



Anthrax outbreaks in western Uganda: The role of illegal meat dealers in spreading the infection, August 2022–April 2023

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Summary

Background: From 2017–2022, Uganda experienced nineteen human anthrax outbreaks, all associated with handling or eating meat from cows found dead. Dealers in such meat (illegal meat dealers) may facilitate the spread of anthrax outbreaks. We uncovered the network of illegal meat dealers in Ibanda District, described their effect on anthrax outbreaks, and explored the drivers of the illegal meat trade.

Methods: During an anthrax outbreak in Ibanda District in April 2023, we conducted 11 key informant interviews (KII) to learn about illegal meat trade. We used snowballing to identify illegal meat dealers. KII participants included the Ibanda District Surveillance Focal Person, security officers, farmers, and the dealers. We used open coding to generate themes and conducted thematic analysis.

Results: We found a well-organized network of illegal meat dealers in Kagongo Division, Ibanda District. They are well known to farm workers in and around the district. The dealers buy animals found dead or sick from farms and sell the meat at a reduced price to consumers in Ibanda and fellow dealers in neighboring Kitagwenda District. During the August 2022 and March-April 2023 outbreaks, illegal meat dealers butchered animals found dead and sold the meat in the affected areas; five of the six dealers also developed anthrax in the most recent outbreak. Key drivers of the illegal meat trade were delayed and non-reporting of animal deaths, non-compliance to mandatory disposal of animal carcasses, non-functional surveillance for animal deaths, weak meat market regulations and misperception of the risk of anthrax.

Conclusion: Illegal meat dealers operate well-organized networks in Ibanda District which likely facilitated the spread of anthrax infection and widened the scope of recent outbreaks. The practice also spreads and sustains anthrax spores in the grazing areas, which could explain the recurrent outbreaks. Deliberate measures should be taken to prohibit this trade to mitigate risks for future anthrax outbreaks.

Background

Anthrax is an acute zoonotic bacterial disease caused by spore-forming, *Bacillus anthracis*. The spores survive for approximately two decades in animal carcasses, slaughter and disposal sites of infected animals (1). The animals can acquire anthrax when they breathe in or ingest spores from contaminated soil, plants, or water.



Transmission of Anthrax in humans always occurs through handling or eating meat from infected animals or their carcasses, contact with their products or by breathing in spores (2, 3). An estimated 20,000-100,000 cases of human anthrax are reported globally every year, with most occurring in rural areas without a routine vaccination program for anthrax (3).

Uganda experiences recurrent human anthrax outbreaks mainly in the cattle corridors of western, eastern, and northern regions. These outbreaks are usually associated with handling or eating meat from cows found dead (2, 4-8). During January 2017–April 2023, Uganda reported 19 anthrax outbreaks, seven of which occurred in the western region (9).

In March 2023, six months from a previous anthrax outbreak in August 2022, Ibanda District reported another outbreak in Kagongo Division. On April 16, 2023, Ministry of Health (MoH) dispatched a team to investigate the recent outbreak. During the investigation, rumors of a network of illegal meat dealers (persons involved in the trade of meat from animals (cattle, goats or sheep) that are found dead emerged. Animals that are found dead or die suddenly are suspected to have anthrax. Thus illegal meat dealers may facilitate the spread of anthrax infection and amplify outbreaks. We investigated to understand the network of illegal meat dealers in Ibanda District, describe their effect on the spread of anthrax, and explore the drivers of illegal meat trade to generate evidence-based recommendations.

Methods

Study setting

We conducted the study in April 2023 during an anthrax outbreak in Kagongo Division, Ibanda District in western Uganda. The district has 17 sub-counties and 600 villages, with a total population of approximately 277,300 people (10, 11). The main source of livelihood is subsistence agriculture in form of animal and crop farming which employs 78% of the population. Accordingly, sixty-four percent of the households in Ibanda District are involved in livestock farming (11). In addition, Ibanda is bordered by seven districts including Kazo, Kiruhura and Mbarara which lie in the western cattle corridor. During August 2022–April 2023, Ibanda District reported two human anthrax outbreaks in Kagongo Division (7) In both outbreaks, cattle found dead at farms in Kazo and Ibanda respectively were butchered and the meat sold in the affected areas.

