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Antimicrobial Use and Stewardship among practicing veterinarians in Uganda

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Abstract

Appropriate, affordable, and readily available veterinary drugs are an essential component of any animal health service. The availability of certain drugs for companion animals (pets), food animals, and wildlife, along with the practitioners' understanding of their use, is crucial in curbing antimicrobial resistance. The aim of this study was to establish categories of drugs commonly used by veterinarians working with companion animals, food animals, and wildlife in Uganda. A cross-sectional study was done to establish common antimicrobial drugs used by practicing veterinarians in Uganda. Fifty-seven veterinarians were purposively selected to participate in the survey. The veterinarians responded to an online questionnaire distributed by a link to their emails and mobile applications. The questionnaire solicited information regarding their demographic traits, expertise pertaining to antimicrobials, and the types of antimicrobials they frequently utilise. Most of the respondents, 53/57 (93%), were male veterinarians, and 29/57 (50.9%), were mixed animal practitioners. Although they were all involved in some kind of practice, only 18/44 (40.9%) confidently understood antimicrobial stewardship. However, the majority, 38/44 (86.4%), agreed on the importance of antimicrobial stewardship in reducing antimicrobial resistance (AMR). The majority, 26/43 (60.5%) of the veterinarians, were aware of the animal owners' indiscriminate use of the antibiotic without expert prescription. Penicillins and tetracyclines were the most used antimicrobial drugs. Other antimicrobials often used were cephalosporins, fluoroquinolones, aminoglycosides, and chloramphenicol. Field veterinarians need to undergo further training on the current categories of antimicrobial agents, antimicrobial stewardship, and AMR. The Veterinary Formulary should be updated following the WHO list of critically-important-antimicrobials (CIA). The veterinarians should also familiarize themselves with the 'Essential Veterinary Medicines List for Uganda'.

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Introduction

Antimicrobial stewardship refers to the actions veterinarians take, individually and as a profession, to preserve the effectiveness and availability of antimicrobial drugs through conscientious oversight and responsible medical decision-making while safeguarding animal, public, and environmental health (AVMA, 2018). Core principles of antimicrobial stewardship in

veterinary medicine involve maintaining animal health and welfare by implementing a variety of preventive and management strategies for common diseases; using an evidence-based approach in making decisions to use antimicrobial drugs; and then using antimicrobials judiciously, sparingly, and with continual evaluation of the outcomes of therapy, respecting the client's available resources (AVMA, 2018).

Veterinary pharmaceuticals, including antibiotics, antimicrobials, antihistamines. antiprotozoals, and hormones, are essential for therapeutic and prophylactic measures in animal health care (Tufa et al., 2018). The most prominent and commonly used is the class of antibiotics that are used in the treatment of bacterial infections, antiparasitics applied in the control of endoand ectoparasites, and drugs used in the management of pain (Caneschi et al., 2023). When drugs are used in normal doses to achieve such functions, they are sometimes followed by certain reactions which are harmful and unintended (Morimoto et al., 2004). However, effective regulatory measures can significantly reduce adverse drug reactions (ADRs) or side effects (Coleman and Pontefract, 2016; Jordan et al., 2018). Collection. detection. assessment, monitoring, and prevention of adverse effects of pharmaceutical products can be achieved with proper veterinary pharmacovigilance (VPV) (Mekasha et al., 2024; NDA, 2023). Veterinary pharmacovigilance is a systematic procedure for collecting and analysing information to identify and mitigate unforeseen or undesirable adverse effects associated with the use of veterinary medicines (Mekasha et al., 2024; Silley, 2009). It appropriate utilisation promotes the of veterinary pharmaceuticals, hence diminishing their indiscriminate application by both trained and untrained users.

Antimicrobial resistance (AMR) has developed into a critical public health challenge that undermines existing control measures and necessitates innovative, multidisciplinary approaches (Habarugira *et al.*, 2021; Krushna *et al.*, 2024). In May 2015, the World Health Assembly (WHA) adopted resolution 68.7, urging member states to engage in a comprehensive worldwide program for monitoring AMR and to implement a tailored national action plan in accordance with the worldwide Action Plan on AMR (Aworh *et al.*, 2021). Globally, strategies, like antimicrobial stewardship (AMS) programs and improved surveillance, have been developed to mitigate its dissemination. Nevertheless, particularly in lower- and middle-income nations, there frequently exists a deficiency in comprehension about the comprehensive scope of antimicrobial resistance and the continuous surveillance, stewardship, or investigative initiatives (Aworh *et al.*, 2021; Habarugira *et al.*, 2021).

