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IRRATIONAL USE OF VETERINARY DRUGS: A CURRENT THREAT ON ANTIMICROBIAL RESISTANCE

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Abstract

Veterinary medicines may be used appropriately or inappropriately in animal health care. Misuse of these drugs represents a major challenge in modern veterinary practice, resulting in medication-related problems, treatment failures, and increasing risks to animal, human, and environmental health, as well as higher drug expenditures. These challenges arise from administering drugs to cases not requiring treatment, prescribing or dispensing unsafe products, and improper drug use by animal owners. Irrational drug use remains a major concern in many developing nations, including Ethiopia, where veterinary drug prescriptions are commonly based on tentative diagnosis in clinics. Limited availability of veterinary pharmaceuticals, weak regulatory enforcement, and poor access to drug information also drive misuse. Studies from Ethiopia have documented illegal drug vendors operating under poor conditions and a high incidence of irrational drug use and its contributing factors. The most alarming consequence of misuse is antimicrobial resistance, a serious threat to both human and animal health. Evidence shows that antimicrobial resistance generated from animal sources significantly contributes to the wider AMR problem, in combination with human and environmental factors. Continued irrational circulation of veterinary pharmaceuticals poses future threats to global human, animal, and environmental health. Accordingly, the World Health Organization has adopted a multisectoral One Health strategy to address irrational drug use and antimicrobial resistance, although implementation emerged late. Another critical public health issue is drug residue in food animals. High levels of antimicrobial residues in meat, milk, eggs, and organs are strongly linked to misuse of veterinary medicines. These consequences also bring economic burdens through increased treatment costs, livestock mortality, reduced productivity, and loss of income for vulnerable farmers. Therefore, minimizing irrational veterinary drug use and its repercussions requires strengthened regulatory oversight and promotion of rational drug utilization.

Keywords: *Antimicrobial resistance; Irrational use; Prescription; Rational use; Veterinary drug.*

1. INTRODUCTION

Veterinary drugs refer to substances administered to animals for therapeutic treatment, disease prevention, diagnosis, or to alter physiological functions or behaviors (Ture *et al*., 2019). These drugs may be utilized rationally or irrationally within livestock systems (Beyene and Tesega, 2014; Isse *et al*., 2017). Irrational veterinary drug use describes inappropriate or improper application of animal medicines, often characterized by over-prescription, incorrect dosing, wrong treatment duration, or unnecessary risk to animals (Beyene *et al*., 2016). Typical features of irrational use include excessive drug combinations, inadequate treatment doses or duration, administering antibiotics for non-bacterial conditions, failure to prescribe necessary drugs, and inappropriate self-medication by livestock owners (Ofori and Agyeman, 2016).

Across both developed and developing countries, veterinary and medical facilities commonly experience

medically inappropriate, ineffective, and economically wasteful drug use (Beyene *et al*., 2016). Misuse of antimicrobial agents is especially widespread and is one of the main drivers of global antimicrobial resistance (AMR) (Sutradhar *et al*., 2014; Sweileh, 2021). The burden is more pronounced in many developing nations due to fragile or poorly coordinated veterinary and medical systems (Sweileh, 2021).

In the African context, illegal veterinary drug markets significantly compromise pharmaceutical safety. Misuse, circulation of poor-quality drugs, and lack of efficacy are frequently observed due to inadequate regulation. Despite the potential adverse effects of counterfeit or poorly standardized drugs, monitoring mechanisms are largely absent across most African countries (Mouiche *et al*., 2019). Drug supply chains are highly complex and involve both formal and informal actors. The influx of substandard pharmaceuticals undermines access to reliable and affordable animal health inputs, emphasizing the need for effective and strictly enforced regulatory authority (Grasswitz *et al*., 2004).

In Ethiopia, several studies have documented widespread irrational veterinary drug use. In Batu and Arsi-Negelle, inappropriate prescription practices and drug combinations were prevalent (Etefa *et al*., 2021). Research in Bishoftu, central Ethiopia, and Gimbi identified poor diagnosis, lack of standardized veterinary treatment guidelines, inadequate drug formularies, and low adherence to generic prescribing as contributing factors (Beyene *et al*., 2016; Nimota *et al*., 2017). Similarly, findings from Modjo veterinary clinic highlighted lack of laboratory service, low prescriber capacity, drug misuse and overuse, and absence of essential medicines as key drivers of irrational drug use (Guta and Selamawit, 2019). In contrast, a study from Gondar, North Ethiopia, reported that polypharmacy, generic prescription practices, and reliance on the Ethiopian veterinary drug list were not significant problems (Berihun *et al*., 2019).