Study design and participants

We conducted a qualitative study using Key Informant Interviews (KIIs). We used an interview guide with open-ended questions to understand the network of illegal meat dealers, effect of illegal meat trade on anthrax outbreaks and drivers of the trade. An illegal meat dealer was defined as anyone involved in the trade of meat from animals (cattle, goats or sheep) that are found dead, including butchers, slaughterers and restaurant owners. The Public Health Act of Uganda (2023), under statutory instrument 281-18 provides public health (meat) rules for cities, municipalities, and towns. The rules dictate that where a slaughterhouse exists, no animal shall be slaughtered



elsewhere than in the slaughterhouse, except with the permission of the authority. Furthermore, the rules require that all animals be inspected for diseases before slaughter and forbid slaughter of animals with, or suspected to have disease.

We used purposive sampling to identify individuals who were most likely knowledgeable about the illegal meat trade in Kagongo Division, Ibanda District. In addition, we used snowballing to identify illegal meat dealers. The study participants included the Ibanda District Surveillance Focal Person (DSFP), security officers, farmers, Village Health Team (VHT), and illegal meat dealers in Kagongo Division, Ibanda District.

Data collection

We conducted KIIs using an interview guide with open-ended questions in the local language (Runyankole) to learn about the network of illegal meat dealers, effect of illegal meat trade on anthrax outbreaks, and drivers of the trade. We asked about demographic characteristics such as age, sex, occupation, sources of illegal meat, mode of transport of the meat, and marketing of the illegal meat. To describe the effect of illegal meat trade on anthrax outbreaks, we asked questions about villages of operation of individual dealers, and the possible role of dealers in spreading anthrax in the affected villages from August 2022 to April 2023. To explore the drivers of illegal meat trade, we asked questions on motivating factors for dealing in animals found dead, adherence to public meat rules, reasons why members of the community consume meat from animals found dead, movement of animals and their products, notification and reporting of animal deaths, and dealers' perceptions about anthrax.

We first interviewed a key informant at the district health department who informed us about a likely network of dealers in meat from animals found dead. He revealed one of the dealers in Kagongo Division and advised us to reach him through either the internal security officer or area councilor. The rest of the dealers were then reached with the help of security, village health teams (VHT), and area local leaders. We additionally disguised as restaurant customers to obtain more information. To reach some of the elusive dealers, we posed as farmers seeking buyers for our dead cattle.

We conducted and recorded all the interviews in privacy and used password protected smartphone recorders. We achieved saturation of information after 11 KIIs including seven with illegal meat dealers, the DSFP, security officer, farm manager and a VHT respectively. At that point, additional interviews were not generating any new information or ideas.

Data management and analysis

We transcribed and translated audio recorded data from the local language into English. This was done by two members of the study team who were proficient in both languages. We checked the transcribed data against the audio recordings to ensure accuracy. In addition, we conducted triangulation by comparing the transcribed data with field notes and seeking clarification from the respondents. We reviewed each individual interview several times to familiarize ourselves with data and identify words, phrases, sentences and paragraphs that described particular phenomena. These were



summarized into codes manually using open coding. We reviewed and refined the initial codes and merged similar ones to generate three themes and fourteen subthemes.

We used the inductive thematic analysis approach to analyze the themes and subthemes. We presented the findings along the themes and also quoted representative statements by respondents verbatim.

Ethical considerations

This study was conducted as a response to public health emergency by the National Rapid Response Team. The Ministry of Health Uganda provided administrative clearance to conduct this investigation. In addition, we received a non-research determination clearance from the US Centers for Disease Prevention and Control (US CDC). This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy. § See e.g., 45 C.F.R. part 46, 21 C.F.R. part 56; 42 U.S.C. §241(d); 5 U.S.C. §552a; 44 U.S.C. §3501 et seq. Furthermore, all the respondents were above the age of 18 years, and gave individual verbal consent for interviews. We conducted interviews in privacy to ensure confidentiality and the data kept under password protection by the study team.

