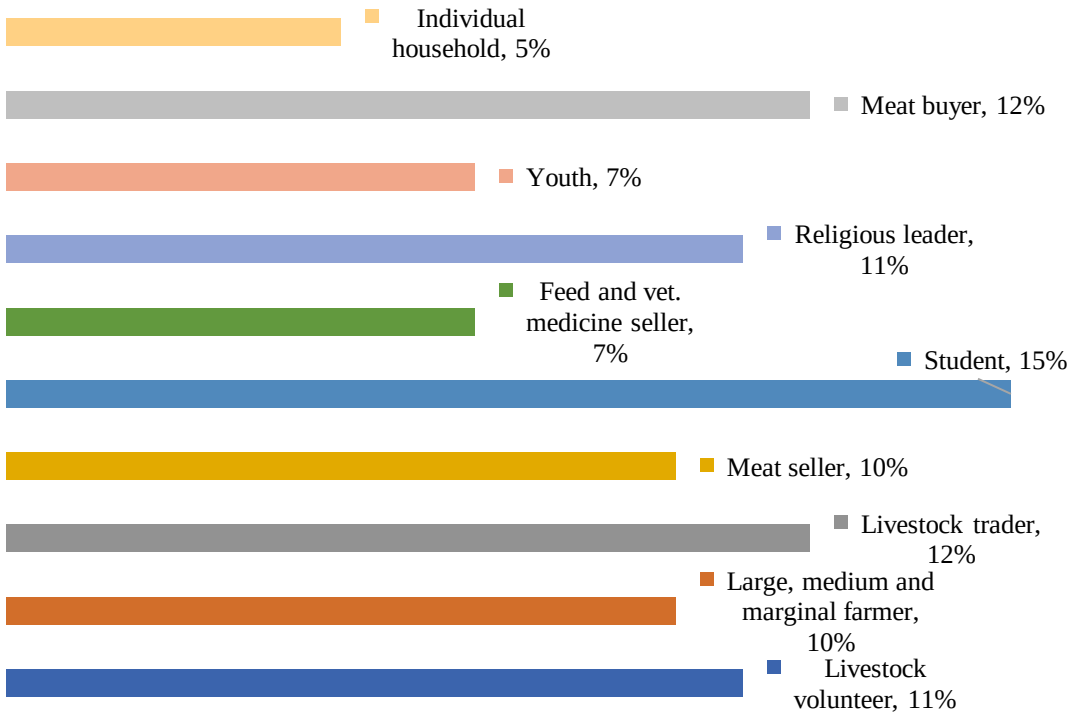

Figure 3. Sources where respondents received their information on anthrax

Demographic and Exposure to Livestock Characteristics of Participants

Of the 372 participants approached for baseline and evaluation surveys, all participated, giving a response rate of 100%. The majority (34.41%) and (38.17%) of them were in the age group 31 and 40 years respectively. The result showed that male and female participation was almost 47.58%. Most respondents had primary or higher level of education and had exposure to livestock. The detailed findings are shown in Table 1.

Table 1.
Demographic Characteristics of Participants and Exposure to Livestock Management Practices.

Characteristics	Baseline		Evaluation	
	N	*%*	*N*	*%*
Age group (Years)				
11-20	33	8.87	47	12.63
21-30	54	14.52	68	18.28
31-40	128	34.41	142	38.17
41-50	67	18.01	50	13.44
51 and above	90	24.19	65	17.47
Sex				
Male	195	52.42	180	48.39
Female	177	47.58	192	51.61
Education				

Illiterate	45	12.10	30	8.06
Primary school	77	20.70	101	27.15
High school	139	37.37	100	26.88
College or higher	111	29.84	141	37.90
Occupation				
Employed	290	77.96	312	83.87
Unemployed	82	22.04	60	16.13
Exposure to livestock				
How often contact with livestock:				
Frequently	234	62.90	197	52.96
Sometimes	100	26.88	87	23.39
Never	38	10.22	72	19.35
Unclear	0	0.00	16	4.30
Seen any illness signs of livestock:				
Frequently	48	12.90	54	14.52
Sometimes	120	32.26	111	29.84
Never	98	26.34	109	29.30
Unclear	106	28.49	98	26.34
Seen any sudden death of livestock:				
Frequently	14	3.76	19	5.11
Sometimes	78	20.97	104	27.96
Never	211	56.72	196	52.69
Unclear	69	18.55	53	14.25

Change in Knowledge, Attitude and Practice Level of Participants

The comparison of the baseline and the midterm survey results indicates the majorityof community members (97.5%) became aware of the nature, occurrence, public health importance, and managements of the disease. There was notable change in the knowledge level ($p < 0.05$) after awareness interventions. The misconception of "diseased animal can be slaughtered for meat" decreased from 90% to 60% among members of the target community. Also, the percentage of people who believe anthrax can be prevented and vaccine is effective increased from 10% to 70% and 13% to 77% respectively. But the participation in anthrax control awareness program was not increased like other attitude indicators. Vaccination coverage and primary diagnosis knowledge of anthrax disease among the farmers were increased. The percentage of vaccination coverage was increased from 40% to 85% and the percentage of farmer who can diagnose anthrax has been increased from 30% to 40%. But other practice indicators like proper carcass disposal, the slaughter of sick animals, and compulsory certification were not significantly ($p < 0.05$) improved. The detailed finding from the KAP questionnaire survey of respondents is shown in Table 2.

