



Comparative performance of human and veterinary laboratories in selected laboratory quality management system indicators during an anthrax investigation, Kanungu District, Uganda, March 2026

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Summary

Background: Laboratories play a key role in disease diagnosis, surveillance, outbreak detection, and public health response. Laboratory quality management systems (LQMS) are essential for quality laboratory services, importantly within the One Health framework for zoonotic disease detection and response. During investigation of a suspected anthrax outbreak in Kanungu District, Uganda, we conducted a comparative assessment of selected LQMS domains in human and veterinary laboratories to identify strengths and opportunities for strengthening integrated laboratory systems.

Methods: The assessment was conducted in March 2026 in Kanungu District, southwestern Uganda. Three laboratories were purposively selected: Kambuga hospital laboratory, Kanungu health centre IV laboratory, and Kanungu district veterinary laboratory. Using the World Health Organization standardized laboratory quality assessment tool, the three laboratory managers were assessed by two laboratory specialists across five LQMS domains, with laboratory managers as respondents: documented procedures, specimen management, laboratory request and result return systems, reagents and consumables management, and bio-risk management. Descriptive analysis was performed and results summarized as percentages.

Results: Kambuga hospital achieved the highest overall performance across assessed domains, scoring 100% for documented procedures and laboratory request/result return systems, 96% for specimen management, 80% for reagents and consumables management, and 70% for bio-risk management. Kanungu health centre IV demonstrated moderate performance, with scores ranging from 50% to 95%. The Kanungu veterinary laboratory recorded the lowest scores across all assessed domains, including documented procedures (42%), specimen management (47%), laboratory request and result return (27%), reagents and consumables management (31%), and bio-risk management (38%). Differences were seen between human and veterinary laboratory quality system implementation across all five domains.

Conclusion: We highlight stronger implementation of laboratory quality management systems in human health laboratories compared to the assessed veterinary laboratory. The findings identify gaps in veterinary laboratory quality systems at the subnational level and suggest that targeted technical assistance in quality improvement could be of value.



Introduction

Laboratories are fundamental to disease diagnosis, surveillance, outbreak detection, and public health decision-making (1). Reliable laboratory services depend on well-established laboratory quality management systems (LQMS) that promote consistency, accuracy, traceability, biosafety, and continuous quality improvement (2).

The increasing recognition of the interconnectedness of human, animal, and environmental health has strengthened emphasis on the One Health approach (3). Effective implementation of One Health requires functional laboratory systems across both human and animal health sectors to support timely detection and investigation of zoonotic diseases such as anthrax, rabies, brucellosis, Ebola virus disease, Rift Valley fever, and avian influenza

Uganda has strengthened laboratory quality systems in the human health sector through implementation of national laboratory quality-improvement and accreditation programmes (5). However, information on the implementation of comparable quality-management systems in subnational veterinary laboratories remains limited. Understanding the quality-system capacity of both sectors is important for identifying gaps that may affect coordinated detection and response to zoonotic disease threats.

On March 5, 2026, the Uganda Ministry of Health deployed a national rapid response team, including two laboratory specialists, to investigate a suspected anthrax outbreak in Kanungu District following reports of suspected anthrax deaths among cattle and suspected human cases. During the response, we assessed and compared selected laboratory quality management system indicators in human and veterinary laboratories in Kanungu District to identify strengths and opportunities for strengthening integrated laboratory systems.

Methods

The assessment was conducted in Kanungu District in southwestern Uganda, approximately 427 km from Kampala. Livestock keeping is a key economic activity in the district. Kanungu hosts Bwindi Impenetrable national park and is located near Queen Elizabeth national park and Virunga national park in the neighbouring Democratic Republic of the Congo.

The district health system comprises two general hospitals, four Health Centre IVs, 19 Health Centre IIIs, and 41 Health Centre IIs, with laboratory services available at Health Centre III level and above. The district veterinary system has one laboratory operated by one laboratory technician, providing limited serological testing for brucellosis and foot and mouth disease. More than 80% of samples from animals are referred to the National Animal Disease Diagnostics and Epidemiology Centre (NADDEC). During anthrax investigations, human specimens are referred through the National Health Laboratory and Diagnostic Services, while animal and environmental specimens are



transported through the national specimen referral system to NADDEC and other designated national reference laboratories.

Three laboratories were purposively selected to represent key functions in the district anthrax response. Kambuga General Hospital Laboratory was selected because it managed confirmed human anthrax cases, had the highest attendance among assessed facilities, and was accredited to ISO 15189. Kanungu Health Centre IV Laboratory was selected because it served as the district laboratory hub and specimen referral point for transportation to national reference laboratories. Kanungu District Veterinary Laboratory was selected because it was the only animal-health laboratory in the district.

A standardized World Health Organization laboratory quality assessment tool was used to assess the three laboratories, comprising two human-health laboratories and one veterinary laboratory. Laboratory managers participated in the assessment, and available records and laboratory practices were reviewed. Five laboratory quality management system domains were assessed: documented procedures, specimen management, laboratory requests and return of results, reagents and consumables management, and biorisk management.