Results

We conducted eleven Key Informant Interviews. Of these, seven were among illegal meat dealers while the rest were a security officer, DSFP, VHT, and a farm manager. The manager was responsible for the farm where animals were found dead and butchered during a recent anthrax outbreak in March-April 2023. Of the seven illegal meat dealers, five were traders while two were restaurant owners. The mean age of the respondents was 38 years with a range of 28 to 60 years and majority (9/11) was male. The education level of the participants ranged from primary to tertiary education with the majority above primary. We generated three themes and fourteen subthemes (Table 1).

Illegal meat dealers in Ibanda District

We identified eleven illegal meat dealers operating in Kagongo Division. They included eight traders and three restaurant owners, and operated in Rwensuri, Bisheshe, Bugarama, Bufunda and Central Wards. The interviewed dealers revealed that they specialize in meat from animals that are found dead, sick or injured and were aware of the negative implications. The dealers were well known to the community and operate meat stalls in several parishes in Kagongo Division.

“I have been doing this for several years...I mainly buy animals that get damaged during transportation, run over by others and those that collapse and die.”

- 53-year-old male meat dealer

“I had been into this business for several years but I abandoned it last year after I was arrested because some of my clients contracted anthrax from the meat I had supplied.”

52-year-old male meat dealer



Network of illegal meat trade

The illegal meat dealers operate a wide network including agents and farm managers within and outside Ibanda District. We discovered that when animals become ill or die in Ibanda, Kazo or Kiruhura districts, farm managers or agents notify network leaders in Ibanda District. The network leaders buy and butcher the animals and supply meat to their fellow dealers in Ibanda and beyond who then sell the meat to the community.

“There are several dealers in meat from animals that are found dead in Ibanda District...They buy animals that die from farms in Ibanda, Kazo and Kiruhura districts through agents.”

46-year-old male security officer

“We were called by the farm owner, who informed us that some of her cattle had collapsed and died, and wanted us to go and buy them.”

-52-year-old male meat dealer

Sources of animals that are found dead

The dealers have well-known sources of animals found dead or their meat within and around Ibanda District. The main sources are farms in Ibanda and neighboring districts of Kazo and Kiruhura, and occasionally cattle markets. The dealers have agents/informers in the various areas that alert them about animal deaths and link them to the farm managers or owners. Occasionally, the dealers are directly contacted by the farm owners or managers.

“We buy most of the dead animals from farms in Ibanda and sometimes from Kazo and Kiruhura. We also occasionally buy sick or injured animals from cattle markets in Ibanda.”

28-yr-old male meat dealer

Transportation of animals that are found dead or their meat

The network leaders transport the whole slaughtered animal carcasses or dissected meat from neighboring districts on Tricycles. The meat from animals slaughtered from farms in Ibanda District is transported on motorcycles (boda-boda taxi).

“We carry whole animal carcasses on tricycles...we use boda-boda taxis to transport the meat if the animal is already slaughtered”

-28-year-old male meat dealer

Market for meat for animals found dead

The meat is supplied mainly to co-traders, and restaurant owners in Ibanda District and the surplus to fellow dealers in Kitagwenda District, who then sell to the community in those areas.



“We also supply to some restaurants around Central Market and Bigulu Street...the surplus is sold to our colleagues in Kitagwenda.”

55-year-old male meat dealer

“... Their market is big and goes as far as to Kitagwenda District.”

46-year-old male security officer

Internal redistribution mechanism

The dealers also have an internal redistribution mechanism for replenishing each other's stock depending on their area of operation as illustrated in the schematic diagram.

“...We gave some of the meat to our colleague to sell in Rwampanga village. We usually communicate with our colleagues in case of excess stock or stock outs so that we redistribute and maintain constant supply of meat to our customers.”

28-year-old male meat dealer

Effect of illegal meat trade on anthrax outbreaks

We found evidence suggesting that dealers had amplified outbreaks in all areas affected by the recent and previous anthrax outbreaks in Ibanda District. The meat dealers butchered animals found dead from within and beyond the district and sold meat in the villages that reported human anthrax cases. This practice led to importation of anthrax in previously unaffected areas, thus widening the scope the outbreaks.