In Uganda, initiatives are being established to inform public health policy about AMS and comprehension AMR, enhance of AMR guide future surveillance, and research endeavours (Kivumbi and Standley, 2021). A One Health strategy must be adopted for the surveillance of AMR to enhance comprehension of the mechanisms underlying resistance transfer at the human-animal-environment interface, including further exploration of antiviral and antifungal resistance (Kivumbi and Standley, 2021).

The veterinarians require in-depth knowledge of veterinary drugs to make a clinical diagnosis and make the right choice of antimicrobials; therefore, knowledge is the basis of AMS programs. This has been tested in some countries and proved efficient in changing mindsets of both veterinarians and their clients (Geta and Kibret, 2021; Kivumbi and Standley, 2021; Scarborough et al., 2021). Behavioral change (mindset change), although often difficult, has improved among many veterinarians and other clinicians, hence increasing awareness. As a result, more clinicians and animal owners have responded positively to educational interventions and have become good antimicrobial stewards (Tufa et al., 2018). In Uganda, the Ministry of Agriculture, Animal Industry, and Fisheries (MAAIF) has set up programs for veterinarians and other animal care practitioners to undergo further training on the current categories of antimicrobial agents, antimicrobial stewardship, and AMR (Kivumbi and Standley, 2021) and to familiarise themselves with the 'Essential Veterinary Medicines List for Uganda' (MAAIF, 2020). A survey therefore was conducted to assess antimicrobial use and stewardship among practicing veterinarians in

Uganda. This paper therefore presents the findings of the survey regarding the level of knowledge of veterinarians on the different types of antibiotics, the kinds of antibiotics they use in their practice, and AMS plans implemented as part of mitigation measures for the associated AMR.

Materials and Methods

Study Design

This cross-sectional study was conducted among 57 licensed veterinarians in Uganda from March to April 2020. The purposive sampling technique was utilised, concentrating solely on registered practicing veterinarians. The list of veterinarians for consideration was obtained from the Uganda Veterinary Association (UVA) headquarters in Kampala.

A meticulously designed, pretested questionnaire was distributed over a web link shared via the WhatsApp application and email. The questionnaire solicited information about the veterinarians' demographics, experiences with antimicrobial usage, comprehension of antimicrobials, prescribing patterns to assess AMS practices, and AMS strategies.

Data Management and Analyses

The completed online questionnaires were meticulously examined to verify the accuracy of the respondents' submissions. The acquired data were cleaned and analysed using Epi Info version 7. Frequency tables and graphs were created to summarize the veterinarians' demographics and their knowledge of antimicrobials and antimicrobial resistance (AMR).

Ethics approval and consent to participate

The work was presented before a research panel for approval at the College of Veterinary Medicine, Animal Resources and Biosecurity at Makerere University. The purpose of the research and the content of the questionnaires were explained to each respondent/participant to obtain their consent before the interview was carried out.

Results

Demographic Characteristics of Study participants

Most respondents, 53/57(93%), were male veterinarians compared to 3/57 (5.3%) who were female. One respondent did not indicate their gender. Most respondents 29/57 (50.9%), were mixed animal practitioners. Many of them were older veterinarians who graduated from university before 2010. Only 13/57 (22.8%) respondents graduated after 2010. Details are presented in Table 1 (Table 1 near here).

