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Implementation of a One Health Surveillance System in the Democratic Republic of the Congo

Paige Rudin Kinzie,[1,2] Boniface Lombe,[3,4] Sydney Merritt,[5] Megan Halbrook,[5] Emmanuel Hasivirwe Vakaniaki,[6,7] Patrick Mukadi,[6,8] Alex Madidi L'k'ye,[3] Jean Mona,[3] Daddy Kanonge,[3] Milette Mfwangkang,[6] Danae Witte,[9] Carleigh Melofchik,[10] Jean-Jacques Muyembe-Tamfum,[6,8] Nicole A. Hoff,[5] Augustin Twabela,[3,4] Placide Mbala-Kingebeni,[6,8] Lisa E. Hensley,[10] and Anne W. Rimoin[5]

[1]*College of Veterinary Medicine, Purdue University, West Lafayette, IN*
[2]*School of Public Health, University of Minnesota, Minneapolis, MN*
[3]*Laboratoire Vétérinaire Centrale de Kinshasa, Kinshasa, Democratic Republic of the Congo*
[4]*Faculté de Médecine Vétérinaire, Université Pédagogique Nationale, Kinshasa, Democratic Republic of the Congo*
[5]*Department of Epidemiology, Jonathan and Karin Fielding School of Public Health, University of California, Los Angeles, CA*
[6]*Institut National de Recherche Biomédicale, Kinshasa, Democratic Republic of the Congo*
[7]*Department of Clinical Sciences, Institute of Tropical Medicine, Antwerp, Belgium*
[8]*Microbiology Service, Department of Medical Biology, Cliniques Universitaires de Kinshasa, University of Kinshasa, Kinshasa, Democratic Republic of Congo*
[9]*College of Veterinary Medicine, University of Florida, Gainesville, FL*
[10]*Zoonotic and Emerging Disease Research Unit, National Bio and Agro-Defense Facility, USDA Agricultural Research Service (ARS), Manhattan, KS*

Abstract: Active animal disease surveillance is essential for detecting zoonotic emerging infectious diseases. In the Democratic Republic of the Congo (DRC), limited infrastructure, economic instability, and armed conflict constrain surveillance capability. This ongoing work to characterize the prevalence of zoonoses like Crimean-Congo hemorrhagic fever virus implements an in-country One Health approach to disease surveillance and capacity building in a limited-resource setting. Veterinarians and technicians from the DRC's Central Veterinary Laboratory with technical support from national and international partners completed 135 site visits across 9 provinces between June 2023 and July 2024 collecting bovine, porcine, and human serum samples along with attached and grossly engorged ticks. At each site, community animal health workers and local veterinarians were invited to participate for training in clinical competencies and emerging zoonosis identification. Facility survey data revealed that, while more than half of sites report using antibiotics (63% of sites with cattle; 75% of sites with swine), only a quarter of sites vaccinate livestock (18% of sites with cattle; 28% of sites with swine)—a larger trend of curative care outpacing preventative action. This disparity demonstrates a

Equally supervised: Augustin Twabela, Placide Mbala-Kingebeni, Lisa E. Hensley, Anne W. Rimoin.

Correspondence to: Placide Mbala-Kingebeni, e-mail: mbalaplacide@gmail.com

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need for veterinary capacity strengthening to realize long-term gains in disease prevention and economic stability.

Keywords: Crimean-Congo hemorrhagic fever, veterinary surveillance, one health, capacity building, emerging infectious disease, Democratic Republic of the Congo

Introduction & Purpose

The Democratic Republic of the Congo (DRC) presents a complex landscape where interactions among humans, animals, and ecosystems heighten the risk of spillover of zoonotic emerging infectious diseases (EIDs). The One Health (OH) framework–emphasizing the interconnectedness of animal, environmental, and human health–offers a practical approach for improving disease surveillance in such high-risk contexts. While OH principles have gained traction in some settings (Stärk et al., 2006; Zinsstag et al., 2023), their implementation in low- and middle-income countries (LMICs) like the DRC remains uneven, particularly in veterinary and ecological monitoring systems that are critical to detecting zoonoses. Entities like the Africa One Health Network are working to aggregate resources and knowledge to enhance regional sharing of best practices, but work continues to understand the unique strengths and challenges of OH system implementation across the African continent.

