



**Antimicrobial Resistance  
knowledge, attitudes, and  
practices amongst drug  
vendors, farmers, and the  
general public in Kenya**

# Executive summary

Inappropriate use of antimicrobials and antimicrobial resistance (AMR) are growing global concerns. The main objective of this study was to explore the levels of AMR knowledge and prescribing practices among veterinary and human drug vendors, farmers, and the public across 19 counties in Kenya.

A cross-sectional survey was conducted between November and December 2020. Semi-structured questionnaires were electronically administered to collect socio demographic and Knowledge, attitudes and practices data through face-to-face interviews.

A total of 1,142 participants were interviewed – 581 (50.9%) members of the public, 276 (24.2%) human pharmacists, 168 (14.7%) farmers, and 117 (10.2%) veterinary pharmacists.

**Antibiotics were the commonly sold product in human and veterinary stores and antibiotic sales contributed significantly to the total revenue in both stores. Vaccines were not a commonly sold/bought product. Although levels of knowledge on antibiotics and AMR were relatively evident, improper practices were evident in all study categories.**

**1,142:** 

No of participants interviewed

**581**   
**(50.9%)** members of the public

**276**   
**(24.2%)** Human pharmacists

**168**   
**(14.7%)** Farmers

**117**   
**(10.2%)** Veterinary pharmacists

Inappropriate practices included rampant sale of antibiotics without prescriptions, self-medication practise, failure to complete course of antibiotic therapy, sharing of antibiotics, and stockpiling of remaining antimicrobials. Farmers and the public were less aware of the World Antibiotic Awareness Week Initiative.

Among respondents, knowledge and practices related to antibiotics showed significant gaps and, therefore the need for an urgent effort to mitigate such practices. The study highlighted the need to develop a more effective method to improve public awareness of the WAAW initiative and AMR.



# 1. Introduction

It is now generally agreed that antimicrobial resistance (AMR) has, and continues to impact human and animal health and global economies across the globe <sup>[1]</sup>. More than before, it is clear that an interdisciplinary approach is needed to tackle this growing antimicrobial resistance challenge <sup>[2]</sup>. As a result, international agencies, including the World Health Organization (WHO), the Food and Agriculture of the United Nations (FAO) and the World Organisation for Animal Health (OIE), have developed global action plans and strategies to address AMR <sup>[3]</sup>. These global efforts are emulated and are being implemented by respective governments and place a strong emphasis on improving awareness and understanding of AMR amongst professionals and the public. At the heart of this was the creation of the WHO's World Antibiotic Awareness Week (WAAW) – a week-long series of activities aiming “to improve awareness and understanding of AMR through effective communication, education and training” in order to “encourage best practises among the public, health workers, and policymakers”<sup>[4]</sup>.

**Following a concerted effort by Kenya's government, supported by FAO and WHO, Kenya adopted its AMR National Action Plan in 2017 [5]. The policy document provides a coherent policy framework and priority actions to contain the emergence and spread of AMR, with a reduction in antibiotic use and prudent prescribing behavior and practices as key themes in the national policy.**

To further support antibiotic use and antibiotic stewardship programmes it is critical to have an in-depth understanding of knowledge and attitudes towards antibiotics within different population groups such as farmers. Knowledge, attitudes, and practices (KAP) surveys are often used to analyse and quantify the gaps in AMR knowledge (e.g., do you understand AMR phenomena?), attitudes, (e.g., do you believe that AMR will impact your health and your livelihood?), and practices (e.g., do you self-prescribe antibiotics?). KAP surveys have been and continue to provide critical and much-needed information critical to developing targeted awareness campaigns in low- and middle-income countries (LMICs).

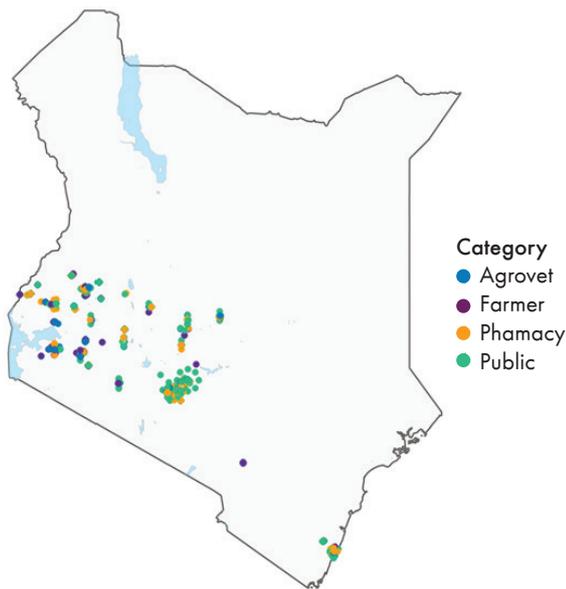
Although often limited in number, previous KAP surveys in Kenya and similar global settings show that AMR awareness levels are often limited, and improper antibiotic prescribing and use practices are rife. **This study analyses the levels of AMR knowledge and prescribing practices among veterinary and human drug vendors, farmers, and the public across Kenya.**



