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Antibacterial Drug quantities, Prescription and Dispensing practices among Veterinary Drug shops in Eastern region, Uganda

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Abstract

Background

Data on veterinary antibacterial sales, prescription and dispensing practices in Uganda remain limited. This study estimated antibacterial quantities sold and assessed prescription and dispensing practices in veterinary drug shops in Eastern Uganda.

Methods

A cross-sectional study involving 139 veterinary drug shops across 36 districts in Eastern Uganda was conducted between August 2024 and January 2025. Antibacterial quantities sold over the preceding 12 months were estimated from retrospective inventory records, while prescription and dispensing practices were assessed using structured questionnaires.

Results

Among 139 veterinary drug shop owners, 71 (51.1%) were male and 58 (41.7%) held diplomas, while 81 (58.3%) attendants were female and 71 (51.1%) held diplomas. Registered para-veterinarians (diplomas) constituted the largest category of personnel attending to clients, reported in 59 (42.4%) shops, while 11 (8.0%) shops reported having students attending to clients An estimated 90,478.51 kg of antibacterial active ingredients were sold through the surveyed shops. Tetracyclines accounted for 59.19% (53,555.27 kg), followed by macrolides at 11.57%(10,467.38 kg) and fluoroquinolones at 8.86% (8,016.39 kg). Based on the EMA-AMEG classification, 72.7% of estimated antibacterial quantities belonged to Category D and 13.9% to Category B, while 95.0% were classified as veterinary critically important antimicrobials under WOAH. Verbal prescriptions were reported by 69 (49.7%) shops, while fellow farmers were identified as the most common prescription source (56.8%). Shop attendants provided prescriptions in 68 (48.9%) shops. Regarding dispensing practices, 80 (57.6%) shops did not maintain antibacterial dispensing records, while 63 (45.3%) did not report advising farmers about withdrawal periods.

Conclusion

Substantial quantities of antibacterial active ingredients were estimated to have been sold through the surveyed shops, alongside gaps in prescription practices, dispensing documentation and farmer counselling. Strengthening veterinary prescribing oversight, antimicrobial stewardship training and routine sales surveillance could promote prudent antibacterial use.

Background

Antibacterials are essential for preventing and treating bacterial diseases in livestock, supporting animal health, productivity, and livelihoods (Hao et al., 2014; Mikecz et al., 2020). However, inappropriate use of

antibacterials has been reported to contribute significantly to the development and spread of antibacterial resistance (ABR), currently recognized as a global public health threat (Singh et al., 2024). Antimicrobial resistance could cause up to 10 million human deaths annually by 2050 if current trends persist, with antibacterial resistance being the biggest contributor (Murray et al., 2022).

In food-producing animals, antibacterials are commonly used for treatment, prophylaxis, and, in some settings, growth promotion, practices that may increase selection pressure for resistant bacteria (Mikecz et al., 2020). Globally, antibacterial consumption in food animals is substantially high and continues to rise, particularly in low- and middle-income countries where livestock production is increasing and regulatory enforcement is weak (Ayukekbong et al., 2017; Tiseo et al., 2020). In Uganda, veterinary drug shops are the primary sources of antibacterial drugs for most livestock farmers (Dione et al., 2021). Despite this central role, no empirical data quantify antibacterial sales, prescription, and dispensing practices at the regional and veterinary drug shop level Previous studies in Uganda have largely focused on antimicrobial residues (Basulira et al., 2019; Nanteza et al., 2026; Sasanya et al., 2005), farmer awareness (Buckel et al., 2026; Kato et al., 2026; Muleme et al., 2023), and antimicrobial resistance patterns (Muwonge et al., 2025; Okubo et al., 2019; Steven et al., 2025), leaving a gap in evidence on antibacterial distribution and use practices within veterinary drug retail outlets.

Eastern Uganda is a region with a substantial livestock population and varied access to veterinary services (UBOS, 2024). The use of antibacterials, whether appropriate, inappropriate, overused, or underused, creates strong selective pressures over time that drive the development and spread of ABR. The bacteria most vulnerable to antimicrobials die quickly, while the most resilient bacteria survive, replicate, and threaten our ability to treat infections in both animals and humans(Sinha & Upadhyay, 2025). Uganda has no regional data on antibacterial consumption and use. Understanding the quantities of antibacterials sold and the associated prescription and dispensing practices in this region is critical for informing antibacterial use stewardship interventions and policy.

Antibacterial consumption and associated prescription and dispensing practices surveillance data are crucial for identifying problems and taking corrective action to optimize antibacterial use, including stewardship interventions and policy changes. The rising use of antibacterials in animal production, largely driven by increased demand for animal protein and the intensification of farming systems in low- and middle-income countries, underscores the importance and urgency of such data. Additionally, regional-level evidence on the quantities of antibacterial active ingredients sold and on prescription/dispensing practices among veterinary drug shops in Uganda remains limited.

This study, therefore, aimed to quantify antibacterial drug sales and describe prescription and dispensing practices among veterinary drug shops in the Eastern region of Uganda, using a One Health perspective to inform regulatory and pharmacovigilance monitoring of antibacterials in food-producing animals.

Materials and Methods

Study design

We conducted a cross-sectional survey of veterinary drug shops in Eastern Uganda between August 2024 and January 2025, with a retrospective review of antibacterial drug sales records covering the 12 months preceding each shop visit.