Effective surveillance of zoonotic EIDs requires both passive and active approaches, tailored to local infrastructure, workforce capacity, and sociocultural factors (Hoinville et al., 2013). In the DRC, passive surveillance is currently coordinated by the Ministry of Fisheries and Livestock through the Service National d'Epidémio-surveillance, which publishes biweekly reports on priority diseases like rabies, salmonellosis, and Newcastle disease. However, this decentralized system lacks consistency and integration into broader global monitoring frameworks, such as the World Organisation for Animal Health World Animal Health Information System. The DRC national government initiated a national OH platform in 2011, but demonstrated limited commitment, intersectoral tensions, and limited domestic funding and data-sharing practices have been cited as ongoing barriers (Yambayamba et al., 2024). Presently, the system is a splintered passive surveillance reporting structure.

The unique disease landscape of the Democratic Republic of the Congo (DRC) positions public health workers to reimagine ongoing efforts to detect and control disease. Organizations and systems established to combat specific outbreaks such as Ebola virus disease and mpox can be creatively applied to augment workforce capacity and translate lessons learned (Halliday et al., 2017). Surveillance for WHO-priority EIDs like Crimean-Congo hemorrhagic fever virus (CCHFV) can benefit from the revitalization and expansion of existing systems such as the historic Animal Disease Surveillance System (Abubakar et al., 2022; WHO R&D Blueprint Team, 2024). Evidence of the spread of CCHFV in animals has been confirmed in the DRC and some of its neighbors, including Uganda and Zambia, through ongoing livestock seroprevalence assessments (Balinandi et al., 2021; Sas et al., 2017; Kajihara et al., 2021). Documentation of recent sporadic human outbreaks in Uganda further underscores the need to characterize and monitor prevalence and incidence of the disease throughout sub-Saharan Africa (SSA) to prevent amplified virus spillover and spread in human populations (Atim et al., 2023).

Targeted efforts to expand OH surveillance capacity are now underway. A consortium involving both veterinary and national human health laboratories of the DRC is conducting systematic, longitudinal sampling at livestock and abattoir sites nationwide. This research prioritizes diseases like CCHFV and other pathogens with known or suspected animal reservoirs and increasing regional presence. The integration of CAHWs and veterinarians into these efforts not only enhances data collection but also strengthens passive surveillance through field training, biosecurity education, and awareness of disease signs and transmission pathways. This report highlights cross-sectional survey results describing initial findings regarding livestock vaccination and antibiotic usage, which are previously unreported in the DRC.

Overall, these efforts highlight the importance of bolstering veterinary systems in the DRC as a foundation for more effective and inclusive surveillance. By linking laboratory science with local knowledge and infrastructure, the country can build a more resilient system capable of early detection, rapid response, and long-term disease prevention at the human-animal-environment interface.

METHODS

This surveillance activity was designed to holistically gather data related to animals and zoonotic disease determinants as well as the veterinary public health issues that contribute to maintaining or promoting EIDs in the region, particularly in DRC. Sampling across all nine provinces proceeded with the collection of questionnaire data at the facility and individual level (Fig. 1).

Biological sample collection collected in tandem supplements the epidemiological data reported in this study and is intended to be used for future analysis.

In a typical site visit, investigation team members had three specific roles: interviewer, technician, and technician assistant (Fig. 2). The interviewer conducted tablet-based data collection via an online survey platform with offline capabilities (REDCap), recording information related to individual animals using barcode-based identification. The interviewer also completed a facility questionnaire with the consenting facility manager, who may be the livestock owner, a general manager, or an on-site veterinarian familiar with the livestock medical history and facility operations. Data collected for individual animals included: species, sex, castration status, age, body condition score (BCS), overall health status and clinical history (as reported by the owner), existing visible lesions or clinical signs, presence of attached and engorged ticks, and pregnancy status, if applicable. The comprehensive facility survey supplemented the individual record with information related to all animal populations on-site such as recent disease outbreaks and illnesses within the herd, vaccination practices and vaccine availability, pharmaceutical products and traditional remedies, exposures to other domestic animals and wildlife, sources of livestock water and food, and biosecurity practices.