## 2. Methods

### 2.1 Study site and design

The study consisted of a cross-sectional survey targeting veterinary drug stores (agrovet), pharmacies, farmers, and the public across 19 counties in Kenya in November and December 2020 (Figure 1).



This was a cross-sectional study and the data was collected using a self-administered structured questionnaire. The questionnaire collected data on demographic information of the respondents, knowledge on antibiotics and AMR, antibiotic sources and sale dynamics, awareness on AMR, and prescribing pattern of antibiotics.

Questionnaires were adapted from previous publications and consultation with experts and pre-tested. One hundred (100) individual students administered the questionnaires from 13 different institutions of higher learning. All the participations were voluntary and were not provided any forms of incentives.



### 2.2 Data analysis

All the questionnaires were screened for completeness and errors then processed for data analysis. Descriptive analysis was carried out for all data, including frequencies and percentages for categorical variables (e.g., gender and education level) and means, medians, standard deviations (SDs), quartiles, and ranges for quantitative variables (e.g., working duration). Univariate analysis using chi-square or Fisher's exact test using R were used to describe differences between categorical variables and Mann-Whitney U test to compare continuous variables. Generalized linear model (GLM) was fit to assess the possible influence of the type of drug store (human/veterinary), clinical/veterinary training (present or absent), and duration of working on antibiotic prescription practices. A difference with p-value less than 0.05 was considered as statistically significant.

## 3 Results

### 3.1 Demographic characteristics of respondents

A total of 1,142 participants were interviewed – 581 (50.9%) members of the public, 276 (24.2%) human pharmacists, 168 (14.7%) farmers, and 117 (10.2%) veterinary pharmacists (table 1). Overall, the majority of the respondents were male 648 (57%). The median age of farmers was slightly higher (32.5 years) compared to both veterinary and human pharmacists (30 years), and members of the public (26 years). The mean duration of working in a veterinary drug store was 3.2 years (range; 0.5-30) and in a human pharmacy was 2.2 years (range; 0.5-38). Human pharmacists (88.3%) were significantly more likely to have clinical training than veterinary pharmacists (69.2%,  $X^2 19.5$ ,  $p < 0.001$ , Binomial Test). Almost all veterinary and human pharmacists had received some form of professional training.

Table 1. Participant demographics and baseline clinical characteristics.

Variable		Agrovets	Pharmacy	Public	Farmer
Sex	Male	69 (59)	148 (53.6)	316 (54.5)	115 (68.9)
	Female	48 (41)	128 (46.4)	264 (45.5)	52 (31.1)
Median age		30	30	26	32.5
Mean duration of working (Years)		3.2 (0.5-30)	2.2 (0.5-38)		
Have animal health/clinical training		69.2 (81/117)	88.3 (242/274)		
Highest level of education	Secondary School	1(1.2)	1(0.4)		
	Certificate	23(28.4)	31(12.8)		
	Diploma	37(45.7)	148(61.2)		
	Undergraduate	18(22.2)	60(24.8)		
	Masters	2(2.5)	2(0.8)		

### 3.2 Antibiotic sold and sales

**Antibiotics were the commonly sold products in more than half (58%) of veterinary drug stores, followed by antiparasitic drugs (34%). Of note, vaccines were reported as the commonly sold product by only 5% of the veterinary stores.**

Of the veterinary stores reporting antibiotics as their commonly sold product, tetracyclines was the commonly sold antibiotic (61.4%), followed by betalactams (19%), sulphonamides (9%) and tylosin (2.6%) (Figure 2)

