



EDELWEISS PUBLICATIONS  
OPEN ACCESS

<https://doi.org/10.33805/2638-8235.111>  
Volume 2 Issue 1 | PDF 111 | Pages 5

# Pharmacovigilance and Pharmacoepidemiology

Research Article

ISSN: 2638-8235

## Awareness of Veterinary Drug Retail Outlets on Antimicrobial Resistance and its Containment Strategy in Ethiopia

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**Citation:** Zeru H, Gemechu A, Andualem T, Seid H and Mengesha F. Awareness of veterinary drug retail outlets on antimicrobial resistance and its containment strategy in Ethiopia (2019) *Pharmacovigil and Pharmacoepi* 2: 9-13.

**Received:** Aug 08, 2019

**Accepted:** Sep 09, 2019

**Published:** Sep 16, 2019

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### Abstract

A cross-sectional study was conducted from January to March 2018 to assess the awareness of veterinary drug retail outlets on Antimicrobial Resistance (AMR) and the availability of veterinary antimicrobials in these facilities. Qualitative and quantitative data were collected using a structured questionnaire from a total of 108 retail outlets. The study revealed that there is a difficulty to treat infectious diseases of animals because of AMR which is reported by 70 (64.8%) of the respondents. 80.6% of the respondents believe that use of wrong antimicrobial is the possible cause of AMR and 79.6% use of counterfeit or poor quality antimicrobials, and 70.4% owners self-prescription of medicines for their animals. 59 (54.6%) of them also answered poor husbandry practices such as overcrowding, poor hygiene and sanitation, and poor feeding practice are the possible causes of AMR while 8 (7.4%) and 9 (8.3%) of the respondents do not know the reason for the AMR development and possible solutions for AMR containment, respectively. Only 24 (22.2%) of the dispensers have taken training on antimicrobial selection, use, resistance and resistance containment. Even though antimicrobials such as Oxytetracycline are available in around 90% of the retail outlets, only 70 (64.8%) of the retail outlets receive an average of 14 prescriptions (ranging from one to 200) per week from public and private clinics which shows a practice of antimicrobials dispensing without prescription. Therefore, strong mainstreaming strategies to prevent and control AMR should be developed and implemented. Antimicrobials prescription and dispensing practice should also be well regulated to avoid irrational prescription and dispensing practices.

**Keywords:** Antimicrobials, Antimicrobial resistance, Veterinary drugs, Retail outlets.

**Abbreviations:** AMR-Antimicrobial Resistance, SNNP-Southern Nations Nationalities and Peoples Region, DVM-Doctor of Veterinary Medicine, VSTG-Veterinary Standard Treatment Guideline, VMF-Veterinary Medicines Formulary, FAO-Food and Agricultural Organization, OIE-International Organization for Animal Health, OTC-Over the Counter, RO-Retail Outlet, VDFACA-Veterinary Drugs and Animal Feed Administration and Control Authority.

### Introduction

Antimicrobials play a critical role in the treatment of terrestrial and aquatic food-producing animals and plants, helping to assure food safety and quality, animal health and welfare, and farmer livelihoods. In food animal production, antimicrobials can be used either to treat sick animals, to prevent diseases from spreading or to promote faster animal growth by applying low concentrations of antimicrobials to animal feed [1]. These drugs must be prescribed, presented, dispensed and used rationally under the proper supervision and involvement of veterinary professionals [2]. Antimicrobials must be used as specified in the authorized product information (Summary of Product Characteristics, package leaflet, and labeling) [3]. Rational use of drugs in veterinary medicine has numerous benefits, such as increasing efficacy, decreasing the potential adverse effects, reducing the risk of drug residue and combating the development of microorganism's drug resistance [4]. Misuse of antimicrobial agents in human and veterinary medicine can hinder the effective treatment and recovery of illnesses in both humans and animals.

It is also crucial to preserve antimicrobial efficacy in order to ensure that animal production keeps pace with growing global demand for high-quality protein [5]. On the other hand, irrational use of antimicrobials may pose impacts on the animal and public health and promoting the development of antimicrobial resistance. Antimicrobial resistance (AMR) can be defined as the ability of microorganisms to survive exposure to a specific concentration of a specific antimicrobial agent (or class of agents) [6].

