



TEPHINET

Training Programs in Epidemiology and
Public Health Interventions Network

Case Studies in Applied Epidemiology
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Anthrax in the Mountains of Uganda: a One Health outbreak investigation case study

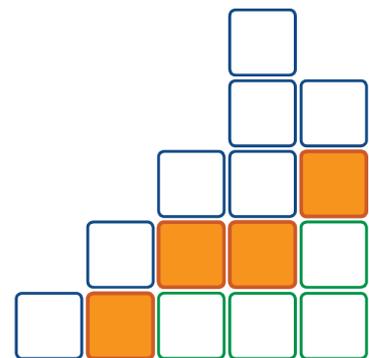
Classroom Version 2.0

Participant Guide

Learning Objectives

After completing this case study, the fellow should be able to:

- ❑ Describe each of the steps of an outbreak investigation, particularly when investigating a zoonotic disease outbreak
- ❑ Describe the One Health approach to an outbreak investigation, including its challenges
- ❑ Develop and evaluate hypotheses about the source of an outbreak
- ❑ Interpret epidemiologic data, both descriptive and analytic
- ❑ Identify strategies for control and prevention of zoonotic disease in animals and people



This case study is based on investigations undertaken in 2018 by the Ugandan Public Health Fellowship Program, particularly lead investigators Esther Kisaakye and Kenneth Bainomugisha, and the Kween District Rapid Response Team. However, the case study is not a fully factual account of these investigations; aspects have been altered to assist in meeting the desired learning objectives.

Version 1.0 of this case study was developed by Ausvet and the Australian National University and edited by Richard Dicker in 2019. An eLearning version was developed by Jeanette Stehr-Green and Brass Drum Media with support from the eLearning team from CDC, TEPHINET, and Public Health Informatics Institute. Version 2.0 combines features of Version 1.0 and the eLearning version, edited by Richard Dicker with review and input from Julie Harris and Claire Jennings.

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Please send corrections, suggestions for improvement, and comments about this case study to:
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Fact Sheet 1: Introduction to One Health (for background reading)

What is One Health?

One Health recognizes the close relationship between humans, animals, and the environment, and the impact that poor health in one of these areas can have on the others.

The U.S. Centers for Disease Control and Prevention (CDC) defines One Health as ‘a collaborative, multisectoral, and transdisciplinary approach — working at the local, regional, national, and global levels — with the goal of achieving optimal health outcomes recognizing the interconnection between people, animals, plants, and their shared environment.’¹ Though this approach is particularly relevant to control of diseases that can be transmitted from animals to humans (zoonoses), a One Health approach is also important for understanding other health challenges that may arise from interactions between humans, animals, and the environment such as antimicrobial resistance, food safety and security, and expanded vector habitats resulting from global warming.

One Health approaches are important for the prevention, investigation, and control of zoonotic diseases. Early detection of zoonoses in animal populations can prevent transmission to humans by, for example, preventing introduction of these pathogens into the food chain, or mitigating the risk of the pathogens if introduced. For some zoonoses, control of infection in animal populations can be the most effective way to prevent disease in humans (e.g., anthrax, brucellosis, rabies, zoonotic Influenza A viruses). Given that approximately 60% of infectious diseases in humans are zoonotic, and approximately 70% of emerging infectious diseases are zoonotic, a One Health approach to disease investigation and management is often appropriate and advantageous.

Investigating and controlling diseases at the human–animal–environment interface requires coordination and collaboration between different disciplines and agencies, at different levels.

Which professions are involved in a One Health approach to zoonotic disease investigation and control?

Relevant professions include:

- Public health epidemiologists
- Veterinary epidemiologists
- Clinicians, pathologists, nurses, and community health workers
- Veterinarians, animal health workers and quarantine officers
- Laboratory technicians
- Environmental scientists, ecologists, and wildlife biologists

Several other professions have key roles in implementing One Health. For example, politicians have a role in developing policies that provide legislative support for disease investigation and control, including compensation schemes; economists have a role in evaluation of the economics of disease intervention strategies; sociologists and social workers have a role in understanding the drivers of human behavior and social conditions that influence the occurrence of and response to outbreaks; and security personnel may have a role in supporting disease investigation and control measures.