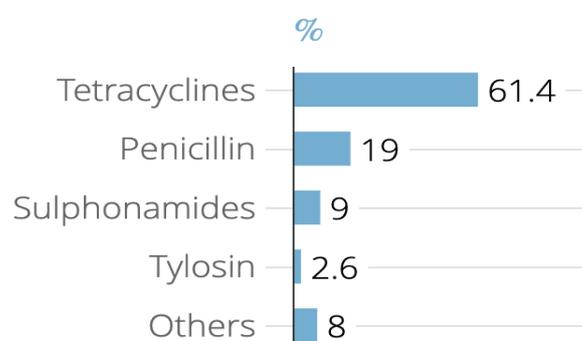


Figure 2. Proportion of commonly sold antibiotics in veterinary drug stores

### 3.2.2 Human pharmacies

**Similarly, antibiotics were the commonly sold product in 43% of human pharmacies, followed by painkillers in 21.4% of stores, cough medicine (16%), and antiparasitic drugs (8.6%).**

In agreement with the veterinary stores, tetracyclines, betalactams and sulphonamides were reported as the commonly sold antibiotic by 33%, 23% and 13% of stores, respectively. Other commonly sold antibiotics were aminoglycosides reported in 5% of stores, trimethoprim (3%), macrolides (3%), and Fosfomycin (2%) (Figure 3).

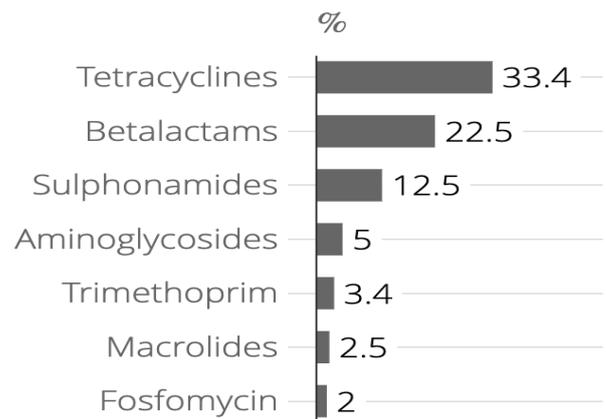


Figure 3. Proportion of commonly sold antibiotics in human drug stores.



### 3.3 Source of antibiotics by both veterinary drug stores and human pharmacies

Large neighbouring wholesale stockists (for this study, defined as companies that buy drugs in bulk and sell them in smaller quantities to drug stores) were reported as the main supplier of antibiotics in 51% of human drug stores. Similarly, local wholesale stockists were the main suppliers of antibiotics to veterinary drug stores (35.6%).

**Both veterinary and human pharmacists reported that antibiotic sales are highest in the wet seasons and lowest in the dry seasons, highlighting a seasonal pattern of sales of antibiotics. As expected, majority of antibiotic sales happened in the evening peak hours.**

Pharmacies reported that antibiotic sales contributed a significantly higher amount (38.8%, range 25-100) of their total revenue compared to agrovets (30%, range 15-80%) ( $p= 0.002$ , Kruskal Wallis) Figure 4.

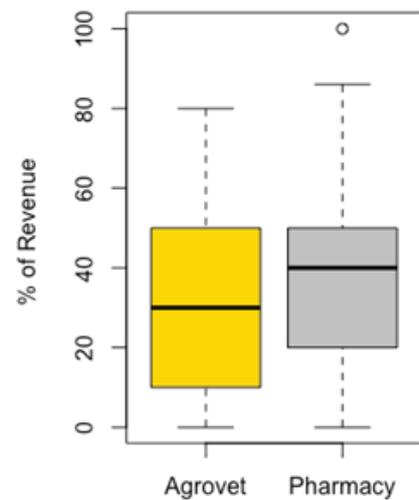


Figure 4. Boxplot indicating proportion of revenue obtained from antibiotic sales by drug store category.



### 3.4 Type of farmers reported to frequently buy antibiotics and associated diseases

**Dairy farmers were reported as the most frequent customers of antibiotics in 49.6% of the veterinary drug stores. Other customers for antibiotics included: indigenous chicken farmers, layer farmers, and broiler farmers reported in 15.4%, 14.5% and 8.5% of stores (Figure 4a).**

Further, antibiotics were reportedly prescribed frequently for various diseases such as East Coast Fever, mastitis, coccidiosis, and Newcastle disease in 19.9%, 15.6%, 12.8% and 12.8% of veterinary stores, respectively. Additional prescriptions were linked to anaplasmosis, pneumonia and Foot and Mouth Disease in 10.6%, 9.2% and 8.5% of stores, respectively (Figure 5b).

