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Original Paper

Veterinary Drug Use Pattern in livestock and Its Public Health Significance, Gondar Town Veterinary Clinic, Northern Ethiopia

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***Abstract*— A cross-sectional and retrospective study design and simple random sampling strategy was conducted in Gondar town veterinary clinic, northern Ethiopia with the aim of evaluating drug use pattern and show public health significance of irrational veterinary drug use. A total of 2117 drugs were prescribed to 1717 veterinary patients randomly selected from the case registry in this study. The result indicates average number of drugs prescribed per case was 1.23 and the maximum of three drugs was prescribed. The percentages of antimicrobial, anthelmintic, endectocide and other drugs prescribed were 1182 (55.7%), 481 (22.7%), 426 (20.1%), and 28 (1.3%), respectively. All patients were treated without correct laboratory support. As a result, antimicrobials were inappropriately prescribed in 1.4% of viral diseases, 0.2% of external parasitic diseases, 0.8% of internal parasitic diseases, 0.3% of metabolic diseases, 0.1% of fungal diseases, and anthelmintics in 0.1% of bacterial diseases and 0.5% of external parasitic diseases. 2013/2117 (95.1%) the route of administration of the prescribed drugs was not stated. Clinic professionals were 80% animal health assistants and 20% veterinarians. The results reveal problems with correct diagnosis, low level of education of prescribers, few essential drugs, absence of standard veterinary drug lists, and inappropriate drug use; these all principals to public health significance. Therefore, the availability of key essential drugs should improve and available drugs be prescribed with its appropriate doses, routes, and regimens. Veterinarians should be made aware of the irrational use of veterinary drugs and their public health implications.**

Keywords—Gondar, Prescribing, Public-health, Rational, Retrospective, Vet-drugs

I. INTRODUCTION

Therapeutics for animal diseases has advanced significantly over the past century. However, there are only a limited number of approved pharmaceuticals for specific animal species and conditions. As a result, veterinarians often resort to using products outside the approved conditions of use to treat diseases and ease suffering [1].

Veterinary drugs are used rationally and irrationally in livestock treatment, prevention, and growth promotion. Alexandrian physician Herophilus, believed that drugs, when used with reason and prudence, represent the hand of God, demonstrating the ancient concept of rational drug use. The rational use of drugs has gained significant medical, socioeconomic, and legal importance in recent times [2].

Rational drug use involves using the right drug, dose, cost, and time as outlined by the World Health Organization, while irrational use involves excessive prescriptions, inappropriate dosages, and non-adherence to clinical guidelines " [3], [4]. Inappropriate use of drugs can cause ineffective treatment, unnecessary waste of resources, and harm to patients [5], [6], [7].

The irrational use of drugs in veterinary medicine need to control even in greater problem when they are used in food animals [8]; since residues may lead to harmful effects on consumers (public health effects). Trace amounts of veterinary drugs or their metabolites left in animal-derived foods like meat and milk can pose risks to human health [8], [9], [10], [11], [12].

Residues from improper withdrawal, overdosing, or prohibited drug use can cause drug resistance, hypersensitivity, and intestinal microflora disruptions. Cooking methods can reduce residues, but not always to safe levels [8], [9], [10], [11], [12].

To prevent residue risk, the drug must be used rationally. That is, they should be used only when truly indicated, in the right way, at the right time, in the right dose, and with the appropriate withdrawal period [13]. Regulatory authorities set maximum residue limits (MRLs) to control residues, emphasizing monitoring programs and sensitive analytical methods for food safety [8], [9], [10], [11], [12].

Ethiopia boasts the largest number of livestock in Africa, with 66 million head of cattle, 38 million sheep, 46 million goats, 41.35 million poultry, 2.14 million horses, 10 million donkeys, 0.36 million mules, 7 million camels, and 5.98 million hives. [14].

Despite this huge livestock population, Ethiopia's livestock resources are underutilized due to various factors such as

diseases, droughts, infrastructure issues, malnutrition, improper husbandry, lack of trained personnel [15], [16], [17], [18], and stressing the need for disease prevention and control measures [16]. Widespread livestock diseases indeed pose a significant challenge to the development of livestock production in Ethiopia [17],[18], [19], [20], and as a result, veterinarians use anthelmintic and antibiotics to treat these diseases.

Studies in Ethiopia have shown irrational drug use in hospitals [21] and veterinary clinics in Bishoft, Adama District, Mojo and Gondar by [22], [23], [24] and [25] respectively reported in central and northwest Ethiopia.

Previously there was study in this clinic in combination with University of Gondar and Azezo veterinary clinics by Berihun et al. (2019), but the data taken from this clinic was too shallow and used twelve months recorded data from February 01, 2014 to January 01, 2015 retrospectively with low sample size (250 samples), but in present study 1717 samples from 20688 prescriptions written over a 5-year period were taken with cross-sectional and retrospective study using systematic random sampling method, this can display enough drug using trend information. Therefore, this study assess drug use pattern, and show public health significance of irrational veterinary drug use in Gondar town veterinary clinic of northern Ethiopia.

II. Materials And Methods

A. Study Area

This study was conducted from November 2019 to May 2020 at Gondar town veterinary clinic. Gondar town is the capital of the central Gondar administrative district of the Amhara National Regional State. Gondar town is located 740 km northwest of Addis Ababa at 12.6°N latitude, 37.47°E longitude and approximately 2133 meters above sea level elevation. The climate in Gondar town exhibits varying trends in temperature and rainfall these variability in rainfall patterns highlights the complex nature of precipitation in Gondar town [26], [27]. The livestock production system in and around Gondar town comprises a mix of sedentary (mixed crop-livestock production) and mobile livestock production systems [28].