Resistance to antimicrobials is a natural, biological evolutionary phenomenon but human practices hasten it [2]. There is a growing consensus that the major risk factor for the development and acceleration of AMR is excessive and inappropriate antimicrobial use. The evidence that antimicrobial use in animals contributes significantly to AMR in human and animal microbial pathogens continue to grow as new epidemiological studies are conducted [7]. Some of the common factors that contribute to the development of antimicrobial resistance

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are lack of regulation and oversight of use, poor therapy adherence and non-therapeutic use, over-the-counter use of antimicrobials, availability of counterfeit or poor-quality antimicrobials, overuse of antibiotics and the use of broad-Spectrum antibiotics [1,4,6]. The increasing occurrence of antimicrobial resistance has serious implications for the treatment of animal disease. It adversely affects both clinical and financial therapeutic outcomes with effects ranging from the failure of an individual patient to respond to therapy and the need for expensive and/or toxic alternative drugs to the high morbidity and mortality rates, increased health care costs and the need for changes in empirical therapy, more severe or prolonged illness; production losses; and reduced livelihoods and food security [1,8].

The prevention and containment strategies of AMR mainly depend on the rational use of antimicrobials. European Union is also now enforcing its member countries to control the use of antimicrobials in food-producing animals. Activities associated with the responsible and prudent use of antimicrobial agents should involve all relevant stakeholders. Coordination of these activities at the national or regional level is recommended and may support the implementation of targeted actions by the stakeholders involved and enable clear and transparent communications [9].

Pasteurellosis, Trypanosomiasis, Anthrax, Blackleg, Brucellosis, Mastitis, Footrot and Babesiosis are the most common microbial diseases in Ethiopia [10,11]. Out of the total prescribed veterinary drugs in the country, 54.5% of them are antibiotics. Oxytetracycline, penicillin-streptomycin fixed combination, and sulfa drugs (sulfadimidine and sulphamethoxazole-trimethoprim fixed combination) are also the most commonly prescribed and dispensed antimicrobials [12]. However, *S. aureus* isolates from mastitic cows were found highly resistant to Penicillin G, Streptomycin, Tetracycline, and Sulfamethoxazole-trimethoprim fixed combination [13,14]. The primary responsibility for the prudent use of antimicrobials lies with the prescriber, dispenser and the person administering the antimicrobials. Veterinary drug dispensers are responsible for ensuring that a valid prescription is presented at the time antimicrobials are supplied, and for providing clear and correct information on product use.

Retailers distributing veterinary antimicrobial drugs should only do so on the prescription of a veterinarian or other suitably trained person authorized in accordance with national legislation and all products should be appropriately labeled [15]. Improving awareness and understanding of all stakeholders on AMR, surveillance, and research to strengthen knowledge and evidence, and implementation of effective sanitation, hygiene and infection prevention measures are also important to prevent and containment of AMR. Countries develop their own strategic plans of AMR prevention and containment based on the magnitude, risk factors and level of awareness of AMR in their country. The level and type of interventions also base on these grounds. Ethiopia is also working against AMR in one health approach by developing a containment strategy. Therefore, this study is aimed to assess the level of awareness of veterinary drug retail outlets on the trend of AMR and its containment strategies.

## Study Methods

The study was conducted in different areas of Ethiopia from January to March 2018 to assess the awareness of veterinary drug retail outlets on AMR and the availability of veterinary antimicrobials in these facilities.

A total of 108 retail outlets (39 from Oromiya, 22 from SNNP (Southern Nations Nationalities and Peoples Region), 30 from Amhara, 8 from Tigray, 4 from Afar, 2 from Ethio-Somale and 3 from Direedawa regions) were included in the study based on their accessibility and

willingness of the personnel to participate on the study. Age, sex, educational level and work experience of the respondents is also considered as shown in **Table 1** below.