Study area

Uganda is a middle-income country with a GDP per capita of USD 987, a population of 52.7 million (as of 2026, according to the adjusted UN estimate), and an annual average growth rate of 4.16% since 2006. Seventy-two per cent of this population lives in rural areas and depends on subsistence agriculture (UBOS, 2024). In 2021, the Uganda Bureau of Statistics reported that most households engaged in crop and livestock farming for both subsistence and commercial purposes. According to the most recent livestock population census, Uganda has 14.4 million cattle, 17.5 million goats, 7.1 million pigs, 4.4 million sheep, 2.2 million rabbits, 63000 donkeys and 57.8 million chickens (UBOS, 2024). Almost half (47.5%) of households reported using curative treatments for cattle, 23.7% for small mammals and pigs, and 7% for poultry and rabbits. From the same census report, Eastern Uganda had the most households that kept livestock, especially cattle and chicken, under extensive grazing systems. In addition, the region showed stronger orientation toward smallholder farming and less commercial livestock production. The animal health sector is thus important to the livelihood of the Ugandan population for reasons including household income generation, gainful employment, cultural practices, societal expectations, food safety and food security (UBOS, 2021). This study was conducted in Eastern Uganda, a region composed of 36 districts that comply with the zoning stipulated by the National Drug Authority (NDA) and national zoning. In this study, registered veterinary drug shops from the three sub-regions of Eastern Uganda were sampled. (Fig. 1)

Study population

The study population comprised of the registered veterinary drug shops in Eastern Uganda. The names and locations of these shops were obtained from the National Drug Authority (NDA) veterinary drug shop registry as of August 2024 (Suppl. 1).

Sample size determination and sampling technique

The sample size was determined using Yamane's formula (Yamane, 1973), based on a finite population of registered veterinary drug shops and a specified margin of error of 5%; n = $\frac{N}{1+N(e)^2}$ where (n) is the required sample size, (N) is the total number of registered veterinary drug shops in Eastern Uganda (213), obtained from the National Drug Authority (NDA) registry as of August 2024, and (e) is the specified margin of error (0.05). This yielded a sample size of 139 veterinary drug shops.

The list of registered veterinary drug shops was obtained from the NDA website. A total of 139 shops out of the 213 NDA-registered shops were selected through convenience sampling. Shops without antibacterial drug stock or inventory records were excluded, while geographical accessibility and financial constraints

limited the inclusion of shops in hard to reach districts. The sampled veterinary drug shops and their respective districts are presented in Suppl. 2.

Data collection

Data were collected using a pre designed data extraction sheet and a structured questionnaire. The data extraction sheet (Suppl. 3) was used to obtain retrospective antibacterial drug inventory data from the selected veterinary drug shops between August 2024 and January 2025, covering the 12 months preceding each shop visit. The extracted information included brand name, active ingredient, strength, pack size, total units stocked during the preceding 12 months, expired units and remaining stock. The extraction tool was developed with reference to World Organization for Animal Health (WOAH) guidelines for estimating quantities of antimicrobial agents (Gochez et al., 2019). The structured questionnaire (Suppl.4) was administered to veterinary drug shop attendants to collect information on their sociodemographic characteristics and the shops' prescription and dispensing practices. The questionnaire was pretested in veterinary drug shops in Kayunga District, outside the study area, and refined for clarity before field deployment in June 2024.

Computation of antibacterial quantities

The quantity of each antibacterial active ingredient per unit pack was calculated by multiplying its strength (concentration) by the pack size. This quantity was then multiplied by the number of units stocked during the preceding 12 months to determine the total quantity of active ingredient stocked during the reference period. For co-formulated antibacterial products, the quantities of individual active ingredients were calculated separately based on their respective strengths and pack sizes (Gochez et al., 2019). The same procedure was applied to determine the quantities of active ingredients in expired products and remaining stock. The estimated quantity sold was then calculated by subtracting the quantities in expired products and remaining stock from the total quantity stocked. This inventory-based approach was used because records of actual antibacterial drug sales or dispensing quantities were limited or unavailable in many veterinary drug shops.

Antibacterial active ingredients were classified according to the European Medicines Agency's Antimicrobial Advice Ad Hoc Expert Group (AMEG), the World Organization for Animal Health (WOAH), and World Health Organization (WHO) antimicrobial classification systems (EMA, 2025; WHO, 2019; WOAH, 2019). Given the diversity of veterinary antibacterial formulations, including tablets, injectables, oral powders and suspensions, quantities were expressed as the mass of active ingredients rather than defined daily doses (DDDvet). Dose based metrics were not applied because the inventory records did not provide the animal species, treatment indications and dosing information required for their calculation. All active ingredient quantities were converted to kilograms, consistent with the mass-based reporting approach described by (Gochez et al., 2019).

Data analysis

Data were cleaned and analyzed using Stata version 14.2. Descriptive statistics were used to summarize the estimated quantities of antibacterial active ingredients sold, while prescription and dispensing practices were

summarised using frequencies and percentages. Antibacterial quantities were presented as totals and percentages by subregion. Comparisons of antibacterial quantities across subregions were descriptive.

Ethical clearance

The study was approved by the College of Veterinary Medicine, Animal Resources and Biosecurity Institutional Animal Care and Use Committee (SVAR-IACUC/201/2024). Written informed consent was obtained from all participants, and confidentiality was maintained by assigning anonymous identifiers to the sampled veterinary drug shops.

Results

Sociodemographic characteristics of respondents

Among veterinary drug shop (VDS) owners in Eastern Uganda, 51.1% were male, 41.7% had attained a diploma, and 33.1% were aged 20–30 years. Among VDS attendants, 58.3% were female, 51.1% had attained a diploma, and 42.4% were aged 20–30 years (Table 1.1).

Characteristics of surveyed veterinary drug shops

Of the 139 veterinary drug shops surveyed, 72 (51.8%) had been operating for more than three years. The most frequently reported monthly revenue category was UGX 3.1–4.0 million, reported by 29 (20.9%) shops. Registered para-veterinarians constituted the largest category of personnel attending to clients, reported in 59 (42.4%) shops, while 11 (8.0%) shops reported having students attending to clients (Table 1.2).

