









## Essay



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## Coordinated response to anthrax outbreaks in the Upper East Region of Ghana; the role of One Health approach

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## **Abstract**

*High morbidity and mortality from anthrax outbreaks threaten the economy and public health. Recent global recurrence has raised anthrax prevention, surveillance, and control concerns. This essay reports Ghana's anthrax outbreak and management with a focus on the geographical spread, containment, and response. The anthrax outbreak affected 13 Ghanaian districts in the Upper East of which 100 animals died including 51% sheep, 41% cattle, 6% goats, and 2% pigs. Collaboration between human health and veterinary professionals, private and international organizations, anthrax vaccines, and drone delivery shortened the devastating effects of the anthrax outbreak. The effective multiple sectoral and actors coordination, management, and response to the outbreak, could be a model for*

*other countries for intra- and inter-One Health outbreak control collaborations.*

## **Essay**

Anthrax can kill humans and other warm-blooded animals [1,2]. Anthrax, caused by *Bacillus anthracis*, remains a global public health issue, especially in underdeveloped rural agricultural regions like West Africa [3]. Jones [4] says *Bacillus anthracis* thrives and reproduces in its host's circulatory system. The termination of its host and release via post-mortem bleeding allow it to spread to a new host in the environment. The anthrax bacterium produces long-lived soil-based spores. Anthrax spores can survive in the natural environment for almost a century and often live in animal burial sites [5]. There is evidence that anthrax spores can reinfect animals 70 years after disturbing burial sites containing infected animals [6].

Carlson *et al.* [7] report that anthrax outbreaks occur inconsistently around the world. Previous studies show that developing nations like Ghana have more anthrax outbreaks than developed nations [8,9]. Animal and human anthrax have been reported in Ghana. Blackburn *et al.* [9] reported 1,000 anthrax deaths in Ghana between 1980 and 2000. Most cases were in northern Ghana and were caused by infected cattle [9]. Human anthrax infection is usually oral, cutaneous, or pulmonary [10,11]. Human infection can occur through direct contact with domesticated livestock, hunting, slaughtering, and eating anthrax-infected carcasses [12,13]. According to Frankel *et al.* [10], anthrax can be contracted by inhaling or ingesting blood and other tissues from infected animals through broken skin. Direct exposure to animal fur, hide, or wool can also cause anthrax [10,11].

Anthrax outbreaks can cause high morbidity and mortality, putting the economy and public health at risk [14]. Recent global recurrence has increased attention to anthrax prevention,

surveillance, and control [15,16]. This case study analyses an anthrax outbreak in Ghana from epidemiological, clinical, and public health perspectives. Ghana, in West Africa, has a diverse population and relies heavily on agriculture and livestock in May 2023. The above factors create an environment where infectious diseases like anthrax can spread quickly. Ghana has rarely had anthrax outbreaks. However, these outbreaks can have serious consequences, so timely and effective response strategies are needed [17]. This case report describes how public health, veterinary, environmental, local, and medical professionals collaborated to investigate and contain a recent anthrax outbreak. This paper analyses the Ghanaian anthrax epidemic investigation to improve our understanding of anthrax epidemiology, outbreak case management, and public health. This report also emphasises the importance of a multidisciplinary approach to zoonotic diseases and the urgency of mitigating infectious agent spread and its effects.

This essay described the May 2023 anthrax outbreaks in the Bansi community in Binduri, Upper East Ghana. Data on affected individuals, areas, and timeframes were used to assess outbreak extent, geographical spread, containment, and response. On June 2, 2023, Ghanaian health officials reported a possible anthrax epidemic in Binduri District, Upper East Region. The Upper East Regional Health Directorate of the Ghana Health Service received the first two cases, one of which was fatal, on June 1, 2023. After eating the cattle carcass on May 21, 2023, a 65-year-old man became ill and died on May 31, 2023, from suspected anthrax. The family buried him the same day. The second patient to consume the carcass was a young man with arm lesions on June 1, 2023. On the same day, he was taken to a private hospital in Bazua, Upper East Region, Ghana. The third suspected human anthrax case was a young man with cutaneous lesions and a swollen head. There were 13 suspected cases and one suspected anthrax death in Binduri on June 11, 2023. All 11 suspected

patient samples tested negative for human anthrax at the Pong-Tamale Veterinary Laboratory.