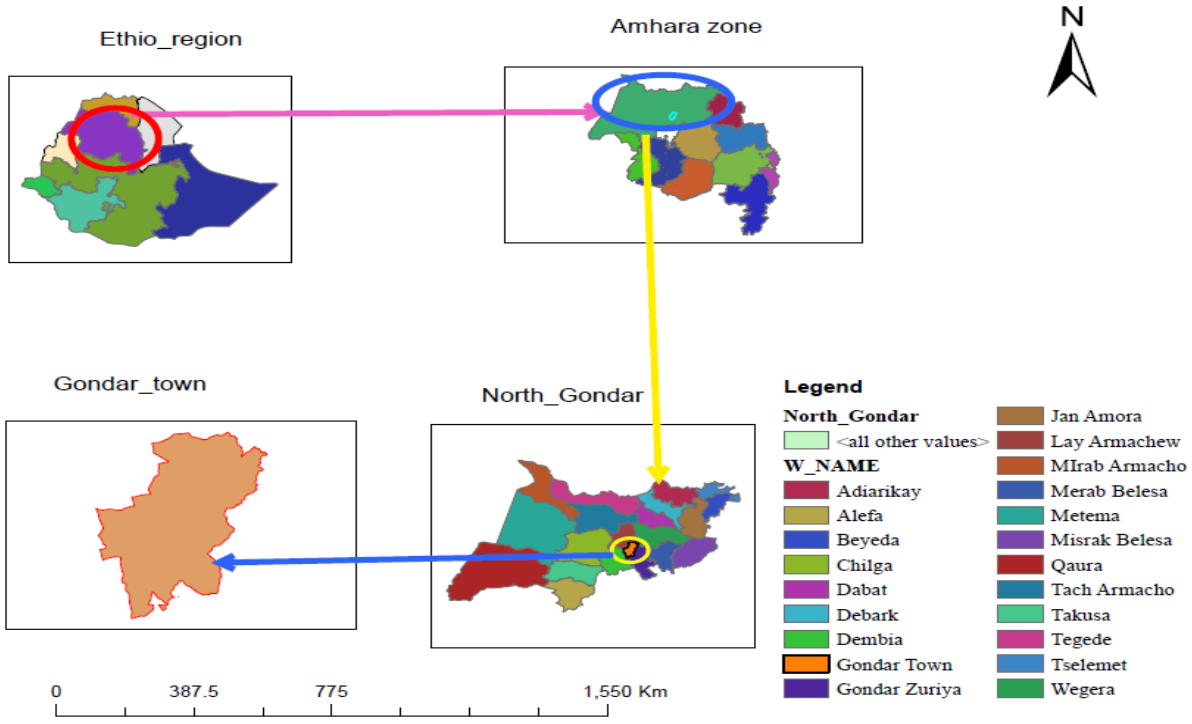

Fig.1. Map of Gondar town

B. Study Animals

The study was conducted from November 2019 to May 2020 on food and non-food animals (cattle, sheep, goats, chickens, pets, and horses) admitted to Gondar town veterinary clinic and treated with drugs.

C. Study Design

A retrospective and cross-sectional survey was designed to assess rational drug use. Samples were selected using a systematic random sampling method, and the sampling units were drugs encountered in Gondar town veterinary clinic for the treatment of acute, subacute, and chronic diseases. Drug use was then assessed based on the WHO Drug Use Indicators as described by WHO [29].

D. Data Collection

Data were collected retrospectively from the case registry of the veterinary clinic in the town of Gondar. The specific data needed to measure the prescribing index were recorded at each animal-patient encounter and entered on the usual prescribing

index form. In this study, animal characteristics (age, sex, animal species, observed clinical signs), disease diagnosis (disease name, empirical or physical clinical examination), drugs prescribed (type, nomenclature [generic or brand name], specific name, number of drugs prescribed, route of administration, therapeutic regimen, availability on the National Animal Drug List) were collected retrospectively from more than 20688 prescriptions written over a 5-year period from January 02, 2015 to January 01, 2020. The availability of veterinary treatment guidelines and the National Veterinary Drug List (EVDL) in the clinics was also observed.

E. Data Analysis

All recorded data were entered into a Microsoft Excel spreadsheet (version 2010) and were captured and analyzed using SPSS (version 2020). Mean, range, and frequency (percentages) were used to describe patient characteristics and compared to WHO recommended standards. Chi-square trend tests were used to examine the association between the type of drug prescribed, the provisional diagnosis, and the specific drug prescribed and the disease diagnosed. All statistical tests were two-tailed, with a P value ≤ 0.05 being significant.

F. Prescribing Indicators

There were no available guidelines for prescribing indicators used in veterinary medicine. Therefore, the WHO prescribing indicators were used in this study [30]. The indicators were pre-tested and slightly modified to fit clinical practice in veterinary medicine so that they could be used to provide accurate data.