¹ Centers for Disease Control and Prevention, 2018. *One Health Basics* (online). Available at: <https://www.cdc.gov/onehealth/basics/index.html>

Fact Sheet 2: Anthrax

Anthrax epidemiology: a brief overview

Anthrax is an illness caused by the bacteria *Bacillus anthracis*. In certain parts of the world the bacteria are endemic in the soil, where they persist as environmentally resistant spores. Sporadically, *B. anthracis* can cause outbreaks of illness in domestic and wild animals and in humans. Outbreaks in humans typically are related to recent anthrax cases or ongoing outbreaks in animals.

Herbivorous animals acquire infection when they graze and ingest spores that have been living in the soil. This usually occurs in areas of previous anthrax occurrence, where spores have been deposited in the soil from infected carcasses that were not buried appropriately. When soil in these areas has been disturbed by flooding, deep plowing, or excavation, the spores may come closer to the soil surface and be ingested during grazing. Omnivorous and carnivorous animals tend to acquire the infection by eating infected animals. Humans may become infected in this way. They may also acquire infection by handling infected animals or contaminated animal products. Spread between live animals or humans is extremely rare.

The vegetative (normal, growing cell) form of *B. anthracis* found in infected animals is fragile; however, when exposed to air, it can form highly resistant spores (inactive, dormant-state structures) that remain viable for many years in some soil types. Both spores and vegetative forms of *B. anthracis* are destroyed by moist heat at 100-105°C for 20 minutes.

Anthrax in animals

Anthrax affects many domestic and wild animal species. In livestock, anthrax causes sudden death in cattle, sheep, goats, and camelids. At death, blood may be present around the nose, mouth, and anus of carcasses. If an animal dies and falls to the ground, anthrax spores can contaminate the soil where the carcass lays. Appropriate management of carcasses of these species includes isolating the carcass from other animals, not opening the carcass (as exposure to oxygen allows spore formation), decontaminating the death site, and incineration or deep burial of the carcass.

Interestingly, pigs have some degree of natural resistance to anthrax and may recover from the disease. Clinical signs may include bloody feces, hemorrhage from the nose, and respiratory distress, or can be relatively mild with fever, enlarged lymph nodes, and localized swelling.

Anthrax in humans

Four forms of clinical anthrax occur in humans, depending on how anthrax spores enter the body

- **Cutaneous anthrax** occurs after spores enter the body through skin lesions, usually while handling contaminated products such as meat from or body parts of an infected carcass. The incubation period is typically 1–7 days, though it can be longer. The classic clinical feature is a group of blisters with associated itching and swelling, progressing to a painless sore with a necrotic black scab (called an *eschar*, pronounced 'ES-kar'). These lesions typically occur on hands, arms, face, or neck.
- **Ingestion (gastrointestinal) anthrax** occurs after a person eats raw or undercooked meat from an infected animal. The incubation period is typically 1–7 days, though it can be longer. Clinical signs may include fever, swollen lymph nodes in the neck, sore throat, headache, nausea, and vomiting (which may include blood), diarrhea (which may include blood), abdominal swelling and fainting.
- **Inhalational (pulmonary) anthrax** occurs after a person inhales aerosolized *B. anthracis* spores, historically associated with processing of contaminated animal hides or wool. The incubation period is typically 1–7 days, though it can be longer. Clinical signs may include fever, fatigue, aches, nausea and vomiting, chest discomfort, a cough and difficulty breathing. In 2001 the U.S., 11 cases of inhalational anthrax (five fatal) occurred among people exposed to mail intentionally contaminated with anthrax spores.
- **Injection anthrax** has been reported among heroin-injecting drug users who shared contaminated needles. Clinical features may be similar to those of cutaneous anthrax but may include deeper infection in tissues under the skin or in muscle where the drug was injected.

Anthrax in the Mountains of Uganda

Part 1

One Health is a collaborative, multisectoral, and transdisciplinary approach — working at the local, regional, national, and global levels — with the goal of achieving optimal health outcomes recognizing the interconnection between people, animals, plants, and their shared environment.

— U.S. CDC and the One Health Commission

or more simply,

One Health is an approach to ensure the well-being of people, animals, and the environment through collaborative problem solving — locally, nationally, and globally.

— One Health Institute, UC Davis

Background and Initial Investigation

20th April 2018 — The Initial Call

On Friday, 20th April 2018, the District Health Officer (DHO) in the Kween District of Uganda received a call from a medical officer at a local health clinic. The medical officer reported seeing seven patients in the last week with signs and symptoms suggestive of cutaneous anthrax — swollen skin blisters and painless sores with black tissue in the center (eschars, see Figure 1).

