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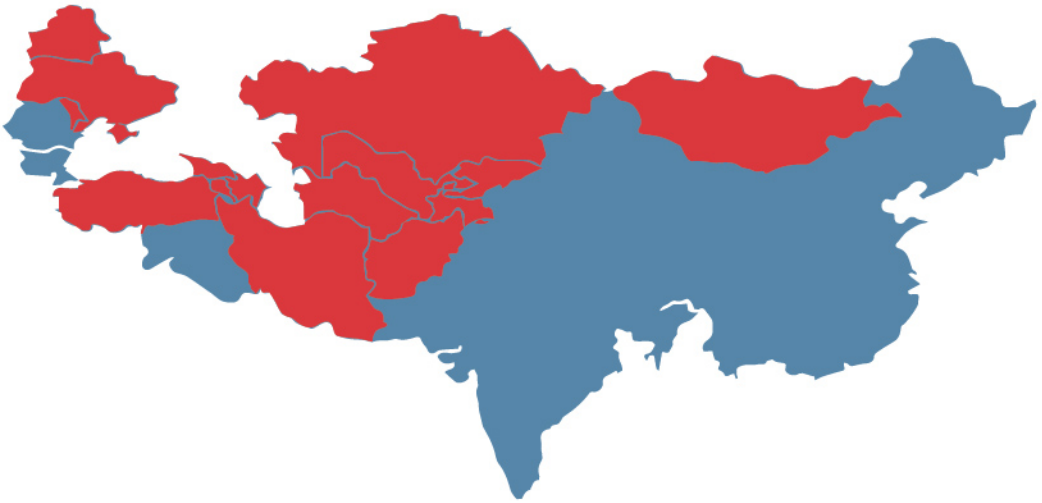
Learning from Practice: Public Health Teaching Case Studies from Eastern Europe and Central Asia



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Anthrax Outbreak Investigation among Humans and Livestock in Meherpur District of Bangladesh, December 2023: A Case Study of One Health Approach

Authors: Md Foyjul Islam[1,&], Quazi Ahmed Zaki[1], Fablina Noushin[1], Jobaida Khanam[2], Mohammad Rashedul Hassan[1], Md. Omar Qayum[1], Ahmed Nawsher Alam[1], Zakir Hossain Habib[1], M Salim Uzzaman[3], Mahbubur Rahman[1],Tahmina Shirin[1]

Affiliations: [1]Institute of Epidemiology, Disease Control and Research (IEDCR), Dhaka, Bangladesh, [2]Department of Livestock Services, Dhaka, Bangladesh, [3]Physician Scientist and Consultant, Emerging Infectious Disease and One Health

Corresponding author: Md Foyjul Islam, Medical Officer Institute of Epidemiology, Disease Control and Research (IEDCR), Dhaka, Bangladesh Directorate General of Health Services Bangladesh, Ministry of Health and Family Welfare, Field Epidemiology Training Program Fellow (Advanced), Institute of Epidemiology Disease Control and Research (IEDCR), Dhaka, Bangladesh

Email: drislam0666@gmail.com

Abstract

This case study examines an anthrax outbreak in Meherpur District, Bangladesh, that occurred in December 2023, highlighting the application of a One Health approach to investigate the impact on both humans and livestock. The outbreak involved 11 human cases—3 confirmed and 8 probable—linked to direct contact with infected animals. Key findings included a higher incidence among middle-aged females and significant risk factors included handling raw meat and skinning sick animals. The investigation also revealed gaps in public health surveillance, healthcare access, and community awareness. The goal of this case study is to equip trainees with practical skills and comprehensive

knowledge for conducting effective outbreak investigations of zoonotic diseases. It focuses on utilizing the One Health approach to analyze data, develop hypotheses, and implement prevention and control strategies. Designed as a training tool for novice field epidemiology students, the case study incorporates group discussions and facilitator-led guidance to reinforce outbreak investigation concepts. Participants will learn to outline outbreak investigation steps, explain the One Health approach, formulate and evaluate hypotheses, interpret epidemiologic data, and propose strategies for preventing and controlling zoonotic diseases. This exercise is intended for Field Epidemiology Training Program (FETP) fellow of frontline, intermediate and advance titer. This also can be used for other public health professional, and who have prior knowledge of disease surveillance and outbreak investigation.

How to Use the Case Study

General instructions: This case study should be used as adjunct training material for novice epidemiology trainees to reinforce the concepts taught in prior lectures. The case study is ideally taught by a facilitator in groups of about 20 participants. Participants are to take turns reading the case study, usually a paragraph per student. The facilitator guides the discussion on possible responses to questions. The facilitator may make use of flip charts to illustrate certain points. Additional instructor's notes for facilitation are coupled with each question in the instructor's guide to aid facilitation.

Audience: This case study was developed for novice field epidemiology students and, environmental health officers or laboratory scientists who work in public health-related fields.

Prerequisites: Before using this case study, participants should have received lectures on disease surveillance and outbreak investigation.

Materials needed: Internet facilities flip charts, markers, computers with MS Excel
Level of training and associated public health activity: intermediate – **Outbreak investigation**

Time required: 2-3 hours

Language: English

Goal of Case Study

To equip field epidemiology training fellows with practical skills and comprehensive knowledge for conducting effective outbreak investigations of zoonotic diseases, utilizing the One Health approach to analyze data, develop hypotheses, and implement prevention and control strategies.