Table 1.1
Sociodemographic characteristics of veterinary drug shop (VDS) owners and attendants in Eastern Uganda (n = 139)

Characteristic	VDS owners, n (%)	VDS attendants, n (%)
Sex		
Female	68 (48.9)	81 (58.3)
Male	71 (51.1)	58 (41.7)
Age (years)		
< 20	4 (2.9)	8 (5.7)
20–30	46 (33.1)	59 (42.4)
31–40	32 (23.0)	28 (20.1)
41–50	31 (22.3)	34 (24.5)
> 50	26 (18.7)	10 (7.2)
Education level		
Primary	6 (4.3)	7 (5.0)
Secondary	9 (6.5)	8 (5.8)
Diploma	58 (41.7)	71 (51.1)
Bachelor's degree	51 (36.7)	53 (38.1)
Postgraduate	15 (10.8)	0 (0.0)

Table 1.2
Characteristics of veterinary drug shops in Eastern Uganda (n = 139)

Characteristic	Category	n (%)
Duration of operation (years)	1–3	41 (29.5)
	> 3	72 (51.8)
	Do not know	26 (18.7)
Monthly revenue (UGX millions)	< 1.0	21 (15.1)
	1.0–2.0	24 (17.3)
	2.1–3.0	24 (17.3)
	3.1–4.0	29 (20.9)
	4.1–5.0	20 (14.4)
	> 5.0	21 (15.1)
Professional qualification of attendant	Registered veterinarian	30 (21.6)
	Unregistered veterinarian	18 (12.9)
	Registered para-veterinarian	59 (42.4)
	Unregistered para-veterinarian	20 (14.4)
	Pharmacist	1 (0.7)
	Student	11 (7.9)

Estimated quantity of antibacterial active ingredients sold

The estimated total quantity of antibacterial active ingredients sold by the 139 surveyed veterinary drug shops over their respective 12-month reference periods was 90,478.51 kg. South East accounted for the largest proportion (39,746.98 kg; 43.9%), followed by North East (27,006.34 kg; 29.8%) and Central East (23,725.19 kg; 26.3%) (Fig. 2)

Distribution of antibacterial sales quantities by pharmacological class

Tetracyclines accounted for the largest proportion of estimated antibacterial sales, contributing 53,555.27 kg (59.19%) of the total quantity sold. Macrolides were the second largest class, accounting for 10,467.38 kg (11.57%), followed by fluoroquinolones at 8,016.39 kg (8.86%). Phenicols and cephalosporins contributed the smallest proportions of the total estimated quantities sold (Fig. 3).

Estimated antibacterial sales quantities according to AMEG, WOAH, and WHO classifications

According to the EMA-AMEG classification, Category D antibacterials accounted for the largest proportion of the total estimated quantity sold, at 65,741.3 kg (72.7%), followed by Category B at 12,593.2 kg (13.9%) and Category C at 12,144.0 kg (13.4%). No antibacterial active ingredients were classified under AMEG Category A.

The WOAH classification showed that veterinary critically important antimicrobials accounted for 85,916.0 kg (95.0%) of the total estimated quantity sold, while veterinary highly important antimicrobials accounted for 4,562.5 kg (5.0%).

Based on the WHO classification, highly important antimicrobials accounted for the largest proportion of estimated sales, at 65,676.2 kg (72.6%). Highest-priority critically important antimicrobials and critically important antimicrobials accounted for 12,381.8 kg (13.7%) and 12,420.6 kg (13.7%), respectively (Table 2).

Table 2
Quantity of antibacterial active ingredients sold according to AMEG, WOAH, and WHO classification systems in Eastern Uganda

Sub region	AMEG			WOAH		WHO		
	Category B, kg (%)	Category C, kg (%)	Category D, kg (%)	VCIA, kg (%)	VHIA, kg (%)	HPCIA, kg (%)	CIA, kg (%)	HIA, kg (%)
Central East	4,072.7 (17.2)	3,564.8 (15.0)	16,087.7 (67.8)	22,229.8 (93.7)	1,495.4 (6.3)	3,807.5 (16.0)	3,794.5 (16.0)	16,123.2 (68.0)
North East	4,336.4 (16.1)	4,401.9 (16.3)	18,268.0 (67.6)	25,452.6 (94.2)	1,553.7 (5.8)	4,328.7 (16.0)	4,337.3 (16.1)	18,340.3 (67.9)
South East	4,184.1 (10.5)	4,177.3 (10.5)	31,385.6 (79.0)	38,233.6 (96.2)	1,513.4 (3.8)	4,245.6 (10.7)	4,288.8 (10.8)	31,212.6 (78.5)
Overall	**12,593.2 (13.9)**	**12,144.0 (13.4)**	**65,741.3 (72.7)**	**85,916.0 (95.0)**	**4,562.5 (5.0)**	**12,381.8 (13.7)**	**12,420.6 (13.7)**	**65,676.2 (72.6)**

AMEG = Antimicrobial Advice Ad Hoc Expert Group; WOAH = World organization for Animal Health (formerly OIE); WHO = World Health Organization; VCIA = veterinary critically important antimicrobials; VHIA = veterinary highly important antimicrobials; HPCIA = highest-priority critically important antimicrobials; CIA = critically important antimicrobials; HIA = highly important antimicrobials. Quantities are expressed in kilograms (kg) of antibacterial active ingredient.

Prescription practices of veterinary drug shops in Eastern Uganda

Among the 139 surveyed veterinary drug shops, 42 (30.2%) reported that farmers often presented prescriptions, while 32 (23.0%) indicated that farmers never presented prescriptions. Verbal prescriptions were the most commonly reported type presented by farmers (69/139; 49.7%). Other farmers were reported as the most common source of prescriptions (56.8%), while veterinarians accounted for 10.8%. At the drug shop level, attendants were the most frequently reported providers of prescriptions (68/139; 48.9%), and these were predominantly verbal (91/139; 65.5%)

(Table 3).