Four cattle died in Bansi between May 20 and June 1, 2023, before human infections were reported. Over 100 people ate the first cattle carcass on May 21, 2023. The emergency health team burned the second cattle death on June 1, 2023. The third cattle death, which occurred around June 1, 2023, was sold to butchers against the veterinarian's advice, but the veterinary officers and district police retrieved the carcasses on June 2. On June 2, 2023, a bull slaughtered at Sapeliga in the Bawku West District and brought to Binduri was intercepted, blood samples were taken, and Pong Tamale Veterinary Laboratory found anthrax in the blood. On June 3, 2023, the fourth cattle died. Blood samples were taken, but the Fulani herdsman ignored the veterinarian's order to bury the carcass. The Bawku abattoir sold the carcass. But local measures got the carcass retrieved and buried properly. Pong-Tamale Veterinary Laboratory found anthrax in the fourth carcass. Cases of anthrax in animals were identified through the use of a history of sudden death of animals, with unclotted blood oozing out from the orifices of the dead animals. Laboratory testing of sudden dead animal blood samples taken from the facial veins of the animals was used to confirm the presence of *Bacillus anthracis*. With regards to human suspected cases, blood samples of humans were collected and tested for the presence of the bacteria. The geographical distribution of the anthrax-affected districts is displayed in the geographical map shown in Figure 1. A total of 7 districts out of 15 in the Upper East Region were affected.

**Animal anthrax death distribution by district:** the results indicated a total of 100 deaths were recorded in districts in the Upper West and Upper East districts of Ghana. Out of these deaths, 41 were cattle, 51 were sheep, 6 were goats and 2 were pigs. Binduri recorded the highest number of deaths (9 cattle, 3 goats, 25 sheep, and 1 pig) in animals, followed by Garu (15 sheep and 2 cattle) and Bawku West (7 cattle, 2 goats, 3 sheep and 1

pig). The least number of deaths were recorded in Pusiga (1 sheep), Nabdam (1 cattle), and Tempane (1 cattle) as shown in Figure 2.

**Human anthrax cases:** a total of 13 cases were suspected, including one death. Out of the 13 suspected cases, 11 of the suspected case samples were taken to the laboratory. All 11 samples tested negative, as shown in Table 1. Between May 18 and June 26, 2023, the peak of cases was recorded on May 27, 2023, with five cases. The last suspected case was recorded on June 1, 2023 (Figure 3). The first cattle death and carcass consumption occurred on May 21, 2023, after which the subsequent deaths occurred from May 30, 2023, to June 5, 2023 (with the maximum number of cases being three). Animal vaccination, the ban on movement slaughtering, and the ban on the sale of animals commenced on June 7, 2023, and 3 cases were recorded on the said date as well. A few deaths were recorded between June 12 and June 13, 2023 (a maximum of two cases) after which no death was recorded until June 20, 2023, when 3 deaths were recorded.

The Government of Ghana, in collaboration with the Veterinary Service Directorate, Environmental Health, Ghana Health Service, and Local Government Agencies, implemented preventive measures in response to the anthrax epidemic. The implemented actions encompassed the establishment of veterinary units and laboratories equipped with the capacity to identify and manage instances of anthrax; alongside public awareness campaigns aimed at disseminating knowledge regarding preventive strategies. The transportation of animals into and out of the affected regions was banned, and the consumption of animal carcasses was forbidden. The official reaction encompassed several particular elements, including; i. The activation of the Regional Public Health Emergency Management Committee. This committee was responsible for coordinating various response operations and exhibited a notable level of involvement from the Regional Minister of the Upper East Region and political institutions. ii.

Regional and District Rapid Response Teams were mobilized to conduct investigations into the epidemic. Furthermore, active case discovery and contact tracking measures were used. iii. In the region, a comprehensive prohibition was implemented on the transportation of animals (including cattle, sheep, goats, donkeys, and pigs) and their associated commodities for one month, commencing on June 7, 2023. iv. On June 7, 2023, a prohibition was implemented for one month, including the slaughtering, eating, and commercialization of both fresh and cooked animals. Additionally, all slaughterhouses within the specified territory were mandated to cease operations during this period. v. The management of suspected cases was commenced by administering antibiotics to all eleven (11) individuals. vi. The commencement of mass animal vaccination across all districts on June 6, 2023, was implemented as a preventive measure to curb the future dissemination of the epidemic throughout the animal population. As of June 8, 2023, a total of 2,339 ruminant animals, comprising 1,068 cattle, 757 sheep, and 514 goats, have received vaccination. As of June 11, 2023, a cumulative number of 16,800 cattle had been administered vaccinations. The vaccinations were deployed through drones as a means of expediting and addressing the urgent need to prevent a widespread outbreak of the illness at a national level. vii. Furthermore, there was an activation of heightened risk communication efforts in anticipation of the forthcoming Eid celebration.