Learning Objectives

After completing this case study, participants will be able to:

1. Outline each step involved in an outbreak investigation, with a specific focus on zoonotic disease outbreaks.
2. Explain the One Health approach to outbreak investigations, detailing its key elements and the challenges associated with its implementation.
3. Formulate and evaluate hypotheses regarding the source of the outbreak, based on epidemiologic and field data.
4. Interpret both descriptive and analytical epidemiologic data to assess the scope, impact, and dynamics of the outbreak.
5. Identify and propose effective strategies for preventing and controlling zoonotic diseases taking Anthrax as a case, addressing both animal and human health aspects.

Part 1 Story (Narrative)

Background and initial Investigation

10th December 2023- Notification

On Sunday, 10th December 2023, the Infectious Disease Hospital (IDH) in Dhaka, Bangladesh, reported a rapidly deteriorating suspected case of cutaneous anthrax. The patient, who had been referred from Meherpur district as a case of irritant dermatitis to Dhaka Medical College Hospital, was subsequently referred to IDH to rule out other infectious causes. The patient exhibited multiple blisters, swelling, and a necrotic skin lesion on the left upper limb. The patient reported slaughtering a sick goat five days before onset of symptoms. [Figure 01]. In response to this disease notification, the Institute of Epidemiology, Disease Control and Research (IEDCR) swiftly formed an outbreak

investigation team. The team collected swabs from the lesion of suspected case for RT-PCR, Gram staining, and culture sensitivity tests. IEDCR's initial verification revealed that other individuals in the neighborhood of the admitted case were also reporting similar symptoms.

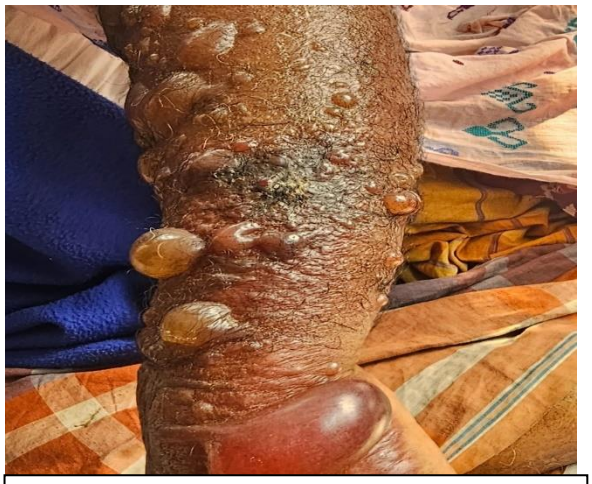


Figure 1: Lesion on left arm, forearm and hand of index case at initial presentation

11th December 2023 — Field Investigation Commences

On 11th December 2023, a One Health rapid response team was assembled. This team included human and animal health experts from the Field Epidemiology Training Programs (FETP-B for human health and FETP-V for veterinary health), along with lab personnel from IEDCR. The One Health Secretariat provided technical assistance to this team for a comprehensive investigation into the potential anthrax outbreak in Meherpur. On the same day, the outbreak investigation team arrived in Meherpur and began a thorough investigation, both retrospectively and prospectively, to identify and manage additional cases in the area.

Setting

Meherpur District, located in southwestern Bangladesh and bordering West Bengal, India, is home to around 700,000 residents. The district is divided into Meherpur Sadar, Gangni, and Mujibnagar upazilas. While agriculturally prosperous, Meherpur faces heightened risks of zoonotic disease outbreaks due to close human-animal interactions, particularly in its predominantly rural areas. Agriculture is the main occupation, and many families maintain cattle farms, which contributes to the district's vulnerability. Both Meherpur Sadar, a mix of urban and rural areas, and Gangni upazila, which is primarily rural, reported anthrax outbreaks previously. These outbreaks are often driven by

traditional practices and limited public health resources, underscoring the need for swift outbreak response.