The medical officer stated that neither he nor his colleagues had seen a case of anthrax at the clinic since he started working there 17 years ago.

Anthrax — Background

Anthrax is an acute zoonotic bacterial infection caused by *Bacillus anthracis*, a gram-positive, spore-forming bacteria that can survive for years in soil where infected animals have died or were buried. Transmission to humans occurs through handling or eating meat from infected animals,

contact with their products e.g., wool, hides, bones, or by breathing in spores [1]. Anthrax commonly takes 3 forms, depending on the route of exposure: cutaneous, ingestion (gastrointestinal), and inhalational.

Figure 1. Anthrax eschar



Photo courtesy of Mr. Job Morukileng, Uganda PHFP fellow, Cohort 2020

Question 1: What questions should the DHO ask the medical officer about these patients? (5 minutes).

Setting

Kween district (approximate population 100,000) is in a mountainous area in eastern Uganda known as the “cattle keeping corridor,” close to the border with the Republic of Kenya (Figure 2).

Most households in Kween district depend on subsistence farming. They raise livestock, particularly cattle and goats, along with sheep, pigs, and poultry. About one-third of the population is illiterate. Radio serves as the main source of information in the area.

First 7 Patients -- Clinical Information

The medical officer provided the following details about the seven patients:

All patients had skin lesions consisting of blisters and bumps surrounded by large areas of redness and swelling; some had developed eschars. Some also had gastrointestinal symptoms. Two were seriously ill.

Swabs taken from skin lesions of two patients and examined under a microscope in the clinic’s laboratory showed filaments of gram-positive rods consistent with *Bacillus anthracis* (Figure 2). However, no cultures were done from the swabs.

The patients ranged in age from 1 to 38 years. Five were male, two were female. All were from Village A, a small farming village in Kween District. One patient’s symptoms began on 14th April; symptoms for the other six began on 15th April.

According to the medical officer, the patients were hesitant to say how they might have been exposed to anthrax.

In Uganda, anthrax is one of seven priority zoonotic diseases designated for a One Health response. In Africa, anthrax outbreaks in humans have resulted from exposure to the carcasses of cattle, hippopotamuses, and other animals that had died from anthrax.

Figure 2. Kween District, Uganda



Figure 3. Photomicrograph of *B. anthracis*



Question 2: Which government agencies might be interested in participating in an investigation of a possible outbreak of anthrax based on a One Health approach? What types of staff might be part of a field investigation team?
(5 minutes)

The DHO convened a meeting of the District Rapid Response Team and invited representatives from the other relevant agencies. The DHO suggested that a field investigation to Village A should be conducted.

Question 3: What would be your primary objectives of the field investigation? (3 minutes).

Team members assembled equipment and supplies for the field investigation, including antibiotics to treat additional cases of anthrax.

To prepare for the investigation, team members reviewed the biology and epidemiology of anthrax

(see Fact Sheet 2), and what they knew about the cluster so far. Because many team members were not epidemiologists, they also reviewed the steps of an outbreak investigation.

Table 1. Steps of an Outbreak Investigation

1. Identify your team/prepare for field work (Done)
2. Establish the existence of an outbreak (in progress)
3. Verify the diagnosis
4. Construct a working case definition
5. Find cases and develop line list
6. Perform descriptive epidemiology
7. _____
8. Evaluate hypotheses through analytical studies
9. As necessary, reconsider, refine and re-evaluate hypotheses
10. Compare and reconcile epidemiologic findings with laboratory and/or environmental studies
11. Implement control and prevention measures (as early as possible)
12. Initiate or maintain surveillance
13. Communicate findings

Question 4: Which step is missing? (5 minutes)

Question 5: Which steps might be approached differently during a zoonotic disease investigation compared with a non-zoonotic (e.g., foodborne or person-to-person) disease investigation? (5 minutes)

Investigation of Human and Animal Cases

21st April 2018

A One Health team was assembled and met in Village A. The team consisted of the following staff:

- from the district government: District Health Officer; district laboratory focal person
- from the Ministry of Health: epidemiologist (fellow in Uganda's Field Epidemiology Training Program); health educator
- from the Ministry of Agriculture, Animal Industry and Fisheries: district veterinary officer; sub-county veterinary assistant
- from the Uganda Wildlife Authority: wildlife biologist
- from the Ministry of Water and Environment: environmental specialist

The team met first with the village council leader. They learned that Village A had a population of 234 persons. Most households engaged in subsistence farming and raised livestock. The village faced frequent droughts and flash floods leading to crop loss, food insecurity, and poverty. The village had a high rate of illiteracy, and almost no one had access to mass media.