Relevant administrative authorities or representatives, owners, managers, farm or abattoir staff, CAHWs, and local veterinarians were invited to participate in all steps of

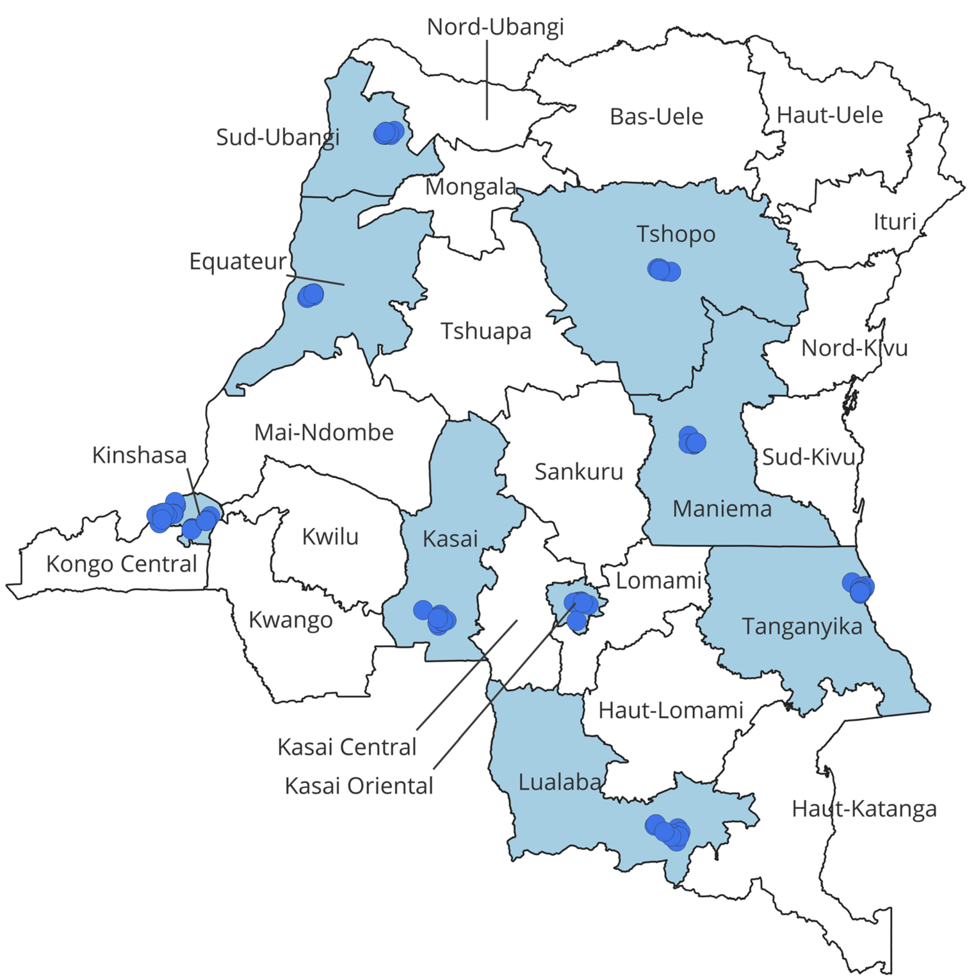

Figure 1. Location of sites visited by the investigation team throughout the study period (June 2023 to July 2024).