The final version of the pre-tested indicators is as follows:

1. To measure the extent of polypharmacy, the average number of drugs prescribed per encounter was calculated by dividing the total number of different drugs prescribed by the number of encounters surveyed; any combination of drugs prescribed for one health problem was counted as one.
2. The percentage of drugs prescribed by generic name was calculated by dividing the number of drugs prescribed by generic name by the total number of drugs prescribed and multiplying by 100 to measure the propensity to prescribe by generic name;
3. The percentage of encounters for which antibacterial, anthelmintic, and other drugs were prescribed was calculated by dividing the number of patient encounters in which drugs were prescribed by the total number of encounters studied and multiplying by 100 to measure the overall use of overused (unreasonably prescribed) and expensive drug therapies.
4. The percentage of drugs prescribed from the Ethiopian National Veterinary Drug List (EVDL), was calculated by dividing number of products prescribed which are in veterinary drug list with the total number of drugs prescribed, multiplied by 100 to measure the degree to which the practices conform to a national drug policy as stated in the EVDL of Ethiopia [31].
5. Rational use of a veterinary drug means that a sick animal receives the appropriate dose of the drug for its clinical needs, for the appropriate duration, meeting the appropriate individual requirements, and at the lowest cost to the patient and its community [32]. Irrational use of a drug, on the other hand, means misuse of a drug by a patient (i.e., the patient is given a drug that is inappropriate for his or her clinical needs, for the appropriate duration, meeting the appropriate individual requirements, and at the inappropriate or excessive dosage) [33].

III. Results And Discussion

A. Valuation of polypharmacy, generic name prescription and availability of ENVDL

A total of 1717 patients were evaluated from the case registry book of Gondar town veterinary clinic. A retrospective study revealed that 2117 drugs were prescribed, with an average of 1.23 drugs per prescription and a maximum of 3 drugs per prescription (Table 1), indicating that polypharmacy is no longer practiced.

This result is similar to studies conducted in CVMA-VTH and Ada district veterinary clinic that reported 1.23 [22], in Adama district veterinary clinic that reported 1.25 [23], in Mojo veterinary clinic that reported 1.11 [24], and in North India, the non-polypharmacy index was reported to be 1.19, within the optimal range, signifying a lower likelihood of polypharmacy concerns [34].

However, it is lower than 1.95 at Debre Tabor Comprehensive Specialized Hospital [35], 2.5 at a referral and teaching hospital in Northeast Ethiopia [36], 1.8 at Finoteselam and 2.05 at Asirade Zewudie hospitals [37], 1.46 at a referral hospital in Ethiopia [38], 2.3 in Lumame Primary Hospital [39] and 2.84 at Tikur Ambessa Specialized Hospital [40]; where the average number of drugs prescribed per prescription falls within the range of 1-5 drugs in the hospitals assessed; the WHO human standard is 1.6-1.8 [41], indicating no polypharmacy problem.

The low average number of drugs per prescription may be due to the difficulty in obtaining drugs or to prescribers receiving proper training on the complications of drug combinations. However, the low numbers in this study indicate a lack of drugs in the clinics rather than proper training of prescribers.

In this study, the percentage of drugs prescribed by generic name was 100% (Table-1) in line with the study in Ateso veterinary clinic [42] and in general outpatient departments of the public Arbaminchi and Chencha hospitals show all drugs were prescribed using generic names [43].

Whereas; higher than 90.1% in Bishoftu [22], 97.4% in Adama district [23], and 91.8% in Mojo Veterinary clinic [24]. Also greater than 90.61% in a public hospital in eastern Ethiopia [44].

The percentage of drugs prescribed from Ethiopia's National Veterinary Drug List (ENVDL) was assessed; however, there was no veterinary drug list in Gondar town veterinary clinic; which is similar with Batu and Arsi-Negelle

district veterinary clinics [45], Ateso veterinary clinic [42] and two of three veterinary clinics of Gondar town [25] which have no national veterinary drug list.

TABLE I. PRESCRIBING INDICATORS AT GONDAR TOWN VETERINARY CLINIC

Prescribing indicator	Frequency	Percent
The average number of drugs prescribed per encounter	1.23	1.23
Percentage of drugs prescribed by generic name	2117	100
Encounters with Antimicrobial	811	47.2
Encounters with Antihelmentic	363	21.1
Encounters with antimicrobial + antihelmentic	95	5.5
Encounters with Others	2	.1
Encounters with Antimicrobial + antihelmentic + other	1	.1
Encounters with Antimicrobial + other	17	1.0
Encounters with Antihelmentic + other	1	.1
Encounters with endectocide	174	10.1
Encounters with endectocide + antimicrobial	229	13.3
Encounters with endectocide + antimicrobial + other	2	.1
Encounters with endectocide + antihelimentic	11	.6
Encounters with endectocide + other	1	.1
Encounters with endectocide + antimicrobial + antihelmentic	10	.6
Percentage of drugs prescribed from national veterinary drug	0	0

Endectocide=drugs which can treat both endo-parasites and ecto-parasites

B. Veterinary drug prescription patterns

From the 2117 total drug prescriptions, 811 (47.2%) were for antimicrobials, 363 (21.1%) were for anthelmintics, 229 (13.3%) were for endectocide with antimicrobials, and 174 (10.1%) were for endectocide (Table 1).

The prescribing pattern of veterinary drugs in this clinic was antimicrobial for 1182(55.7%), anthelmintic for 481(22.7%), endectocide for 426(20.1%) and others for 28(1.3%) prescribed to treat animal patients. Penicillin G-streptomycin fixed-dose 409/1182 (34.6%), short-acting oxytetracycline 401/1182 (33.9%) and long-acting oxytetracycline 193/1182 (16.33%) were the most commonly prescribed antibacterial drugs, while albendazole 395/481 (82.1%) was the most commonly prescribed anthelmintic (Table 2).