Assessment findings were descriptively analyzed and summarized by laboratory and quality management system domain as percentages. Each assessment item was scored as 1 for full implementation/compliance, 0.5 for partial implementation, and 0 for non-implementation/non-compliance. Items that were not applicable or had no score were excluded from calculations. Domain scores were calculated as the mean of valid item scores, including the applicable means of sub-domains or related item groups. Scores ranged from 0 to 1 and were expressed as percentages where appropriate. Overall laboratory performance was calculated as the arithmetic mean of all assessed domain scores, giving equal weight to each domain regardless of the number of items assessed. Domains without valid scores were excluded.

The outbreak investigation was conducted as part of a public health emergency response and was classified as non-research/public health practice by the Uganda Ministry of Health and the US CDC. The investigation was approved by the Uganda Ministry of Health and reviewed by the US CDC in accordance with applicable federal laws, CDC policy, and the Declaration of Helsinki. Permission was obtained from the district health officer and district veterinary officer, and verbal consent was obtained from laboratory managers because the information collected was considered minimally sensitive.



Results

Performance of assessed laboratories across laboratory quality management and biosafety domains in Kanungu District, Uganda

Kambuga Hospital scored highest across all domains: documented procedures (100%), laboratory requests and result return (100%), specimen management (96%), reagents and consumables management (80%), and bio-risk management (70%). Kanungu HC IV scored 95% for laboratory requests and result return, 58% for documented procedures, 53% for specimen management, 58% for reagents and consumables management, and 50% for bio-risk management. Kanungu veterinary laboratory scored lowest across all domains: documented procedures (42%), specimen management (47%), laboratory requests and result return (27%), reagents and consumables management (31%), and bio-risk management (38%) (Table 1).

Table 1: Laboratory quality management system assessment scores in two human health laboratories and one veterinary laboratory, Kanungu District, Uganda, March 2026

Domains	Kambuga Hospital (%)	Kanungu HC IV Laboratory (%)	Kanungu veterinary laboratory (%)
Documented procedures	100	58	42
Specimen management	96	53	47
Laboratory requests and result return	100	95	27
Reagents and consumables management	80	58	31
Bio-risk management	70	50	38

Discussion

The assessment found differences between the laboratories in the implementation of quality management domains that are key to outbreak response. Kambuga Hospital performed best in implementation of laboratory quality systems. Kanungu HC IV performed second best, with Kanungu veterinary laboratory scoring least. The performance of Kambuga hospital laboratory showed a mature laboratory quality system, a reflection of strong investment in laboratory strengthening as the laboratory



was internationally accredited. Kanungu Health Centre IV showed a moderate performance. While laboratory request and result management were well established, weaknesses in documentation, specimen management, inventory control, and biosafety showed opportunities for targeted quality improvement interventions.

Kanungu veterinary laboratory consistently scored lower across all assessed quality system domains. These findings suggest that veterinary laboratory quality management systems at the sub-national level may need to have similar levels of investment in quality systems technical assistance that has been evidenced in human health laboratory strengthening initiatives (8). Deficits in documented procedures can lead to inconsistent laboratory operations, and inadequate consumables management can increase the risk of stock-outs, wastage through expiry, and poor-quality testing. Inadequate bio-risk management can lead to ecological risks that are important when handling zoonotic pathogens (9).

An Armenian study reported baseline general indicator scores of 21%–46% among human laboratories and 37%–60% among veterinary laboratories, indicating substantial gaps in QMS implementation (9). Similarly, Kanungu veterinary laboratory showed generally weak performance across all domains, scoring 27%–47%, while the human health laboratories performed considerably better, particularly Kambuga Hospital (70%–100%) and Kanungu HC IV (50%–95%). These findings reinforce the observation that laboratory quality systems may vary considerably between human and veterinary sectors and highlight the need for a coordinated One Health approach to laboratory quality improvement.

The findings support the need to further strengthen veterinary laboratory systems within Uganda's One Health framework. Extending technical assistance programs such as quality system mentorship, quality improvement programs, biosafety training, standardized operating procedures development, and supportive supervision to veterinary laboratories would benefit preparedness for future public health emergencies (10).

Study limitations: This assessment involved only three laboratories and only selected quality management domains were selected, therefore the results may not be generalized to human and veterinary laboratories in other districts. Secondly, the assessment covered selected QMS domains consequently the findings provide partial assessment of quality management system implementation. The domains not included are; equipment, human resources and testing performance. This is because these laboratories only referred samples to the national testing laboratories. Nevertheless, it provides useful baseline information on key quality management gaps and highlights essential areas that must be strengthened during a public health response. Larger studies involving multiple districts human and veterinary laboratories would provide more comprehensive comparative evidence to guide national laboratory strengthening strategies.



Conclusion: The comparative assessment between human health laboratories and the assessed veterinary laboratory showed relatively stronger laboratory quality management systems in the human health laboratories compared to the veterinary laboratory. The findings identify gaps in veterinary laboratory quality systems at the subnational level and suggest that targeted technical assistance in quality improvement could be of value.

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