Strengthening Rwanda's Antimicrobial Resistance Response: A Policy Evaluation and Recommendations, 2025

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ABSTRACT

INTRODUCTION: Antimicrobial resistance (AMR) threatens public health, food safety, and economic stability, with low- and middle-income countries like Rwanda disproportionately affected. AMR leads to resistant infections in humans and animals, increasing morbidity, mortality, and healthcare costs.

METHODS: A qualitative policy evaluation was conducted using a literature and policy review of Rwanda's National Action Plans (NAP 1: 2020–2024; NAP 2: 2025–2029) and global evidence on AMR control. Four policy options (strengthening surveillance, regulating livestock antimicrobial use, enforcing prescription-only antibiotic sales, and maintaining the status quo) were assessed using criteria including equity, sustainability, efficacy, value for money, and One Health alignment.

RESULTS: Policy evaluation of four alternatives strengthening AMR surveillance, regulating livestock antimicrobial use, enforcing prescription-only antibiotic sales, and maintaining the status quo shows that enhanced surveillance is most equitable, sustainable, and holistic. Livestock regulation ranks highest in efficacy and cost-effectiveness, while doing nothing risks worsening the AMR burden.

CONCLUSION: Rwanda should prioritize establishing a decentralized, multisectoral AMR surveillance system integrating human, animal, and environmental data, supported by livestock antimicrobial regulation and strict enforcement of prescription-only antibiotic sales.

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INTRODUCTION

Antimicrobial resistance (AMR) occurs when microorganisms, including bacteria, parasites, viruses, and fungi, develop the ability to resist antimicrobial agents designed to kill them [1]. Globally, AMR was responsible for an estimated 1.27 million deaths and was associated with 4.95 million deaths in 2019 [2]. Low- and middle-income countries (LMICs) are disproportionately affected due to weaker health systems, limited laboratory capacity, and widespread misuse of antibiotics [3].

Rwanda faces a growing AMR burden. Studies have reported increasing resistance to commonly used antibiotics, including ceftriaxone, ampicillin, and ciprofloxacin [4], with additional reports of multidrug-resistant infections among hospitalized patients [5], high rates of bloodstream infections with resistant bacteria [6], and emerging artemisinin partial resistance in Plasmodium falciparum infections [7]. Evidence also indicates high levels of antimicrobial use in animals, contributing to the transmission of resistant pathogens to humans [8, 10]. AMR threatens public health, food safety, and economic stability. Globally, AMR could push 24 million people into extreme poverty by 2030 and reduce global GDP

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by up to US$3.4 trillion annually if not addressed [11,12]. Rwanda has implemented the first National Action Plan (NAP 1), but only 34% of planned activities were achieved [13]. The proposed NAP 2 (2025–2029) risks similar shortfalls if gaps such as weak surveillance, misuse of antimicrobials in livestock, and over-the-counter antibiotic sales are not addressed [14,15].

Therefore, the purpose of this policy evaluation is to identify gaps in Rwanda's current AMR response and assess the effectiveness, sustainability, equity, and feasibility of potential interventions. By analyzing key policy options, this study aims to provide evidence-based recommendations to strengthen national surveillance, regulate antimicrobial use in humans and livestock, and curb over-the-counter sales of antibiotics.The goal is to support Rwanda in implementing a robust, coordinated, and sustainable AMR strategy that protects public health and aligns with global standards.

METHODS

This study employed a qualitative policy evaluation approach to assess strategies for strengthening antimicrobial resistance (AMR) control in Rwanda. The analysis was guided by commonly used frameworks in global health policy evaluation. A policy analysis and comparative assessment design was used to evaluate existing AMR policies and identify potential interventions. The study involved three main steps.

First, a literature review was conducted to examine Rwanda's current AMR response and global evidence on effective AMR control strategies. Key national policy documents reviewed included the Rwanda National Action Plan on Antimicrobial Resistance (NAP 1: 2020–2024) and the National Action Plan on Antimicrobial Resistance (NAP 2: 2025–2029). These were complemented by international guidelines and reports from the World Health Organization (WHO) and other global health agencies. Peer-reviewed studies from databases such as PubMed and Google Scholar were also examined to identify evidence on AMR drivers and effective policy interventions implemented in other countries.