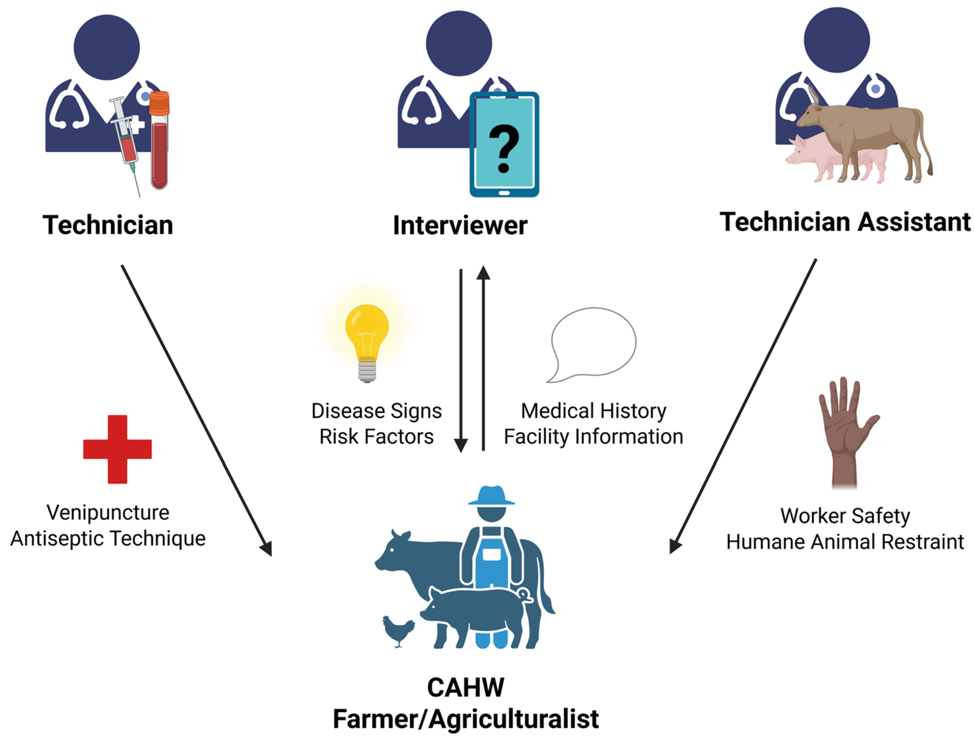

Figure 2. Site visits involve bidirectional information exchange between the investigation team (technician, interviewer, technician assistant) and participating CAHWs, farm or abattoir staff, livestock owners, and managers across surveillance activities.

sampling. Sites were chosen at the recommendation of provincial authorities. Recommended sites that were unreachable by standard routes deemed safe to transit by the local research team were excluded from the study. At each site, a maximum of 20 bovine and 20 porcine subjects were individually restrained by the technician assistant with help from one to two other participants. Investigation team members wore personal protective equipment (PPE) including disposable smocks, surgical masks, and nitrile examination gloves. Other biohazard risks were managed by cleaning and disinfecting dedicated work boots before beginning and after completing sampling. All other participants were also offered the same PPE, and the team answered questions about safety and biosecurity practices.

At each site, the technician assistant would demonstrate the appropriate level of humane restraint for the age of an animal, including the use of sorting boards, hind leg restraint and holding for piglets, and restraining snares for short periods (CFSPH, 2024b). For cattle, depending on the site, permanent or temporary chutes with head restraint or lariats and halters were used to safely restrain for sample collection (CFSPH, 2024a). The technician collects a blood sample, and any ticks on the animal were collected using blunt-tipped forceps or a tick key.

For most sites, INRB staff collected voluntary serum samples and survey responses from up to five consenting at-risk people for future comparison of the seroprevalence of exposure to priority emerging diseases in livestock and humans.

Before departing a site, the investigation team completed all documentation and shared recommendations with site managers. Depending on the team's experience collecting samples and the knowledge of the livestock owners, suggestions may include improved animal restraint (e.g., installation of chutes and corrals for cattle); husbandry practices (e.g., implementing confinement systems to reduce disease incidence in free-ranging pigs); biosecurity measures (e.g., instituting quarantine periods for new animals); and treatment, vaccination, or monitoring based on reported epizootics in the area.

Results

Across the 135 site visits, the investigation team's conversations with owners, facility managers, local veterinarians, and CAHWs characterized baseline veterinary treatment and surveillance capacity in selected provinces, measured by vaccination rates, medications used, outbreaks reported, and anecdotal detection of pathogens at each site. A variety of antibiotics as well as traditional medicine approaches and vitamin supplementation were documented at 63% of sites with cattle and 75% of sites with swine, compared to 18% of sites with cattle and 28% of sites with swine that report routine vaccination. In the event of animal illness, 22% of sites with cattle and 24% of sites with swine reported that they had alerted government officials in the province or health zone of potential outbreak after disease-driven mass mortality events. Documenting the presentation of atypical lesions as potential EID or atypical presentations of endemic diseases yielded evidence for a number of anecdotal reports, including support for co-circulating mpox and swinepox viruses (Kalonji et al., 2024).

The investigation team collected cattle and swine samples from 68 and 71 sites respectively (Table 1). Three sites had both cattle and pigs available to sample. 85% of sites visited were farms, 12% were abattoirs, and 3% were village herds. Local veterinarians and CAHWs were invited as part of the clearance process to visit individual farms, abattoirs, and villages, frequently joining sampling activities by performing restraint. These workers tended to be knowledgeable about both individual animals and sites; they frequently responded to questions related to animal medical history and general herd management practices. Often, site managers deferred to their staff veterinarians to answer questions related to vaccination and pharmaceutical products as the exclusive sources of pertinent information.

Table 1. Sites visited during the study period reported by province and frequency of species sampled across all sites.

Province	Sites (n)		Total Site Visits* (n)
	Cattle	Swine	
Equateur	6	12	16
Kasai	5	5	10
Kasai-Oriental	5	5	10
Kinshasa	27	20	47
Lualaba	5	6	10
Maniema	4	6	9
Sud Ubangui	6	4	10
Tanganika	5	7	12
Tshopo	5	6	11
Total Frequencies	68	71	135

*Some provincial site counts include sites with pigs and cattle.