Table 3
Prescription practices reported by veterinary drug shops in Eastern Uganda

Prescription practice	Category	n (%)
Frequency with which farmers presented “prescriptions”	Sometimes	26 (18.7)
	Often	42 (30.2)
	Never	32 (23.0)
	Rarely	39 (28.1)
Type of “prescription” commonly presented by farmers	Verbal	69 (49.7)
	Written	38 (27.3)
	Never	32 (23.0)
Most common source of “prescriptions”	Veterinarian	15 (10.8)
	Veterinary drug shop attendant	14 (10.1)
	Community animal health worker	8 (5.8)
	Other farmers	47 (56.8)
	Not sure	23 (16.5)
Provider of “prescriptions” issued at the drug shop	Veterinary drug shop attendant	68 (48.9)
	Veterinarian	36 (25.9)
	Computerised prescription system	35 (25.2)
Nature of “prescriptions” issued at the drug shop	Verbal	91 (65.5)
	Written	7 (5.0)
	Both verbal and written	41 (29.5)
Source of drug information used by the drug shop	National regulatory bodies, e.g., MAAIF and NDA	38 (27.3)

Prescription practice	Category	n (%)
	Veterinary associations, e.g., UVA	28 (20.1)
	Pharmaceutical companies	17 (12.2)
	Academic institutions	16 (11.5)
	Veterinary drug shop guidelines	16 (11.5)
	None	24 (17.3)

MAAIF = Ministry of Agriculture, Animal Industry and Fisheries; NDA = National Drug Authority; UVA = Uganda Veterinary Association.

Dispensing, counselling, record-keeping, and inventory management practices of veterinary drug shops in Eastern Uganda

Dispensing practices varied among the surveyed veterinary drug shops. Veterinary drug shop attendants were the most frequently reported dispensers of antibacterials (125/139; 89.9%), while 83 (59.7%) shops reported verifying prescriptions before dispensing. Drug prices were considered during dispensing by 85 (61.2%) shops, and 95 (68.4%) reported labelling and packaging antibacterials before dispensing.

Advising practices also varied. Overall, 56 (40.3%) shops reported often educating clients before dispensing antibacterials, while 91 (65.5%) advised farmers to complete treatment courses and 76 (54.7%) advised them to observe withdrawal periods.

Record-keeping practices were limited, with 80 (57.6%) veterinary drug shops reporting that they did not maintain antibacterial dispensing records and 71 (51.1%) did not advise farmers to keep antibacterial use records. Regarding inventory management, 82 (59.0%) shops did not implement a First-In-First-Out (FIFO) stock rotation policy, although 102 (73.4%) reported checking expiry dates during dispensing (Table 4).

Table 4
Dispensing, counselling, record keeping, and inventory management practices among veterinary drug shops in Eastern Uganda, n = 139

Practice	Indicator	Response	n (%)
Dispensing practices	Person dispensing antibacterial drugs after prescription	Veterinary drug shop attendant	125 (89.9)
		Veterinarian	13 (9.4)
		Pharmacist	1 (0.7)
	Price considered during dispensing	Yes	85 (61.2)
	Antibacterials labelled and packaged before dispensing	Yes	95 (68.4)
	Prescription verified before dispensing	Yes	83 (59.7)
	Customer preferences considered during dispensing	Never	28 (20.1)
		Rarely	27 (19.4)
		Sometimes	33 (23.7)
		Often	51 (36.9)
Counselling practices	Clients educated before dispensing antibacterials	Never	21 (15.1)
		Rarely	30 (21.6)
		Sometimes	32 (23.0)
		Often	56 (40.3)
	Client compliance monitored after dispensing	Yes	80 (57.6)
	Farmers advised to adhere to dosage and treatment regimens	Yes	78 (56.1)
	Farmers advised to complete treatment courses	Yes	91 (65.5)
	Farmers advised to observe withdrawal periods	Yes	76 (54.7)
	Farmers advised to follow vaccination programmes	Yes	82 (59.0)

Practice	Indicator	Response	n (%)
	Farmers advised to quarantine new animals	Yes	85 (61.1)
	Farmers advised to conduct regular veterinary health checks	Yes	88 (63.3)
Antibacterial drug use and dispensing record-keeping practices	Farmers advised to keep antibacterial drug use records	Yes	68 (48.9)
	Antibacterial drug dispensing records maintained by drug shop	Yes	59 (42.4)
Inventory management practices	First-In-First-Out stock rotation policy implemented	Yes	57 (41.0)
	Expiry dates checked during dispensing	Yes	102 (73.4)

Discussion

This study estimated antibacterial drug sales in veterinary drug shops in Eastern Uganda using retrospective inventory records and assessed prescription and dispensing practices among the surveyed shops. The estimated quantity of antibacterial active ingredients sold by the 139 veterinary drug shops was approximately 90.48 tonnes (90,478.51 k) over their respective 12-month reference period. The findings also highlighted gaps in prescription practices, including limited involvement of qualified veterinarians in prescriptions presented by farmers and the frequent provision of verbal treatment recommendations. These practices raise concerns about professional oversight of antibacterial use in livestock production, particularly where treatment decisions are made without adequate veterinary assessment.