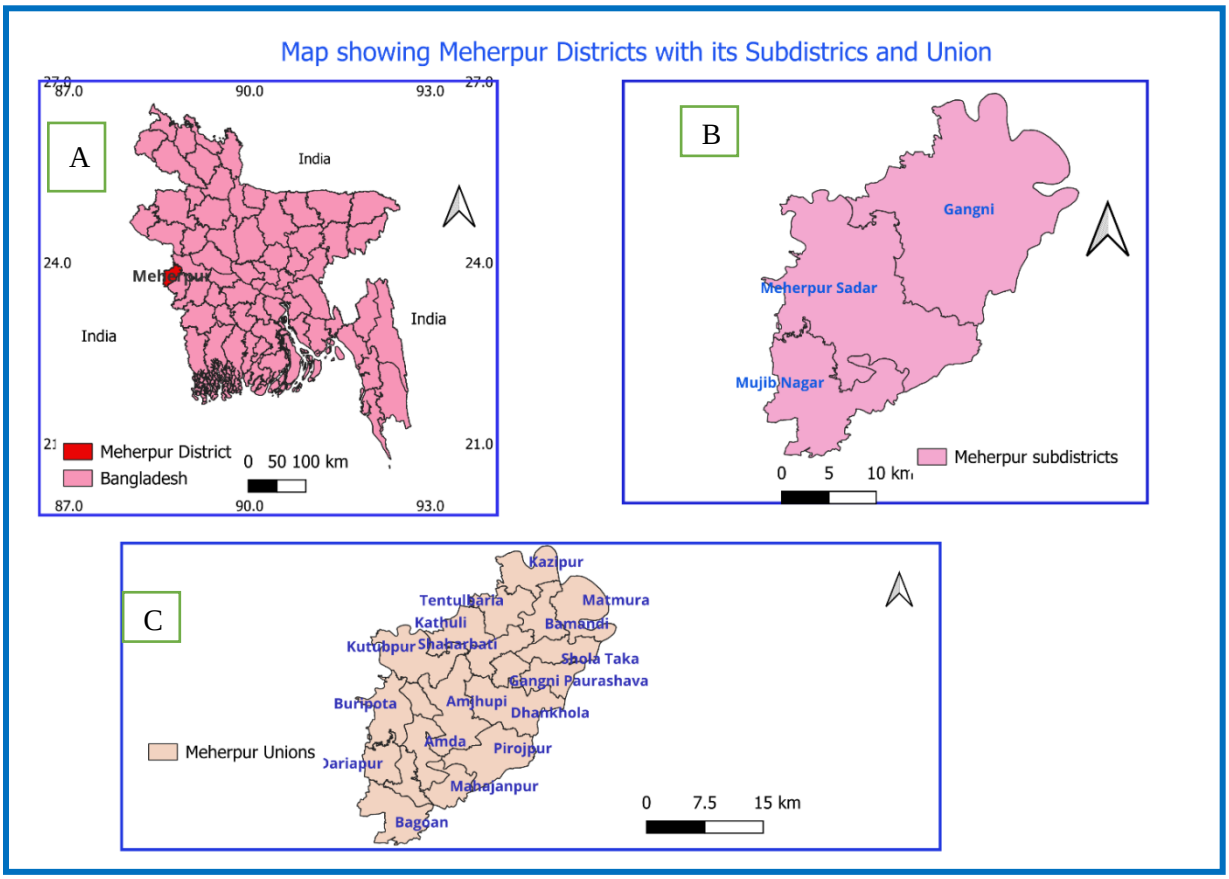


Figure 02: Map showing Meherpur district (A) , subdisrtrict (B) and Union(C) locations

Index Case -- Clinical Information

The index case in the anthrax outbreak is a 65-year-old livestock trader from Daxin Para, Modnadanga, Shyampur Union, Meherpur Sadar. He slaughtered a sick goat on 26 November, 2023, and by 2nd December, he developed fever and lesions on his left forearm, which spread to his arm, hand, and left leg. After initially seeking treatment at Meherpur District Hospital on December 3, he was referred to Dhaka Medical College Hospital (DMCH) on December 5 and then to the Infectious Disease Hospital (IDH) on December 7.

On December 10, an IEDCR team collected swabs from his skin lesion, which was sent to the Department of Virology and Microbiology of IEDCR for Gram staining, culture, and RT-PCR for

Bacillus anthracis. The RT-PCR test confirmed the presence of Bacillus anthracis, although the Gram stain was negative, and the culture showed no growth.

Other laboratory findings from December 6 revealed an elevated white blood cell count, abnormal differentials, altered electrolyte levels, and a high C-reactive protein (CRP). Treatment initially involved Inj. Ceftriaxone and Flucloxacillin at DMCH , continuing at IDH, where Vancomycin, Doxycycline, and Roxadex were added on December 9. Due to renal impairment, vancomycin was replaced with oral Linezolid on December 12. The patient completed 14 days of Doxycycline and 7 days of Linezolid before discharge.

Part 1 questions

Question 1: Would you call this an outbreak? Why or why not?

Answer 1:

Question 2: What government agencies might be interested in participating in an investigation of a possible outbreak of anthrax based on a One Health approach?

Answer 2:

Question 3: What types of staff might be part of a field investigation team for this anthrax outbreak?

Answer 3:

Question 4: What would be your primary objectives of the field investigation?

Answer 4:

Question 5: What are the key laboratory tests required to confirm a case of anthrax?

Answer 5:

Part 2 Methods (NARRATIVE)

Field Investigation: December 11, 2023, and Onwards

Following the notification of a cutaneous anthrax outbreak in Meherpur District, the investigation team mobilized and arrived at the district on the same day. Upon arrival, the team engaged with key stakeholders, including the Civil Surgeon, the District Livestock Officer, and the Upazila (subdistrict) Livestock Officers. These initial meetings were essential for gathering comprehensive information on human and animal case notifications, animal vaccination status, and other relevant data and coordination of the field activities.

An emergency coordination meeting was promptly convened at the district level, involving representatives from the, the Civil Surgeon's Office, the District Livestock Office, and local healthcare facilities. These meetings were held daily to monitor the evolving situation, review findings, and make informed decisions regarding control measures and treatment protocols for the affected individuals. Meanwhile, the outbreak team began to develop a case definition for the outbreak.

Then the investigation team conducted field visits to the home of the index case and the surrounding village. The suspected animal case was a goat that had suddenly fallen ill. This moribund goat was slaughtered by the index case, with the assistance of three others. Through interview with index case family members the team identified two additional suspected human cases related to this incident having skin lesions and other symptoms. A comprehensive line list of all suspected, probable, and confirmed cases was created and updated daily. The team also focused on reviewing registries at Meherpur District Sadar Hospital and the Upazila Health Complex in Gangni Upazila. Preliminary findings were shared with upazila, district, and national Rapid Response Team authorities. Through record review additional suspected cases with skin lesions from adjacent communities were identified. Therefore, active case finding was planned and executed in the affected communities.

During the active case search, similar instances of anthrax exposure were observed in the one union in Gangni Upazila, approximately 15.1 km from Modnadanga. The team identified eight human probable cases linked to two suspected animal exposures:

- **Garbaria Village, Kathuli:** Two human probable cases were identified, both displaying typical skin lesions after handling and cooking meat from a moribund animal slaughtered and sold in November 25

- **Lakhinarayanpur, Dhola:** Six human probable cases were found, all associated with a moribund cow slaughtered on November 13. These cases were related to slaughtering, meat processing, and consumption.