Data on the drug selection and dispensing practice of AMs, the awareness of AM use, resistance prevention and containment, the frequently dispensed drugs and the available antimicrobial drugs and infection prevention supplies were collected by using a structured questionnaire. Data collected were filled into Microsoft Excel spread sheet and screened for data quality and integrity. Descriptive statistics were used to describe the data and make inferences.

Sociodemographic characteristic	Number	%
<b>Age (years)</b>		
19-29	52	48.14
30-50	45	41.67
>50	11	10.2
<b>Gender</b>		
Male	79	73.1
Female	29	26.9
<b>Education</b>		
MSc	1	0.9
DVM	31	28.7
Animal Health Degree (BSc/BVSc)	5	4.6
Animal Health Diploma	69	63.9
Animal Health Lab Technician	2	1.9
<b>Year of Service</b>		
<2	31	28.7
3-5	28	29.9
6-10	22	20.4
>10	27	25

**Table 1:** Sociodemographic characteristic of respondents.

## Study Result/Findings

### Socio-demographic characteristics of respondents

29 (26.9%) of the retail outlets were run by females and those 79 (73.1%) are male dispensers. The respondents have a variety of educational background and experience. Only one has MSc degree, 31 (28.7%) Doctor of Veterinary Medicine (DVM), 5 animal health degree and 71 (65.8%) are animal health diploma and animal health laboratory technicians (Table 1). The average duration of experience was 9 years (range = 1 month to 40 years). Their age also ranges from 19 to 70 years old.

### Animal health provision

41 (38%) of the retail outlets are diagnosing and treating animals in addition to dispensing medicines. Besides these practices one retailer is also doing artificial insemination and another one is doing mobile farm management.

73.1% and 67.6% of the respondents said owners go to nearby veterinary clinic and to veterinary pharmacy respectively, when their animals get sick. Self-medication of patient animals by buying medicines from any shop or open market and using traditional medicines are also indicated by 39.8% and 44.4% of the respondents (Table 2).

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Owners practices when their animals are sick	Number	%
Do nothing	0	0
Go to a nearby vet clinic	79	73.1
Go to a veterinary pharmacy	73	67.6
Buy/treat with medicines from any shop/open market	43	39.8
Use traditional medicines in their area	48	44.4
Slaughter the animal	32	29.6

**Table 2:** Owners practices when their animals are sick.

76 (70.4%) of the retailers said owners are self-prescribing antimicrobials. Oxytetracycline 10% and 20% injections and a combination drug called Pen strep (Procaine Penicillin G+ Dihydrostreptomycine Sulphate) injection are the most often requested antimicrobials by the owners as shown on (Table 3).

Owners are also requesting medicines below the recommended dose in 55 (72.4%) of the retail outlets. 64.5% of the self-prescribing owners request antimicrobials by asking their specific name and 51.3% of them by asking the category of the medicines. 89.5% and 72.4% of the retail outlets said owners are self-prescribing antimicrobials, also mentioned owners are requesting antimicrobials by telling the illness of the animal and showing previously used medicine package, respectively.

#	Frequency of self-prescription of antimicrobials by owners n= 76	Number	%
		76	70.4
<b>Top 5 antimicrobials self-selected recalled by retail outlets</b>			
1	Oxytetracycline 10% injection	65	85.5
2	Procaine Penicilline G+Dihydrostreptomycine Sulphate injection	52	68.4
3	Oxytetracycline 20% Injection	38	50
4	Sulpa drugs	24	31.6
5	Procaine Penicilline powder for injection	14	18.4
<b>Request of antimicrobials by owners</b>			
1	Ask specific name of the product	49	64.5
2	Ask the category	39	51.3
3	Ask by showing previously used medicine package	55	72.4
4	Ask by telling the illness of the animal	68	89.5

**Table 3:** Self-prescription of antimicrobials by owners reported by retail outlets.

### Dispensing practice and job aids to select and dispense medicines

70 (64.8%) of the retail outlets receive an average of 14 prescriptions (range = 1-200) per week from public and private clinics. 77 (71.3%) of the outlets use their own experience to select and dispense veterinary medicines. In addition to that 42.2%, 61.1% and 46.3% of the retailers use list of veterinary medicines, Veterinary Standard Treatment Guideline (VSTG) and veterinary medicines formulary as an aid for selecting and dispensing veterinary medicines, respectively (Table 4).

