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Uganda Public Health Fellowship-Laboratory Leadership Program support, achievements, and challenges experienced in response to an anthrax outbreak, Amudat District, June 2024

Authors: Esther Nabatta[1,2], Hannington Katumba[1,7], Patrick Kwizera[1], Annet Martha Nankya[1,5], Rutogire Tracy[1,6], Joshua Kayiwa[1], Rebecca Nakidde[4], Samuel Gidudu[1]
Institutional affiliation: [1]Uganda National Institute of Public Health, Ministry of Health, Kampala Uganda; [2]National Animal Disease Diagnostics and Epidemiology Center, Ministry of Agriculture Animal Industry and Fisheries, Entebbe, Uganda [3]; Amudat District local government, Amudat, Uganda; [4]National Health Laboratory and Diagnostics Services, Ministry of Health, Kampala, Uganda; [5]Uganda Virus Research Institute, Ministry of Health, Entebbe, Uganda; [6]Kampala Capital City Authority, Kampala Uganda
Correspondence: Email: enabatta@uniph.go.ug, Tel: +256 782539910

Summary: On 15th March 2024, Amudat District registered its first anthrax outbreak. We describe the Uganda Public Health Fellowship (UPHFP)-Laboratory Leadership Program (LLP) support, achievements, and challenges experienced in response to the anthrax outbreak, Amudat District, June 2024.
Methods: We conducted a laboratory capacity assessment using the World Health Organization (WHO) laboratory assessment tool, 2012 for two laboratories to assess human resource, sample collection, handling, and transportation, biorisk management, presence of a response plan, and sample referral register.
Results: The average laboratory capacity to respond to anthrax outbreaks was 51%. Amudat Hospital laboratory and Karita HCIV laboratory performance was 54% and 47% respectively. The district had adequate sample referral supplies and had only 13% competent staff. Biorisk management score was 0% for both laboratories indicating that these were high risk facilities. The district lacked a laboratory response plan and sample referral register. We supported the DLFP to develop a response plan and Karita HCIV was supported to open a sample referral register. The sample referral register facilitated calculation of turnaround time (TAT).
Conclusion: Significant gaps in anthrax outbreak preparedness and response, with a suboptimal overall capacity score and critical deficiencies in biorisk management, human resource competence, and response planning were identified. The UPHFP-LLP strengthened local laboratory systems by supporting the development of a district laboratory response plan and establishing a sample referral register. These interventions were essential for improving turnaround time and enhancing the district's readiness for future zoonotic disease outbreaks.

Background

Anthrax is an acute infectious disease caused by the spore-forming gram-positive rod-shaped bacterium *Bacillus anthracis (1)*. Anthrax primarily affects herbivorous animals, but humans can become infected through direct or indirect contact with infected animals or their products (1). The disease manifests in three main forms: cutaneous, inhalational, and gastrointestinal anthrax (3).

Laboratory response is a critical component of anthrax outbreak management, providing definitive diagnosis and guiding public health interventions. Accurate laboratory diagnosis relies on the timely collection of appropriate clinical specimens, which varies depending on the form of anthrax suspected. Additional specimens such as serum, pleural fluid, or environmental samples may also be required to confirm infection and trace sources during outbreaks. Diagnostic methods include culture and microscopy to identify *B. anthracis*, complemented by advanced techniques such as polymerase chain reaction (PCR), immunofluorescence assays, and toxin detection tests that enhance sensitivity and specificity (4). Laboratory work with anthrax requires stringent biosafety measures, typically involving Biosafety Level 2 for clinical specimens and Biosafety Level 3 for environmental and aerosolized samples, to protect personnel from exposure to infectious spores (5). Proper sample collection, handling, and transport protocols are essential to maintain specimen integrity and ensure accurate results.

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Methods

Capacity assessment to respond to anthrax outbreaks

Jointly with the district laboratory focal person (DLFP), we conducted a laboratory capacity assessment using the World Health Organization (WHO) tool at two laboratories (Amudat Hospital and Karita HC IV Laboratory). We focused on the two laboratories because of the patients sought care from there. Additionally, Amudat hospital was in charge of packaging and referring the samples. The tool evaluates parameters such as human resource, sample collection handling and transportation and biorisk management, presence of a response plan, and sample referral register.