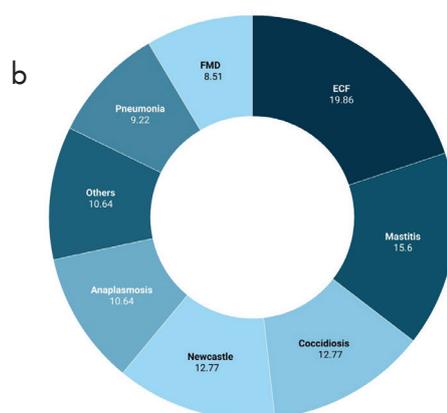
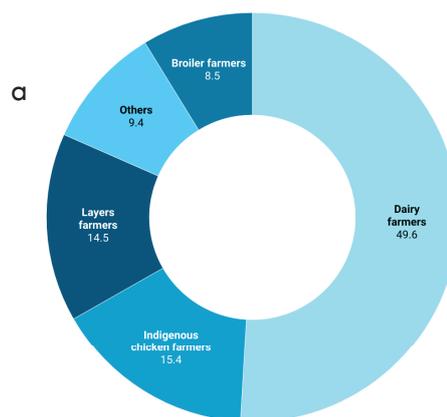


Figure 5a-b. Proportion of veterinary drug stores reporting: a) the different types of farmers purchasing antibiotics, b) the commonly presented diseases/symptoms requiring antibiotics.

### 3.5 Most common diseases associated with antibiotics prescription in human pharmacies

**On the other hand, antibiotics were reportedly prescribed frequently for upper respiratory tract infections, common cold, malaria and urinary tract infections in 23.5%, 17.9%, 17.4% and 10.5% of human drug stores, respectively.**

Additional symptoms/diseases reported were typhoid, pneumonia, and diarrhoea in 8.5%, 6.6% and 4% of stores, respectively (Figure 6)

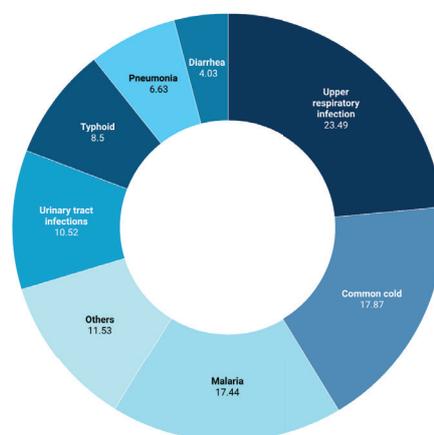


Figure 6. Proportion of commonly presented diseases/symptoms requiring antibiotics in human drug stores

### 3.6 Antibiotic prescribing practices in veterinary drug stores and human pharmacies

**More than two-thirds (68.1%) of human drug stores reported that they sold antibiotics without a prescription compared to 59% of veterinary drug stores (Figure 7).**

Logistic regression analysis revealed that the human pharmacists were significantly more likely (68.1%) to sell antibiotic without a prescription compared to veterinary drug sellers (41%, OR = 3.07, P<0.0001, CI 1.97 - 4.82, GLM) but didn't vary by working duration or by clinical/animal health training (p<0.05, GLM).

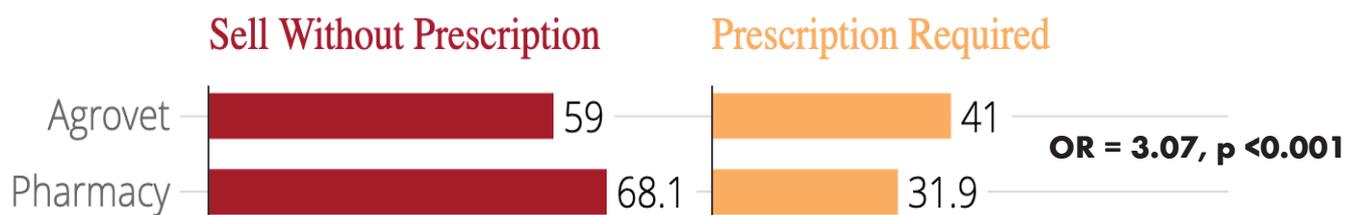


Figure 7. Proportion of drug stores selling antibiotics a) without a prescription and, b) with a prescription



## 3.7 Knowledge about AMR

### 3.7.1 Farmers

**Most farmers interviewed (82.7%) showed some knowledge of antibiotics, with most of them defining antibiotics as drugs used to treat infections. The remaining proportion defined antibiotics as 'painkillers' or 'medicines that cure people'.** Further, the interviewed farmers provided varied responses on the difference between antibiotics and antimicrobials, with 40% of them saying they were unaware of a difference, and 10% saying the two categories were the same. The remaining half provided conflicted responses on the differences. For example, some respondents noted that antibiotics are used in humans while antimicrobials are used in animals. Majority of the farmers recognised that AMR is a problem affecting human health and animal health.