The study oxytetracycline 83.6%, penicillin G streptomycin fixed dose 13.8% [22], oxytetracycline 73.90%, penicillin G streptomycin fixed dose 22.60% [23], oxytetracycline 86.14%, penicillin G streptomycin fixed dose 13.56% [24] were reported as the most commonly prescribed antibiotics, similar prescription tendency to the present study.

TABLE II: PRESCRIBED VETERINARY DRUG TYPES IN THE CLINIC

Veterinary drugs	Frequency	Percentage
Antimicrobials		
Penicillin G streptomycin fixed combination	409	19.3
Short acting oxytetracycline	401	18.9
Long acting oxytetracycline	193	9.1
Oxytetracycline powder	32	1.5
Sulfa drug	105	5.0
Diaminazinaceturate	32	1.5
Amprollium	5	.2
Ashoxy	2	.1
Oxytetracycline eye ointment	1	.0
Intramammary suspension	1	.0
Gentamycin	1	.0
Sub total	**1182**	**55.7**
Anthelimentics		
Albendazole	395	18.6
Triclealbendazole	11	.5
Tetramisole	54	2.6
Tetraclozash	9	.4
Fenbendazole	11	.5
Duxame	1	.0
Sub total	**481**	**22.7**
Endectocide		
Ivermectin	426	20.1
Sub total	**426**	**20.1**
Others		
Multivitamin	24	1.1
Indigestion powder	4	.2
Sub total	**28**	**1.3**
Total	**2117**	**100**

Antimicrobials percentage of prescribing encounters in this study was 55.7% (Table-2), but there is no report on the ideal standard encounters rate at which antibiotics are prescribed to animals and varies based on the specific setting and species. In small animal veterinary hospitals, the prevalence of antibiotic drug use (AU) ranges from 15.5% to 58.3% for outpatient dogs and 30.6% to 58.3% for inpatient dogs, with similar rates for cat [46].

However, 20.0-26.8% of antibiotics are prescribed in humans [47], based on this our result indicate that average antimicrobials prescription rate was higher. The study was higher than 46.4% in Adama District Veterinary clinic [23], 48.67% in Arba Minch [43] and lower than 64% in Pakistan

[48], 60.41% in Mojo Veterinary clinic [24], and 60.20% in Chencha Hospitals [43]. Also similar with 57.87% in selected public hospitals of eastern Ethiopia [44] and 58% in Hawassa University Hospital [30].

The high rate of antimicrobials prescribed in this study could be attributed to lack of disease awareness, unavailability of diagnostic aids for confirmatory tests, lack of appropriate drugs, and lack of prescriber knowledge.

C. Association between drug type and tentative diagnosis

The study also examined the relationship between drug administration and the preliminary diagnosis of diseases to determine if drugs were being used appropriately. The findings revealed that antimicrobials were prescribed for viral diseases (1.4%), ectoparasitic diseases (0.2%), endoparasitic diseases (0.8%), metabolic diseases (0.3%), and fungal diseases (0.1%). Anthelmintics were administered for bacterial diseases (0.1%) and ectoparasitic diseases (0.5%), while endectocide was prescribed for bacterial diseases (0.6%), protozoal diseases (0.1%), and metabolic diseases (0.1%). These prescription patterns were deemed irrational based on a p-value of 0.000 (Table 3).

TABLE III: ASSOCIATION BETWEEN DRUG TYPES WITH TENTATIVE DIAGNOSIS

Drug type	Tentative diagnosis								
	Bacterial	Viral	Ecto-Parasitic	Endo-Parasitic	Protozoal	Metabolic	Surgical	Miscellaneous	Fungal
AM	636(37.0%)	24(1.4%)	3(0.2%)	13(0.8%)	31(1.8%)	6(0.3%)	63(3.7%)	34(2.0%)	1(0.1%)
AH	2(0.1%)	0(0.0%)	9(0.5%)	352(20.5%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)
AM + AH	35(2.0%)	0(0.0%)	2(0.1%)	52(3.0%)	1(0.1%)	0(0.0%)	5(0.3%)	0(0.0%)	0(0.0%)
O	1(0.1%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	1(0.1%)	0(0.0%)	0(0.0%)	0(0.0%)
AM + AH +O	1(0.1%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)
AM + O	11(0.6%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	3(0.2%)	1(0.1%)	2(0.1%)	0(0.0%)
AH + O	0(0.0%)	0(0.0%)	0(0.0%)	1(0.1%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)
E	10(0.6%)	0(0.0%)	81(4.7%)	76(4.4%)	1(0.1%)	1(0.1%)	0(0.0%)	5(0.3%)	0(0.0%)
E + AM	133(7.7%)	1(0.1%)	23(1.3%)	41(2.4%)	1(0.1%)	1(0.1%)	14(0.8%)	12(0.7%)	3(0.2%)
E+ AM+ O	1(0.1%)	0(0.0%)	0(0.0%)	1(0.1%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)
E + AH	1(0.1%)	0(0.0%)	5(0.3%)	5(0.3%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)
E + O	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	1(0.1%)	0(0.0%)	0(0.0%)
E + AM + AH	3(0.2%)	2(0.1%)	4(0.2%)	1(0.1%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)

AM=Antimicrobial, AH=Antihelmentic, E=Endectocide and O=Others.