  Additionally, another moribund goat was slaughtered on December 14 in the same community and subsequently sold. A suspected cow had died on December 7 in the same household.

  Environmental and animal health teams collected samples from suspected livestock, soil, and grass in accessible areas. These samples, along with swabs from suspected human cases, were sent to the Institute of Epidemiology, Disease Control and Research (IEDCR) and animal and environmental samples to the Central Disease Investigation Laboratory (CDIL) for laboratory testing, including RT-PCR, Gram staining, and culture sensitivity.

Part 2 Questions

Question 6: How does an outbreak case definition differ from a surveillance case definition? How will you develop a case definition for this outbreak?

Answer 6:

Question 7: What are some ways you might look for additional cases (active case finding) among humans?

Answer 7:

Question 8: What control measures and interventions need to be implemented?

Answer 8:

Descriptive Analysis of Outbreak:

The team decided to conduct an epidemiological study to gather information about the cases. The team identified 11 human cases (3 confirmed and 8 probable) through active case search and interviewed them using a standardized questionnaire developed by the team. The interviewers collected data on demographics, clinical symptoms, and relevant exposure. A descriptive analysis was conducted using Stata 17.0 version to analyze the data by person, place, and time. Furthermore, the FETP fellow and the team decided to conduct an analytical study to identify risk factors associated with the anthrax outbreak. The study design focused on comparing individuals who developed anthrax (cases) to those who did not (controls), aiming to ascertain differences in exposure that could explain the outbreak.

Q9: What type of epidemiologic study was planned? Why do you think the team chose this study design?

Answer 9:

Part 3: Results (Narrative, figures, tables)

The majority of cases were aged 21-40 years (45.5%) and 41-60 years (36.4%), with a median age of 35 years. Most cases were female (63.6%) and had only up to primary education (90%). Additionally, 90.9% were married. One-third of the cases were housewives (36.4%), another third were livestock farmers (36.4%), and 18.2% were butchers. All affected individuals were Muslim. [Table I]

Table I: Demographic Characteristics of Cases in the Anthrax Outbreak Investigation Among Humans in Meherpur District, Bangladesh, December 2023, N=11

SL	Characteristics	Frequency	Percentage
01	**Age (years)**		
	< 20	1	9.1
	21-40	5	45.5
	41-60	4	36.4
	> 60 y	1	9.1
	((Median (IQR)	35.00 (34-53)	
02	**Gender**		
	Male	4	36.4
	Female	7	63.6
03	**Level of Education**		
	mal Education	5	45.5
	Primary	5	45.5
	Secondary	1	9.1
04	**Marital status**		
	Married	10	90.9
	Unmarried	1	9.1
05	**Occupation**		
	Housewife	4	36.4
	Butcher	2	18.2
	Livestock Farmer	4	36.4
	Student	1	9.1
06	**Religion**		
	Islam	11	100

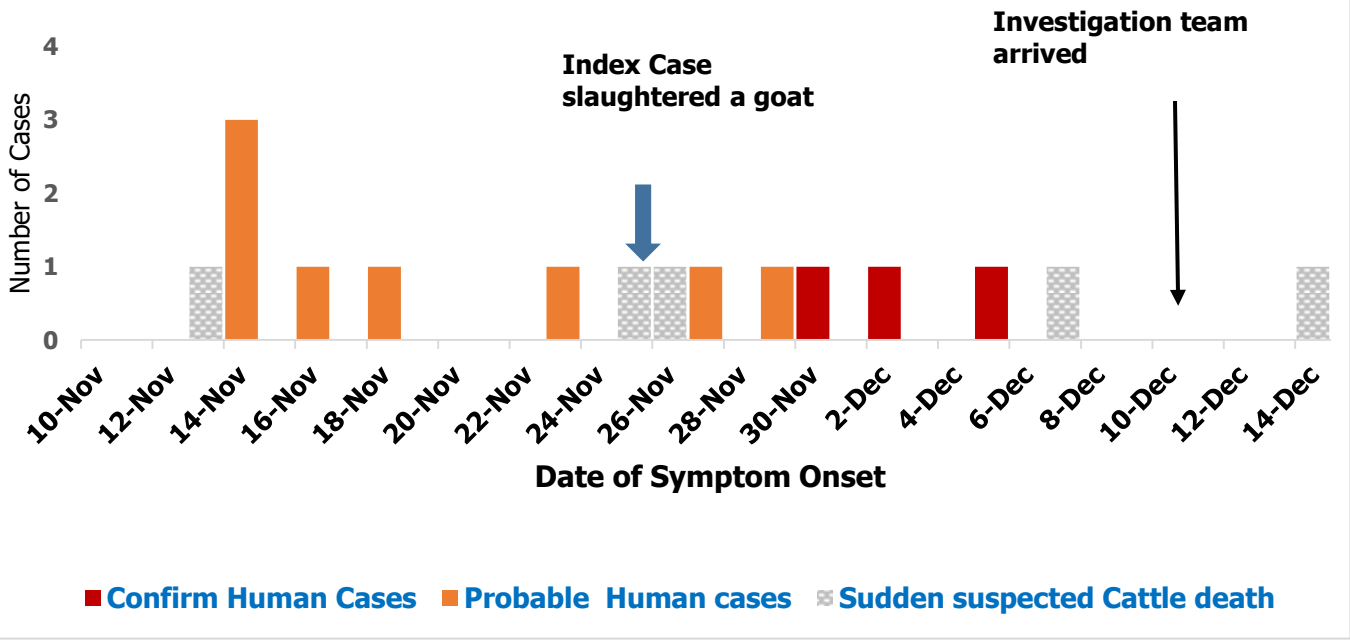
Q10: Why is it important to examine the distribution by demographic characteristics among study participants?