**82.7%**

Farmers who showed some knowledge of antibiotics

**40%**

Farmers unaware of the difference between antibiotics and antimicrobials

**10%**

Farmers said that antibiotics and antimicrobials are the same.

**50%**

Farmers who provided conflicted responses on the difference between antibiotics and antimicrobials

**Thirty-six percent of farmers reported to self-prescribe antibiotics in treating animals and stopped giving their animals the prescribed dose once the animals clinically showed recovery (i.e. started feeling better (Figure 8))**

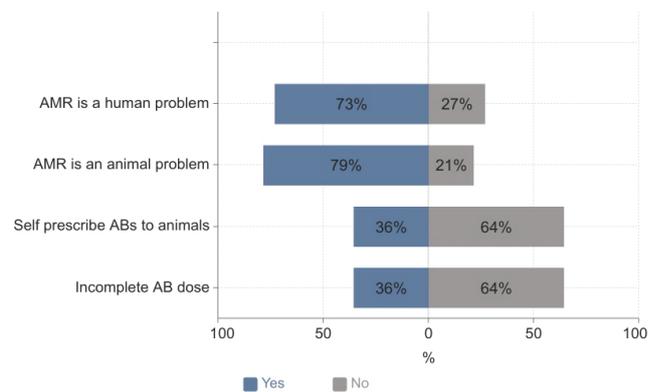


Figure 8. Statements indicating knowledge of AMR and practices amongst farmers



### 3.7.2 Human and veterinary drug stores

**Forty-two percent and 67.8% of veterinary drug stores (agrovets) and human pharmacies respectively reported to have encountered an antibiotic failure in the past.**

When asked about the term (or descriptor) defining the failure, most respondents in both store types were aware of the terms 'drug resistance' and 'resistance'. Other descriptors provided were: 'antimicrobial resistance', 'antibiotic resistance' and 'drug failure'. Notably, and in this study, 24.3% of those working in the veterinary drug stores didn't know the terminology used to describe this failure (Figure 9).

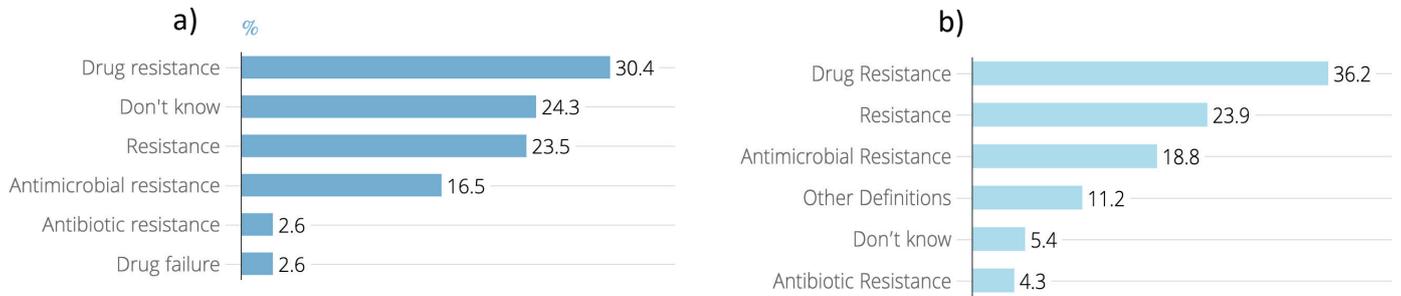


Figure 9. Terms used to describe antimicrobial resistance



About 15% of both human and veterinary pharmacists believed that AMR occurs when their body becomes resistant to antibiotics rather than the bacteria themselves that develop resistance. Similarly, 39% of veterinary respondents believed that antibiotics could and should be used to manage viral infections (Figure 10).