Due to its hyper-endemicity and frequent outbreaks in West Africa, anthrax is underreported worldwide. This case report examined the recent anthrax outbreak in northern Ghana and the management strategy used to stop its spread. May to June 2023 was the duration of this anthrax outbreak. After a long dry season, Ghana's rainy season begins. Rains promote spring green-up and anthrax seasonality [7]. The anthrax outbreak affected 13 Northern Ghanaian districts, particularly the Upper East District. The 100 animals killed included 51% sheep, 41% cattle, 6%

goats, and 2% pigs. The livestock distribution in the Upper East region where this outbreak occurred explains the higher anthrax rate in such livestock. Animal deaths were highest in Binduri, where the outbreak began. The Upper-East region has seen the majority of Ghana's anthrax outbreaks, with various districts affected, according to Blackburn *et al.* [9] and Awoonor-Williams [18].

Investigating herbal remedies used to cook anthrax-infected meat led to one death out of 13-suspected cases in Binduri. The butchering and eating of the anthrax-infected carcass caused many suspected human infections. This study and another by Opare *et al.* [19] confirmed the role of human behaviour, perceptions, and belief in human anthrax outbreaks. The infection may also spread due to improper carcass disposal [20]. Males outnumbered females in this outbreak of human anthrax. This supports previous outbreak reports by Awoonor-Williams *et al.* [18] and Blackburn *et al.* [9] that Upper East anthrax patients are mostly men. Men are more likely to be exposed to anthrax spores in infected animals because they slaughter and butcher them. Women cook the meat.

This outbreak lasted less than a month (from May 20, 2013, when the first cattle died to June 1, 2023, when the last suspected anthrax case was recorded). The shorter outbreak management time is due to human health and veterinary professionals working together, as seen during the COVID-19 pandemic. This coordinated approach may have been influenced by COVID-19 lessons. This may have led to the prompt 24-hour reporting to the appropriate authority, which activated the district-level emergency One-Health response team. After the regional emergency response unit was activated, anthrax vaccination, animal movement, slaughter, and sale bans began. The management and control of this outbreak are worthy of note because of the availability of the vaccine, the quick vaccine delivery using drones and the collective effort of human and animal health sectors with the involvement of private and

international organizations hastened the process of the rapid response to dealing with this emergency outbreak. These private sector initiatives of vaccine delivery using drones were coordinated by Drone manufacturer, Zipline and technology pioneer Cowtribe who partnered with the Veterinary Service Department (VSD), Ministry of Health, and the Upper East Regional Coordinating Council (UER-RCC) to respond to the outbreak by distributing animal anthrax vaccine.

The international agencies which include FAO, WHO, UNHCR, and USAID promptly provided funds to facilitate the mobilization of the staff of VSD and the Ministry of Health in all these districts to combat the ravaging outbreak. The Regional Coordinating Council promptly coordinated the fund utilization in response to the outbreaks, while FAO led the joint field outbreak investigation using the One Health approach. In September 2023, FAO supported the Ghana Health Service in training its field staff as well as provided support to the Veterinary Services Directorate to organize an after-action review (AAR) to document lessons learned and the way forward with funding from the United States Agency for International Development (USAID). These interagency collaborations are very crucial for the mobilization of the veterinary staff to carry out vaccination, which enhances the coverage and control of outbreaks in Africa. The current anthrax outbreak in Ghana showed high case fatality in livestock, with a single death in humans. Despite this, the management and response involved a coordinated approach between several sectors and actors. This collective effort by the local authorities (VSD, MOH, UER-RCC), Private Sector (Zipline & Cowtribe), and international agencies (FAO, WHO, UNHCR, and USAID, among others) in the control of anthrax outbreak in the Upper East Region of Northern Ghana could serve as a model of intra and inter collaborations necessary for outbreak control using the One Health approach.

## Competing interests

The authors declare no competing interest.