Estimated antibacterial drug sales

The surveyed veterinary drug shops recorded an estimated 90.48 tonnes of antibacterial active ingredient sales over their respective 12-month reference periods. The antibacterial sales data from this study, contributes additional data to what was previously reported by Kitutu *et al.*, of the 137.4 tonnes of annual imported antibacterial drugs reported nationally in Uganda (Kitutu et al., 2025). However, the two datasets are not comparable as our data is on antibacterial sales from only one region, with a bearing a on annual imports that require recent analysis. The considerable quantity recorded in the surveyed veterinary drug shops may partly reflect the importance of livestock production in Eastern Uganda, a region reported to have a large cattle population, estimated at 3.3 million cattle (UBOS, 2024). The estimated quantity also exceeded Rwanda's reported average annual antibacterial drug imports of 11.76 tonnes between 2019 and 2021 (Manishimwe et al., 2024), although differences in data sources and geographical coverage limit direct comparisons.

Despite the lack of livestock biomass data to standardize antibacterial sales relative to the livestock population, these findings highlight the importance of monitoring antibacterial distribution through veterinary

drug shops. Antibacterial overuse and misuse in livestock production can contribute to the emergence and spread of antimicrobial resistance (Singh et al., 2024). Previous studies have documented the use of antibacterials for growth promotion and prophylaxis in livestock production (McEwen & Fedorka-Cray, 2002). Despite the threat posed by inappropriate antibacterial use to animal and public health, limited national data are available on veterinary antibacterial consumption, particularly in developing countries (Iskandar et al., 2021; Pokharel et al., 2019). Inadequate monitoring systems and challenges in regulatory enforcement in resource-limited settings, particularly in sub-Saharan Africa, have also hindered routine monitoring of antibacterial distribution and use (Kariuki et al., 2022). In this context, the findings demonstrate the potential value of veterinary drug shop inventory records as a source of information for monitoring antibacterial sales. Strengthening routine inventory and dispensing records, alongside the collection of animal species, treatment indication and livestock population data, could support more reliable estimates of antibacterial use and inform veterinary antimicrobial stewardship efforts.

Pharmacological classes of antibacterials sold

Tetracyclines, macrolides and fluoroquinolones accounted for the largest proportions of estimated antibacterial sales in this study. The predominance of tetracyclines is consistent with previous findings from Uganda and Rwanda, where oxytetracycline was reported among the most commonly used antibacterials (Kitutu et al., 2025; Manishimwe et al., 2024). The widespread distribution of tetracyclines may be attributed to their relatively low cost and broad antimicrobial activity against bacteria, rickettsial organisms, including *Anaplasma*, and certain protozoa (Del Castillo, 2013). In contrast, Mbwasi et al. (2020) reported doxycycline, amoxicillin and trimethoprim-sulfamethoxazole as the most commonly used antibacterials in Tanzania. (Mbwasi et al., 2020). However, differences in the antibacterial categories reported and the methods used to quantify them limit direct comparisons between studies. Variations in product availability, regulatory practices and local prescribing behaviour may also contribute to the observed differences.

Classification of antibacterials sold:

According to the EMA-AMEG classification (EMA, 2025), most (72.7%) of the estimated antibacterial quantities sold belonged to Category D (Prudence), while 13.9% belonged to Category B (Restrict). Notably, no Category A (Avoid) antibacterials were recorded among the surveyed veterinary drug shops. These findings are consistent with those reported by Kitutu et al. (2025) in their assessment of antimicrobial consumption in Uganda (Kitutu et al., 2025). The absence of Category A antibacterials in the recorded sales is encouraging, given that this category comprises antimicrobials that should be avoided in food producing animals (EMA, 2025). Nevertheless, the presence of Category B antibacterials highlights the importance of appropriate veterinary oversight and prudent prescribing to minimize the risk of antimicrobial resistance.

The WOAH classification showed that the majority (95.0%) of the estimated antibacterial quantities sold belonged to the Veterinary Critically Important Antimicrobial Agents (VCIA) category. These antimicrobials are important for treating animal infections, particularly where effective therapeutic alternatives may be limited (WOAH, 2019). Their predominance in the recorded sales underscores the need for prudent use to preserve their effectiveness in veterinary medicine. Strengthening veterinary prescription practices, professional oversight and antimicrobial stewardship could help reduce inappropriate use of these medicines.

Based on the WHO classification, 72.6% of the estimated antibacterial quantities sold belonged to the Highly Important Antimicrobials (HIA) category, while 13.7% were classified as Highest Priority Critically Important Antimicrobials (HPCIA). These findings are comparable to those reported by Kitutu et al. (2025) in Uganda. The WHO classification identifies antimicrobials according to their importance in human medicine and provides a framework for prioritizing measures to preserve their effectiveness (WHO, 2019). Previous studies have highlighted the importance of regulatory and prescribing practices in antimicrobial use (Al-Jedai et al., 2022; Belachew et al., 2021). Strengthening the regulation of veterinary antibacterial prescribing and dispensing is therefore important for promoting prudent use and supporting efforts to address antimicrobial resistance.

Prescription and dispensing practices

This study identified important gaps in antibacterial prescription and dispensing practices among veterinary drug shops in Eastern Uganda. The reliance on verbal recommendations and advice from fellow farmers, together with the limited involvement of veterinarians in prescriptions presented by farmers, raises concerns about professional oversight of antibacterial use. Similar practices were reported by Dione et al. (2021) in Uganda, where 37% and 40% of veterinary practitioners in Lira and Mukono, respectively, reported supplying veterinary medicines both with and without prescriptions. The same study found that some practitioners selected medicines based on farmers' descriptions of symptoms without examining the animals. Such practices may compromise appropriate antibacterial selection and dosing, particularly where clinical assessment and diagnostic support are limited.

The findings also revealed gaps in dispensing documentation, farmer guidance and inventory management. More than half of the surveyed shops did not maintain antibacterial dispensing records (57.6%) or implement a First-In-First-Out (FIFO) stock rotation policy (59.0%), while 45.3% did not report advising farmers to observe withdrawal periods. These findings are important because adequate documentation and counselling support the traceability of antibacterial distribution and the safe use of veterinary medicines. The World Organization for Animal Health recommends that veterinary antimicrobial distributors maintain detailed sales records, provide appropriate product information and participate in training on responsible antimicrobial use (WOAH, 2024).