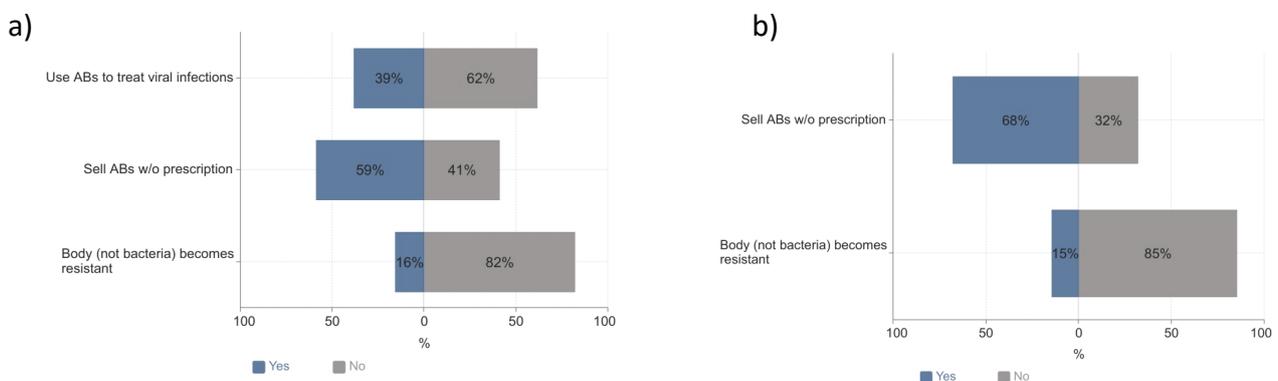


Figure 10. Statements indicating knowledge of AMR and practices amongst a) veterinary drug stores, b) human drug stores.

### 3.7.3 General public

Most respondents agreed that AMR occurred when infections were untreatable by drugs, hence necessitating other medication. For example, one respondent described AMR as: “Dawa ikikosa kufanya kazi ugonjwa haiishi na inabidi utumie dawa zingine”, translated to mean ‘when drugs don’t work, one doesn’t get better and is forced to buy another drug type’.

**The vast majority (83.3%) of people knew what antibiotics are. For instance, they mostly described antibiotics as drugs used to treat bacterial infections. Other people described antibiotics as ‘drugs used to treat illnesses’, ‘curative drugs’, ‘medicines’, or ‘drugs’.**

Furthermore, the interviewed people provided varied responses on the difference between antibiotics and antimicrobials, with 44.8% of them saying they were unaware of the difference, and 13.4% saying the two categories were the same. The remaining 41.8% gave conflicted responses on the differences. For example, some people believed that antibiotics are used to manage pain while antimicrobials cure illnesses.

Most people (71%) recognised that AMR is a problem affecting human health. However, 44% of people reported to self-prescribe antibiotics while 66% said that they stopped taking the prescribed antibiotic dose once the recovery phase was initiated (they are started feeling better). Interestingly, 36% of people shared antibiotics with other people, including even with domestic animals (Figure 11).

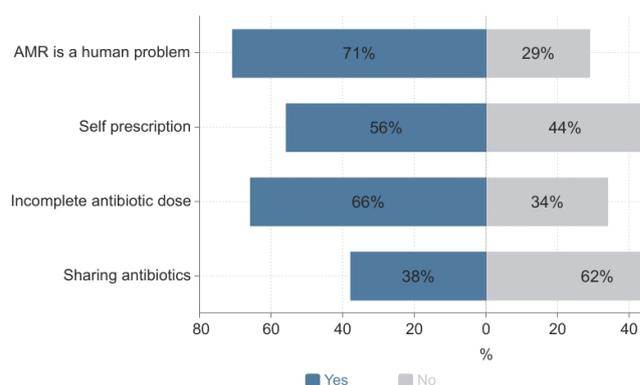


Figure 11. Statements indicating knowledge of AMR and practices amongst the public

# 44%

Respondents who reported to self-prescribe antibiotics.

# 66%

Respondents said that they stopped taking the prescribed antibiotic dose once the recovery phase was initiated.

# 36%

Respondents who shared antibiotics with other people, including domestic animals.



### 3.8 Awareness of World Antibiotic Awareness Week

**Veterinary (40.2%) and human (51.4%) pharmacists were significantly more aware of WAAW compared to both the public (18.6%) and farmers (19.1%) who had similar levels of awareness. ( $P < 0.01$ , GLM).**