Second, the policy and literature review were used to identify major gaps in Rwanda's AMR response. The analysis highlighted three key challenges: weak AMR surveillance systems, misuse of antimicrobials in livestock production, and widespread over-the-counter sales of antibiotics without prescription.

Third, policy alternatives were developed and comparatively assessed based on these identified gaps and evidence from global best practices. Four policy options were evaluated: strengthening AMR surveillance systems, regulating antimicrobial use in livestock, enforcing the prohibition of over-the-counter antibiotic sales, and maintaining the current approach without additional interventions.

Each policy option was evaluated using five criteria commonly applied in health policy analysis: equity, sustainability, efficacy, value for money, and a holistic approach aligned with the One Health framework, which integrates human, animal, and environmental health sectors. These criteria were used to compare the potential impact of each policy option in addressing antimicrobial resistance in Rwanda.

The results of this evaluation are presented in Table 1, where policy options are scored using a qualitative three-level scale: + (low contribution), ++ (moderate contribution), and +++ (high contribution). These scores were assigned based on the strength of evidence from the reviewed literature, policy reports, and documented experiences from other countries implementing similar AMR interventions. These criteria were selected based on widely used frameworks in health policy analysis and global health decision-making based on evidence from published literature, international guidelines, and policy reports.

This policy review was based solely on the review and analysis of publicly available policy documents, reports, and peer-reviewed literature related to antimicrobial resistance in Rwanda. No human participants, interviews, surveys, or primary data collection were involved in this policy evaluation. Therefore, ethical approval from an institutional review board was not required. All sources used in the study have been appropriately cited to ensure academic integrity and transparency.

RESULTS

Gaps in AMR Control in Rwanda

In Rwanda, AMR caused 2,400 deaths and contributed to 9,800 deaths in 2019, ranking the country 34th out of 204 nations in age-standardized mortality rates related to AMR [16].

Despite Rwanda's efforts through the first National Action Plan (NAP 1), several critical gaps persist in mitigating AMR.

Weak AMR Surveillance Systems: Local surveillance data reveal alarming resistance patterns. A retrospective study at Kigali University Teaching Hospital (CHUK) from 2017–2018 reported multidrug resistance of 77.1% in 341 positive blood cultures, particularly against penicillin, ampicillin, and trimethoprim-sulfamethoxazole [4]. Moreover, 75.9% of 241 gram-negative isolates from urine, blood, sputum, and wound samples showed resistance to ceftriaxone in 2019 [5]. Bizimungu et al. [6] further highlighted high rates of AMR among gram-negative bacteria and the emergence of carbapenem resistance, while Schreidah et al. [7] detected partial artemisinin resistance in Plasmodium falciparum infections, affecting malaria control. NAP 1 also revealed gaps in laboratory capacity, biosafety standards, data quality, and reporting mechanisms [14]. Only a limited number of laboratories participate in systematic AMR surveillance, and reporting to WHO GLASS remains fragmented [1]. Strong surveillance systems in other countries have been shown to reduce morbidity, mortality, and inappropriate antibiotic use [17, 18], emphasizing the urgent need for Rwanda to strengthen monitoring and reporting frameworks.

Misuse of Antimicrobials in Livestock Production: Antimicrobial use in livestock significantly contributes to the emergence and transmission of resistant pathogens to humans. Resistance to tetracycline was reported at 35.6% among animals in Rwanda's Eastern Province in 2019 [8]. Extensive use of antibiotics for growth promotion and disease prevention in animals has been documented in LMICs, including Rwanda [19]. Such misuse facilitates the emergence of resistant bacteria such as E. coli and Salmonella [8]. Evidence from the European Union demonstrates that restricting antimicrobial use in livestock significantly reduces resistance transmission, improving both human and animal health outcomes [9,20]. AMR from livestock also impacts food safety and productivity, creating broader societal and economic risks [1,21].