Dealers operated in the affected villages in the recent anthrax outbreak in Ibanda

During the recent outbreak, dealers butchered and sold meat from cows found dead in the 5 affected villages. The investigation subsequently linked this dealer and his colleagues to the outbreak. In addition, the network leader and all his co-dealers, and colleagues that helped him in the slaughtering process except one were among the confirmed anthrax cases. In total, 5 of the 6 confirmed anthrax case-persons were dealers.

“I bought the first 3 cows that died... I sold all the meat in Kakijerere I and II, Kasambya, Kaberebere and Rwampanga villages...”

53-year-old male meat dealer

“I was supported by 6 colleagues during slaughter, and all of us except one, developed lesions on the hands and arms and we were told that we contracted anthrax”

53-year-old male meat dealer

The dealers also butchered cows linked to a previous anthrax outbreak in Ibanda

Dealers also butchered cows linked to a previous anthrax outbreak in August 2022, and are aware of the negative implications of the practice. Dealers butchered cows that had died at a farm in Kazo District and sold the meat sold in the affected villages in Ibanda District. This led to the importation of the anthrax outbreak from the neighboring Kazo District into Ibanda District which had not reported any animal anthrax cases at the time.



"I had dealt in that meat for several years, until last year...people contracted anthrax from the meat I had supplied.....I was arrested and made to compensate the family of the deceased and pay medical bills of the sick"

52-year-old male meat dealer

Drivers of trade of the illegal meat trade

Our findings revealed several drivers of the trade in meat obtained from animals found dead in Kagongo Division, Ibanda District. The drivers included individual level, veterinary health system, societal and structural factors. At individual level, people in the affected communities were generally complacent to the illegal meat trade thus sustaining it. Furthermore, the meat dealers were driven by the need to make quick profits with minimal regard of the negative health and legal consequences of their business. In addition, failure to promptly detect and control animal anthrax outbreaks by the district veterinary health system provided dealers an opportunity to conduct their business. At societal and structural level, inadequate regulation of meat trade and movement of animal and their products also propagated the illegal meat trade.

Public willingness to buy meat from animals found dead

Members of the public in Kagongo Division willingly and knowingly buy meat from animals found. This ensures a ready market for the illegal meat trade thus driving the practice. The community had even come up with a local name for the meat for ease of identification. Locally, meat from animals found dead was referred to as "kyakorwa mukama", loosely translated as "God has done it for us."

"Our people buy the meat knowingly and willingly because it is cheap. They even nicknamed it 'Kyakorwa mukama' loosely translated as "God has done it for us."

60-year-old male VHT

Weak beef market regulations in peri-urban and rural areas

Most of the meat stalls and restaurants dealing in illegal meat trade were in peri-urban areas and not licensed. Hence, animals butchered at such stalls are not usually inspected by the veterinary and medical health teams as observed by one of the key informants.

"...meat from there never bears any stamp as opposed to the one sold in the butcheries in Central Market."

32-year-old female restaurant owner

Delayed or non-reporting of animal deaths by farmers

The farmers in Ibanda District and beyond were not reporting or delaying reports of animal deaths to veterinary health authorities. Thus animal disease anthrax control measures like appropriate disposal of animal carcasses were always delayed, allowing the illegal meat dealers enough time to transact their business. This is contrary to the Uganda animal diseases act which requires all farmers to notify veterinary health authorities about sudden animal deaths.

"...It's me who notified the district authorities about the animal deaths and human death, almost 2 weeks after the first animal death. This was the same case during last year's anthrax outbreak..."



-46-year-old male security officer

Non-compliance of farmers to appropriate disposal of dead animals

The farmers were also non-compliant when it came to appropriate disposal animal carcasses, and instead opted to sell them to the illegal meat dealers to avoid total losses. This complacency ensures the dealers have constant source of meat from animals found dead thus propagating the practice. *"... I was called by the farm owner to go and buy some cows that had died"...They sell them to us to avoid total losses."*

-52-year-old male meat dealer

High profitability of the illegal meat trade

The illegal meat trade requires very low capital in terms of investment and yet has very high returns. This is because the sick animals and animal carcasses are sold very cheaply as noted by one of the key informants. This makes illegal meat trade a very attractive business for persons with limited working capital and those looking for quick profits.