Economically, Ethiopia is severely impacted by unmanaged animal disease and irrational drug use, which contributes to loss of foreign currency and reduced veterinary service performance (Dione *et al*., 2021). Misuse of medicines results in compromised animal health delivery, diminished productivity, and loss of livestock-based income that could otherwise support export markets requiring residue-free products (FAO, 2017). The application of incorrect or unnecessary veterinary drugs increases treatment cost, contributes to livestock mortality, reduces production, and undermines livelihoods, especially for poor farmers (Michelo, 2015).

The most serious consequence of irrational veterinary drug use is antimicrobial resistance, which threatens both animal and human health. Resistant pathogens originating from animal agriculture significantly contribute to the overall AMR burden, alongside human and environmental sources (Palma *et al*., 2020). Evidence from Ethiopia shows increasing treatment failures because commonly used veterinary antimicrobials are losing effectiveness (Gemeda *et al*., 2021). The spread of resistance is accelerated by excessive and improper antimicrobial use (Gebeyehu *et al*., 2021). Although AMR emergence is influenced by multiple interacting factors in developing countries, inappropriate antibiotic use in human healthcare, agriculture, and veterinary medicine remains a critical driver, compounded by microbial adaptive responses (Kifle and Tadesse, 2014; Ayukekbong *et al*., 2017; Gemeda *et al*., 2021).

In Ethiopia, drug misuse continues to pose a serious public health and veterinary concern due to shortages of trained professionals, knowledge gaps, and financial challenges. These problems contribute to ineffective treatment outcomes, higher cost of care, and preventable death (Geta and Kibret, 2021; Melku *et al*., 2021). Another growing public health concern is the presence of drug residues in animal-derived foods. Irrational veterinary drug use leads to accumulation of antimicrobial residues and toxic metabolites in edible tissues including meat, internal organs, eggs, and milk (Mutua *et al*., 2020). Consumption of contaminated products exposes humans to resistant microorganisms, treatment failure, and long-term food safety risks (Ture *et al*., 2019; Canton *et al*., 2021). Drug residues and associated resistance further reduce consumer confidence, restrict export potential, and pose environmental risks (FAO, 2017). Consequently, AMR has emerged as a global challenge undermining disease control and livestock productivity.

Given these concerns, this review aims to synthesize recent information on irrational veterinary drug use, its consequences, and strategies to address the problem.

2. ASPECTS OF IRRATIONAL USE OF VETERINARY DRUGS

The drivers of irrational veterinary drug use are multifaceted and stem from several interacting sources, including animal owners, prescribers, the work environment, drug supply and industry pressure, regulatory systems, and the circulation of accurate and misleading information (Chaturvedi *et al*., 2012; Michelo, 2015; Ofori and Agyeman, 2016; Qamariat, 2021). Veterinarians initiate irrational practices through unnecessary prescribing, use of multiple drugs, preference for costly medicines, and excessive reliance on antibiotics and injectables. Such overuse results in the administration of drugs that are not required, and the selection of higher-generation antimicrobials or unnecessarily high doses (Ofori and Agyeman, 2016; Mehreen, 2017).

Faulty prescription practices are widespread among both medical and veterinary clinicians and heighten the risk of drug-related harm, even when safer or equally effective alternatives exist. Unethical prescribing reduces the overall quality of treatment and contributes to increased adverse reactions, drug interactions and most critically the rise of antimicrobial resistance (Landers *et al*., 2012; Garg *et al*., 2014; Robbins *et al*., 2020). Rational prescribing requires a structured, evidence-based process aimed at maximizing therapeutic benefit, minimizing harm, conserving limited resources, and respecting patient expectations (Maxwell, 2016).

Illegal drug supply networks further fuel irrational drug use. Pharmaceutical companies can negatively influence prescribing through marketing strategies such as promotions, sponsored events, sales representatives, samples, and advertising, all of which may bias treatment decisions (Donohue, 2006; Prejmerean, 2007).

Misinformation also plays a strong role in misuse. Smugglers and unlicensed drug distributors often publicize veterinary products on social media using exaggerated or false claims, misleading users about drug safety and effectiveness. Such deceptive promotion encourages irrational consumption in the absence of scientific evidence (Khaja *et al*., 2018). Nevertheless, the media and drug promoters must be engaged to raise awareness about the dangers of inappropriate drug use and the irreversible global threat of antimicrobial resistance (Woolhouse *et al*., 2016).

In addition, unethical dispensing practices contribute to the problem. Some veterinary pharmacists sell medicines without prescriptions, and farmers commonly self-medicate their animals because of inadequate awareness. When legal outlets refuse to supply drugs without proper documentation, many livestock owners turn to the illicit market. These practices accelerate antimicrobial resistance, making infections harder and more costly to control worldwide (Beyene *et al*., 2016; Koji *et al*., 2020).