The village leader noted that a cow had died suddenly and unexpectedly at a local farm on 11th April.

Some members of the team went to visit the farm where the cow had died, while others met with the clinic medical officer who had reported the seven cases.

According to the medical officer, all seven had skin lesions consistent with cutaneous anthrax. Five of the seven also had diarrhea, vomiting, and/or abdominal pain that could be consistent with ingestion anthrax.

To verify the suspected diagnosis, the laboratory technician arranged to collect clinical specimens from the patients and send them to the National Reference Laboratory in Kampala for urgent PCR testing for anthrax.

The FETP fellow began to develop a case definition for the outbreak.

Question 6: How does an outbreak case definition differ from a standard surveillance case definition? (5 minutes)

The FETP fellow developed the following outbreak case definitions for cutaneous anthrax and for ingestion anthrax.

Case definitions for human anthrax, Anthrax Field Investigation, Kween District, April 2018

Clinical

- **Suspected cutaneous anthrax case:** Itching, redness or swelling of skin areas PLUS either skin lesions (bumps, blisters, or eschars) or swollen lymph nodes
- **Suspected ingestion anthrax case:** Abdominal pain PLUS at least one of the following: bloody or non-bloody diarrhea, vomiting, sore throat, swollen lymph glands, or lesions in the mouth or throat
- **Confirmed anthrax case:** A suspected case with PCR-positivity for *Bacillus anthracis* from a clinical sample (swab from skin lesions or vesicles, and/or blood sample)

Time: Onset of symptoms from 6th April onwards

Place, Person: Resident in Kween District's Village A or nearby village

The team's next step was to look for additional human and animal cases.

Question 7: What are some ways you might look for additional cases (active case finding) among humans? (5 minutes)

To identify additional human cases some team members asked community leaders about other cases, and reviewed chief complaints listed on the clinic sign-in sheet, looking for new skin lesions or gastrointestinal symptoms suggestive of anthrax. Four more suspected cases were identified.

Meanwhile, the district veterinary officer, veterinary assistant, and environmental specialist visited the farm where the cow died.

The farmer reported that the cow seemed fine the night before, but on the morning of 11th April the cow staggered about, fell to the ground and died a short time later, oozing blood from its mouth, nose, and anus. The farmer reported that his other cows seemed healthy, and none had died recently. None were vaccinated against anthrax.

The farmer told the team that, after the cow died, he and several other men dragged the cow to an

open spot in the pasture and butchered it. None of them wore any type of personal protective equipment. The farmer gave a portion of the meat to each of the men and sold the rest of the cow parts in neighboring villages so he could afford to buy a new cow.

The animal investigation team members visited neighboring farmers and asked about livestock illnesses and deaths; none were reported. They also decontaminated the cow's death site, vaccinated livestock that had access to the site, and advised the owner and neighbors on how to manage anthrax risk in their animals.

At the end of the day team members met, shared their findings, and made plans to contact the people in the surrounding communities who had purchased portions of the implicated cow.

Question 8: How might information from the animal investigation help the human investigation, and vice versa? (5 minutes)

To help describe the chronology of the investigation when it came time to write the outbreak report, the FETP fellow created a timeline of key events and findings (see Table 2).

Table 2. Timeline of Key Findings, Anthrax Field Investigation, Kween District, 11th – 30th April 2018

11 th April	Cow dies suddenly, is butchered and eaten in Village A
...	
20 th April	Seven people come to clinic with anthrax-like symptoms, medical officer calls DHO
21 st April	Team begins field investigation, learns about exposure of cases to dead cow. Anthrax suspected.
22 nd April	
23 rd April	
...	
29 th April	
30 th April	

22nd April 2018

On Sunday, 22nd April, the sub-county veterinary assistant reported that another cow owned by the same farmer had died. The veterinary assistant was able to examine the cow prior to its death and found it to have a swollen neck, hemorrhages under its skin, and blood stains on its skin and anus.