Type of job aids for selecting medicines	Yes	Percent
Use own experiences	77	71.3
Use List of Veterinary Medicines	46	42.6
Use VSTG (management and treatment of diseases)	66	61.11
Use Veterinary Medicines Formulary (VMF) (detailed information about vet medicines)	50	46.3

Note: 63.88% of the retail outlets have VSTG and 90.74% and 93.51% of them believe that VSTG and Veterinary Medicines Formulary are essential for their dispensing activity, respectively.

**Table 4:** Job aids followed in selecting and dispensing medicines.

### Antimicrobial use and resistance prevention and containment

75 (69.44%) of the retail outlets are practicing prescribing of antimicrobials in addition to their dispensing activity. 92%, 56% and 50.7% of them are respectively prescribing antimicrobials for the purpose of treatment, prophylaxis/metaphylaxis and growth promotion or fattening (Table 5).

Purpose of antimicrobials use	Frequency	Percent
Treatment of sick animals	69	92
Prophylaxis/ metaphylaxis of animal diseases	42	56
Perceived growth promotion/fattening of animals	38	50.7

**Table 5:** Purpose of antimicrobials use.

Only 37 (34.3%) of the retail outlets (7 female and 30 male) have had in-service training. Among these 24 (64.86%) of them have taken training on antimicrobial selection and use, resistance and resistance containment. The respondents mentioned poor diagnosis because of lack of laboratory facility, equipment's and consumables and shortage of diagnostic materials as challenges of animal health service. Shortage of drugs and poor awareness of owners are also among the challenges indicated.

Difficulty to treat infectious diseases of animals because of AMR is reported by 70 (64.8%) of the respondents. 65 (60.2%) of the respondents also know AMR is a global public health and economic threat, and 18 of them are females. 8 (7.4%) of the respondents (2 female and 6 male) do not know the reason for antimicrobial resistance. 5 of them are diploma holders and are below 30 years old. 3 of the respondents who don't know the cause of AMR have not more than 2 years' work experience and 3 of them are with 3-6 years of experience.

Whereas 80.6% of the respondents believe that use of wrong antimicrobial is the possible cause of AMR and 79.6% use of counterfeit or poor quality antimicrobials, 75.9% improper diagnosis and treatment of infectious disease, 74.1% non-adherence to treatment, and 70.4% owners self-prescription of medicines for their animals. Sharing of antimicrobials that are prescribed for some other animal is also mentioned by 70 (64.8%) of the respondents as a possible cause of AMR. 59 (54.6%) of the respondents also answered that poor husbandry practices such as overcrowding, poor hygiene and sanitation and poor feeding practice are the possible causes of AMR.



Frequency of difficulty encounters in the treatment of bacterial infectious animal diseases (n=70)	Number	%
	70	64.8
Possible reasons for difficulty in treating diseases	#Yes	%
Do not know	8	7.4
Improper diagnosis and treatment of infectious disease	82	75.9
When use the wrong antimicrobial	87	80.6
Non-adherence to treatment	80	74.1
Use of Counterfeit or poor quality antimicrobials	86	79.6
Owners self-prescription of medicines for their animals	76	70.4
Sharing of antimicrobials that are prescribed for some other animal	70	64.8
Overcrowding, poor hygiene and sanitation and poor feeding practice	59	54.6

**Table 6:** Frequency of difficulty in treating animal infectious diseases and possible reasons.

The respondents also give their suggestion on the possible solutions to prevent and contain AMR. Proper diagnosis and treatment of infectious diseases, development of new medicines, vaccines and fast diagnostics, and adherence to withdrawal period of medicines are the frequently responded mechanisms of AMR containment, accounting 81.5%, 79.6% and 78.7% of the respondents, respectively.