## Authors' contributions

Benjamin Obukowho Emikpe conceptualized, designed, and drafted the article, Garba Maina Ahmed, and Anthony Akunzule conceptualized, acquired data, and reviewed the article critically for important intellectual content. Nii Nortey Hanson-Nortey, Peter Awin, Queenly Quartey, Henry Nii Ayi Anang, Augustine Agamba, Ransford Okornor, Adongo Issifu Rahaman, Jeffery Elorm Akortia Agbemeetsi, Albert Agyapong Tweneboah, Robert Bayuo aided in the acquisition of data and analysis of the data. Derrick Adu Asare drafted the article analysed and interpreted the data. Evans Ayamdooh Nsoh, Fenteng Danso, and Emmanuel Allegye-Cudjoe revised the article and provided some important information. All the authors have read and agreed to the final manuscript.

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## Table and figures

**Table 1:** distribution of human anthrax cases as of July 3, 2023

**Figure 1:** map of districts in the Upper East affected by anthrax (as of July 3, 2023)

**Figure 2:** animal anthrax death distribution by district

**Figure 3:** EPI curve of suspected cases of anthrax by the estimated date of onset - Binduri District, May 18 - June 26, 2023

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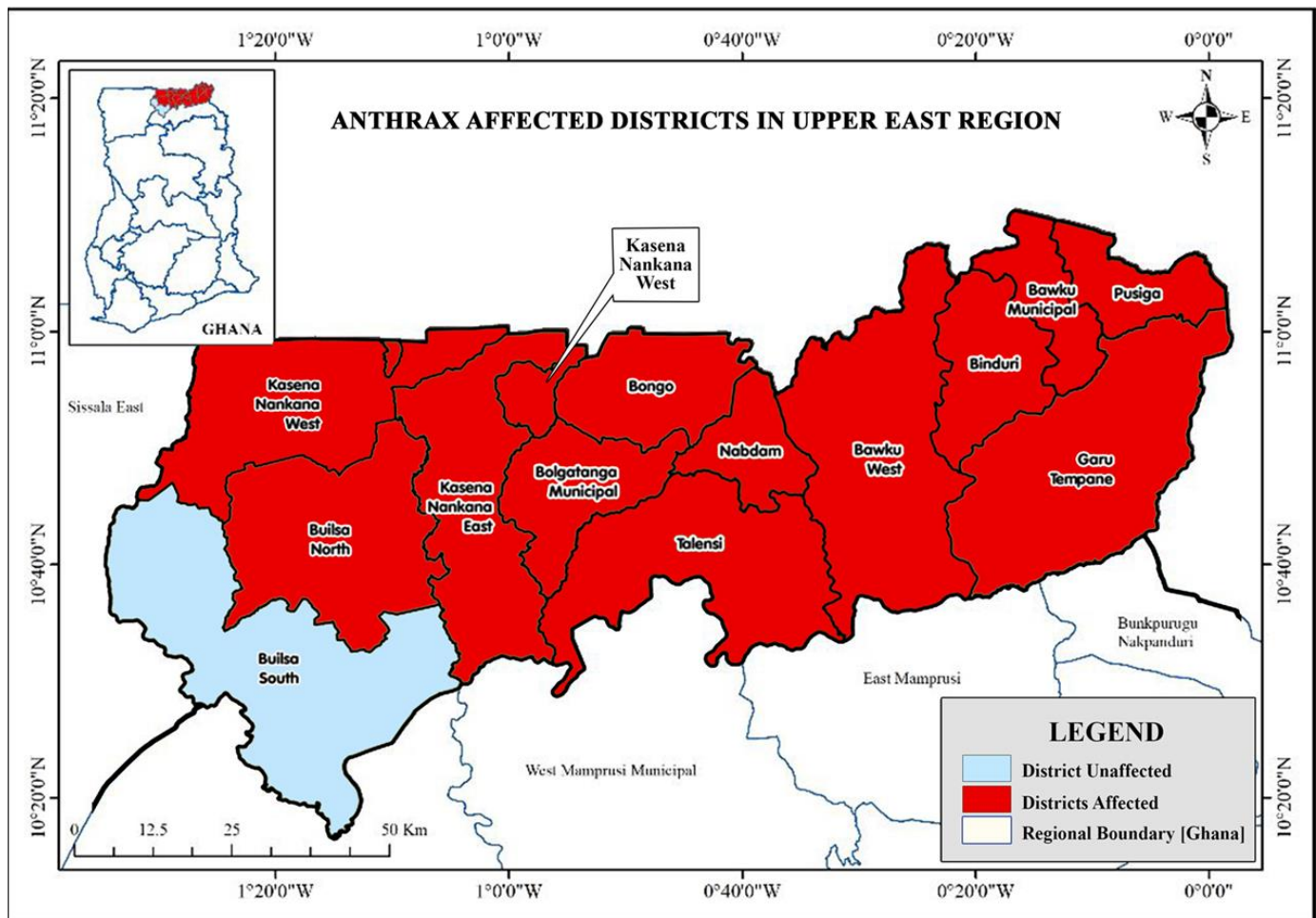
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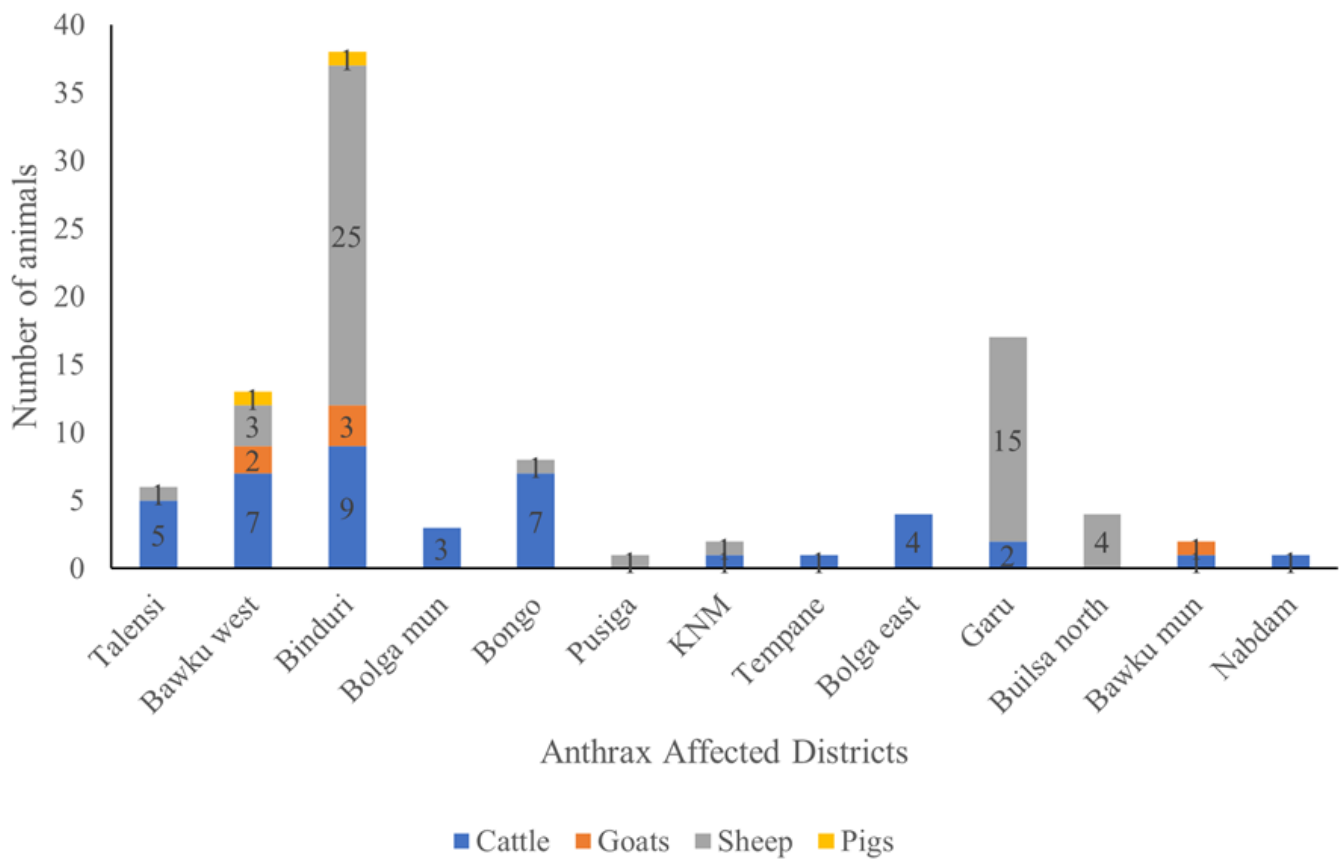
**Table 1:** distribution of human anthrax cases as of July 3, 2023