The assistant thought that the findings were consistent with anthrax and took a blood sample for rapid diagnostic testing. The cow died a short time later. The veterinary assistant supervised burial of the carcass to ensure that no parts of the cow were eaten or used for other purposes. The death site was decontaminated.

Question 9: What key information from 22nd April would you add to the Table 2 timeline? (2 minutes)

23rd April 2018

On Monday, 23rd April, the sub-county veterinary assistant reported that seven additional cows had been found dead in and near Village A — one on the Village A's communal pastureland and six in a nearby stream and in surrounding bushes. None were owned by the farmer whose cows died earlier. The deaths were consistent with anthrax.

Again, the team oversaw proper burial of the carcasses and decontamination of the death sites.

24th / 25th April 2018

By 24th April, the team had identified 26 people who met the case definition for suspected cutaneous and/or ingestion anthrax. The FETP fellow conducted in-depth hypothesis generating interviews with twelve of the case-patients. The purpose of these interviews was to identify activities, behaviors, events, or locations that were commonly reported so that investigators could develop a list of exposures to evaluate further as hypotheses. The FETP fellow listed the reported exposures (Table 3).

Table 3. Exposures reported by case-patients in the week before onset of their symptoms, suspected anthrax outbreak, Kween District Village A, April 2018

Exposure	Number exposed (%)
Moved, butchered, or skinned cow that died on 11 April	12 (100%)
Consumed meat or other parts of cow that died on 11 April	12 (100%)
Performed work that required regular contact with soil	10 (83%)
Trapped and skinned wild animals	3 (25%)
Travelled out of area	2 (17%)
Attended a large gathering	2 (17%)

Question 10: What would be your leading hypotheses about how the case-patients were exposed?
(5 minutes)

29th April 2018

On 29th April 2018, another cow was found dead in Village A. The district veterinary officer collected samples from the carcass for rapid

testing for anthrax and oversaw proper burial and decontamination. The rapid tests were positive for *B. anthracis*.

Question 11: What key information from 23rd–29th April would you add to the Table 2 timeline?
(2 minutes)

30th April 2018

By 30th April, the 26 suspected human cases had been interviewed using a standard case investigation form. All 26 reported onset of symptoms after contact with the cow that died on

11th April. Reported contact included skinning, butchering, carrying, and eating meat from the dead cow.

Question 12: What key information from 30th April would you add to the Table 2 timeline? (2 minutes)

Anthrax in the Mountains of Uganda

Part 2

Descriptive epidemiology and an epidemiologic study

Epidemiologic Study

The FETP fellow decided to conduct an epidemiologic study to obtain more information on risk factors for this anthrax outbreak. The team would visit all 57 households in the village,

attempting to enroll the entire population of the village and interview them using a standard questionnaire developed by the fellow.

Question 13: What type of epidemiologic study was planned? Why do you think the team chose this study design? (5 minutes)

The team visited all 57 households and were able to enroll 141 of the 234 Village A residents. The most common reason for non-enrollment was absence from the village when the interviewer visited, including children who were away at boarding school and adults who had travelled to neighboring villages for trade, cattle-rearing, and farming.

The interviewers collected data on demographics, clinical symptoms, and relevant possible exposures.

The FETP fellow summarized the participation rate (see Table 4).

Table 4. Comparison of sex and age distribution among study participants and target population, Village A, 2018

Characteristic	Participants	Village A Population	Participation Rate
Total	141	234	60%
Sex			
Males	77	127	61%
Females	64	107	60%
Age group (years)			
0 – 4	23	41	56%
5 – 10	21	38	55%
11 – 17	13	51	25%
18 – 34	37	45	82%
35 – 54	22	30	73%
≥ 55	25	29	86%

Question 14a: Why is it important to calculate participation rates and look at the distribution of age and sex among study participants versus the target population?

Question 14b: What do you conclude about the participation rate and age distribution comparison? (8 minutes)

The FETP fellow explained to the team that he had been taught to analyze the descriptive data by

What (clinical information), When (time), Where (place), and Who (person characteristics).