Over-the-Counter (OTC) Sales of Antibiotics: The availability of antibiotics without prescription remains a significant driver of AMR in Rwanda. A study in Kigali found that 73% of pharmacies dispensed antibiotics without prescriptions [22], despite regulatory frameworks prohibiting such practices [23]. Globally, strict enforcement of OTC bans has been shown to reduce antibiotic misuse and slow the spread of resistant strains [13, 24]. Failure to regulate OTC sales undermines national AMR strategies and increases the risk of treatment failures, prolonged hospitalization, and additional healthcare costs [1, 21].

Broader Public Health and Economic Impacts

AMR threatens human health, animal health, and the environment, leading to infections that are increasingly difficult or impossible to treat. Such infections require costly second- or third-line therapies and longer hospital stays [1]. Globally, AMR could cause economic losses of $300 billion to $1 trillion by 2050 [16], disproportionately affecting LMICs due to high infectious disease prevalence and labor dependence [21]. The overuse of antibiotics in livestock exacerbates these challenges through transmission of resistant zoonotic pathogens [1]. These gaps underscore the urgent need for strengthened AMR surveillance, regulation of antimicrobial use in humans and animals, enforcement of OTC bans, and multisectoral interventions in Rwanda.

Current Approaches to AMR Control in Rwanda

Following the 68th World Health Assembly in 2015, which urged countries to develop National Action Plans (NAPs) on antimicrobial resistance (AMR), Rwanda established its first NAP on AMR (NAP 1.0) covering the period 2020–2024 [14]. NAP 1.0 adopted a One Health approach, addressing AMR through enhanced awareness, surveillance, infection prevention and control, sustainable investment, and regulation of antimicrobial use across human, animal, and environmental health sectors [14]. However, an evaluation by the Republic of Rwanda indicated that only 34% of planned actions were fully implemented [15]. Key gaps included incomplete mapping of antimicrobial distribution pathways, limited laboratory capacity, and inadequate data management within the animal health sector [15]. To address these shortcomings, Rwanda developed NAP 2 for the period 2025–2029, spearheaded by the Rwanda Biomedical Center (RBC) in

collaboration with the Food and Agriculture Organization of the United Nations (FAO) [3]. NAP 2 emphasizes the establishment of a comprehensive surveillance system, detailed mapping of antimicrobial distribution, and pilot studies to strengthen data collection and analysis [6]. While NAP 2 demonstrates a more structured and comprehensive approach, its success depends heavily on effective implementation. Current evidence suggests that AMR remains underreported outside teaching hospitals, indicating persistent surveillance gaps [25]. Therefore, coordinated and actionable interventions are urgently needed to reduce the burden of AMR in Rwanda.

Call for Action: Policy Alternatives for Strengthening AMR Control in Rwanda

Option 1: *Establish a Stronger AMR Surveillance System in Human and Veterinary Medicine*

A robust AMR surveillance system is essential to detect resistance patterns and respond with timely interventions [17]. Weak surveillance allows resistant bacteria to spread silently, exacerbating AMR [21]. Establishing a national AMR surveillance system accessible to healthcare providers and veterinary specialists is crucial. This system should be decentralized to district hospitals and veterinary posts, equipped to detect resistant pathogens promptly. For example, Nepal implemented a One Health AMR surveillance system in sentinel hospitals and veterinary laboratories, which facilitated the detection of multidrug-resistant Vibrio cholerae and informed antibiotic stewardship [26].

Advantages: Effective surveillance provides data to track AMR trends, informing infection prevention and control policies nationally and contributing to WHO GLASS reporting [27].

Disadvantages: Implementation requires advanced diagnostics, skilled personnel, and funding, which could strain national budgets without external support from stakeholders such as the private sector, NGOs, WHO, and other international organizations [18].

Option 2: *Regulate Antimicrobial Use in Livestock*

The overuse of antibiotics in animals for growth promotion, treatment, and prophylaxis contributes significantly to human AMR via direct contact or consumption of animal products [19,28]. Restricting antimicrobial use in livestock has proven effective, as seen in the European Union, where antibiotics for growth promotion were banned and prophylactic use requires veterinary supervision, reducing AMR in animals and humans [9,29]. In Rwanda, awareness gaps persist; a study in the Eastern Province found that 83.9% of cattle farmers obtained antibiotics from neighbors or friends, and 61.9% used them for growth promotion [30].