Table 2

Knowledge, Attitude and Practice Level of Participants in Baseline and Evaluation Survey

Parameter	Baseline	Evaluation	Odds ratio	*p*

	Yes %	No %	Yes %	No %	(95% CI)	
Knowledge:						
Heard of Anthrax or *Torka*	13	87	97.5	2.5	0.00 (0.01,0.00)	0.000
Learn from awareness program	3	97	67	33	0.02 (0.04,0.01)	0.000
Vaccine availability in Livestock office	10	90	70	30	0.05 (0.09,0.02)	0.000
Certification needed for slaughtering	5	95	50	50	0.05 (0.12,0.02)	0.000
Slaughtering diseased animal is illegal	2	98	65	35	0.01 (0.03,0.00)	0.000
Attitude:						
Anthrax can be prevented	10	90	70	30	0.05 (0.09,0.02)	0.000
The vaccine is effective in animal	13	87	77	33	0.06 (0.12,0.03)	0.000
Diseased animal. can be slaughtered	90	10	60	40	6.00 (2.93,12.29)	0.000
The awareness program is effective	15	85	70	30	0.8 (0.14, 0.04)	0.000
Willingness to participate in awareness program	5	95	15	85	0.30 (0.82,0.11)	0.018
Practice:						
Regularly vaccinate cattle	40	60	85	15	0.12 (0.22,0.06)	0.000
Carcass disposal procedure followed	2	98	7	93	0.27 (1.22,0.06)	0.088
Certification before slaughtering	5	95	13	87	0.47 (1.41,0.16)	0.179
Informing Livestock department about death animal	7	93	30	70	0.18 (0.40,0.08)	0.000
Slaughtering of sick animals	6	94	8	92	0.73 (2.19, 0.25)	0.579
Never buy meat of infected animals	5	95	37	63	0.09 (0.21, 0.04)	0.000

Discussion

The vaccination of healthy animals is a special aspect of the control of anthrax (Ahmed, 2018; Kaufman et al., 1973). They studied the impact of vaccination using the Sterne strain vaccine in controlling the disease. However, a single dose Stern spore vaccine could not be kept with a protective immunity level for a year until the introduction of an additional single dose as a booster (Ndiva et al., 2012; Turnbull et al., 2004; WHO 2008). According to DLS (2018), anthrax vaccination rate was not more than 30-40% in the rural area, like our finding in our research area. The success of the establishment of an anthrax free area by mass community awareness extension program depends on the capability to mobilize resources in different sectors, coordination and intersectoral approaches, especially between different stakeholders, including veterinary, health, administration, law enforcement agencies, and public health services. The Model includes all possible stakeholders that can play a role to improve community awareness since each department has their own strategies, responsibilities and

service for the well being of the community. Collaboration and constant communication must improve knowledge, attitudes and practice level of the mass of people in the community.

A study in Wisconsin by Grant and Olsen (1999), indicated that not only did physicians and veterinarians hold very different views about the disease risks from certain animals and infectious agents, but that they also communicated very little with each other about zoonotic diseases and their prevention. Many researchers (Hairi et al., 2003; Itrat et al., 2008; Nalongsack et al., 2009), recommended the development of educational strategies designed to improve behavior and practice of effective disease control measures.

Regarding the origins of outbreaks of anthrax, guidelines for the surveillance and control of anthrax in humans and animals compiled by the Veterinary Public Health Anthrax Group of the World Health Organization in 1993 highlighted the need for comprehensive preparedness and response guidelines (Anonymous, 1993). Shanko et al. (2015) also recommended a model for success in the prevention and control of major zoonoses. They suggested that the model depends on the capability to mobilize resources in different sectors and on coordination and intersectoral approaches, especially, between national (or international) veterinary and public health services. Our Model in the research area follows and is supported by this recommendation.

The demographic data of our survey resembles the national agriculture and rural statistics (BBS, 2018). National agricultural and rural statistics about literacy rate, man-women proportion and involvement with livestock aresimilar tothose of our survey findings. Knowledge, attitude and practice level at the baseline of this study are comparable with the findings of other researchers in Bangladesh (Hasan et. al., 2015; Islam et. at., 2018). However, the respondents' practice improvements over the course of the extension program were much lower than their knowledge and attitude improvements. The attention of local administration and law enforcing agency should be focused on that issue. On the other hand, the poor economic background together with the dispersed settlement nature of the farmers were the main possible reasons that have continued to force them to slaughter infected animals, sell their products and conceal that information from any potentialnotice. But it can be said that the knowledge, attitude and practice level were significantly improved in the Model area due to the awareness-raising interventions.

Conclusions and Recommendations

Through the application of the Integration Extension Model over two years, most of the community members (97.5%) became aware of the nature, occurrence, public health importance and the management of the disease. The negative impact due tothe attitude toward the slaughtering of sick animals was reduced (<30%). The attention of local administration and law enforcement agencies markedly focused on that issue. On the other hand, the percentage of vaccination coverage was increased from 40% to 85% and the percentage of farmers who can diagnose anthrax has been increased from 30% to 40%. It would not be possible for only the local governmental LDS and/or Health departmentsof the localarea to control any zoonotic disease by a time-bound program.

Based on these findings, it can be concluded that this model is efficient, effective, and suitable to increase the awareness level of the people toward thecontrol of any zoonotic disease like anthrax. However, the program did not show promising results over the behavior improvements of the target community. The change of behavior/practice is the most important thing for the controlling the disease. Further research should be focused on exploring this aspect of integrated extension programming.

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