Question 15: How would you analyze these components, that is, what tables, figures, or maps might you use? (5 minutes)

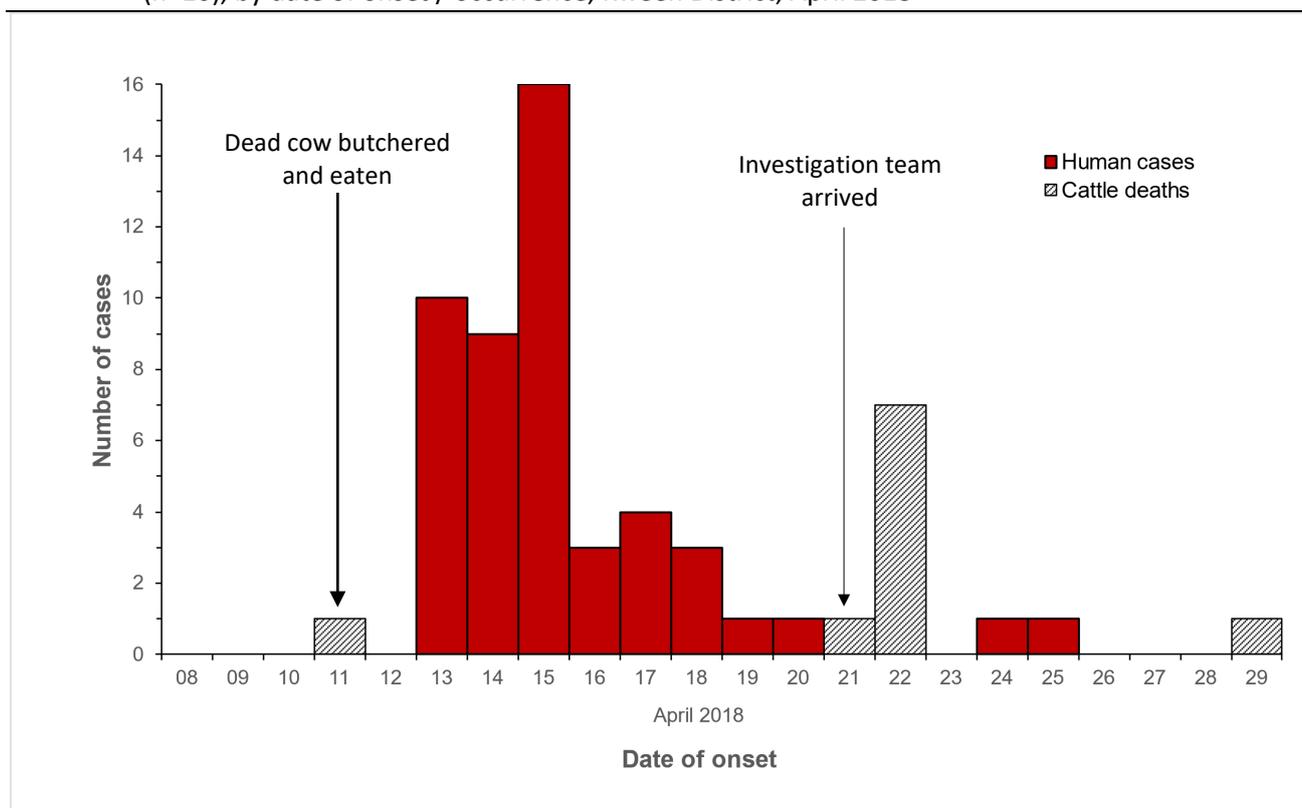
Descriptive Epidemiology

A total of 49 case-patients were identified —47 from Village A and 2 from nearby Village B. The clinical information, time, and person data are shown in Table 5, Figure 4, and Table 6.

Table 5. Distribution of suspected and confirmed human cases of anthrax by clinical presentation, Kween District, April 2018 (n=49)

Type of anthrax presentation	Cases	
	Number	Percentage (%)
Cutaneous only	13	26
Gastrointestinal only	16	33
Cutaneous and gastrointestinal	20	41
Total	49	100

Figure 4. Suspected and confirmed human cases of anthrax (n=49), and sudden deaths of local cattle (n=10), by date of onset / occurrence, Kween District, April 2018



Note: Figure includes two case-patients from Village B with onset of symptoms on 13 April.

Table 6. Attack rates of suspected and confirmed human cases of anthrax by sex and age group, Village A, April 2018 (n=47*).

Characteristic	Cases	Participants	Attack Rate (%)
Total	47	141	33.3%
Sex			
Males	32	77	41.6%
Females	15	64	23.4%
Age group (years)			
0 – 4	9	23	39.1%
5 – 10	6	21	28.6%
11 – 17	3	13	23.1%
18 – 34	10	37	27.0%
35 – 54	10	22	45.5%
≥ 55	9	25	36.0%

* Does not include 2 case-patients with ingestion anthrax only from Village B

Question 16a: Interpret the epidemic curve (Figure 4).