"...These animals are cheap and fetch a lot of profits. We buy a cow at UGX 200,000 (54USD) and earn a profit of over UGX 710,000 (189USD)..."

32-year-old female restaurant owner

Community preference for cheap meat

The community members generally preferred cheap meat and thus facilitated the illegal meat trade by ensuring a readily available market. Key informants noted that people in the peri-urban and rural areas preferred cheap meat since most can't afford the price of normal meat.

"I buy a kilogram of meat at UGX 3,000-6,000 (≈1USD-2USD)...my customers and I can't afford the normal meat whose price is UGX 12,000 (4USD)..."

48-year-old female restaurant owner

Misperception of risk of anthrax transmission among dealers

The illegal meat dealers misperceived their risk of acquiring anthrax from handling animals found dead or their meat. They did not perceive that butchering or handling meat from animals found dead posed a risk of acquiring anthrax to them. Even those that developed anthrax were dismissive of the diagnosis and instead attributed their symptoms to witchcraft.

"...I don't think it is dangerous to butcher those animals. We were told that we acquired anthrax from the dead animals that we slaughtered but...this was witchcraft..."

53-year-old male meat dealer

Discussion

We found a well-organized network of dealers in meat from animals found dead, operating in Ibanda District and beyond. They buy animals found dead from the local farms in Ibanda and neighboring districts of Kazo and Kiruhura districts, and sell the meat to local consumers in Ibanda and fellow dealers in neighboring Kitagwenda District. By butchering and selling meat from infected cows in several villages, the dealers likely facilitated spread of anthrax infection and widened the scope of recent outbreaks. Reported drivers of illegal meat trade included delayed or non-reporting of



animal deaths, non-compliance to mandatory disposal of animal carcasses and high profitability of the illegal meat trade. In addition, there was poor enforcement of meat market regulations, non-functional surveillance for animal deaths and misperception of risk of acquiring anthrax among dealers.

Our study revealed that illegal meat dealers were linked to the March-April, 2023 anthrax outbreak in Kagongo Division, Ibanda District when they butchered cattle that were found dead at a local farm. Subsequently, all the human anthrax cases were reported from five villages where the above meat was sold. In August 2022, dealers had also facilitated the human anthrax outbreak by butchering cattle that had died on a farm from the neighboring district of Kitagwenda (7). Furthermore, butchering animals that have died of anthrax also spreads and sustains anthrax spores in the grazing areas, which could explain the recurrent outbreaks.

The discovery of well-organized networks of illegal meat dealers adds a new dimension to the investigations of anthrax and other zoonotic disease outbreaks in humans. We did not find previous studies that had found such organized illegal meat trade in the context of anthrax or zoonotic disease outbreaks. However, a previous study in France that had highlighted the role of the meat production chain in amplification of infectious diseases. It found that meat production industry had likely amplified zoonotic infectious disease epidemics in France (12)

The role of butcheries in spreading anthrax infection was also highlighted during an anthrax outbreak investigation in Isingiro District. It was found that case-patients had bought and eaten meat from a particular butcher who had slaughtered a diseased cow from a local farm (2).

In addition, such uninterrupted networks of illegal meat dealers discourage farmers from complying with the mandatory reporting and appropriate disposal of carcasses. They opt to selling them to the dealers to avoid total losses in absence of a functional animal death surveillance system. By butchering diseased animals, the dealers sustain spores in the environment including grazing areas which could explain the recurrent anthrax outbreaks in these areas. This assertion is supported by findings of the environmental studies during the outbreak investigation in Ibanda District. Soil samples from three different sites in the affected farm returned positive results for *Bacillus anthracis*. In addition, a study in Uganda found that disposing or butchering livestock with suspected anthrax within <50m from kraals or near grazing areas were associated with recurrent anthrax outbreaks (4)

Many of the drivers of illegal meat trade were also consistent with findings of previous studies in Uganda about factors associated with anthrax outbreaks (2, 4-6, 8).