Regulatory authorities play a crucial role in ensuring rational drug use. Weak enforcement, absence of standardized guidelines, and limited technical capacity all create opportunities for inappropriate use. A strong veterinary regulatory system must employ evidence-based mechanisms to verify the safety, quality, and efficacy of products before approval and ensure ongoing monitoring and control once drugs are available in the market (Smith, 2013).

In Ethiopia, the Agricultural Authority is legally mandated to regulate veterinary pharmaceuticals by developing frameworks and tools to safeguard product quality (FDRE, 2012; Zeru, 2019). However, inadequate regulatory infrastructure, limited financial and technical resources, and weak enforcement have resulted in the circulation of substandard or smuggled products and eroded confidence in veterinary drugs across the country (Zeru, 2019).

3. FACTORS LEADING TO IRRATIONAL USE OF VETERINARY DRUGS

Factors that hinder rational drug utilization often stem from the consequences of irrational drug use. Key contributors include inadequate continuing professional education, the presence of comorbid conditions, and the educational level of prescribers (Melku et al., 2021). In veterinary practice, additional factors influencing irrational medicine use include limited access to accurate information, poor communication between animal health professionals and animal owners, insufficient diagnostic facilities or diagnostic uncertainty, pressure from animal owners, and aggressive promotional activities by pharmaceutical companies. These factors not only encourage inappropriate drug use but also amplify the potential negative impacts associated with such practices (Beyene and Tesega, 2014).

Misuse of medications is caused by a combination of factors, including a flawed system for supplying drugs, ineffective drug regulation (due to factors such as an oversupply of drugs on the market and the lack of a centralized authority to oversee them), and the improper promotional practices of pharmaceutical companies (Shivhare et al., 2010; UNODC, 2019).

3.1 Weak Regulation on veterinary drug use

Reports from Ethiopia indicate that the widespread misuse of veterinary drugs is largely driven by weak regulatory capacity. Inadequate enforcement of existing laws, poor coordination among enforcement agencies, and limited alignment between federal and regional authorities create major gaps in drug control. Additional contributors include inter-regional market linkages, low awareness among stakeholders and livestock owners, limited community engagement in regulatory efforts, insufficient border control, imbalance between drug supply and demand, and inadequate oversight of veterinary services and animal health professionals (Suleman *et al.*, 2016; Zeru, 2019).

3.2 Illegal veterinary drug distribution

The circulation and trade of illegal veterinary medicines represent another major driver of irrational drug use. These products may be expired, substandard, diluted, adulterated, or completely counterfeit. Such drugs have infiltrated markets to the point that, based on packaging and labeling alone, they are often indistinguishable from legitimate products. The problem is fueled by limited access to veterinary services and pharmaceutical supplies, and further exacerbated by insufficient regulatory oversight and

weak legal enforcement. Because illicit drug trafficking frequently crosses national borders, it poses a significant public and animal health risk. Strengthening efforts to combat the illegal veterinary drug trade is therefore crucial in reducing inappropriate drug use and safeguarding health (IGAD, 2020).

3.3 Low Availability and Affordability of veterinary drugs

Several challenges restrict access to rational and quality veterinary medicines. Markets may be flooded with illegal or substandard drugs, or the supply may be inadequate due to limited market size, low purchasing power, fragmentation, and weak regulatory systems. In many developing countries, the lack of local veterinary drug manufacturers and inadequate financial or infrastructural support further hinder the availability of reliable products. As a result, farmers often turn to low-quality or questionable drugs, about which they have little or no accurate information (WHO, 2010; Jongh *et al*., 2021).

3.4 Non-professional Actors in Veterinary Drug Supply Chains

Selling veterinary medicines comes with important responsibilities and requires sellers to possess sufficient knowledge about the products they distribute. This responsibility includes ensuring that drugs are properly handled and are used only when necessary and according to the label instructions. Sellers must also confirm that animal owners clearly understand the intended species, correct usage precautions, and required withdrawal periods after administration (BCMA, 2015). Veterinary drugs offered for sale should carry accurate labels, be stored and managed by trained personnel under suitable conditions, and prescription-only medicines must be dispensed strictly on the order of a licensed veterinarian (Achenef *et al*., 2016).

3.5 Unethical dispensing of veterinary drugs

When veterinary drugs are correctly dispensed, they reach the appropriate animal, in the right dose and quantity, accompanied by clear usage instructions. A competent dispenser oversees all steps from the moment a prescription or verbal request is received to the point the medication is provided to the client. These dispensing activities may occur within veterinary health facilities or community-based veterinary drug retail shops (Achenef *et al.,* 2016; ABVMA, 2017).