Use of quality or legal sources or non-counterfeit antimicrobials, good husbandry practice and proper animal waste/manure disposal are also suggested by 74%, 65.5% and 64.8% of the respondents respectively, as a possible means of AMR prevention and containment (**Table 7**).

But 9 (8.3%) of the respondents do not know the possible solutions of AMR containment. Diploma holders are shown with low awareness of the possible solutions of AMR as they account 5 (55.6%) of the respondents they said do not know, as compared to 3 (33.3%) are DVM and 1 (11.1%) animal health BSc holders. But work experience doesn't have effect on the level of awareness of respondents.

Suggested solution to prevent and contain AMR	Number	%
Do not know	9	8.3
Good hygiene, sanitation and proper feeding of animal	74	65.5
Proper diagnosis and treatment infectious diseases	88	81.5
Use of quality or legal sources or non-counterfeiting antimicrobials	80	74
Proper animal waste/manure disposal	70	64.8
Wait until the antimicrobials are cleared from body of food animals before their products are consumed	85	78.7
Develop new medicines, vaccines, fast diagnostics	86	79.6

**Table 7:** Suggested solution to prevent and contain AMR.

### Availability and dispensing trend of veterinary antimicrobials

Among the most commonly dispensed ten veterinary medicines four of them are antibiotics, namely Oxytetracycline injection, Procaine penicillin G+Dihydrostreptomycine Sulphate, Sulpha drug and Oxytetracycline powder for oral solution.

Oxytetracycline injection is the most commonly dispensed medicine listed by 86 (79.6%) of the respondents. Albendazole is the second drug followed by Ivermectin and Procaine Penicillin G+Dihydrostreptomycine Sulphate injection enlisted by 84 (77.8%), 77 (71.3%), 70 (64.8%) of the study participants respectively (**Table 8**).

Only 10 (9.25%) and 9 (8.3%) of the retail outlets mentioned Cloxacillin+Amoxicillin (Intramammary Injection) and Isomethamedium Chloride are commonly dispensed medicines respectively.

Most frequently dispensed medicines	Frequency	%
Oxytetracycline Injection	86	79.6
Albendazole	84	77.8
Ivermectin	77	71.3
Procaine Penicillin G+Dihydrostreptomycine Sulphate	70	64.8
Tetraclozan (Tetramisole+Oxyclozanide)	61	56.5
Tetramisole Hydrochloride bolus	47	43.5
Multivitamin injection	38	35.2
Fenbendazole Granule	32	29.6
Sulpha drugs	31	28.7
Oxytetracycline Powder for Oral solution	27	25
Diminazene Aceturate	24	22.2
Triclabendazole	22	20.4
Amprolium Powder	16	14.8
Cloxacillin+Amoxacillin (Intramammary Injection)	10	9.25
Isomethamedium Chloride	9	8.3
Procaine penicillin	9	8.3

**Table 8:** The most common medicines dispensed over the last one year.

Upon the observation conducted during the study Oxytetracycline injection is the most commonly available antimicrobial in the retail outlets.

It is found in 97 (89.8%) of the retail outlets visited. Oxytetracycline powder, Procaine Penicillin G+Dihydrostreptomycine Sulphate, Sulpha drugs, and Diminazine Aceturate are the following drugs commonly available in 62, 60, 60 and 60 dispensaries respectively. Colistin Sulphate, Amoxicillin, Enrofloxacin and Gentamycin are the least available antimicrobials (**Table 9**).

Among the infection prevention and medical supplies disposable syringe, thermometer, alcohol denatures 70% and non-disposable syringe are commonly available in the observed retail outlets. On the other hand an important antiseptic, Chlorhexidine+Ceterimide solution, is only available in 14 (13%) retail outlets as the above supplies are found in 84, 71, 67 and 67 retailers.