X^2=1954.980, P-value = 0.000.

In the study by [23], antimicrobials were irrationally prescribed to treat viral diseases (16.2%) and surgical cases (5.6%), and anthelmintics were also irrationally used in bacterial diseases (2.9%) and surgical cases (0.9%). In the study by [24], anthelmintics were irrationally prescribed in bacterial diseases (28.7%), metabolic diseases (7%) and viral diseases (3.8%), and antimicrobials were also irrationally prescribed for viral (26.2%), parasitic (8.6%), surgical (0.2%), and metabolic (0.9%) diseases. Anthelmintics (44.3%) were also improperly prescribed for the treatment of non-parasitic diseases at the University of Gondar veterinary clinic [49].

Studies highlight that irrational drug use in veterinary medicine is a common problem, often stemming from factors like lack of knowledge, inadequate diagnostic support, and over-prescription [45], [50], [51].

In this study inappropriate use of these drugs may be due to prescriber's lack of knowledge about the appropriate drug for the suspected case, drug unavailability, and owner's assumptions about antimicrobial injections; this drug use pattern leads to high public health significance.

D. Route and regimen of drug administration and prescribers educational background

Almost all cases encountered in Gondar town veterinary clinic were provisionally diagnosed without correct laboratory corroboration and then the drug was administered; the route of administration of the prescribed drug 2013/2117 (95.1%) was not indicated, which is similar with 96.5% by [24], 99.1% by [23] and 98.9% by [22] which have its own contribution for the presence of irrational drug use.

Incorrect drug administration can reduce efficacy and exaggerate pharmacological reactions, such as toxicity and unexpected side effects. Irrational prescribing of antibiotics is primarily due to inadequate infection recognition, improper route selection, and incorrect selection of doses and regimens [22].

A study of the educational background of drug prescribers revealed that the majority of our prescribers were animal health assistants or diploma level (80%), and only 20% were veterinarians. This study is consistent with similar studies conducted at Mojo Veterinary clinic 67.9% and 32.06% [24], Adama Veterinary clinic 88.1% and 11.9% [23], and at VTH-CVMA and Ada District Veterinary clinic 70.8% and 29.2% [22] of the prescriptions were done by animal health assistants or diploma levels and veterinarians, respectively. This indicates that the level of education of prescribers of veterinary drugs is low and requires attention to avoid treatment failure, misuse of drugs, and development of drug resistance.

Federal Constitution of Ethiopia Decree No. 728-2011 stipulates that veterinary drugs shall only be prescribed by veterinarians. It also states that veterinarians must follow prescribing procedures and prescribe veterinary drugs on standard prescription forms [52].

From 2117 drugs, 283 (13.4%) were prescribed without a regimen indicated and 61 (2.9%) drugs were prescribed with incorrect regimens.

This result similar with routes of drug administration and duration of treatment in CVMA-VTH and Ada district veterinary clinics were not fully specified for most cases [22] and Adama district veterinary clinic 99.1% of prescribed drugs route of administration and 93.5% length of treatment of encounters was not specified [23]. In one study, 239/689 (34.7%) were adequately labeled with dosage regimens [53]. Additionally, another study highlighted that 286/480 (59.6%) were unadjusted dose [54]. This indicates that there give little attention for regimen and dose records which leads to irrational drug uses.

E. Availability of laboratory test and patient data recording and handling method

No laboratory tests were performed at all in this clinic. This result is similar to the 98.2% and 96.6% of patients admitted to Mojo Veterinary Clinic [24], CVMA-VTH and Ada District Veterinary Clinic [22] and all patients admitted to Adama District Veterinary Clinic [23], were received empirical treatment without receiving a correct definitive diagnosis (laboratory support). This indicates that affected animals are being treated based solely on a tentative diagnosis. This implies that affected animals are not being managed with a specific treatment or that drugs are being used irrationally without knowledge of the specific cause of the disease.

In addition, other problems related to rational drug use included the lack of standard prescription forms, standard case registration book in the clinic, poorly organized case registers, and lack of complete information on animal age, observed history and clinical signs, prescribed drug doses, dosages, routes of administration, and regimens were mentioned. Drugs administered were done without taking into account the weight of the animals, which may lead to under- or over-dosing of drugs, and these reveal irrational use of drugs. Low inventories of key essential drugs were observed, leading to overuse of drugs.

F. Irrational veterinary drug use and public health significance

This study indicates inappropriate use of veterinary drugs which can leads to drug residue, resistance and public health significance. Irrational use of veterinary drugs also indicated at Bishoftu [22], Adama district [23] and Mojo [24] veterinary clinics which have the same trend with this study.

Irrational practices, such as over-prescription, inappropriate dosages, and incorrect durations, can lead to various detrimental outcomes. These include limited efficacy, increased risk of drug resistance and residues, wastage of resources, and psychosocial impacts. The misuse of antimicrobials in food-producing animals, especially in sectors like poultry, cattle, and pigs, poses a significant threat to human health due to potential exposure through the food chain [55].

The public health importance of the improper use of veterinary drugs is significant [13], [32], [50], [56] leading to various consequences such as the presence of antimicrobial residues, the development of drug resistance, hypersensitivity reactions, carcinogenicity, mutagenicity, teratogenicity, bone marrow suppression, destruction of normal gut flora [57], and therapeutic failure [51].