Errors or failures in the veterinary drug dispensing process can have serious implications for animal health, leading to adverse medical and economic outcomes as well as potential public health risks. Consequently, veterinary drug dispensers play a pivotal role in the therapeutic process and in preventing irrational drug use, particularly when they adhere to professional ethical standards rather than engaging in unethical or inappropriate dispensing practices (AVA, 2013; Achenef et al., 2016).

4. STATUS OF IRRATIONAL USE OF VETERINARY DRUGS IN ETHIOPIA

The irrational use of drugs remains a key health problem in many developing countries including Ethiopia, where, prescription of veterinary drugs follows the tentative diagnosis in animal health clinics. The prescribed drug might be misused for other non-prescribed conditions or the prescriber physician may mis-prescribe the drug (Beyene *et al.*, 2015). In this context, there are problems in antibiotics use, description of routes of administration, length of treatment, and shortage of laboratory diagnostic facilities. These in their side aggravate antimicrobial resistance (Etefa *et al*., 2021).

Reports from Ethiopia indicate the presence of illegal drug vendors who dispense medicines under inappropriate conditions, including direct exposure to sunlight, thereby violating established standards for drug handling and storage (Tufa et al., 2018). In addition, several studies conducted in Ethiopia have examined the prevalence of irrational drug use and the factors associated with such practices (Michelo, 2015).

Table 1: Irrational use of veterinary drug and its extent in some parts of Ethiopia

Irrational veterinary drug use activities		**Places of study**	**Prevalence**	**Reference**
Mis-practices	**Description**			
Mis-prescribing	Anthelmintics for Bacterial disease Anthelmintics for Metabolic disease Anthelmintics for Viral disease	Modjo Veterinary clinics	28.7% 7% 3.8%	(Guta *et al.*, 2019)
	Anthelmintics	Gondar Veterinary clinics	44.3%	(Kassahun *et al.*, 2016)
	Antibiotics were prescribed irrationally for cases that were tentatively diagnosed as	Bishoftu Veterinary	21.6 %	(Beyene *et al.*, 2015)

	parasitic	clinics, Central		
	Antibiotics were prescribed irrationally for cases that were tentatively diagnosed as viral to prevent secondary bacterial complications	Ethiopia,	6.0 %	
	Prescription without getting the correct laboratory-supported diagnosis.		96.6 %	
	Miss indicating of route administration on prescription		98.9%	
Mis-Dispensing	Dispensing without prescription	Affar	94.5%	(Angesom, 2015)
Illegal veterinary medicine trade	Illegal drug source		20%	

5. IMPACTS OF IRRATIONAL USE OF VETERINARY DRUGS

5.1 Current threat on antimicrobial resistance

The inappropriate use of veterinary medicines presents significant risks to human health, animal welfare, and environmental safety (Collignon and McEwen, 2019). A major outcome of such misuse is the emergence and spread of antimicrobial resistance (AMR), which undermines treatment effectiveness, poses serious public health threats, and results in substantial economic losses (Bengtsson and Greko, 2014). Antimicrobial resistance is a complex, multifactorial issue that has evolved into a global challenge affecting both developed and developing countries (Dadgostar, 2019). The World Health Organization has identified antibiotic resistance as a "global security threat," emphasizing its far-reaching implications for health systems, food security, and socio-economic development, comparable in scale to threats such as terrorism and climate change (Wall, 2019). The increasing prevalence of AMR is associated with more severe infections, higher complication rates, prolonged hospital stays, and elevated mortality levels (Llor and Bjerrum, 2014).

Continuous exposure of food-producing animals to low doses of antibiotics is a major driver of AMR and has accelerated the emergence of multidrug-resistant pathogens worldwide (Landers *et al*., 2012). Poor adherence to drug withdrawal periods further exacerbates the problem by leaving antimicrobial residues in animal products, which contribute to resistance in pathogenic bacteria (Okocha *et al*., 2018).

Excessive and repeated use of veterinary antibiotics in food animals can result in residues accumulating in muscle and organs. Consumption of these products exposes humans to antimicrobial residues, promoting the development of resistant bacteria and posing serious public health risks (Ture *et al*., 2019).

In many low-income countries, veterinary antibiotic use is largely unregulated, and there is inadequate disposal of unused or expired drugs. As a result, antibiotics enter terrestrial and aquatic ecosystems, contributing to environmental contamination, the spread of resistant bacteria, and toxicity to humans, animals, and plants (Kumar *et al*., 2012). From this perspective, the unauthorized and excessive application of veterinary drugs in livestock and aquaculture systems poses substantial risks to human health and to other organisms within the environment (Wang et al., 2021).