The delay in reporting animal deaths by farmers as they buy time to sell them to the dealers, delays outbreak response subsequently delays the response. This contributes to further spread of anthrax in animals and humans as they continue to handle and/or eat meat from the slaughtered infected animals.

In Ibanda District, the above situation was made worse by lack of a functional animal



anthrax disease surveillance system. Animal deaths were only occasionally notified by concerned citizens and security officer and such notifications often reached the District veterinary officer late. This gap in detection of anthrax outbreaks if not addressed, would make it difficult for Uganda to attain the targets of the global '7-1-7' goal for early outbreak detection and control at source (13).

Study limitations

The perspectives of farm managers in Kazo and Kiruhura districts, the dealers' agents and co-dealers in Kitagwenda District were not sought. However, we were able to achieve saturation after 11 interviews which meant that any additional interviews wouldn't have generated valuable new information.

We relied on self-reports from the dealers for most of the data on the illegal meat trade which might have led to social desirability bias. Nevertheless, it was minimized during the consenting process during which dealers were assured of confidentiality and no risks arising out their participation. We also endeavored to create enough rapport with the participants and conducted all the interviews in privacy to encourage disclosure.

Conclusion

Illegal meat dealers operate well-organized networks in Ibanda District. By butchering and selling meat from infected cows in several villages, they likely facilitated spread of anthrax infection and widened the scope of recent outbreaks. The practice is also known to spread and sustain anthrax spores in the environment including grazing areas and could explain the recurrent outbreaks. The reported drivers included delayed or non-reporting of animal deaths, non-compliance to mandatory disposal of animal carcasses, non-functional surveillance for animal deaths, public willingness to buy meat from animals found dead or ill, inadequate enforcement of meat market regulations and misperception of risk of acquiring anthrax among dealers.

Recommendations

To mitigate the risk of future outbreaks, we recommended the following:

The district veterinary and production, and health departments and law enforcement agencies should strengthen enforcement of laws that prohibit trade in animals that are found dead or diseased through multisectoral collaboration. Such laws include the public health (meat) rules, UNBS hygienic requirements for butchereries, and animal diseases act.

The district health, and veterinary and production departments working together should also sensitize the community members, meat traders and farmers on anthrax. The messages should include information on the cause, transmission, prevention, presentation and management of anthrax in both animals and humans.

The district veterinary and production department working with the law enforcement agencies should strengthen regulation of animal movements and their products within



and between districts, and lower local governments. This can be achieved through strict enforcement of the animal diseases act and other relevant laws on animal trade, and through enacting appropriate bye-laws.

The district veterinary and production department should ensure that all animals are inspected before slaughter in all areas including rural, urban and peri-urban settings. More emphasis needs to be put on peri-urban and rural areas where the meat market is poorly regulated.

The district veterinary department should enhance surveillance for animal deaths to enable timely detection and reporting of anthrax and other zoonotic diseases. This will facilitate prompt control of any future outbreaks at source thus limiting the scope in both animals and humans.

The government of Uganda should consider compensating farmers for reported and verified animal deaths to incentivize reporting, and appropriate disposal of animal carcasses. This will dissuade farmers from selling or slaughtering the animal carcasses for human consumption.

The ministry of agriculture, animal industries and fisheries working with the ministry of health should consider conducting further investigations into illegal meat trade in other anthrax prone districts in Uganda to inform targeted interventions. This is necessary for the broader prevention of anthrax outbreaks attributable to the practices of illegal meat traders in the entire country.

Conflict of interest

The authors declare no conflict of interest.

Authors' contributions

YN, DK, DA, AK, IS, SW, BK, RM and DK designed the study, contributed to data collection and analysis. YN led the writing of the bulletin. YN, DK, DA, IS, SW, LB, BK, RM, FM, and ARA participated in bulletin writing and review to ensure scientific integrity and intellectual content. All authors contributed to the final draft of the bulletin. All authors read and approved the final bulletin.

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