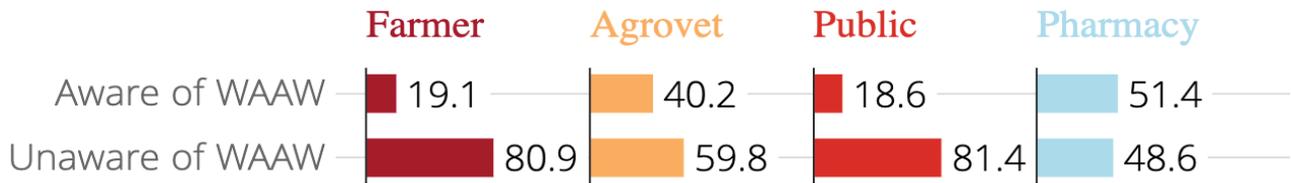


Figure 12. Level of awareness of WAAW week amongst study groups



## 4 Discussion

It is essential to explore how the main stakeholders of antimicrobial use (patients, clinicians, veterinary professionals, drug retailers and farmers) interact, practice and use the antibiotics. This study investigated the level of awareness and practices related to AMR amongst veterinary drug stores (agrovets), pharmacies, farmers, and the public across Kenya. **Antibiotics were the commonly sold product in human and veterinary stores and their sales contributed significantly to the total revenue in both stores. This contrasts with the low sales of vaccines and other preventive medicines.** It is widely agreed that vaccines, normally used prophylactically, decrease the likelihood of infectious disease occurrence, and thus antibiotic use and the associated emergence and dispersal of AMR [6].

**Therefore, a concerted effort is urgently needed to sensitise antibiotic use stakeholders, especially farmers and the public, on the need to adopt vaccines as a disease reduction strategy in the livestock industry and communities, respectively.**

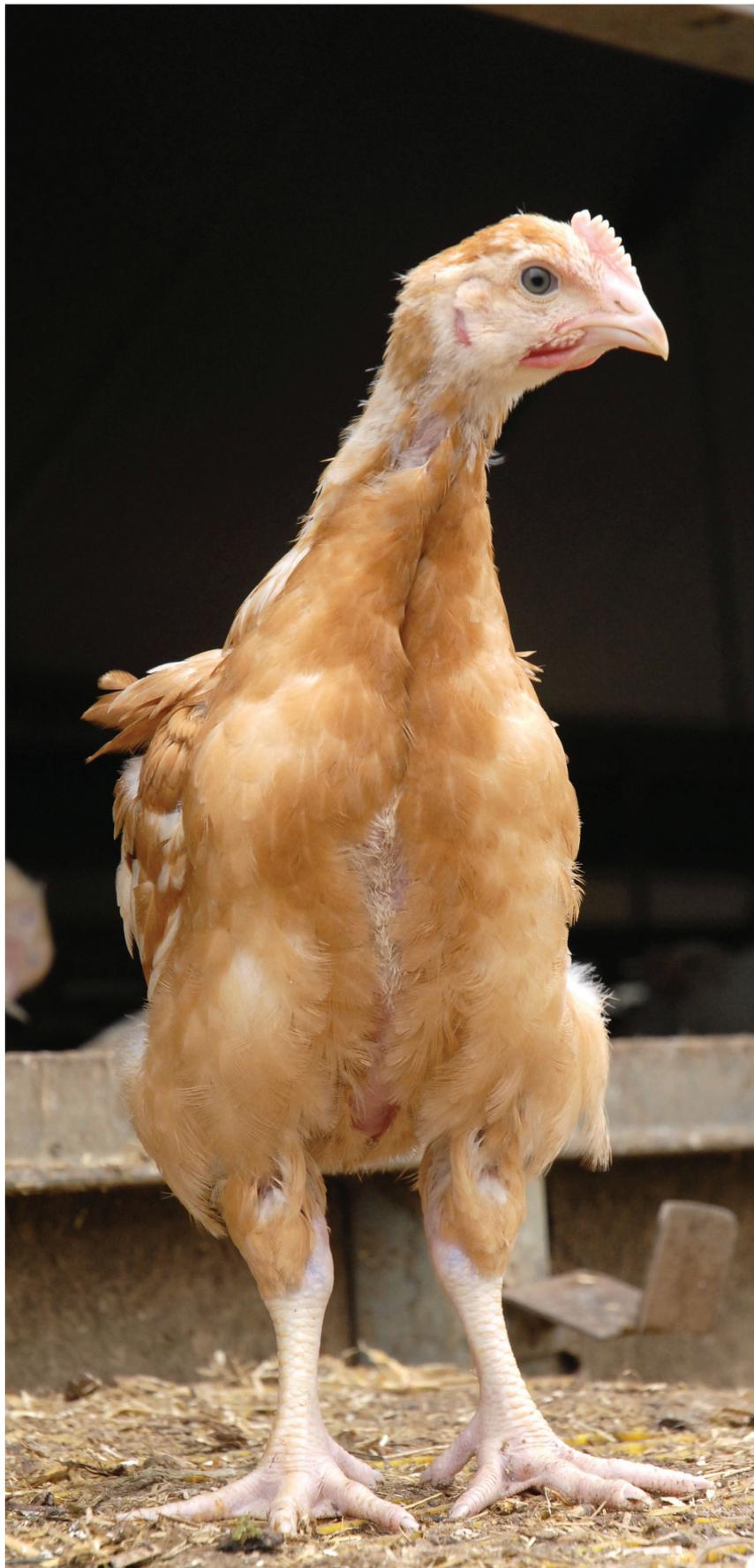
**In agreement with previous studies, the commonly reported symptoms prompting antibiotic purchase in human drug stores were respiratory tract infections, common colds, and diarrhoeal disease [7-9]. Similarly, commonly reported infectious diseases in livestock production such as East Coast Fever, mastitis, and pneumonia were frequently associated with antibiotic purchase. Broad antibiotics such as tetracycline, beta lactams, and sulphonamides were the most commonly sold/bought antibiotics in both human and veterinary drug stores.**