Regulating the use of antimicrobials and other medications in livestock is vital for preventing adverse effects on consumers and mitigating the emergence of antimicrobial resistance. Monitoring drug residues in food is essential for ensuring adherence to safety standards and safeguarding public health [55].

Inappropriate drug usage in food animals can lead to reduced effectiveness, higher chances of adverse effects, and drug resistance development. These outcomes pose a danger to public health and food safety [32].

Symptomatic treatment of viral infections and adequate feed and water are better than routinely used antimicrobials, which may exacerbate drug resistance. Antimicrobials for endo-parasitism and ecto-parasitism are inappropriate as they must bind to the microorganism's binding site to be effective, preventing drug resistance.

IV. Conclusions

The findings on veterinary drug prescribing in this study showed that the lack of proper diagnosis of disease and selection of appropriate drugs, lack of laboratory testing, low level of education of prescribers, presence of a few essential drugs, lack of a national veterinary drug list and standard veterinary drug treatment guidelines, lack of standard prescription forms, and case registry books. On the other hand, polypharmacy and generic drug prescribing are not considered a problem. Therefore, all important patient-related information should be well documented in standard case forms and case registration books. In order to reduce inappropriate use of medicines, the supply management of medicines should be strictly controlled and the availability of key essential medicines should be improved. Appropriate drugs should be prescribed in appropriate doses, routes, and regimens. Laboratory support should appoint and laboratory equipment, chemicals, and reagents should enrich to confirm provisionally diagnosed diseases. Governments, private veterinary practitioners, and animal owners should promote the rational use of pharmaceuticals. Veterinarians should be made aware of the irrational use of veterinary drugs and their public health implications. These all improvements can lead to rational use and reduce public health effects of drug residues.

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References

[1] EMA/CVMP, "Guidance on the classification of veterinary medicinal products indicated for minor use minor species (MUMS) / limited market," *Ema/Cvmp/388694/2014*, vol. 44, no. 15 September, pp. 1–15, 2014.

[2] Ambwani S. and Mathur A., "Rational drug use.," *Heal. Adm.*, vol. XIX, pp. 2–5, 2017, [Online]. Available: https://www.researchgate.net/publication/317491410

[3] F. D. Sema, E. D. Asres, and B. D. Wubeshet, "Evaluation of rational use of medicine using WHO/INRUD core drug use indicators at Teda and Azezo Health Centers, Gondar Town, Northwest Ethiopia," *Integr. Pharm. Res. Pract.*, pp. 51–63, 2021.

[4] N. A. Kshirsagar, "Rational use of medicines: Cost consideration & way forward," *Indian J. Med. Res.*, vol. 144, no. 4, pp. 502–505, 2016.

[5] J.-L. Cracowski *et al.*, "Prevention of risks associated with inappropriate use/unnecessary consumption of medicines," *Therapies*, vol. 77, no. 1, pp. 79–88, 2022.

[6] A. Neiva and M. Trevisan, "Influência do armazenamento e prazo de validade na estabilidade e ocorrências de eventos adversos no uso de medicamentos," *Res. Soc. Dev.*, vol. 10, no. 15, pp. e91101522341–e91101522341, 2021.

[7] D. Kroon *et al.*, "Effectiveness of interventions aiming to reduce inappropriate drug prescribing: an overview of interventions," *J. Pharm. Heal. Serv. Res.*, vol. 12, no. 3, pp. 423–433, 2021.

[8] J. Wu Haoting, Zhao and J. Wan, "A Review of Veterinary Drug Residue Detection: Recent Advancements, Challenges, and Future Directions," *Sustainability*, vol. 15, no. 13, p. 10413, 2023.

[9] M. Getahun, R. B. Abebe, A. K. Sendekie, A. E. Woldeyohanis, and A. E. Kasahun, "Evaluation of antibiotics residues in milk and meat using different analytical methods," *Int. J. Anal. Chem.*, vol. 2023, 2023.

[10] D. Dessie, "Review on effect of antimicrobial residual on human health," *Int. J. Biol. Sci.*, vol. 1, no. 2, pp. 35–41, 2019, doi: 10.33545/26649926.2019.v1.i2a.44.

[11] M. G. Feleke, R. B. Abebe, A. K. Sendekie, A. E. Woldeyohannis, and A. E. Kasahun, "Determination of antibiotic drug residues in milk and meat using different analytical methods: a review," 2022.

[12] L. Cantón, C. Lanusse, and L. Moreno, "Veterinary drug residues in meat-related edible tissues," in *New Aspects of Meat Quality*, Elsevier, 2022, pp. 755–783.

[13] V. Ćupić, S. Dobrić, B. Antonijević, and S. Čelebićanin, "The significance of rational use of drugs in veterinary medicine for food safety," *Sci. journal" Meat Technol.*, vol. 52, no. 1, pp. 74–79, 2011.

[14] ESS, "Federal Democratic Republic of Ethiopia. Ethiopian Statistical Service; Agricultural Sample Survey; Report on livestock and livestock characteristics (private peasant holdings)," *Stat. Bull.*, vol. 2, pp. 15–28, 2022.

[15] D. Tulu, S. Gadissa, F. Hundessa, and E. Kebede, "Contribution of climate-smart forage and fodder production for sustainable livestock production and environment: lessons and challenges from Ethiopia," *Adv. Agric.*, vol. 2023, pp. 1–11, 2023.

