

Review Article

# Antimicrobial Resistance in Livestock a Global Concern and Ethiopian Perspective

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## Abstract

Antimicrobial resistance (AMR) in livestock is a significant global issue, posing serious threats to animal health, food safety, and public health. The overuse and misuse of antibiotics in animal production have accelerated the emergence of resistant bacterial strains, complicating disease management and treatment. This review examines global trends in AMR in livestock, highlighting the major bacterial pathogens affected and the extent of resistance to commonly used antibiotics. Additionally, it explores the specific challenges in Ethiopia, where limited regulatory enforcement, poor veterinary infrastructure, and widespread unregulated antibiotic use contribute to the escalating problem. The transmission of resistant bacteria from livestock to humans through direct contact, food consumption, and environmental exposure further amplifies public health concerns. Addressing AMR requires a multifaceted approach, including the enforcement of strict antibiotic regulations, improved surveillance systems, promotion of alternative disease control strategies such as probiotics and vaccinations, and farmer education programs on responsible antibiotic use. Furthermore, international collaboration and investment in research are essential for the development of novel antimicrobial alternatives and enhanced diagnostic tools for early resistance detection. By adopting a comprehensive and sustainable approach, Ethiopia can mitigate the impact of AMR and contribute to global efforts in controlling resistance. This review provides insights into the critical issues surrounding AMR in livestock and underscores the need for urgent and coordinated action to ensure the long-term sustainability of animal agriculture and public health protection. Antimicrobial resistance (AMR) in livestock is a growing global concern, affecting animal health, food safety, and public health. The widespread and often indiscriminate use of antibiotics in animal production has led to the emergence of resistant bacterial strains, which pose challenges for disease management and treatment. This review explores the global trends in AMR in livestock, factors contributing to its rise, and the specific challenges faced in Ethiopia. Additionally, potential strategies for mitigating AMR in livestock production are discussed.

## Keywords

Antimicrobial Resistance, Food Safety, Livestock, Sustainable Farming

## 1. Introduction

The use of antimicrobials in livestock production has undeniably played a critical role in improving animal health, enhancing productivity, and supporting the control and

treatment of infectious diseases. Nevertheless, the widespread overuse and inappropriate application of these drugs have significantly contributed to the emergence and rapid spread of

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antimicrobial resistance (AMR), posing a serious threat to both veterinary and human health systems. Resistant bacteria originating in animals can be transmitted to humans through several pathways, including the consumption of contaminated animal products, direct contact with infected animals, and environmental dissemination through manure and water systems. This growing threat calls for immediate and coordinated intervention strategies. In Ethiopia, recent studies have revealed an alarming prevalence of multidrug-resistant (MDR) bacterial strains, particularly *Staphylococcus aureus* and *Escherichia coli*, within dairy and beef production chains—from on-farm practices to processing and retail stages—with resistance levels surpassing 40% against several commonly used antimicrobials [1]. Moreover, in the country's dominant smallholder livestock systems, a high burden of AMR has been documented. For example, *E. coli* strains isolated from both livestock and adjacent soil samples have shown notable resistance to frequently used antibiotics such as streptomycin and tetracycline [2]. Contributing to this escalating problem are systemic challenges, including weak regulatory enforcement, insufficient diagnostic infrastructure, and limited awareness among livestock producers about the risks of indiscriminate antimicrobial use [3]. To effectively mitigate AMR in Ethiopia, there is an urgent need for comprehensive policy reforms that prioritize antimicrobial stewardship, enhance public and producer education, strengthen veterinary services, and promote sustainable livestock management practices.

## 2. Global Trends in Antimicrobial Resistance in Livestock

AMR has been reported across various regions, with resistant bacterial strains identified in poultry, cattle, and swine. The following global trends have been observed:

### 2.1. Increased Resistance to Common Antibiotics

Increased resistance to common antibiotics is a growing global concern, particularly among bacteria such as *Escherichia coli*, *Salmonella*, and *Staphylococcus aureus*. These pathogens have developed significant resistance to widely used antibiotics, including tetracyclines, sulfonamides, and  $\beta$ -lactams. A study analyzing bacterial isolates from food sources highlighted the high prevalence of antibiotic resistance, with *S. aureus* frequently exhibiting resistance to sulfonamides and tetracyclines, while *E. coli* showed resistance to tetracyclines, nitrofurantoin, and streptomycin. Notably, *Salmonella* strains demonstrated multidrug resistance, raising concerns about the transferability of resistance genes to other bacteria [4]. The increasing resistance patterns among these pathogens underscore the urgent need for robust antimicrobial stewardship programs to mitigate the spread of resistant strains in both clinical and agricultural settings.