Assessment findings

Both laboratories had adequate supplies to support sample collection, packaging and transportation. Both had two competent staff in sample collection and referral. However, the district lacked a laboratory response plan because they lacked the knowledge and skills to for its development. There was also no sample referral register to ease tracking of samples. The district also lacked knowledge on biorisk management requirements for handling anthrax (Table 1).

Table 1: Key performance scores for Amudat Hospital laboratory and Karita Health Center Four

Key indicator	Karita HCIV (%)	Amudat General Hospital (%)
Indicator score	47	54
Organization and management	31	58
Documents	47	64
Specimen collection, handling and transport	54	69
Data and information management	75	77
Consumables and reagents	93	79
Equipment	NA	100
Facilities	51	24
Human resources	12	14
Biorisk management	0	0
Public health functions	63	54

*NA- Not assessed

Interventions and public health actions to address identified

Following the capacity assessment, we mentored the DLFP and laboratory staff on the proper sample collection and referral documentation using a register. We also mentored the team regarding the development and use of a laboratory response plan. Jointly, we designed a sample tracking and referral register and a laboratory response plan. We also mentored staff on Biorisk management one of the lowest scoring indicators putting emphasis on chain of custody to ensure that there is no accidental or intentional release of anthrax. We additionally reminded the team about proactively calling the hub riders to ensure prompt sample transportation. We also supported the DLFP to contact the Result Dispatch System (RDS) developers to ensure activation of the accounts for the district staff.

Ethical considerations

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 the 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. We sought verbal consent from the district team that we interviewed to obtain the laboratory capacity.

Achievements following the assessment and interventions

We drafted a costed laboratory preparedness and response plan which was presented in the District Task Force meeting by the DLFP. Capacity was built for three additional staff (two staff from the human health sector and one from animal health sector) on anthrax sample collection, packaging, and referral. We mobilized sample collection and packaging materials from Karita HCIV to support sample collection from suspected dead animals. Together with the mentored staff, six animal

samples were collected, packaged and sent to NADDEC for testing. We developed a sample referral register which facilitated tracking the number of samples collected, transported, received, and results returned. The register also facilitated calculation of TAT for the collected samples. The RDS account for the DLP was successfully activated and access to results made possible.

Challenges during the response

We encountered network issues as we tried to communicate with the hub coordinators to facilitate quick sample transportation. Additionally, due to the insecurities in Karamoja region, adjustments to enable sample pick up in the later hours of the day was not possible, therefore in most instances' samples were picked the next day.

Discussion

We revealed major challenges in district-level preparedness and response, especially in laboratory coordination, biorisk management, and sample referral systems. The absence of a laboratory response plan and a sample referral register was one of the critical gaps identified. These tools are essential for coordinating outbreak response and ensuring timely feedback of results.

We reveal a biorisk management score of 0% indicative of high risk for the laboratories. Poor biosafety and biosecurity practices increase the risk of accidental exposure for responders and facilitates the spread of the pathogen, laboratory-acquired infections and environmental exposure, particularly when handling dangerous pathogens such as *Bacillus anthracis*. Strengthening local laboratory capacity through training and implementation of International Organization for Standardization (ISO)-based standards like ISO 35001:2019 can reduce these risks and improve outbreak handling.

Challenges such as poor network connectivity and insecurity slowed down the response activities. Improving coordination, communication systems, and security support especially in hard-to-reach areas will be critical in managing similar outbreaks in the future.

Study limitations

This study faced some limitations that may have influenced the findings and their interpretation. The relatively short period of engagement with the district team limited our ability to observe and document the full extent of improvements attributable to the PHFP-LLP support. We present immediate effects of our efforts. Observing and documenting the long-term effects of the interventions is important but was not done. Future studies would benefit from establishing prospective documentation systems and conducting follow-up assessments over an extended period to better evaluate the durability of capacity gains and process improvements.

Conclusion

Significant gaps in anthrax outbreak preparedness and response, with a suboptimal overall capacity score and critical deficiencies in biorisk management, human resource competence, and response planning were identified. The UPHFP-LLP

strengthened local laboratory systems by supporting the development of a district laboratory response plan and establishing a sample referral register. These interventions were essential for improving turnaround time and enhancing the district's readiness for future zoonotic disease outbreaks.

Conflict of interest
The authors declare that they had no conflict of interest.

Authors contribution
NE, designed the study and data analysis. SG, HK, PK, AMN, TR, LB, JK, RN, GB, TN, DK and ARA participated in bulletin review to ensure scientific integrity and intellectual content. All authors read and approved the final bulletin.

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