Answer 10:

Table II: Clinical Characteristics of Cases in the Anthrax Outbreak Investigation Among Humans and Livestock in Meherpur District, Bangladesh, December 2023, N=11

SL	Characteristics	Frequency	Percentage
1.	**Clinical Feature**		
	Fever	4	36.4
	Local Pain	10	90.9
	Myalgia	4	36.4
	Joint Pain	1	9.1
	Itching	11	100
	Lymphadenopathy	1	9.1
2.	**Type of Skin Lesion**		
	Papule	1	9.1
	Vesicle	5	45.5
	Blister	2	18.2
	Edema	2	18.2
	Depressed Escher	8	72.3
3.	**Location of Lesion**		
	Left Hand Finger	5	45.5
	Right Hand Finger	5	45.5
	Left Arm to left hand Finger	1	9.1

Figure 3: Probable and confirmed human cases of anthrax (n=11), and sudden deaths of cattle (n=5), by date of onset / occurre 03nce, Meherpur District, November-December 2023



Question 11: Interpret the Epidemic Curve (Figure 03)

Answer 11:

Table III: Health seeking practices of Cases in the Anthrax Outbreak Investigation Among Humans and Livestock in Meherpur District, Bangladesh, December 2023, N=11

SL	Characteristics	Frequency	Percentage
1.	**Seek Medical Attention**	11	100
2.	**Health institution where seek medical attention**		
	Sub district Hospital	6	54.5
	Local dispensary	3	27.3
	District Hospital	3	27.3
	DMCH	1	9.1
	IDH	1	9.1
3.	**Sought medical attention before going to health institution**		
	vate Chamber	2	18.2
	lage Practitioner	2	18.2
4.	quired Hospital Admission	2	18.2
5.	**Mean Hospital stay (days)**	14 ±7	
6.	**Antibiotics**		
	Single Antibiotics	6	54.5
	Multiple Antibiotic	5	45.5
7.	**Type of Antibiotics**		
	Tab. Ciprofloxacin	9	90.9
	Tab. Flucloxacilin	3	27.3
	Cefuroxime plus Clavulanic Acid	2	18.2
	Tab. Doxycycline	1	9.1
	Tab. Moxifloxacin	1	9.1
	Tab. Linezolid	1	9.1
	Inj. Ceftriaxoine	2	18.2
	Inj. Vancomycin	1	9.1
	Inj.Meropenem	1	9.1

Question 12: Summarize the Key Findings from Table II and Table III

Answer 12:

Livestock handaling practices and Incubation and recovery:

Table IV shows Livestock handling Practices and Table V shows the Incubation Period and Recovery Time of Human Anthrax Cases

Table IV: Livestock handling practices of Cases in the Anthrax Outbreak Investigation Among Humans and Livestock in Meherpur District, Bangladesh, December 2023, N=11

SL	Characteristics	Frequency (N)	Percentage(%)
1.	**History of Meat Consumption 13th November to 14th December**	10	90.9
2.	**Sources of Meat**		
	Buying from Butcher	2	18.2
	Buying from Villagers	7	64.6
	Receiving from Villagers	1	9.1
	Slaughter self-sick cattle	1	9.1
3.	**Involved in skinning and dissecting**	5	45.5

4.	**Involved in raw meat handling**	8	72.7
5.	**Involved in cooking meat**	8	72.7
6.	**Experience cuts or abrasion during cutting or skinning**	0	0

Table V: Median Incubation Period and Recovery Time for Anthrax Cases in Meherpur District, Bangladesh, December 2023

SL	Variable	Median (IQR) days
1.	**Incubation Period**	3.00(1-6)
2.	**Time required to recovery**	46 (41-67)

The incubation period was determined based on the time between the date of exposure to the animal and the onset of symptoms. In contrast, the recovery period was calculated from the date of symptom onset to the clinical resolution of cutaneous lesions.

Question 12: What do you mean by Incubation Period? What can you conclude from Table IV and Table V?

Answer 13:

Question 13: What is a hypothesis in outbreak investigations? From your descriptive analysis, what will be your hypothesis for conducting the case-control study?

Answer 13:

Table VI: Associations between potential risk factors and Cutaneous Anthrax Infection in Meherpur District, Bangladesh, December 2023, N=11

Characteristics	Case	Control	Odds Ratio	P-value	Lower Bound	Upper Bound
History of Meat Consumption (13th November to 14th December)						
Yes	10(90.1)	32(72.7)				
No	1(9.09)	12(27.27)				
Involved in skinning and dissecting of Moribund Animal						
Yes	5(11.36)	5(11.36)				
No	6(54.55	39 (88.64)				
Involved in raw meat handling						
Yes	8(72.73)	5(11.36)				
No	3(27.27)	39(88.64)				
Involved in Cooking meat						
Yes	8(72.73)	17(38.64)				
No	3(27.27)	27(61.36)				

Own Unvaccinated Cattle						
Yes	8(72.73)	24(54.55)				
No	3(27.27)	20(45.45)				
Had heard about Anthrax Before						
Yes	2(18.18)	26(59.09)				
No	9(81.82)	18(40.91)				

Q14A: Complete the table using statistical software using the given dataset.