These findings highlight the need to strengthen veterinary prescribing and dispensing practices in Uganda. Although national guidance on appropriate antimicrobial use in animals exists, there is a need to ensure that practical, standardized, species-specific clinical prescribing and treatment protocols are available and accessible to veterinary professionals and other authorized animal health practitioners. Such guidance should be accompanied by targeted antimicrobial stewardship training for veterinary drug shop personnel, particularly in prescription verification, farmer counselling, withdrawal-period advice and dispensing documentation. Strengthening professional oversight and routine regulatory inspections could further improve adherence to recommended practices. Together with improved record-keeping and inventory management, these measures could promote prudent antibacterial use and strengthen surveillance of veterinary antibacterial sales.

Study limitations

This study provides valuable estimates of antibacterial sales and insights into prescription and dispensing practices among veterinary drug shops in Eastern Uganda. However, some limitations should be considered when interpreting the findings. The estimated antibacterial quantities sold were derived from retrospective inventory records and therefore may not reflect actual antibacterial consumption by animals. Furthermore, the use of convenience sampling and the exclusion of some hard-to-reach districts may limit the generalizability of the findings to all veterinary drug shops in Eastern Uganda. Prescription and dispensing practices were assessed through self-reported responses, which may have been subject to recall and social desirability biases. Finally, the absence of species-specific livestock biomass data prevented standardization of antibacterial sales quantities relative to the animal population, limiting comparisons of antibacterial use intensity across sub-regions and with other settings.

Conclusion

This study reveals that high quantities estimated at 90.48 tonnes of antibacterial active ingredients were sold by the 139 surveyed veterinary drug shops in Eastern Uganda over the 12-month study reference period. The findings also revealed important gaps in antibacterial prescription and dispensing practices, including reliance on verbal recommendations and advice from fellow farmers, with limited involvement of qualified veterinary professionals. Furthermore, more than half of the shops did not maintain antibacterial dispensing records or implement a First-In-First-Out (FIFO) stock rotation policy, while gaps in farmer counselling on antibacterial use were also observed.

These findings highlight the need to strengthen veterinary antimicrobial stewardship in Uganda. The Ministry of Agriculture, Animal Industry and Fisheries (MAAIF), in collaboration with the National Drug Authority (NDA) and relevant veterinary professional bodies, should prioritise improved access to and implementation of standardised, species-specific veterinary treatment and antimicrobial prescription guidelines, enhanced professional oversight, and targeted antimicrobial stewardship training for veterinary drug shop personnel. Strengthening dispensing documentation and farmer counselling, particularly on appropriate antibacterial use, treatment adherence and withdrawal periods, could further promote prudent antibacterial use. Future surveillance studies should incorporate livestock population and biomass data to facilitate standardised comparisons of antibacterial sales across geographical settings.

Abbreviations

AMEG	Antimicrobial Export Group
AMIS	Antimicrobials in Society
AMR	Antimicrobial Resistance
AMU	Antimicrobial use
CDC	Centres for Disease Control and Prevention
CIA	Critically Important Antimicrobials
FAO	Food and Agriculture Organisation
GAP	Global Action Plan
GARP	Global Antibiotic Resistance Partnership
GBP	Great British Pound
GHSA	Global Health Security Agenda
IDRC	Infectious Diseases Research Collaboration
LMICs	Low and Middle-Income Countries
MAAIF	Ministry of Agriculture, Animal Industry and Fisheries
MDG	Millennium Development Goals
MOH	Ministry of Health
NAP	National Action Plan
NDA	National Drug Authority
OIE	World Organisation for Animal Health
SAPs	Structural Adjustment Programmes
SDG	Sustainable Development Goals
SOP	Standard Operating Procedure
UBOS	Uganda Bureau of Statistics
UNAS	Uganda National Academy of Sciences
USD	United States Dollar
UVA	Uganda Veterinary Association
VCIA	Very Critically Important Antimicrobial Agents
WASH	Water, Sanitation and Hygiene
WOAH	World Organisation for Animal Health
WHO	World Health Organisation

Declarations

Ethics approval and consent to participate

The study was approved by the Ethical Committee of the College of Veterinary Medicine, Animal Resources and Biosecurity Institutional Animal Care and Use Committee (SVAR-IACUC/201/2024), a multidisciplinary ethical committee that review and approves veterinary studies that involves animal subjects and human participants that are non-clinical. Hence, the SVAR-IACUC is composed of human doctors, veterinarians, biological scientists, social scientists and community representatives (lay person). The study complied with National Guidelines for use of human participants in research and in accordance with other international regulations and guidelines including Helsinki Declaration.

Consent for publication

Not applicable

Competing Interests

No competing interests to declare

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Author Contribution

LM and DY conceptualised the study, study design, Data collection, Analysis and wrote the first draft; JNB and JPN participated in Data analysis and review while JK particpated in study design and manuscript review. All authors reviewed the manuscript and agreed on submission and publication.