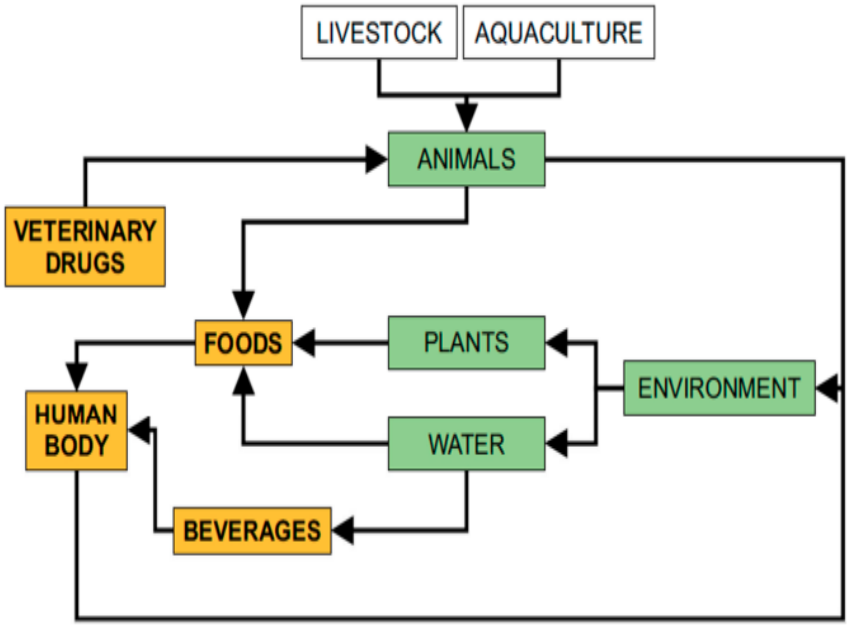

Figure 1: A series of processes involving veterinary drug residues in the human body (Wang *et al.,* 2021)

Antimicrobial resistance (AMR) undermines the effective control of infectious diseases, leading to adverse effects on animal productivity and farm profitability. Affected animals may experience prolonged illness, increased mortality, or require extensive veterinary intervention. Due to AMR, treatment effectiveness may be delayed or reduced, allowing infected animals to remain infectious for longer periods and thereby increasing the likelihood of transmitting resistant microorganisms to other animals. From a public health perspective, such animals may serve as persistent reservoirs of infection, posing heightened risks to the wider community and healthcare personnel. Prolonged disease duration and extended treatment regimens consequently result in increased healthcare expenditures and impose substantial economic burdens on families and society at large (Jindal, 2014).

5.2 Other impacts of irrational use of veterinary drug

The consequences of irrational drug use are well-recognized and pose a significant challenge to both human and veterinary health systems worldwide. Such practices often compromise the quality of healthcare, placing patients at risk and wasting limited resources that could otherwise address other urgent health needs (Ofori and Agyeman, 2016). Irrational drug use can result in serious health problems for animals and humans, harm the environment, and generate negative economic impacts (Prestinaci *et al.*, 2015; Manyi-Loh *et al.*, 2018).

5.2.1 Impact on animal health

Veterinary medicines are administered to animals to maintain or improve health and are developed to serve a broad range of preventive and therapeutic functions. These medicines are used not only in food-producing animals but also in companion animals, exotic species, and wildlife (Woodward, 2003). Within the animal production sector, efforts to enhance productivity are often accompanied by increased reliance on veterinary pharmaceuticals. However, irrational drug use compromises the quality of therapeutic interventions, resulting in higher rates of morbidity and mortality, inefficient use of resources, reduced availability of essential medicines, increased treatment costs, and a greater likelihood of adverse drug reactions (Hassan et al., 2018).

5.2.2 Impact on public health

Public health is substantially threatened by the emergence of drug-resistant microorganisms in animals and by the presence of veterinary drug residues in foods of animal origin. Veterinary pharmaceuticals used to enhance the productivity of food-producing animals intended for human consumption may exert harmful effects on consumers (Ture et al., 2019; Van et al., 2020). One of the primary concerns is drug residue contamination, which most commonly arises from failure to adhere to recommended withdrawal periods following treatment (Ture et al., 2019). Residues of veterinary medicines have been detected in a wide range of animal-derived food products, including meat and poultry, milk and dairy products, eggs, fish and seafood, and honey (Ortelli et al., 2018). Consumption of such residues may result in acute toxic effects, such as allergic reactions, as well as long-term health consequences, including carcinogenic effects and disruption of the human gut microbiota (Ture et al., 2019).