Q14B: What would you conclude from the findings?

Answer 14:

Table VI shows cases who handled raw meat (OR=20.8; 95% CI:4.11-105.20; p=0.01), were involved in skinning and dissecting of moribund animals (OR=6.50; 95% CI:1.43-29.37; p=0.01), and were involved in cooking meat (OR=4.23; 95% CI:1.00-18.22; p=0.04) had a higher odds of infection. Furthermore, a history of meat consumption (OR=3.75; 95% CI:0.43-32.51; p=0.23) and owning unvaccinated cattle (OR=2.22;95% CI: 0.52-9.50; P=0.28) showed a higher odds of contracting anthrax, but this was not statistically significant. Having prior knowledge about anthrax was associated with a significantly lower likelihood of contracting the disease (OR = 0.15; 95% CI: 0.03-0.80; p=0.02).

Question 15: Interpret the OR=20.08; 95% CI:4.11-105.20; p=0.01 for Involved in raw meat handling?

Answer 15:

Table VII demonstrates laboratory investigation findings

Table VII: Laboratory Investigation Findings of Cutaneous Anthrax Infection in Meherpur District, Bangladesh, December 2023

Specimen	Host	Sent	Type of test	Result
Swab from Lesion	Suspected Human Case	IEDCR (Virology Laboratory, Microbiology Department)	RT-PCR, Gram staining, culture and sensitivity	Three cases were positive for Bacillus Anthracis on RT PCR test. Gram staining and culture were negative for all samples
Meat	Suspected Animal	Central Disease Investigation Laboratory (CDIL)	Rapid Test kit, Direct smear examination. Molecular q-PCR	All three meat samples were positive on Rapid test and on q-PCR. Bacillus Anthracis found under microscope with PMB stain in all meat samples
Whole blood	Suspected Animal	Central Disease Investigation Laboratory (CDIL)	Molecular q-PCR	Blood samples were Negative on q-PCR
Grass	Suspected Animal House	Central Disease Investigation Laboratory (CDIL)	Toxicological Analysis	Grass samples were Negative for nitrate poisoning

Question 16: Based on Table VII, which laboratory tests identified Bacillus anthracis, and what do the results suggest about the sources of the outbreak?

Answer 5:

Anthropological assessment

The anthropological assessment was conducted through in-depth interviews with affected individuals, their families, and members of the community. The evaluation aimed to understand the cultural and behavioral practices surrounding the handling and consumption of cattle, which is suspected to be the primary vector for the disease. The community routinely slaughters moribund and visibly ill cattle, consuming the meat within households and selling it in local markets, despite the potential health risks. Economic motivations drive the purchase of this meat, as it is cheaper than meat from healthy animals. Additionally, improper disposal practices, such as shallow burial of larger cattle and discarding smaller animals in rivers or fields, pose significant environmental risks by potentially spreading anthrax spores. When symptoms of anthrax arise, community members initially seek treatment at local pharmacies or sub-district health complexes, with severe cases referred to the district hospital. Although there is some awareness of anthrax within the community, standard precautions for safely handling diseased animals are rarely practiced, exacerbating the risk of transmission and perpetuating the outbreak.

Question 14: How do economic motivations impact the handling and consumption of cattle in the community, and what are the implications for anthrax transmission?

Answer 14:

Question 15: What are the potential environmental risks associated with the disposal practices of diseased cattle, and how might these practices contribute to the persistence of anthrax?

Answer 15:

Prevention and Control Measures and follow up:

The prevention and control measures for the cutaneous anthrax outbreak in Meherpur District emphasize a One Health approach, integrating human, animal, and environmental health. The identification and confirmation of the index case, along with subsequent cases, led to targeted health messaging aimed at affected individuals and local authorities. Efforts included informing farmers about safe handling and burial practices, promoting livestock vaccination, and ensuring timely reporting to IEDCR. Despite these measures, challenges persisted, including cultural practices of consuming meat from symptomatic animals and inadequate carcass disposal, which facilitated disease transmission. Follow-up of cases and contacts demonstrated the effectiveness of health interventions, with all cases recovering.

Question 16: What infection prevention and control measures were implemented during the anthrax outbreak in Meherpur District, and how did they address the key challenges?

Answer 16:

Part 4: Discussion (Narrative, Drawings)

The outbreak investigation of cutaneous anthrax in Meherpur District, which began in December 2023, offers valuable insights into the disease dynamics and public health response. The investigation team, having arrived on-site, first engaged with local health authorities and community leaders to gain a comprehensive understanding of the outbreak's scope. They initiated the investigation by updating the line list of cases and refining the case definition to identify all affected individuals accurately.

The team's findings revealed a clear linkage between direct contact with infected livestock and the occurrence of anthrax infection. They observed that the majority of cases involved middle-aged females, highlighting a demographic pattern influenced by occupational and cultural practices. These insights underscore the importance of targeted interventions focusing on high-risk activities, such as handling and processing sick animals.

Throughout the investigation, several key challenges emerged, including delayed case notifications, inadequate carcass disposal practices, and limited community awareness. Addressing these issues required a multifaceted approach. The team implemented health education campaigns, advised on proper handling and burial of animal carcasses, and advocated for livestock vaccination to prevent future outbreaks. Collaboration with local authorities and field staff was crucial for disseminating information and ensuring compliance with recommended practices.