[16] A. G. DESTA, "Challenges of the forage crops in northwestern Ethiopia," 2023.

[17] J. D. Kitessa, A. K. Deressa, and Y. T. Terefa, "Assessment of animal health and production constraints: The case of three districts," *Vet. Med. Sci.*, vol. 9, no. 1, pp. 391–399, 2023.

[18] A. Nuguse and F. Gemechu, "A Retrospective Study on Common Animal Diseases from 2018 to 2022 in Gida Ayana District, East Wollega Zone, Western Ethiopia," *World J. Med. Case Reports*, vol. 4, no. 2, pp. 26–31, 2023.

[19] Z. Abro, G. M. Fetene, M. Kassie, and T. M. Melesse, "Socioeconomic burden of trypanosomiasis: Evidence from crop and livestock production in Ethiopia," *J. Agric. Econ.*, vol. 74, no. 3, pp. 785–799, 2023.

[20] W. Seyoum, C. Ejigu, and E. Tora, "Prevalence, Risk Factors and Control Practices of Livestock Hirudiniasis in Mirab Abaya District, Southern Ethiopia," *Vet. Med. Res. Reports*, pp. 79–90, 2023.

[21] E. Getachew, S. Aragaw, W. Adissie, and A. Agalu, "Antibiotic prescribing pattern in a referral hospital in Ethiopia," *Afr J Pharm Pharmacol*, vol. 7, no. 38, pp. 2657–2661, 2013.

[22] T. Beyene, D. Endalamaw, Y. Tolossa, and A. Feyisa, "Evaluation of rational use of veterinary drugs especially antimicrobials and anthelmintics in Bishoftu , Central Ethiopia," *BMC Res. Notes*, pp. 1–8, 2015, doi: 10.1186/s13104-015-1466-4.

[23] T. Beyene *et al.*, "Assessment of rational veterinary drugs use in livestock at Adama District Veterinary Clinic, Central Ethiopia," *J Vet. Sci Techno*, vol. 7, no. 319, p. 2, 2016.

[24] G. Mojo, S. Fentahun, and T. Bihonegn, "Assessment of rational use of veterinary drugs in Modjo Veterinary Clinic, Ethiopia," *J. Anim. Res.*, vol. 9, no. 5, pp. 667–673, 2019.

[25] B. Berihun, E. Kebede, M. Birhan, and A. Mohammed, "ASSESSMENT OF PRESCRIPTION PATTERNS OF VETERINARY DRUGS IN GONDAR , NORTH WEST ETHIOPIA," vol. 9, no. 3, pp. 125–133, 2019.

[26] H. S. Mekonnen *et al.*, "Community's misconception about COVID-19 and its associated factors among Gondar town residents, Northwest Ethiopia," *Trop. Med. Health*, vol. 48, pp. 1–9, 2020.

[27] H. Belachew *et al.*, "Sick building syndrome and associated risk factors among the population of Gondar town, northwest Ethiopia," *Environ. Health Prev. Med.*, vol. 23, pp. 1–9, 2018.

[28] A. Tegegne, *Transhumance cattle production system in North Gondar, Amhara region, Ethiopia: is it sustainable?*, vol. 14. ILRI (aka ILCA and ILRAD), 2009.

[29] K. Holloway and L. van Dijk, "Rational use of medicines.," 2011.

[30] A. A. Desalegn, "Assessment of drug use pattern using WHO prescribing indicators at Hawassa University teaching and referral hospital, south Ethiopia: a cross-sectional study," *BMC Health Serv. Res.*, vol. 13, pp. 1–6, 2013.

[31] Y. K. Anagaw *et al.*, "Assessment of prescription completeness and drug use pattern using WHO prescribing indicators in private community pharmacies in Addis Ababa: a cross-sectional study," *J. Pharm. Policy Pract.*, vol. 16, no. 1, p. 124, 2023.

[32] T. Beyene and B. Tesega, "Rational veterinary drug use: Its significance in public health," *J. Vet. Med. Anim. Heal.*, vol. 6, no. 12, pp. 302–308, 2014, doi: 10.5897/JVMAH2014.0332.

[33] H. Amane and P. Kop, "Prescription analysis to evaluate rational use of antimicrobials," *Int J Pharmacol Biol Sci*, vol. 2, no. 2, pp. 314–319, 2011.

[34] S. S. Ahmad, N. K. Agrawal, and A. Ahmad, "Assessment of drug rationality by World Health Organization/International Network of Rational Use of Drugs indicators in the department of ophthalmology A descriptive study in North India," *Natl. J. Physiol. Pharm. Pharmacol.*, vol. 11, no. 4, p. 429, 2021.

[35] Y. S. Yimer, G. T. Addis, and M. A. Alemu, "Evaluation of prescription completeness, rational drug-use patterns using WHO prescribing, patient-care and facility indicators in Debre Tabor Comprehensive Specialized Hospital, Ethiopia: a cross-sectional study," *SAGE Open Med.*, vol. 10, p. 20503121221122424, 2022.

[36] D. B. Mamo and B. K. Alemu, "Rational drug-use evaluation based on World Health Organization core drug-use indicators in a tertiary referral hospital, Northeast Ethiopia: a cross-sectional Study," *Drug. Healthc. Patient Saf.*, pp. 15–21, 2020.

[37] B. Dessie, G. Atalaye, E. Diress, and A. Getahun, "Practice towards rational drug use at Finotselam and Asirade Zewudie Hospitals based on WHO core drug use indicators, Northwest Ethiopia," *Sci. World J.*, vol. 2020, 2020.