While securing necessary permissions for sample collection, the investigation team frequently engages local veterinarians and CAHWs in OH-related discussions. Team veterinarians and technicians explain the value of active surveillance for disease prevention and the benefit of sampling animals, humans, and ticks to detect zoonotic disease at the site. They also share about the health protections offered by wearing PPE. Additionally, the investigation team was consistently asked to support response to suspected disease outbreaks in provinces while visiting. Prior to arrival in these provinces, there was no outbreak information available to the investigation team, and there were no appropriate channels for provinces to request response support. This reporting gap emphasizes the need for accessible reporting structures as a baseline step toward organizing targeted outbreak response.

Interview data gathered about routine vaccination practices revealed low rates of vaccination (18% of sites with cattle; 28% of sites with swine). In general, vaccination coverage was highest for erysipelas (*Erysipelothrix rhusiopathiae)* in swine (21.1%) and pasteurellosis (*Pasteurella multocida* serotype type I, *Mannheimia [Pasteurella] haemolytica* serotypes A1 and A2*)* in cattle (11.8%) (Table 2). Specific vaccines to query were determined based on LVC veterinarians' expertise as the national veterinary laboratory of reference.

Sites with cattle and pigs report using a range of pharmaceuticals, dietary supplements, and traditional medicine products but tend to favor specific drugs that are common across sites. In total, 63% of cattle and 75% of swine sites visited reported using drugs or supplements (Table 3). The most common antibiotics used were oxytetracycline (37% of cattle sites; 37% of swine sites) and a combination procaine penicillin G-dihydrostreptomycin sulfate drug known as "penstrep" (38% of cattle sites; 30% of swine sites). The most common antiparasitic agents reported were ivermectin (28% of cattle sites; 25% of swine sites) and levamisole (22% of cattle sites; 28% of swine sites). Facility managers or local veterinarians responding to the survey sometimes reported "antibiotics" rather than detailing specific drugs. The use of traditional medicines was recorded at one site with swine, and a variety of supplements and vitamins were observed across sites.

Sites with swine and cattle production indicated inconsistent reporting of incidents of illness or death to health zone or province livestock officials. Less than a quarter of sites (22% of sites with cattle; 24% of sites with swine) responded that they have reported an illness or

Table 2. Diseases vaccinated against and rates of vaccination reported by facility managers across sampling sites with cattle and pigs.

Disease	Sites (n)	Vaccination Reported (%)
Sites with Cattle		
Brucellosis	3	4.4%
Contagious Bovine Pleuropneumonia	0	0.0%
Enterotoxemia	0	0.0%
Foot-and-Mouth Disease	1	1.5%
Leptospirosis	3	4.4%
Neosporosis	0	0.0%
Pasteurellosis	8	11.8%
Salmonellosis	0	0.0%
Other	4	5.9%
Sites with Swine		
Erysipelas	15	21.1%
Parvovirus	2	2.8%
Other	4	5.6%

death to health zone or province officials at least once. Anecdotally, however, administrative meetings with provincial officials preceding site visits revealed that many officials were generally aware of outbreak events in their provinces. For example, officials in Sud-Ubangi province informed the investigation team of circulating African Swine Fever virus during a February 2024 field visit, which was confirmed by the team in conversation with owners of farms with porcine populations significantly reduced by the disease. Specifically evaluating provincial or national response to such reports was beyond the scope of data collected during initial site visits but may be included in longitudinal study.

Each site visit during the study period presented an opportunity to detect emerging pathogens and document atypical presentations of endemic disease that could indicate evolution of a disease's etiologic agent. Documentation of all physical lesions seen on animals sampled (Fig. 3), combined with collected sera, creates a robust data set for present and future diagnoses. Documentation of such lesions by a surveillance team is important for OH analysis, as demonstrated in September 2022, when swinepox was confirmed in pigs in a region with known mpox virus, which resulted in further investigation of pigs and people to characterize the prevalence of co-circulating poxviruses (Kalonji et al., 2024). Identification of pox-like lesions in swine enabled rapid response to confirm diagnosis and consider spillover potential. Monitoring continues in the region, supported by the investigation team.(Fig. 4).