Veterinary medicines should be administered only when clinically indicated and used appropriately—at the correct time, in the correct dose, and in strict compliance with recommended withdrawal periods—in order to minimize risks to public health. Routine monitoring of antimicrobial susceptibility and systematic regulation of antimicrobial residues are therefore essential components of responsible veterinary practice (Beyene et al., 2016; Canton et al., 2021). However, given the extensive use of pharmaceuticals in livestock production—where nearly 80% of global antibiotic production is consumed by animals—residues of veterinary drugs may still be detected in foods of animal origin, even when regulatory guidelines governing the proper use of veterinary medicinal products are followed (Ortelli et al., 2018).

5.2.3 Impact on environment

The environmental impacts of drugs are increasingly evident worldwide. Both legal and illegal production, as well as improper disposal, can harm ecosystems in multiple ways. Pharmaceutical manufacturing contributes to large-scale carbon emissions, water depletion, pollution, and biodiversity loss (Burns-Edel, 2016). Because drugs affect biological processes, their presence in the environment can have complex consequences. Medications consumed by humans and animals often enter rivers, lakes, and even drinking water, disrupting hormone levels in aquatic species such as fish and impairing reproduction (Souza *et al*., 2019).

Drug residues can also promote the emergence of resistant bacteria, increasing public health risks. Illegal drug production exacerbates these problems, as it often disregards environmental laws, depletes natural resources, and pollutes ecosystems without accountability. Recognizing the environmental effects of illegal drugs is critical, as pollution poses serious threats to the health of humans and other living organisms (Manyi-Loh *et al*., 2018; Polianciuc *et al*., 2020). Toxic waste can contaminate food, air, and water, with long-term public health consequences (Landrigan *et al*., 2020; Manisalidis *et al*., 2020).

Biodiversity plays a vital role in maintaining the planet's balance and habitability. Species depend on one another for survival for example, many animals rely on fruit for nutrition, while fruit-bearing plants depend on animals for seed dispersal and fertilization. These interconnections sustain ecosystems, regulate carbon levels, and support human life, highlighting the importance of preserving biodiversity for the health of all species (Provenza *et al.*, 2021). Now a day, these chains of species becoming at risk of being disrupted by irrational drug use (Ayukekbong *et al.,* 2017).

5.2.4 Economic impact

Veterinary medicines are costly and represent a substantial portion of overall animal health expenditures. Globally, both human and animal healthcare systems often practice medically inappropriate, ineffective, and economically inefficient use of pharmaceuticals (WHO, 2010). Such irrational use not only wastes scarce resources but also exposes patients to therapies with potential risks and little or no clinical benefit. For example, inappropriate prescribing including prescription errors, overuse or underuse of medications, and unnecessarily expensive drugs harms patients while depleting resources (Beyene and Tesega, 2014).

In developing countries, antibiotics are commonly administered to food animals to promote growth and overall well-being. While this practice provides economic benefits to producers and consumers, it raises significant concerns (Van *et al*., 2020). Repeated exposure of animals to low doses of antibiotics is a major contributor to antimicrobial resistance (AMR), which in turn imposes economic burdens through direct and indirect costs, increased human and livestock morbidity and mortality, and higher healthcare expenditures for treating resistant infections (NAS, 2018).

6. WAYS OF CONTROLLING IRRATIONAL USE OF VETERINARY DRUG

Addressing the underlying causes of veterinary drug misuse is essential to minimize its impact on human health, animal welfare, and the environment. Misuse can occur at three levels: the community level, the animal healthcare level, and the national level. At each of these levels, targeted interventions are needed to promote rational drug use and effectively reduce inappropriate practices (Grand *et al.*, 1999; Qamariat, 2021).

6.1 At community level

Correct prescribing does not guarantee that drugs are used properly at the community level. The non-adherence to prescriptions such as inadequate drug information, inadequate labeling, lack of money, and cultural perceptions of drugs should be improved (Brown and Bussell, 2011).

6.2 At animal health care level

In many developing countries, reliable information on veterinary drugs is limited. Animal healthcare workers often receive minimal basic training or continuing education regarding medications. Knowledge alone, however, does not fully address the issue. Ownership of health facilities by medical or veterinary practitioners can create conflicts of interest, contributing to the overuse of drugs in treatment. The primary goal for all healthcare providers both human and animal should be to continuously improve medication-use practices to ensure the safest and highest-quality care (ISMP, 2009). Additionally, challenges such as misleading pharmaceutical advertisements and pressure from drug sales representatives require corrective measures to promote rational drug use (Grand *et al*., 1999).