Knowledge of antimicrobial stewardship and practice related to AMR

Although all the respondents were involved in some kind of veterinary practice, only 18/44 (40.9%) confidently understood AMS as defined by the World Health Organization (WHO, 2023) and the U.S. Canters for Disease Control and Prevention (CDC, 2024). However, the majority, 38/44 (86.4%), agreed on the importance of AMS in reducing AMR. Also, many veterinarians 26/43 (60.5%) were aware of the animal owners' indiscriminate use of the antibiotic without expert prescription. Details are presented in Table 2

Table 1

Demographic characteristics of practicing veterinarians who participated in the Study Survey in Uganda

Parameter	Number	%age
Gender (n=57)		
Male	53	93
Female	3	5.3
Other	1	1.7
Graduation year (n=57)		
Before 2000	18	31.6
2000 - 2010	26	45.6
After 2010	13	22.8
Category of practice (n=57)		
Exclusively food producing animals	8	14
Food producing and large companion animals (equine, ovine, caprine)	3	5.3
Mixed practice including all types of domestic (food and companion) and wildlife animals	3	5.3
Mixed practice including all types of domestic animals (food animals, large companion animals, small companion animals (dogs/cats)	29	50.9
Small companion animals exclusively (dogs, cats, and other small household pets)	1	1.7
Wildlife/exotics exclusively	8	14
Other	5	8.8

Table 2

Knowledge of practicing veterinarians in Uganda on antimicrobial stewardship and antimicrobial resistance

Parameter	Number	%age
Confidence in understanding of antimicrobial stewardship (n=44)		
Very confident	18	40.9
Fairly Confident	24	54.5
Slightly confident	2	4.5
Importance of antimicrobial stewardship in reducing antimicrobial resistance (n=44)		
Very important	38	86.4
Fairly important	6	13.6
Farmers' antibiotic use without expert prescription (n=43)		
Frequent	26	60.5
Sometimes	8	18.6
Seldom	3	7
Never	6	14
Farmers' anthelmintic use without expert prescription (n=43)		
Frequently	31	72.1
Sometimes	4	9.3
Seldom	3	7
Never	5	11.6
Encounter of treatment failure due to suspected AMR (n=42)		
Frequently	4	9.5
Sometimes	17	40.5
Seldom	14	33.3
Never	7	16.7
Encounter of treatment failure due to Anthelmintic resistance (n=42)		
Frequently	5	11.9
Sometimes	19	45.2
Seldom	8	19
Never	10	23.8
Pressure by clients to prescribe antibiotics not indicated clinically (n=43)		

Frequently	13	30.2
Sometimes	12	27.9
Seldom	9	20.9
Never	9	20.9
Preforming bacterial identification and antibiotic susceptibility testing (n=43)		
Frequently	4	9.3
Sometimes	6	14
Seldom	16	32.2
Never	17	39.5
Client's familiarity with AMR (n=43)		
Very familiar	3	7
Fairly familiar	5	11.6
Slightly familiar	16	37.2
Not familiar at all	19	44.2

Categories of antimicrobial agents prescribed by veterinary practitioners

Penicillin (PEN) and tetracycline (TCN) were the most used antimicrobial drugs in companion animals (Figure 1) and food animals (Figure 2), followed by fluoroquinolones (FQs), cephalosporines (CEP), and aminoglycosides (AMES). In companion animal practice, antibiotics were used for a variety of cases, such as the treatment of uncomplicated diarrhoea; the treatment of dogs with acute kennel cough; routine dental cleaning; routine spaying/neuter procedures; and topical treatment, among others **(Figure 1)**. These drugs can be used singularly or in combination (polypharmacy). Although wild animals are rarely treated, some antimicrobials were mentioned by wildlife veterinarians as key drugs that are sometimes used **(Figure 3)**.

Figure 1





Figure 2



Antimicrobial drug prescriptions for food animals as reported by practicing veterinarians who participated in the Survey in Uganda

Figure 3

Antimicrobial drug prescription for wildlife animals as reported by practicing veterinarians who participated in the Study Survey in Uganda



Discussion

The study has provided us with a wealth of information regarding veterinary practitioners' knowledge of antimicrobial stewardship (AMS), antimicrobial resistance (AMR), the common antimicrobials they prescribe, and their clients' understanding of antimicrobials and AMR, which is necessary in mitigating its health impacts on animals. The respondents' confidence in understanding antimicrobial stewardship was primarily attributed to the diverse programs launched by MAAIF (Kivumbi and Standley, 2021; MAAIF, 2020) that focus on sensitising veterinary practitioners on use of the current categories of antimicrobial agents, AMS, and AMR. The respondents also confirmed that their clients and animal owners, often use drugs indiscriminately or without a prescription from a qualified veterinarian. Animal owners often lack appropriate knowledge about AMR and its dangerous effects. This aligns with previous research, which indicates a high prevalence of low awareness of antimicrobials and AMR among animal owners, as well as a lack of rapid and effective diagnostic techniques (Geta and Kibret, 2021; Scarborough et al., 2021; Tufa et al., 2018).