As the case study concludes, it is essential to reflect on the broader implications of the investigation. The findings highlight critical areas for improvement in surveillance, community education, and healthcare response. Future action plans should focus on strengthening surveillance systems, enhancing community outreach, and improving local healthcare capacities. Implementing these recommendations will be vital for effectively managing and preventing anthrax outbreaks in the future.

Discussion Questions

Q17. What were the key findings of the investigation into the anthrax outbreak, and how did they influence the response strategy?

Answer 17:

Q18. What were the major challenges faced during the outbreak investigation, and how were they addressed?

Answer 18:

Q19. Based on the investigation, what should be the focus of future interventions to prevent similar outbreaks?

Answer 19:

Q20. How can the insights gained from this outbreak inform public health policies and practices in the affected regions?

Answer 20:

Part 5: Case study conclusion

After summarizing their findings using descriptive epidemiology and conducting a case control study, the investigation team observed that the cutaneous anthrax outbreak in Meherpur District was characterized by a strong link between disease cases and direct contact with infected livestock. The investigation revealed that the majority of affected individuals were middle-aged females involved in high-risk activities related to animal handling. Additionally, the team identified significant gaps in community awareness, timely case reporting from health facility , and proper carcass disposal practices.

To address these issues, the investigating team recommended several prevention and control measures. These included enhancing surveillance systems, increasing community education about anthrax, implementing regular livestock vaccination programs, and ensuring safe disposal of animal carcasses. Strengthening local healthcare facilities to manage anthrax cases effectively and revising public health policies to address the identified gaps were also essential recommendations.

Engaging the community in implementing these measures is crucial for their success. To achieve this, community outreach programs should be launched to educate individuals about the risks and prevention of anthrax. Local leaders, health workers, and community organizations can play a pivotal role in disseminating information and encouraging adherence to recommended practices. Interactive sessions, workshops, and the distribution of educational materials can help raise awareness and foster community involvement.

As a member of the team, sharing findings with relevant partners requires a strategic approach. Utilizing forums and communication channels such as stakeholder meetings, local health management committees, and regional health networks will ensure that the findings reach all relevant parties. Collaborations with organizations like the U.S. Centers for Disease Control and Prevention and the World Health Organization (WHO) can further facilitate the dissemination of information and support the implementation of recommendations. These platforms will help coordinate efforts, mobilize resources, and enhance the overall response to the outbreak.

Q21. How can the findings from this outbreak investigation inform future public health strategies for managing similar zoonotic disease outbreaks in other regions?

Answer 21:

Q22. What strategies can be employed to improve the timeliness and accuracy of case reporting and sample collection in future outbreaks?

Answer 22:

Q23. What are the potential challenges in implementing the recommended interventions, and how might these be overcome to ensure successful prevention and control of anthrax?

Answer 23:

Acknowledgements

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Recommended Readings

Outbreak Investigation

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Anthrax

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Case Study Related Readings or Supplied Background Readings

Factsheet 1: Anthrax

Anthrax, a zoonotic disease caused by the Gram-positive, spore-forming bacterium *Bacillus anthracis*, primarily affects herbivores and domestic livestock, which typically acquire the infection by ingesting spores from contaminated soil. Human infection usually results from direct contact with infected animals or exposure to contaminated animal products like meat and hides. The disease in humans manifests in three forms: cutaneous, gastrointestinal, and inhalational, with cutaneous anthrax being the most common, accounting for about 95% of cases, usually arising from handling infected animal carcasses or by-products.