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Data Availability

The generated data has been submitted as a suplimentary material

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Figures

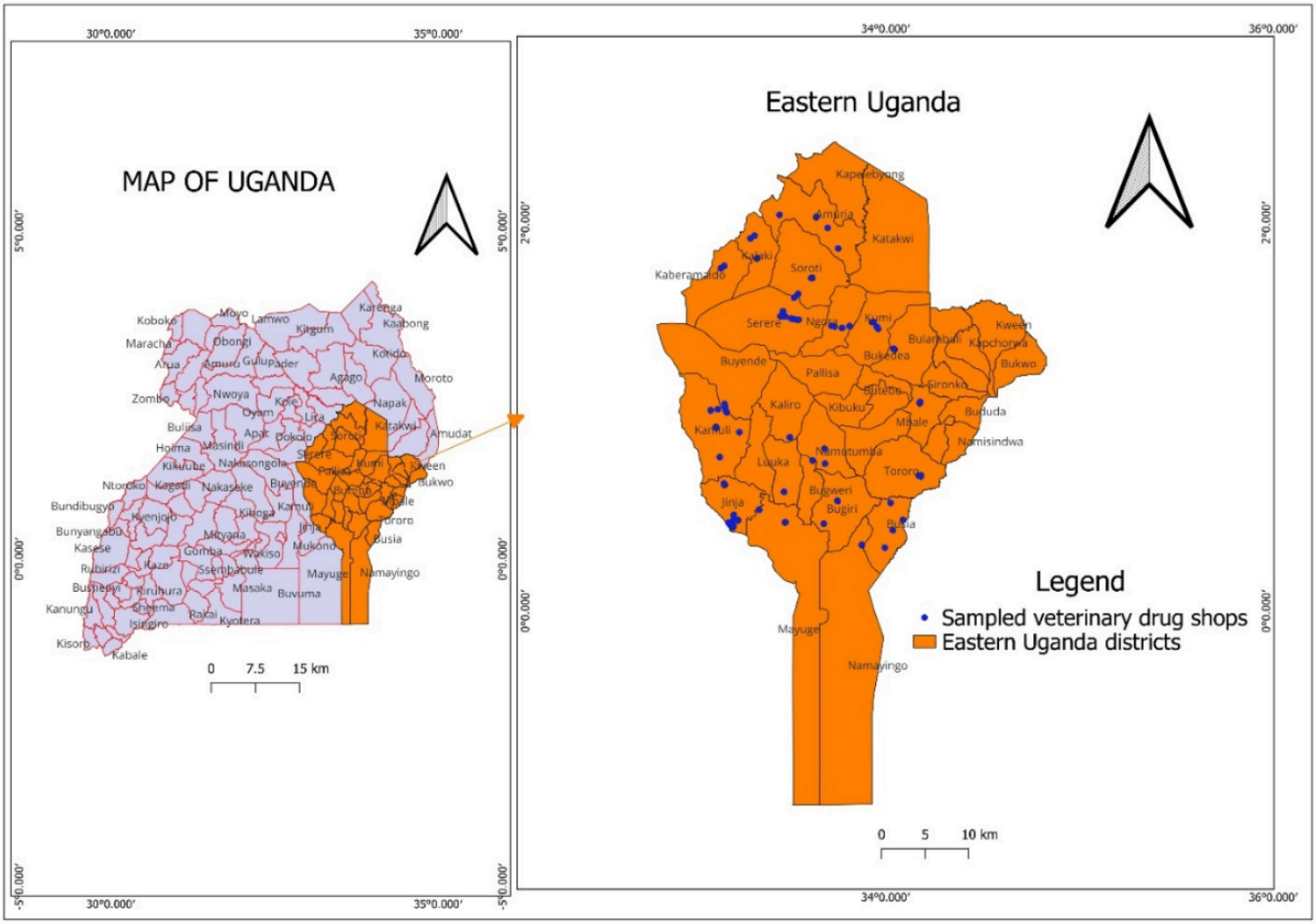


Figure 1

Map of Uganda showing the study area (Developed by the authors using QGIS version 4.0.0)