Indicator	Number	Remarks
Deaths	1	Buried the same day by the family
Admissions	1	Tamale Teaching Hospital
Samples taken	11	Cases suspected during the field visit
Positive	0	All results negative

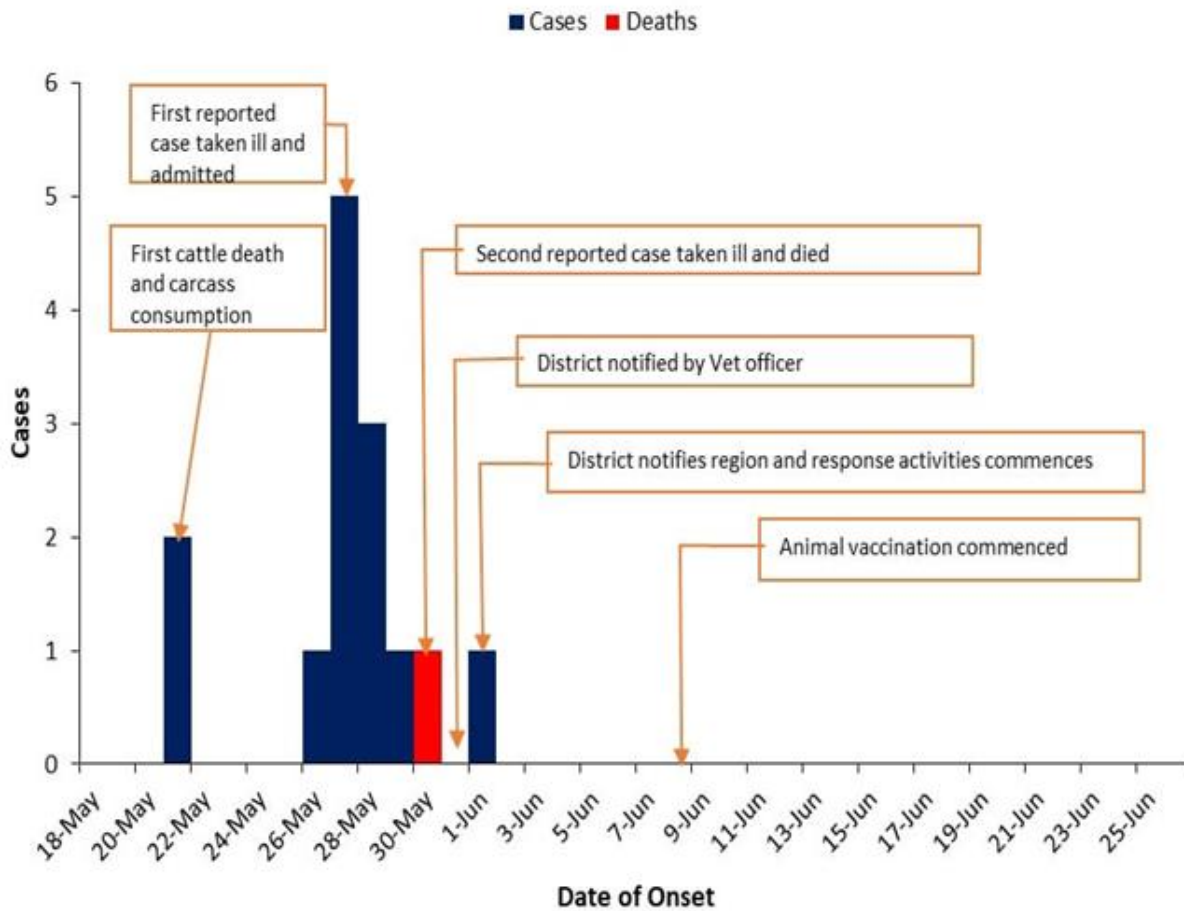




**Figure 1:** map of districts in the upper East affected by anthrax (as of July 3, 2023)



**Figure 2:** animal anthrax death distribution by district



**Figure 3:** epi curve of suspected cases of anthrax by estimated date of onset - Binduri District, May 18 - June 26, 2023