6.3 At the national level

Government authorities need to recognize that the irrational use of medicines poses a serious threat to both animal and public health. This issue represents a complex global health challenge that demands a coordinated, multi-stakeholder response. All stakeholders should understand that the risks extend beyond reduced efficacy and safety in animals they also include threats to human health through consumption of products from animals treated with illegal or unsafe veterinary drugs (Ture *et al*., 2019). One major barrier to addressing this problem is the absence or weakness of national drug policies. Such policies can only be effective if supported by proper implementation mechanisms, including robust monitoring of drug regulations, efficient distribution systems, regular supervision, and adequate storage facilities (Grasswitz *et al.,* 2004).

6.4 Rational use of veterinary drugs

Promoting rational drug use remains the most effective strategy for addressing irrational use of veterinary medicines. Rational use entails administering medications that are appropriate to an animal's clinical condition, at doses and durations that meet individual therapeutic needs, and at the lowest possible cost (WHO, 2011; Achenef et al., 2016). Adopting this approach improves treatment outcomes, reduces the occurrence of adverse drug reactions, minimizes the risk of drug residues in animal products, and contributes to the prevention of antimicrobial resistance (Beyene et al., 2016).

Rational veterinary drug use also encompasses sound prescribing and diagnostic practices, which involve the safe, effective, and economical selection of drugs for the benefit of the patient (Maxwell, 2016). The Ethiopian

Agricultural Authority (formerly VDFACA) recommends a structured approach to effective veterinary drug prescription, including the following steps: (Achenef *et al.*, 2016).

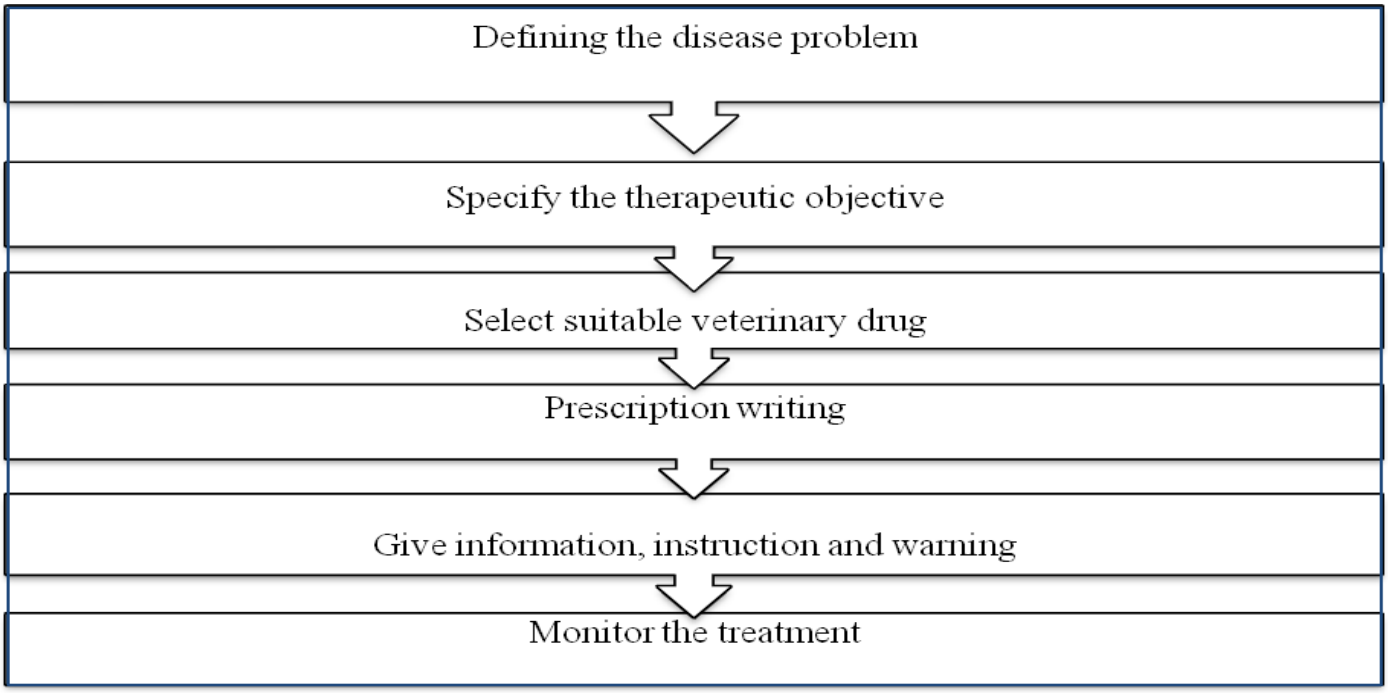

Figure 2: Major steps in the prescription process (Achenef *et al.*, 2016)

Rational drug use also encompasses educational programs, which are a key strategy for reducing inappropriate drug use. Hospitals for both humans and animals should implement training programs to equip medical and pharmacy staff with current knowledge on rational drug use and practical application. Additionally, drug use within these institutions should be regularly monitored and evaluated (Melku *et al*., 2021). Regulatory authorities are responsible for developing strategies that promote awareness, community engagement, and enforcement measures, such as banning unsafe drugs and controlling imports, to ensure that all medicines in circulation are safe, effective, and of high quality (FDRE, 2012; Handoo *et al*., 2012).