[38] B. Kebede and B. Asredaw, "Prescription Completeness, Rational Prescribing, and Dispensing Practice at Referral Hospital, Ethiopia," *Age (Omaha).*, vol. 619, no. 92.53, p. 100, 2020.

[39] A. A. Alehegn, R. G. Aklilu, K. A. Tadesse, B. A. Tegegne, and Z. D. Kifle, "Assessment of drug use practices using standard who indicators in Lumame primary Hospital," *Drug. Healthc. Patient Saf.*, pp. 59–69, 2021.

[40] A. B. Berha and N. Seyoum, "Evaluation of drug prescription pattern using world health organization prescribing indicators in tikur anbessa specialized hospital: a crossâ€"sectional study," *J. Drug Deliv. Ther.*, vol. 8, no. 1, pp. 74–80, 2018.

[41] WHO, "Monitoring antimicrobial usage in food animals for the protection of human health: report of a WHO consultation, Oslo, Norway, 10-13 September 2001," World Health Organization, 2002.

[42] E. Balcha and T. Shawano, "Veterinary Drug Prescribing Practices at AtesoVeterinary Clinic ofMasha Woreda, Sheka Zone, South West Ethiopia," *Int. J. Agric. Biol. Environ.*, vol. 03, no. 04, pp. 01–13, 2022, doi: 10.47504/ijagri.2022.3.4.1.

[43] M. Mensa, T. Tadesse, and A. Ayele, "Assessment of drug use pattern by using WHO core drug use indicators at public hospitals in Ethiopia," *J Community Med Heal. Educ*, vol. 7, no. 559, pp. 2161–2711, 2017.

[44] M. Sisay, G. Mengistu, B. Molla, F. Amare, and T. Gabriel, "Evaluation of rational drug use based on World Health Organization core drug use indicators in selected public hospitals of eastern Ethiopia: a cross sectional study," *BMC Health Serv. Res.*, vol. 17, no. 1, pp. 1–9, 2017.

[45] M. Etefa, A. F. Beyi, D. Ayana, T. J. Beyene, and T. B. Tufa, "Veterinary drug prescribing practices at selected district veterinary clinics of rift valley areas of Ethiopia," *Vet. Med. Int.*, vol. 2021, 2021.

[46] E. R. Bollig, J. L. Granick, T. L. Webb, C. Ward, and A. L. Beaudoin, "A quarterly survey of antibiotic prescribing in small animal and equine practices—Minnesota and North Dakota, 2020," *Zoonoses Public Health*, vol. 69, no. 7, pp. 864–874, 2022.

[47] P. M. Dowling, "Antimicrobial drug residues in foods of animal origin," *Antimicrob. Ther. Vet. Med.*, pp. 431–441, 2013.

[48] S. Arshad, S. Mahmood, S. Rasool, S. Hayat, S. Zafar, and T. Zehra, "Rational Drug use in Pakistan: A systematic review," *J. Pharm. Pract. community Med.*, vol. 2, no. 4, 2016.

[49] C. Kassahun, A. Adem, M. Zemen, G. Getaneh, and K. Berrie, "Identification of commonly used anthelmintic drugs and evaluation of their utilization in University of Gondar veterinary clinic," *J. Vet. Sci. Technol*, vol. 7, p. 81, 2016.

[50] S. F. Ali, "Review on rational use of antmicrobials in veterinary practice," *Int. J. Biomed. Eng. Clin. Sci.*, vol. 5, pp. 70–77, 2019.

[51] F. Koji, A. Kumbe, and A. Beyene, "Cross-sectional Assesses on Irrational Use of Veterinary Drugs in Adami Tulu Jiddo Kombolcha Distrct , East Shoa Zone , Oromia Regional State , Ethiopia," vol. 8, no. 3, pp. 22–27, 2020, doi: 10.11648/j.ijbse.20200803.11.

[52] FDRE, "a Proclamation To Provide for Veterinary Drug and Feed Administration and Control," *Fed. Negarit Gaz.*, vol. 14, pp. 6271–6288, 2012.

[53] T. Gudeta and D. Mechal, "Patient knowledge of correct dosage regimen; the need for good dispensing practice," *J. Prim. Care Community Health*, vol. 10, p. 2150132719876522, 2019.

[54] Z. Hassan *et al.*, "Assessment of medication dosage adjustment in hospitalized patients with chronic kidney disease," *Cureus*, vol. 13, no. 2, 2021.

[55] L. Canton, C. Lanusse, and L. Moreno, "Rational pharmacotherapy in infectious diseases: issues related to drug residues in edible animal tissues," *Animals*, vol. 11, no. 10, p. 2878, 2021.

[56] V. Ćupić, L. Turubatović, B. Antonijević, R. Velev, S. Čelebićanin, and D. Ćupić, "Rational use of drugs in veterinary medicine and food safety," *J. Hyg. Eng. Des.*, vol. 4, pp. 20–25, 2013.

[57] 2020. "Public Health Importance of Veterinary Drug Residues in Food Animals." Applied Journal of Hygiene 9(1): 1–1 Moti and Desa, "Public Health Importance of Veterinary Drug Residues in Food Animals," *Appl. J. Hyg.*, vol. 9, no. 1, pp. 1–11, 2020, doi: 10.5829/idosi.ajh.2020.01.11.