### 2.2. Impact of Intensive Farming Systems

High-density livestock production systems have been associated with greater antimicrobial resistance (AMR) prevalence due to increased antibiotic use for growth promotion and disease prevention. Research on antimicrobial resistance in veal production environments indicates that farm settings, particularly barns housing young calves, serve as reservoirs for multidrug-resistant *Escherichia coli*, with 51.7% of isolates exhibiting resistance to multiple antibiotics. Moreover, resistance prevalence increased in trailers and slaughterhouses, highlighting the role of confined production systems in amplifying AMR transmission [5]. Similarly, a review on antibiotic usage in food-producing animals underscores the link between intensive farming, antibiotic resistance gene transmission, and foodborne pathogen spread, emphasizing the urgent need for alternative strategies such as bacteriophages, probiotics, and synthetic biology to mitigate AMR risks [6]. These findings reinforce the necessity of antimicrobial stewardship and biosecurity measures in high-density livestock systems to curb the emergence and dissemination of resistant pathogens.

### 2.3. Regional Disparities in AMR Prevalence

While high-income countries have made significant progress in regulating antibiotic use, low- and middle-income countries, including Ethiopia, face challenges due to weak enforcement mechanisms and lack of awareness. In Ethiopia, antimicrobial use (AMU) in livestock is largely unregulated, with many farmers using antibiotics without prescriptions, leading to antimicrobial resistance [7]. Studies have found that a significant percentage of livestock producers lack knowledge of AMR, and nearly 97% exhibit unfavorable attitudes toward the consequences of excessive antibiotic use. Furthermore, irrational veterinary drug use, including antibiotics prescribed without proper diagnosis, has been reported, with over 55% of veterinary prescriptions in northern Ethiopia being antimicrobials [8]. Additionally, antibiotic residues have been detected in beef samples, raising concerns about public health risks and the potential for resistance transfer to humans [9]. Addressing these challenges requires stricter enforcement of AMU regulations, improved farmer education on AMR, and enhanced veterinary oversight to ensure responsible antibiotic use in livestock production.

## 3. Factors Contributing to AMR in Ethiopia

Ethiopia, like many developing nations, faces unique challenges in controlling AMR in livestock, including:

### 3.1. Unregulated Antibiotic Use

There are no specific studies directly addressing self-medication with antibiotics in livestock in Ethiopia. However, existing research highlights widespread irrational veterinary drug use, including over-the-counter antibiotic sales and unregulated administration by farmers, which contributes to antimicrobial resistance (AMR). Studies indicate that many Ethiopian livestock producers lack formal knowledge of antibiotic use, often relying on personal experience or informal sources for treatment decisions [7]. A significant proportion of veterinary prescriptions are antimicrobials, frequently administered without proper laboratory diagnosis, which increases the risk of drug resistance [8]. Additionally, antibiotic residues have been detected in livestock products, suggesting improper dosing and withdrawal period violations, further exacerbating public health risks [9]. Addressing this issue requires stricter regulation of veterinary antibiotic sales, farmer education programs, and improved access to veterinary professionals to ensure responsible antibiotic use in Ethiopia's livestock sector.

### 3.2. Poor Veterinary Infrastructure

Limited access to professional veterinary services results in unmonitored antibiotic usage, contributing to antimicrobial resistance (AMR) and improper drug administration in Ethiopia's livestock sector. A study conducted in the Kellel Wollega zone revealed that while 79.3% of veterinary professionals diagnose systemic infections based on tentative assessments, 85.4% lack laboratory facilities, leading to widespread empirical antibiotic use [10]. Similarly, research on veterinary drug prescribing practices in Rift Valley clinics found that 68.3% of diagnoses were made by unspecified professionals, and antibiotics were frequently prescribed without laboratory support, with oxytetracycline being the most commonly used drug [11]. This unregulated antibiotic administration is further exacerbated by farmers self-medicating their livestock, with over 55% reporting awareness of antibiotic resistance but still engaging in inappropriate drug use due to limited veterinary access [10]. Addressing this issue requires improved veterinary infrastructure, enhanced laboratory support, and stricter regulations on antibiotic distribution to promote responsible antimicrobial use in Ethiopian livestock production.