Discussion

This study highlights critical gaps in veterinary surveillance, vaccine coverage, and pharmaceutical use in the DRC, offering a clearer picture of the country's vulnerability to zoonotic disease emergence and spread. Data collected during site visits across varied regions show limited access to vaccines, high dependence on antibiotics, and inconsistent outbreak reporting–factors that, when combined, create ideal conditions for disease amplification and antimicrobial resistance (AMR).

Our findings underscore the urgent need for comprehensive, decentralized, and sustained surveillance systems that can detect and respond to zoonotic threats early. While the current passive surveillance system provides some insight into disease occurrence, it lacks the integration, consistency, and responsiveness needed to manage rapidly evolving public and animal health risks. For instance, despite the known economic and public health burden of canine-mediated human rabies, mass vaccination campaigns remain largely absent or poorly distributed (Twabela et al., 2016). Meanwhile, the absence of national livestock vaccination data reported to WOAH-WAHIS reflects a broader surveillance blind spot across the country. While there is room for improvement in both reporting and

Table 3. Frequency of pharmaceutical and dietary supplement use in sites with swine and cattle sampled over the study period. Items in quotations reflect free-form survey response.

Veterinary Pharmaceutical Use				
Active Compound	Category	Class	Sites (n) (Swine)	Sites (n) (Cattle)
Albendazole	Antiparasitic		1	4
Ampicillin	Antibiotic	Beta-lactam	4	2
Amprolium	Antiprotozoal	Coccidiostat	1	
Chlorpyrifos	Antiparasitic			1
Cypermethrin	Antiparasitic	Pyrethroid		1
Deltamethrin	Antiparasitic			1
Dexamethasone	Analgesic	Corticosteroid	5	5
Diminazene	Antiprotozoal			7
Diminazine aceturate, phenazone (COMBO)	Antiprotozoal			2
Gentamicin	Antibiotic	Aminoglycoside	1	
Ivermectin	Antiparasitic	Macrocyclic lactone	18	27
Levamisole	Antiparasitic		20	15
Metamizole	Analgesic	NSAID	1	1
Oxytocin	Hormone			2
Oxytetracycline	Antibiotic	Tetracycline	26	25
Procaine penicillin G, benzathine penicillin G (COMBO)	Antibiotic	Beta-lactam		2
Procaine penicillin G, dihydrostreptomycin sulfate (COMBO)	Antibiotic	Beta-lactam, aminoglycoside	21	26
Penicillin	Antibiotic	Macrolide	5	4
Phenylbutazone	Analgesic	NSAID		1
Spiramycin	Antibiotic	Macrolide	1	1
Streptomycin	Antibiotic	Aminoglycoside	3	3
Sulfadimidine	Antibiotic	Sulfonamide	3	5
Tylosin	Antibiotic	Macrolide	4	2
"Antibiotics"	Antibiotic		5	3
"Antidiarrhea"	Antidiarrheal		1	
Dietary Supplement Use				
Iron	Vitamin		5	3
Iron, Vitamin B12 (COMBO)	Vitamin		1	
"L'herbe"	Traditional		1	
Multivitamin	Vitamin		13	4
Vitamin A3	Vitamin			1
"Vitamins"	Vitamin		13	18
Vitamins A, D3, E (COMBO)	Vitamin		6	5

practice, data collected by the CVL-INRB-UCLA team represent a valuable first foray into an otherwise black box.

The survey also confirmed widespread use of broad-spectrum antibiotics–particularly oxytetracycline and pen-strep–often in the absence of routine vaccination. In some cases, antibiotic use appeared to substitute for preventive care, likely influenced by cost, availability, and convenience. These practices, while often forced by low-resource settings, contribute directly to the rise in AMR in SSA–a silent but growing threat to both animal and human populations (Akilimali et al., 2022; Kariuki et al., 2022; GRAM, 2023; Dall, 2024). Specifically, resistance to β-lactam antibiotics (e.g., penicillin), cephalosporins, carbapenems, colistin, and tigecycline has been documented in the DRC (Lupande-Mwenebitu et al., 2020). Unfortunately, the patterns of antimicrobial use observed in this study are common among other countries in SSA. Dairy farms in Ethiopia, for instance, have also reported heavy prescription of penstrep and oxytetracycline (Tufa et al., 2023). Across SSA, tetracycline (e.g., oxytetracycline) is noted as the most frequently therapeutically and prophylactically used antibiotic, which aligns with preliminary findings during the initial study period (Odey et al., 2024). Rates of gastrointestinal parasite resistance to anthelmintic products such as ivermectin are also rising in other countries in Africa but have not been widely studied in SSA; no data are reported on status in the DRC (Tsotetsi et al., 2013). With the heavy use of ivermectin observed in this survey, resistance is likely increasing in the DRC, which could negatively impact both animal and human health. Further detail assessing veterinary pharmaceutical use will be gathered from sites in longitudinal follow-up visits.