The study reported oxytetracycline and penicillin as the most frequently used antimicrobials, probably because they are readily available, lowcost, and effective against many pathogens. Most veterinary antimicrobial agents, such as fluoroquinolones, β -lactams, sulfonamides, and tetracyclines, warrant specific consideration due to their economic and health implications, given their extensive usage particularly (Granados-Chinchilla and Rodríguez, 2017). Tetracyclines, in particular, are a chemical group of significance due to their widespread use in livestock farming, surpassing the quantities applied to almost every other antibiotic family (Ferdous et al., 2020; Granados-Chinchilla and Rodríguez, 2017). The tetracycline antibiotic has a broad spectrum of activity, spanning a wide range of gram-positive and gram-negative bacteria, spirochetes, obligate intracellular bacteria, as well as protozoan parasites (Grossman, 2016). In addition, penicillin exhibits a good spectrum of activity against gram-positive and anaerobic bacteria, excluding certain

Staphylococcus species. Penicillin G exhibits synergy with aminoglycosides, and this combination may be efficacious against staphylococci (Kimera *et al.*, 2020).

Greater than 75% of companion animal practitioner respondents reported using topical therapy for superficial skin infections sometimes or frequently, which is consistent with good antimicrobial stewardship (AMS) (Hillier *et al.*, 2014). However, \geq 50% of companion animal respondents reported treating uncomplicated diarrhoea and acute uncomplicated contagious upper respiratory infections with antibiotics either sometimes or frequently, which is considered poor AMS (Ellis *et al.*, 2023; Weese *et al.*, 2019).

The respondents acknowledged using antibiotics for simple diarrhoea, dental cleaning without infection, and feeding, often without prior considerations or thorough enquiries. This finding combined with the pressure practitioners face from animal owners to prescribe certain drugs, as well as increased self-treatment, provides enabling conditions for AMR development. This is consistent with previous research reports which indicate that irrational prescription of antibiotics by clinicians and misuse by the animal owners and farmers might lead to drug resistance (Kamulegeya et al., 2011; Loosli et al., 2024). The timing and nature of prescriptions allow for potential misuse; thus, it is essential to consistently oversee knowledge and prescribing habits (Kamulegeya et al., 2011). The considerable amounts of antibiotics used locally in Uganda, as reported in this study, and the resultant AMR reported before underscore the need for continuous monitoring and surveillance of antibiotics in use and AMR by the Uganda National Drug Authority.

Conclusions

The study reveals that most veterinarians use penicillins and tetracyclines as their primary antimicrobial drugs for treating various animal categories. Other antimicrobials often used were cephalosporins, fluoroquinolones, aminoglycosides, and chloramphenicol. Only a small percentage of the veterinarians interviewed were unaware of antimicrobial stewardship. However, a good proportion of them did understand the importance of antimicrobial stewardship in reducing AMR. Therefore, there is a need for continuing antimicrobial stewardship education programs to preserve the effectiveness and availability of efficacious antimicrobial drugs and to ensure all veterinarians practice judicious use of antimicrobials to combat AMR. This is needed to empower veterinarians with knowledge needed to practice antimicrobial stewardship by observing the following principles: being committed to stewardship, advocating for a system of care to prevent and cure common diseases, including the use of alternatives to antimicrobial drugs, selecting and using antimicrobial drugs judiciously, evaluating antimicrobial drug use practices, and educating themselves and others to build expertise as necessary to mitigate the impacts of AMR on

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animal and people's health. Professionals who manage or prescribe antimicrobial drugs, such as veterinarians and healthcare practitioners, must undertake antimicrobial stewardship training programs and collaborate to mitigate the proliferation of AMR.

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