Question 16b: Summarize the key findings from Table 5 and Table 6.
(10 minutes)

The FETP fellow analyzed data from the epidemiologic study to identify potential risk factors for cutaneous anthrax and for ingestion anthrax.

Table 7. Association between **cutaneous anthrax (n=33)** and skin contact with implicated cow or cow parts, Village A Cohort Study, April 2018.

Skin contact with cow / cow parts	Cutaneous anthrax		Total	Attack Rate (%)
	Yes	No		
Yes	23	18	41	56.1%
No	10	90	100	10.0%
Total	33	108	141	23.4%

Question 17: Using the data in Table 7, calculate a measure to quantify the association between skin contact with the implicated cow or cow parts and cutaneous anthrax, then express that measure in words. (5 minutes)

All 34 (100%) case-patients with ingestion anthrax enrolled in the study ate meat or other parts from the implicated cow. No study participant who did

not eat meat or parts from the implicated cow developed ingestion anthrax. As a result, the RR for this exposure was not calculable (Table 8).

Table 8. Summary of risk factors for ingestion anthrax, Village A Cohort Study, April 2018 (n=34)

<u>Exposure</u>	<u>Risk Ratio</u>	<u>95% Confidence Interval</u>
Ate meat from dead cow	not calculable*	(4.3 – ∞)
Ate meat that was roasted	2.9	(2.2 – 3.9)
Ate meat that was boiled	0.9	(0.5 – 3.2)
Ate meat that was boiled > 60 minutes	0.34	(0.2 – 0.7)

* Attack rate was 0 among those who did not eat meat from the dead cow, so risk ratio denominator = 0.

Question 18: Interpret the risk ratio for eating meat that was boiled for more than 60 minutes. (5 minutes)

In reviewing findings from the cohort study, the FETP fellow had lingering concerns about the 10 case-patients with cutaneous anthrax who did not report butchering the implicated cow (See Cell C

of Table 7). Two of these were the case-patients with onset of symptoms on 24 and 25 April, more than one incubation period after the first patient had onset of symptoms.

Question 19: What might account for these “outliers”? How might you handle them? (5 minutes)

Later, it was determined that, of the 10 unexposed case-patients,

- Five were children who had played in the area where the implicated cow had been butchered, and
- Five, including the two with onset of symptoms on 24 and 25 April, were adults who had contact with the hide and/or bones from the implicated cow during the week after the cow was butchered.

Animal Follow-Up Studies

On 10 May, team members met and shared the results of their various investigations.

The FETP fellow shared that most participants in the epidemiologic study were aware of anthrax and knew that they should not eat meat from animals that died of unknown causes. Despite that knowledge, poverty and food insecurity led many

to eat readily available meat regardless of the risk. Most study participants who did not eat meat from the implicated cow answered that they were not in town or did not have money to buy the meat. In addition, in that region, it was taboo for pregnant women to eat protein-rich foods such as meat, fish, and eggs.

Team members who traced the sale of the meat determined that three legs and the head of the implicated cow were sold to buyers (two bars, a restaurant, and several families) in two nearby villages. The investigators estimated that 52 people from the two villages ate meat from the implicated cow, but only two people from the same family became ill with symptoms suggestive of ingestion anthrax. Both ate meat that was prepared at home.

The district veterinary officer expressed concern that the occurrence of anthrax among livestock in the district might be more widespread than reported.

Question 20: How might you determine the extent of anthrax occurrence among livestock in the district during the past 4 months? (5 minutes)

Farmers across the district were instructed to report anthrax-related livestock deaths so that burial of carcasses and decontamination efforts could be supervised by local authorities, surveillance for anthrax among humans could be

intensified, and community education could be refocused.

Investigation team members, however, were concerned that farmers might not report livestock deaths.

Question 21: Why might some livestock owners with sick or dead animals not report to authorities? What measures could be taken to improve their reporting and compliance? (5 minutes)

Control and Prevention

To address the district veterinary officer's concern about the occurrence of anthrax among livestock in the district, the Uganda Public Health Fellowship Program (Uganda's FETP) conducted a district-wide farm-to-farm survey of possible anthrax-associated deaths in cows between 1 January through 30 April. They identified 107 cow deaths consistent with anthrax during the 4 months.