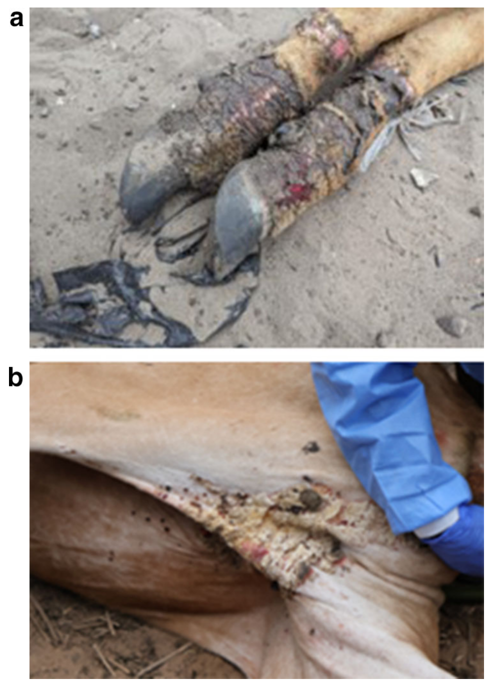

Figure 3. Representative lesions documented in two cattle in Kinshasa.Image courtesy (3a): Danae Witte, 20 June 2023, Kinshasa.Image courtesy (3b): Paige Kinzie, 26 June 2024, Kinshasa.

Within the DRC, there have been calls for improved antimicrobial stewardship and coherent surveillance to understand the full scope of a growing problem (Akilimali et al., 2023a, b; Bunduki et al., 2020). The combination of sparse vaccination coverage and increasing antibiotic use in production animals creates conditions where both endemic