Proper dispensing providing the correct drug to the right patient in the appropriate formulation or dosage, accompanied by counseling, clear instructions, and good stock management—along with rational patient use (adherence/compliance), helps minimize irrational drug use (WHO, 2002). Dispensers should also check for common quality indicators of pharmaceuticals before use (Achenef *et al.*, 2016).

Table 2: Common quality problem indicators for different veterinary pharmaceutical products

Common quality problems	Indicators
All products	Broken or tripped packaging, Missing, incomplete or unreadable label(s)
Liquid products	Discoloration, cloudiness, sediment, broken seal on the bottle, cracks in an ampoule, bottle, or vial, dampness, or moistures in the packaging, leakage, caking
Light sensitive products	Torn or ripped packaging
Latex products	Dry, brittle, or cracked
Lubricated latex products	Sticky packaging, discolored products or lubricant, stained packaging, leakage of the lubricant
Tablets (bolus)	Discoloration, missing boluses, unusual smell, stickiness (specially coated tablets)

Injectable	The liquid does not return to suspension after shaking sterile products, Torn or ripped packaging, missing parts, broken or bent parts Moisture inside the packaging or stained packaging, Particle matter/precipitate
Foil packs	Perforation(s) of packaging
Chemical Reagents	Discoloration

Source: (Achenef *et al.*, 2016)

7. FUTURE PERSPECTIVES ON IRRATIONAL USE OF VETERINARY DRUG

The future of medicine will face both significant challenges and opportunities for human, animal, and environmental health due to the widespread and irrational circulation of veterinary pharmaceuticals globally (Wylie *et al.*, 2019). Misuse of these drugs contributes to antimicrobial resistance (AMR), which poses a major threat to healthcare for both humans and animals, compounded by a lack of new antibiotic discoveries. Without timely intervention, rising AMR rates are likely to drive veterinary medicine costs sharply higher (Jindal, 2014).

Addressing this threat requires recognizing the gravity of AMR, developing coordinated multi-pronged strategies, building infrastructure, and taking urgent, collaborative action. Stakeholders must work together to implement comprehensive solutions. The pharmaceutical industry and research institutions can contribute by investing in the discovery of new antibiotic classes and alternative therapies. Clinicians must exercise greater caution to prevent unnecessary antibiotic prescriptions, while medical technology developers can provide rapid point-of-care diagnostics to distinguish bacterial from viral infections. The World Health Organization promotes this multi-sectoral approach to combat AMR as the 'One Health' strategy. Failure to act now risks reaching a therapeutic dead end, with severe consequences for global health (Jindal, 2014).

8. CONCLUSION AND RECOMMENDATIONS

The inappropriate use of veterinary medicines poses a significant risk to animal health and human society worldwide. Multiple factors drive irrational drug use, originating from livestock owners, prescribers, workplace practices, industry and supply systems, regulatory weaknesses, misinformation, and the interplay among them. Failure to address these factors results in predictable consequences, including a decline in treatment quality, waste of limited resources, increased drug expenses, a higher likelihood of adverse reactions, and the accelerating emergence of antimicrobial resistance. More critically, irrational drug use compounds global health challenges linked to pandemic threats and rising AMR. In Ethiopia, antimicrobial resistance has become a major concern, with repeated reports emerging across the country, while awareness remains low, particularly in rural communities. To protect public and animal health and support the livestock sector, the government should strengthen national animal health systems aligned with international standards that facilitate safe trade and bolster communities at all levels. Ensuring rational veterinary drug use will yield substantial economic, environmental, human, and animal health benefits. Based on these points, the following recommendations are proposed:

- ✓ Integrate continuous intervention programs promoting rational drug use into national animal health systems.
- ✓ Raise awareness among livestock owners, illegal drug vendors, smugglers, and unethical animal health workers and apply corrective measures to curb misuse and highlight its consequences.
- ✓ Restrict antibiotic use to treating clinically ill animals based on diagnostic evidence.
- ✓ Conduct regular assessments of irrational antimicrobial use to inform policy development and strengthen regulatory frameworks.

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