To identify how livestock in the district may have been exposed to anthrax, the FETP conducted a herd case-control study based on findings from the survey. Case-herds were herds in which one or

more cows had died. Control-herds were those with no cow deaths. The case-control study revealed an association between anthrax-related livestock deaths and slaughtering livestock and disposing their carcasses on or near pastureland, and with digging activities on or near pastureland.

Because the farm-to-farm survey demonstrated that livestock from multiple villages had been affected by anthrax, the team recognize the need for more widespread prevention and control efforts. They also acknowledged that contributing factors needed to be addressed for long-term control measures to be successful.

Question 22a: Based on the findings of the outbreak investigation, what short-term and longer-term actions and control measures might you undertake?

Question 22b: What are some possible cultural and contextual challenges associated with the proposed control measures, and other factors that are important to consider?
(15 minutes)

Because of findings from the Village A cohort study, an educational campaign was undertaken to help change attitudes and behaviors related to anthrax among community members.

- Public meetings hosted by community leaders were held to discuss the dangers of anthrax to humans and steps for prevention.
- Public service announcements about the signs and symptoms of anthrax and means of transmission were played on local radio stations.
- An educational poster about prevention of anthrax that used the slogan “Life is more

valuable than the cost of an animal” was displayed in places where community members commonly gathered

On 21 June, team members met to debrief on the anthrax investigation. The team agreed that the One Health approach to the investigation with a multi-sector, multidisciplinary response hastened accurate identification of the outbreak source and implementation of effective control measures. But team members admitted that the One Health approach had its advantages and challenges.

Question 23: Looking back at this One Health approach to outbreak investigation and disease control,
a. what are some of the advantages?
b. what challenges can limit effective multisectoral collaboration? (15 minutes)

Conclusion

This outbreak of anthrax in animals and people highlights the need for coordinated investigations and response for suspected zoonotic disease outbreaks by public health and animal health authorities. In this outbreak, all human cases were linked to exposure to a single cow death. Community health education campaigns and

appropriate management of infected carcasses after the index cow death may have contributed to preventing further human anthrax cases, as no human cases were linked to these subsequent cow deaths. Vaccination of susceptible animals in the area is likely to have also helped prevent cases in cattle.

Question 24: What could be done in THIS country to promote a One Health approach to disease detection, investigation, control, and prevention? (5 minutes)

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Recommended Readings

Outbreak Investigation

- Lesson 6: Investigating an Outbreak. In: *Principles of Epidemiology in Public Health Practice, An Introduction to Applied Epidemiology and Biostatistics*. Third Edition. Published in 2006, updated in 2013. Available at
<https://www.cdc.gov/csels/dsepd/ss1978/lesson6/index.html>
- King ME, Bensyl DM, Goodman RA, Rasmussen SA. Conducting a Field Investigation. In: Rasmussen SA, Goodman RA, eds. *The CDC Field Epidemiology Manual*. New York: Oxford University Press, 2019.
Available at:
<https://www.cdc.gov/eis/field-epi-manual/chapters/Field-Investigation.html>

One Health

- Centers for Disease Control and Prevention. One Health. Available at
<https://www.cdc.gov/onehealth/index.html>
- Food and Agricultural Organization. One Health: Food and Agriculture Organization of the United Nations Strategic Action Plan. Available at <http://www.fao.org/3/al868e/al868e00.pdf>
- World Organization for Animal Health (OIE). One Health at a Glance. Available at
<https://www.oie.int/en/for-the-media/onehealth/>

Anthrax

- World Health Organization (WHO). *Anthrax in Humans and Animals*. Fourth Edition. 2008. Available at
<https://www.who.int/csr/resources/publications/AnthraxGuidelines2008/en/>
- World Health Organization. *Guidelines for the Surveillance and Control of Anthrax in Humans and Animals*. Third Edition. Available at
https://www.who.int/csr/resources/publications/anthrax/WHO_EM_C_ZDI_98_6/en/
- Centers for Disease Control and Prevention (CDC). Anthrax. Available at
<https://www.cdc.gov/anthrax/index.html>
- Merck Manual, Veterinary Medicine. Overview of Anthrax. Available at
<https://www.merckvetmanual.com/generalized-conditions/anthrax/overview-of-anthrax>