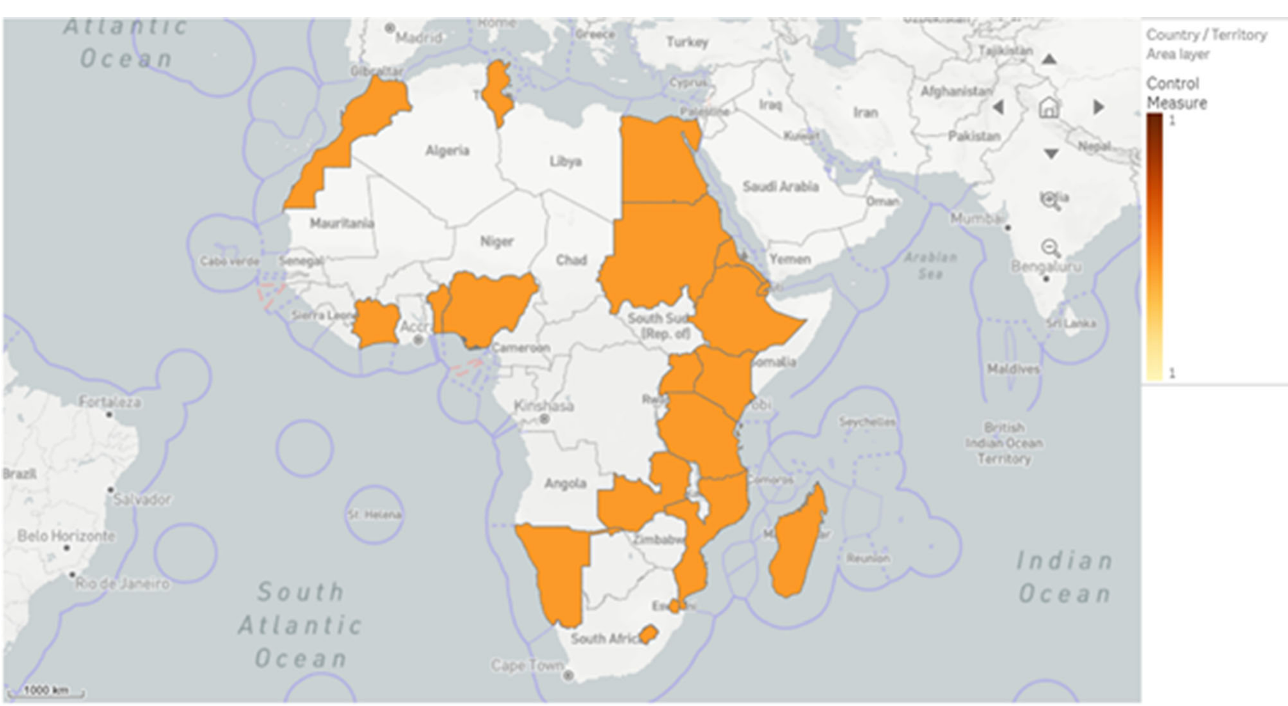

Figure 4. WOAH-WAHIS Control Measure Dashboard data depicting coverage of official vaccination of domestic animals in Africa, 2023. Retrieved 4 July 2024 (WOAH-WAHIS, 2024b).

and emerging diseases have the potential to spread quickly. Working with CAHWs and veterinarians to communicate the importance of vaccination and perform vaccination services has potential to decrease antibiotic use (Laxminarayan et al., 2024); localized intervention is essential to halt the rise in resistance rates. Developing effective antimicrobial stewardship programs in high-income countries continues to be challenging, however, highlighting the need for contextualized interventions (Charani et al., 2019). Within the context of the DRC, there are several barriers to increasing vaccination rates as a method for decreasing antibiotic use by preventing severe disease. Batch pricing gathered from local veterinary pharmacies and vendors around Kinshasa in early July 2024 indicates that it is almost 10 times more expensive to purchase vaccines (approximately $70 USD) compared to antibiotics (approximately $8 USD), which could be a barrier to acquisition for livestock producers, although the individual cost is likely similar between vaccines and antibiotics. Anecdotally, easier access to antibiotic products compared to vaccines also dictates a reactive approach to treating disease rather than prevention by convenience.

Strengthening disease surveillance in the DRC requires investment in veterinary capacity, workforce training, and community engagement. Veterinary services are constrained by limited resources and gender disparities, particularly in rural areas such as South Kivu, where women remain underrepresented in the profession (VSF Belgium, 2024). Community animal health workers (CAHWs), trained to provide basic animal care and disease reporting in underserved areas, represent a vital resource in conducting syndromic surveillance (Catley et al., 2004).

Additional issues caused by insufficient systematic national active veterinary surveillance activities manifest in the breakdown in outbreak reporting described in this study. Failure by a local producer or veterinarian to report an outbreak could stem from multiple factors, including delay in transmitting information and responding due to physical infrastructure disruption; the absence of motivation to report without the promise of supportive administrative response; and limited educational capacity to understand disease severity and controls. In longitudinal follow-up, we intend to assess whether reporting behaviors or provincial and national outbreak responses have changed since the first site visit. To further build national capacity, we recommend that the DRC ensure widespread communication of a simplified national list of reportable diseases of economic or biological concern in addition to the Guide SIMAR (Surveillance Intégrée des Maladies Animales et Riposte), which is currently available in only some pilot provinces, and train CAHWs to recognize and report disease. We also recommend revitalizing and strengthening a centralized, open-access electronic system to receive, review, and track reports at the national level, perhaps through a process similar to that described by Worsley-Tonks et al. (2022).

Conclusion

As the study and data analysis continues with longitudinal sampling at study sites, the investigation team plans to share diagnostic information with livestock owners, facility managers, local veterinarians, and CAHWs. During return visits, the team will also share recommendations for improved animal husbandry and herd management, infectious disease controls, biosecurity and outbreak containment practices, and preventive medicine measures. By incorporating local stakeholders into the data collection process, the door has been opened for continued conversation and education about emerging and re-emerging zoonotic disease at sites scattered throughout the country. We underscore the potential of the relational capital and shared skillset established by this project and encourage other stakeholders working in the DRC and other LMICs to assess the feasibility of similarly inclusive active OH veterinary surveillance approaches.

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Declarations

Ethical Approval & Informed Consent

All activities conducted by the study team were in accordance with applicable institutional and national guidelines for the care and use of animals. This research was specifically approved by the University of California, Los Angeles Institutional Animal Care and Use Committee (IACUC, approval number ARC-2023–009). In the DRC, the study was approved by the Scientific Committee of the Faculty of Veterinary Medicine at the Université Pédagogique Nationale (Approval No. FMV/CS/023/2024) and by the Ethics Committee of the School of Public Health at the University of Kinshasa (Approval No. ESP/CE/46/2023). All applicable institutional and national guidelines for the care and use of animals were followed. Informed consent was obtained from all individual participants in the study.

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