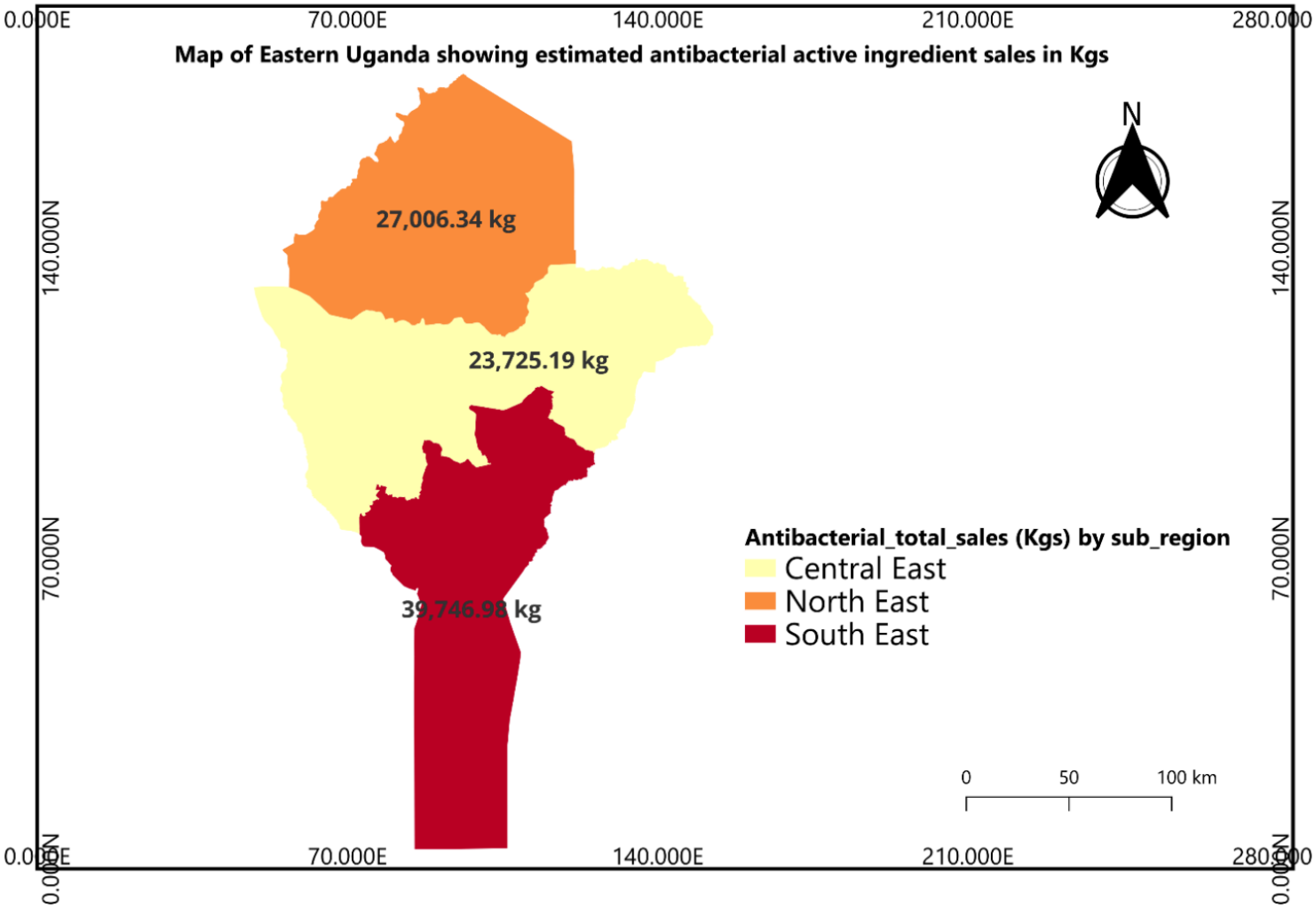


Figure 2

Map of Eastern Ugadan showing antibacterial sales by sub region

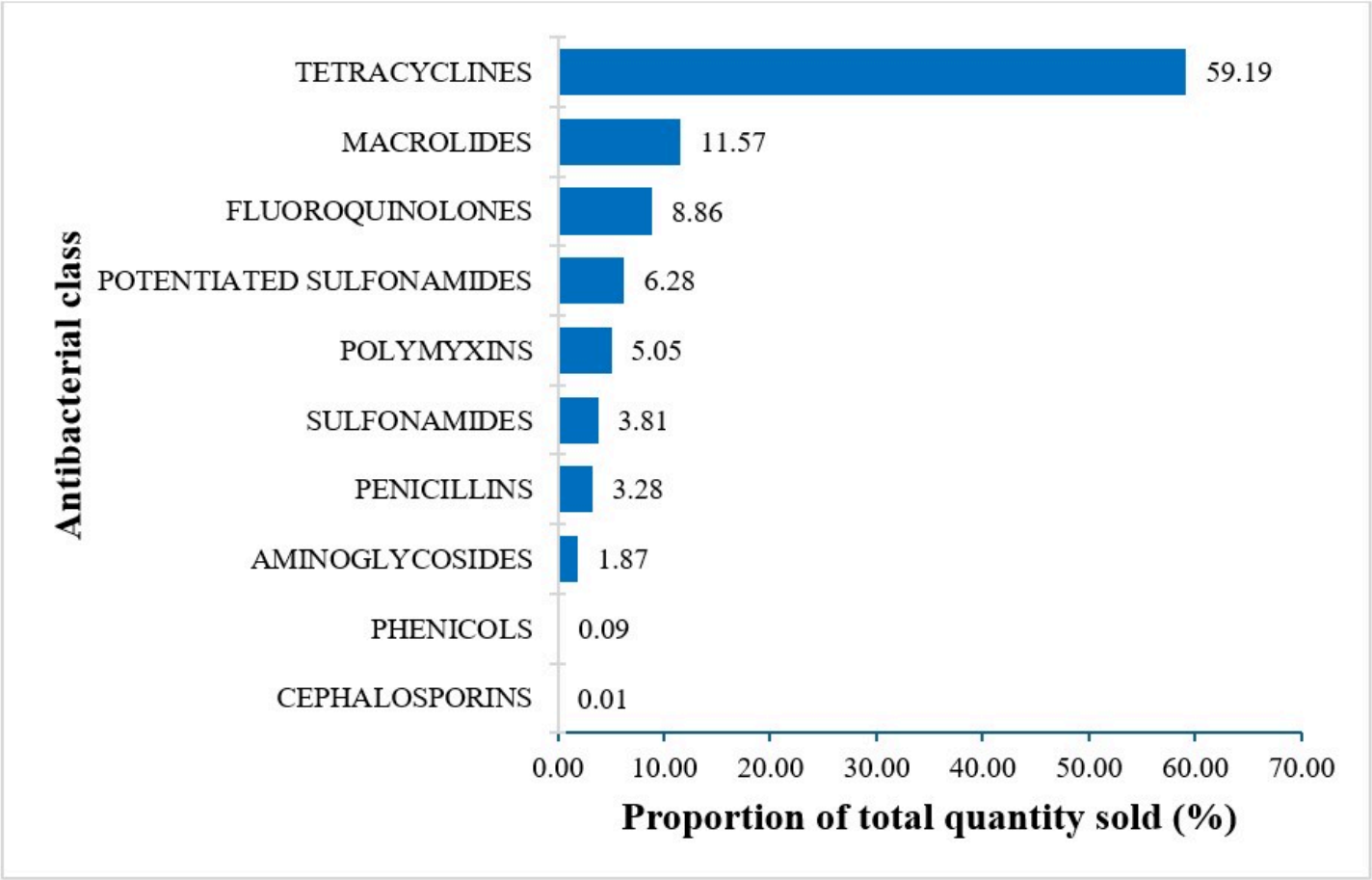


Figure 3

Proportion of antibacterial active ingredients sold by pharmacological class among veterinary drug shops in Eastern Uganda

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