Advantages: Proper antimicrobial use in livestock reduces AMR through a One Health approach, improves farmer knowledge, and minimizes economic losses from overuse [20, 31].

Disadvantages: Limited knowledge among animal health professionals could hinder policy enforcement; 67.96% of respondents in five Rwandan districts were unaware of the link between animal and public health [32].

Option 3: *Enforce Prohibition of Over-the-Counter (OTC) Antibiotic Sales*

OTC sales of antibiotics without prescriptions drive misuse and increase AMR [13,33]. Before 2022, Rwanda lacked an explicit policy prohibiting OTC sales, but the Rwanda FDA now enforces regulations with sanctions for violations [23]. Despite regulatory efforts, non-prescribed antibiotic use remains common globally, including in Rwanda, necessitating robust law enforcement and monitoring [24,34].

Advantages: Reducing OTC sales can significantly decrease antibiotic misuse, lowering AMR risk [12].

Disadvantages: Stricter enforcement may increase patient load on healthcare systems and limit access to medicines in rural areas with few healthcare providers [21].

Option 4: *Maintain Status Quo ("Do Nothing")*

This alternative proposes minimal additional intervention, leaving NAP 2's activities unenhanced.

Advantages: No additional funding, training, or surveillance is required, minimizing budgetary impact.

Disadvantages: AMR will continue to rise, potentially causing 39.1 million global deaths over the next 25 years and exacerbating poverty in LMICs [35].

Comparing AMR Policy Actions

Policy options were compared across five criteria

(equity, sustainability, efficacy, cost-effectiveness, and One Health alignment) based on their advantages, disadvantages, and feasibility.

Table 1 presents a qualitative comparison of four policy alternatives for addressing AMR in Rwanda using five evaluation criteria: equity, sustainability, efficacy, value for money, and holistic approach. The scores reflect the relative strength of each policy option based on these criteria.

Strengthening surveillance systems scored highest in equity and sustainability, as decentralized surveillance allows nationwide monitoring and ensures that both rural and urban populations benefit from early detection of antimicrobial resistance patterns. This option also strongly supports a One Health approach by integrating data from human, animal, and environmental health sectors. Regulating antimicrobial use in livestock showed the highest performance in efficacy and value for money, as reducing antibiotic misuse in food-producing animals addresses one of the major drivers of AMR and has demonstrated effectiveness in several countries, including those within the European Union.

Enforcing the prohibition of over-the-counter antibiotic sales showed moderate benefits across most criteria, particularly in sustainability and efficacy. However, potential equity challenges may arise in rural areas where healthcare access remains limited. In contrast, maintaining the status quo ("do nothing") option scored lowest across all criteria, as failure to strengthen AMR control strategies would likely allow resistance to continue increasing, resulting in greater health and economic burdens.

Policy Recommendations

Rwanda should prioritize a robust, decentralized AMR surveillance system that integrates human, animal, and environmental health data. This approach enables early detection of resistance, supports evidence-based clinical decisions, and strengthens national reporting to WHO GLASS [27]. Surveillance should extend beyond tertiary hospitals to district hospitals, veterinary laboratories, and environmental sites to improve coverage and inform targeted interventions.

To complement surveillance, antimicrobial use in livestock should be regulated to reduce resistance transmission from animals to humans, and prescription-only antibiotic sales should be strictly enforced to prevent community misuse.
Together, these strategies adopt a One Health approach, recognizing the interconnectedness of human, animal, and environmental health. Implementation requires coordinated collaboration among government agencies, veterinary services, research institutions, and international partners. This combined approach offers Rwanda a sustainable and comprehensive pathway to reduce antimicrobial resistance and protect public health [6].

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Table 1: *Comparative Assessment of Policy Alternatives for AMR Control in Rwanda*

Policy	Equity	Sustainability	Efficacy	Value for Money	One Health Approach
Do Nothing	+	+	+	+	+
Strengthening Surveillance System	+++	+++	++	+	+++
Reduction of antimicrobial use in Livestock	++	++	+++	+++	++
Stopping Over the counter sales of Antibiotics	+	++	++	++	++

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