These findings are consistent with previous studies in Kenya and similar settings and partly are indicative of the disease patterns in the population or simply the affordable broad-spectrum antimicrobials [10-12].



The most common symptoms prompting antibiotic purchase in humans were similar to those reported in other studies, respiratory tract infections and diarrhoeal disease<sup>[9, 13, 14]</sup>. Broad-spectrum beta lactams, fluoroquinolones, first and second generation cephalosporins and metronidazole were the most commonly sold/bought antibiotics in human drug stores. This finding is consistent with patterns of antibiotic prescription in the community in previous Kenyan studies.

Exploring what patients understood by the terms 'antibiotic' and 'antimicrobials' revealed majority of respondents were not always aware of the differences and that most people believed that antibiotics could treat all diseases. **The perception that antibiotics could treat all diseases may promote the purchase and sale of over-the-counter antibiotics primarily to treat non-bacterial infections such as cold and flu.** Similarly, this study found that the greatest familiarity of 'antibiotic failure' is associated with 'drug resistance' terminology compared to 'antibiotic resistance' or the commonly used 'antimicrobial resistance'<sup>[15]</sup>. This highlights the need for AMR awareness initiatives to consider effective and contextual strategies when designing communicating calls/asks and messages. **While most people interviewed understood the threat posed by AMR to public and animal health, findings from this survey indicate that improper antibiotic use/prescribing practices were rife. Notably, the dispensing and use of antibiotics without prescriptions, failure of completion of antibiotic prescriptions/doses, and sharing and stockpiling of remaining antimicrobials.** Numerous findings have reported rampant self-medication practise and failure to complete course of antibiotic therapy and highlight the need for educational and awareness programs especially those targeting end users of these lifesaving drugs<sup>[7, 16, 17]</sup>.



Mass media awareness campaigns are, at their core, public health interventions – WAAW not excepted, although relatively new in Kenya.

**Findings from this study indicate remarkable knowledge gaps in awareness of WAAW, especially amongst farmers and the public <sup>[18]</sup>.**

WAAW offers an opportunity for all stakeholders to reflect on their relationships with antibiotics, now and into the future thus for these campaigns to be a success and a means towards prudent antibiotic use, there's a need to pay attention to the end users of antimicrobials.

Akin to all KAP surveys, participants in our study may have incurred recall bias or provided socially desirable answers rather than expressing their true opinions or practices. For example, our finding that only about 40% of drug stores required a prescription when selling an antibiotic potentially indicates social desirability bias. Future studies, potentially using ethnographic methods can be used to explore underlying reasons for the improper antibiotic use practices. Nonetheless, this study serves as a reference to the context and situation of AMR knowledge, attitudes and practices in Kenya.

## Conclusion:

1. Although levels of knowledge on antibiotics and AMR were relatively evident, improper practices were evident in all population categories. Antibiotic stewardship initiatives in Kenya – especially those using a One Health approach – need to address these gaps through education, awareness and mass campaigns to mitigate the inappropriate use of antibiotics.
2. As WAAW grows in Kenya, there is a need to make deliberate choices about AMR messaging and involvement of different groups, particularly farmers and the public, as with other public health interventions
3. There is a need to articulate and reiterate the role of vaccines in reducing improper antibiotic use and subsequently AMR beyond.



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### Contact us:

World Animal Protection

Westside Tower

9th Floor - Suite 901

Lower Kabete Road

Westlands, off Brookside Roundabout.

**T:** +254 20 3673 456

**F:** +254 20 3673231

**E:** [africaenquiries@worldanimalprotection.org](mailto:africaenquiries@worldanimalprotection.org)

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