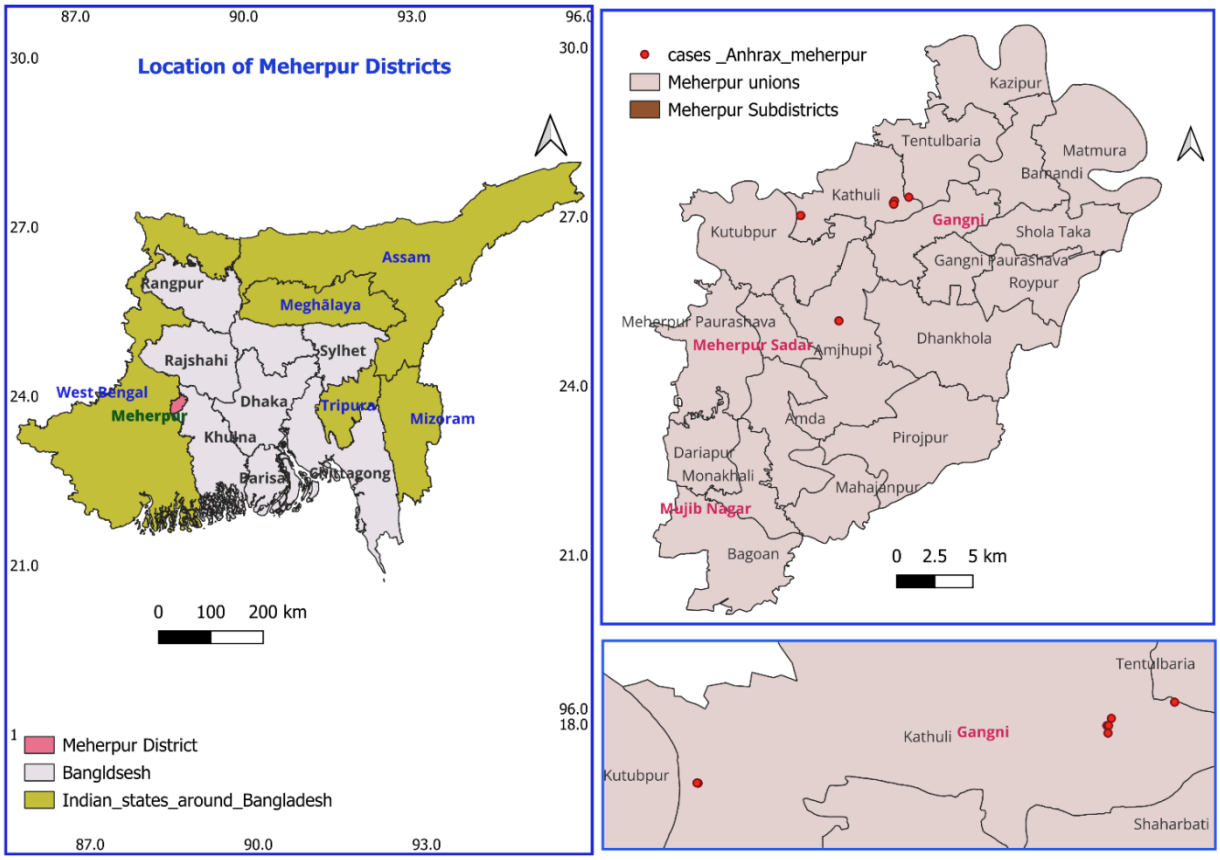

Figure 04: Map showing location of cutaneous anthrax outbreak in Meherpur District, Bangladesh 2023

Globally, an estimated 2,000 to 20,000 human anthrax cases are reported annually, mainly in endemic regions of sub-Saharan Africa and Asia. Bangladesh, a densely populated country with over 170 million people, relies heavily on agriculture and livestock farming, particularly in rural areas where limited health infrastructure exacerbates the spread of zoonotic diseases like anthrax. Meherpur District, in southwestern Bangladesh bordering West Bengal, India, has around 700,000 residents. The district, divided into Meherpur Sadar, Gangni, and Mujibnagar upazilas, is agriculturally prosperous but faces heightened risks of zoonotic disease outbreaks due to close human-animal interactions. Meherpur Sadar is a mix of urban and rural areas, while Gangni is primarily rural. Both have a history of anthrax outbreaks, driven by traditional practices and limited public health resources, underscoring the need for swift outbreak response. In Bangladesh, sporadic anthrax outbreaks have been reported annually since 2010, particularly in the Northern region. The Institute of Epidemiology, Disease Control, and Research (IEDCR) initially conducted

sentinel surveillance for human anthrax at five sites using a One Health approach, though currently, surveillance is only active in Gangni (Meherpur). Staff from both human and animal health sectors are involved in surveillance efforts.

Between 2009 and 2010, Bangladesh saw a surge in anthrax cases in both animals and humans, with human cases often linked to prior animal cases, indicating zoonotic transmission. The districts of Pabna, Sirajganj, Tangail, and Meherpur were identified as hotspots for these outbreaks, influenced by environmental, demographic, and cultural factors.

From 2016 to 2018, IEDCR investigated 15 anthrax outbreaks, reporting 378 cases in 2020. Insufficient availability of anthrax vaccines has hindered effective control of outbreaks among livestock. The Bangladesh Livestock Research Institute produced six million doses of the vaccine during 2019-2020, but this fell short of the 41 million doses needed for adequate coverage [1].
Factors such as inadequate livestock vaccination, butchering sick animals, improper disposal of carcasses, handling raw meat, social norms, and poverty contribute to anthrax outbreaks in Bangladesh [2]. Efforts to control anthrax include livestock immunization, fast identification diagnostic laboratories, and public awareness campaigns. However, control efforts are challenged by limited resources, remote healthcare infrastructure, and underreporting [3].

Factsheet 2: One health (Background Reading)

One Health Approach

One Health is a collaborative, multisectoral, and transdisciplinary approach that recognizes the interconnectedness of human, animal, and environmental health. Defined by the U.S. Centers for Disease Control and Prevention (CDC) as a strategy working at local, regional, national, and global levels, the One Health approach aims to achieve optimal health outcomes by addressing the interconnections between people, animals, plants, and their shared environment. This approach is particularly crucial in the prevention, investigation, and control of zoonotic diseases—diseases that can be transmitted from animals to humans—which make up approximately 60% of all infectious diseases in humans and around 70% of emerging infectious diseases.

One Health is not limited to zoonoses; it also addresses other health challenges arising from interactions between humans, animals, and the environment, such as antimicrobial resistance, food

safety and security, and expanded vector habitats due to global warming. By focusing on the human-animal-ecosystem interface, the One Health approach facilitates early detection of zoonoses in animal populations, preventing their transmission to humans and helping to control diseases like anthrax, rabies, and zoonotic influenza.

Effective implementation of the One Health approach requires coordination and collaboration across various professions, including public health and veterinary epidemiologists, clinicians, veterinarians, laboratory technicians, environmental scientists, and wildlife biologists. It also involves key roles for politicians, economists, sociologists, and security personnel, who support legislative frameworks, economic evaluations, understanding of human behavior, and enforcement of control measures.

One Health Approach in Bangladesh:

In Bangladesh, the One Health approach has been formalized through the Ministry of Health and Family Welfare, which organized an inter-ministerial meeting in June 2016. This gathering brought together One Health partner ministries, implementing agencies, and international organizations such as WHO, FAO, and USAID to establish the necessary institutional frameworks and technical procedures for the prevention and control of emerging infectious diseases. This collaborative effort laid the foundation for the **Strategic Framework for the Application of a One Health Approach in Bangladesh (2017 – 2021)**, highlighting the critical role of One Health in protecting public health and addressing zoonotic and other health threats.