Antimicrobials	Availability	%
Oxytetracycline Injection	97	89.8
Oxytetracycline Powder for Oral solution	62	57.4
Procaine Penicillin G+Dihydrostreptomycine Sulphate	60	55.6
Sulpha drugs	60	55.6
Amoxicillin 100G jar	7	6.5
Cloxacillin+ Ampicillin (Intramamary infusion)	10	9.3
Doxycycline 100G jar	8	7.4
Diminazene Aceturate	60	55.6
Isomethamedium Chloride	32	29.6
Colistin Sulphate	3	2.8
Penicillin G	27	25
Enrofloxacin 100ml	8	7.4
Gentamycine injection	16	14.8
Albendazole	101	93.5
Ivermectin	97	89.8
<b>Infection prevention supplies</b>		
Alcohol Denature 70%	67	62
Chlorhexidine+Ceterimide solution	14	13
Iodine	64	59.3
Cotton	59	54.6
Syringe (non-disposable)	67	62
Disposable syringe	84	77.8
Gauze non-sterile	43	39.8
Surgical glove	57	52.8
Utility or heavy duty gloves	37	34.3
Thermometer	71	65.7

**Table 9:** Availability of Antimicrobials and Infection prevention supplies in the ROs.

## Discussion

In this study, the awareness of the dispensers on the possible causes for the development of AMR and the strategies to contain it is good. All the contributing factors and possible solutions mentioned are in accordance with the study conducted by Tackle B, et al. and with those mentioned on the FAO AMR Containment strategy [4,15]. However, 7.4% and 8.3% of the respondents still don't know the possible causes and containment strategies of AMR, respectively. So, this number is not too small to aggravate the impacts of AMR. The study also reveals few dispensers (22.2%) have got training on antimicrobials use, AMR and its containment strategies. This result shows poor implementation of the strategy for the prevention and containment of antimicrobial resistance for Ethiopia as conducting regular pre-service and in-service training for practitioners in animal health and production on the proper use of antimicrobials, resistance prevention, and containment is put as one strategic action [16]. The major finding of this study is also dispensing of antimicrobials without prescription, which is in contradiction with the veterinary drugs and feed administration and control proclamation no. 728/2019 and with Codex Alimentarius code of practice to minimize and contain antimicrobial resistance [15,17].

Self-prescription of owners, even by asking the specific name of antimicrobials, is also confirmed by the study which is the major contributing factor for the development of AMR. Oxytetracycline, Procaine penicillin G+Dihydrostreptomycine fixed combination and sulpha drugs are the major veterinary antimicrobial drugs frequently asked by owners and dispensed without prescription. This result correlates with the high resistance level of *S. aureus* isolated from

mastitic dairy cows to these antimicrobials reported by Abera, et al and Fitsum T [13,14].

The national AMR prevention and containment strategy put a principle to conduct regular antimicrobial culture and sensitivity tests for prescribing and dispensing decisions and ensure the availability and monitoring the use of and adherence to evidence-based guidelines and job aids, such as VSTGs, antimicrobial use policies, lists of veterinary medicines, and standard prescription forms [16]. However, most of the retail outlets (71.3%) are using their own experience to dispense antimicrobials instead of evidence based dispensing practices.

## Conclusion

The findings of this study on the awareness of veterinary drug retail outlets on the trends of AMR and its containment strategy showed that pre-service and in-service training on antimicrobials use, resistance and containment strategies are not well addressed to dispensers. Over the Counter (OTC) dispensing of antimicrobials when directly asked by animal owners, traditional way of dispensing antimicrobials without evidence-based tools and aids (such as sensitivity test, VSTG, VMF, prescription paper, etc). Therefore, efforts are required to incorporate and revise the course content for undergraduate and postgraduate animal health professionals to accommodate topics and allocate sufficient time to AMR prevention and containment. Continuous on-job capacity building training should be given to veterinary drug dispensers as per the national AMR prevention and containment strategy. Antimicrobial prescription and dispensing practice also need strong regulation to avoid OTC availability and dispensing of antimicrobials.

## Acknowledgements

The study team would like to thank FAO/UN for both the technical and financial supports. We would also like to forward our appreciation to VDFACA management for allowing us to seat together and focus on the study and for its continuous overlook and support. We are also grateful to the veterinary drug retail outlets for their willingness to give us important data for this study.

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