### 3.3. Lack of Surveillance Systems

There are no specific studies directly addressing antibiotic resistance monitoring in Ethiopian livestock. However, existing research highlights significant gaps in surveillance, leading to widespread antimicrobial resistance (AMR) due to unregulated antibiotic use in livestock. Studies indicate that many Ethiopian farmers and veterinary professionals lack

access to laboratory diagnostics, resulting in empirical antibiotic administration without monitoring resistance [10]. Additionally, the improper use of antimicrobials, including oxytetracycline and penicillin-streptomycin, has been linked to rising resistance, but the absence of systematic data collection prevents the formulation of effective response strategies [11]. Antibiotic residues detected in meat and milk further suggest misuse of antimicrobials, yet Ethiopia lacks a centralized reporting system to track resistance patterns in animal production [9]. To address this issue, Ethiopia needs to establish nationwide AMR surveillance programs in the livestock sector, strengthen laboratory diagnostic capabilities, and enforce stricter regulations on antibiotic use to mitigate resistance risks.

### 3.4. Traditional Livestock Farming Practices

Many smallholder farmers in Ethiopia rely on unprescribed antibiotic use, exacerbating resistance issues due to a lack of awareness and veterinary oversight. A study conducted in Oromia found that 63.3% of smallholder dairy farmers purchase and use veterinary drugs without prescriptions, primarily due to unrestricted access and the high cost of veterinary services [12]. Similarly, research on antimicrobial use among smallholder livestock farmers revealed that 72.3% of pastoralists do not complete the full course of antibiotic treatments, while 70% are unaware of recommended withdrawal periods for milk and meat, leading to antibiotic residues in food products [13]. Another study assessing livestock producers' knowledge and attitudes toward antimicrobial use in Ethiopia found that 94% of farmers have poor knowledge about antibiotic resistance, with 44% self-administering antimicrobials without professional guidance [7]. Addressing this issue requires stricter regulations on antibiotic sales, farmer education programs on responsible antimicrobial use, and improved veterinary service access to curb rising resistance trends in Ethiopia's livestock sector.

## 4. Strategies for Mitigating AMR in Livestock

To combat antimicrobial resistance (AMR) in Ethiopia, a multifaceted approach integrating regulatory measures, awareness campaigns, and alternative disease control methods is essential. Strengthening regulations by implementing strict policies on antibiotic prescription and sales is crucial, as studies highlight the widespread misuse of antimicrobials due to weak enforcement mechanisms [14]. Enhancing surveillance through the establishment of AMR monitoring systems is critical for tracking resistance trends, given the lack of structured national reporting frameworks [15]. Promoting alternative solutions, such as probiotics, vaccination, and improved biosecurity measures, can reduce reliance on

antibiotics, as evidenced by One Health initiatives emphasizing holistic AMR mitigation strategies [14]. Additionally, farmer education programs play a key role in raising awareness about responsible antibiotic use, as studies indicate that a significant proportion of Ethiopian farmers lack knowledge about AMR, with only 51.53% demonstrating adequate awareness levels [15]. A comprehensive strategy incorporating these elements is necessary to reduce antibiotic misuse and curb the growing threat of AMR in Ethiopia.

## 5. Conclusion

AMR in livestock is a critical global issue with significant implications for Ethiopia. The persistence of antibiotic-resistant bacteria in food-producing animals not only threatens animal health but also poses serious risks to human health through zoonotic transmission. If left unaddressed, AMR could lead to economic losses in the livestock sector, increased treatment costs, and reduced effectiveness of antibiotics for both veterinary and human medicine.

Addressing this challenge requires coordinated efforts among policymakers, veterinarians, farmers, and researchers. Strengthening regulations on antibiotic use, enhancing surveillance systems to monitor resistance trends, and promoting alternative health strategies such as probiotics, biosecurity measures, and vaccinations can play a crucial role in mitigating AMR. Additionally, farmer education programs are essential to raise awareness about the responsible use of antibiotics and best practices for disease prevention in livestock management.

Furthermore, international collaboration and investment in research and innovation will be necessary to develop new antimicrobial alternatives and improve diagnostic tools for early detection of resistant strains. By implementing a holistic and integrated approach, Ethiopia can contribute to global efforts in combating AMR and ensuring the sustainability of its livestock production systems for future generations. Addressing this challenge requires coordinated efforts among policymakers, veterinarians, farmers, and researchers. Strengthening regulations, enhancing surveillance, and promoting alternative health strategies can play a vital role in mitigating AMR and ensuring sustainable livestock production.

## Abbreviations

AMR	Antimicrobial Resistance
β-lactams	Beta-lactam Antibiotics

## Author Contributions

**Helen Aklilu:** Writing – original draft

**Danayit Alem:** Conceptualization, Writing – review & editing

## Conflicts of Interest

The author declares no conflicts of interest.

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