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# Integrating the One Health Approach to Combat Antimicrobial Resistance in Developing Countries

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## ABSTRACT

The study reviews Antimicrobial Resistance (AMR) within the One Health (OH) concept framework. We went over papers covering "AMR" and "OH." AMR most clearly embodies the idea of OH among world health concerns. AMR is a worldwide problem affecting people, their surroundings, and wildlife. This relates to every one of the three components because of the careless and too-strong use of antimicrobials in many different sectors (human, cattle, and agricultural). Resistant bacteria proliferate due to inadequate antibiotic management, poor infection control, agrarian waste, environmental pollutants, and human and animal mobility, carrying resistant germs. Emphasizing the several stakeholders involved in OH, the study aimed to investigate the problem of AMR from the health perspective.

**Keywords:** *Health, Antimicrobial Resistance, Review, Medical, One Health, Antimicrobials*

## INTRODUCTION

Among world health concerns, antimicrobial resistance (AMR) [1] best illustrates the One Health (OH) [2][11] approach. The OH approach is a cooperative effort across several disciplines to solve environmental, human, and animal health issues. These components are linked to AMR because of the unethical and excessive use of antibiotics across many sectors, including human healthcare, cattle, and agriculture [3]. Under antimicrobial stress, bacteria acquire mobile genes and genetic components that can spread to other germs of either the same or different genera. AMR-developing bacteria improve their ability to proliferate in humans, animals, and the surroundings [4] [12]. Resistance is partly spread by incorrect use of antimicrobials, inadequate treatment of illnesses, agricultural waste, environmental pollutants, and mobility of people and animals carrying resistant bacteria.

The "OH, One World (OW)" concept includes molecular epidemiologic features that improve understanding of antibiotic resistance development and genetic relationships in infections, hosts, and their environments globally. Important drivers for the global spread of AMR are economic ones, including international trade, conflicts, forced travel, and human and animal transportation [5]. It emphasizes

geographically close surroundings necessary for the spread of AMR. Recent advancements in the OH-OW effort to fight AMR internationally have come from Chile-Sweden cooperation [6]. In humans and animals, poor use of antibiotics, contaminated environment, and ineffective infection control policies help to explain AMR's local and global spread. The indiscriminate use of antibiotics in people, animal neighborhoods, and their habitats has resulted in resistant reservoirs from which drug remnants or genes resist in the ecosystem [13]. Many environmental reservoirs—including soil, water, hospitals, industrial sites, agricultural waste, and innumerable polluted ecosystems—help spread AMR. The elements affecting AMR's worldwide and local distribution include environmental pollution, careless antibiotic use in humans and animals, and inadequate infection control policies. The indiscriminate use of antibiotics in people, animal neighborhoods, and their habitats has resulted in resistant reservoirs from which drug remnants or genes resist in the ecosystem [7]. Several environmental reservoirs that help AMR spread include soil, water, hospitals, factories, agricultural waste, and innumerable polluted ecosystems. The transmission or dissemination of infections possessing genes for resistance is facilitated among individuals, creatures, and their respective environments [14]. Recently, a few scientists have challenged the role of the animal industry in the ABR epidemic, citing little illnesses in humans linked to cattle or fisheries [10].

### **Related Works**

Utilization of Antimicrobials in People, Humans, and Vegetation Certain antimicrobials were utilized for decades before the emergence of resistance, while others exhibited resistance in a significantly shorter timeframe [8]. Antimicrobials characterized by a gradual rise in resistance, particularly vancomycin, were esteemed for their sustained efficacy in treating infections unresponsive to more frequently utilized antibiotics [9]. The rising resistance to vancomycin is alarming, as some bacterial strains, formerly considered minor health threats, such as vancomycin-resistant microorganisms, are significantly contributing to death and morbidity, especially in hospital settings. Antimicrobials serve multiple purposes in animals: pets, aquaculture fish, bees, and livestock. Antimicrobials have various functions (therapeutic, preventive, and growth promotion) and are crucial in the farming of animals. The global amount of antimicrobials utilized in animals is anticipated to exceed that used in people. Several antimicrobials utilized in human treatment are prescribed for livestock, including essential categories such as wide-spectrum beta-lactic acids and quinolones.

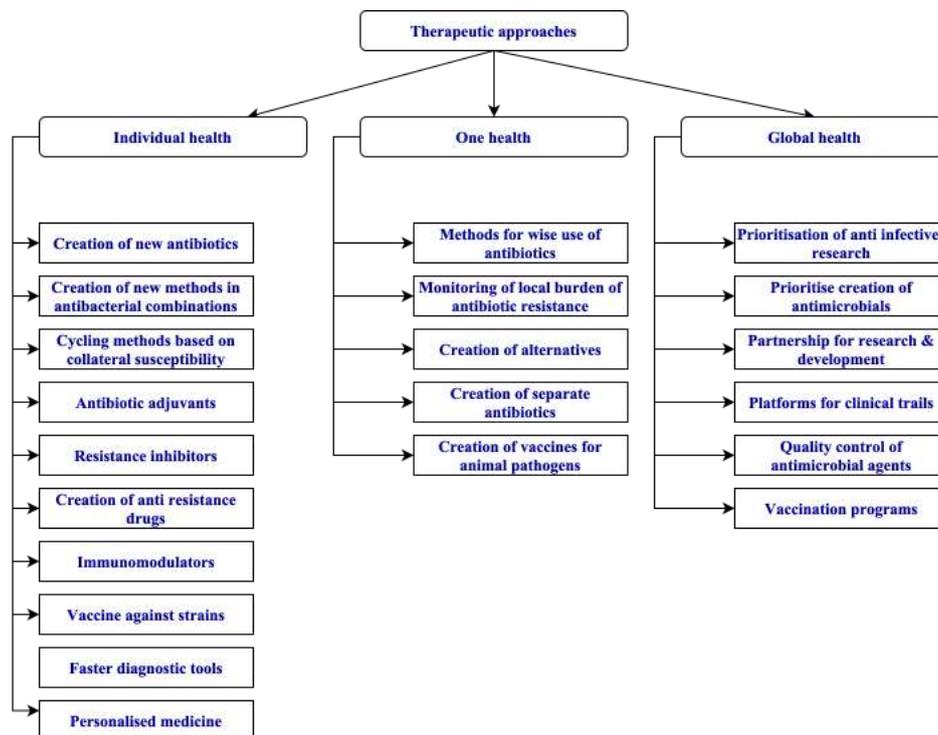


Fig. 1. Therapeutic model classifications

Certain antimicrobials in people and animals, such as tetracycline, triazoles, and streptomycin, are utilized therapeutically in vegetation (Fig. 1). AMR can be readily disseminated across various ecosystems and people; resistant zoonotic organisms exist in the soil, from which they infect crops, vegetables, and fruits. The application of antibiotics to crops has been shown to promote the transmission of AMR fungus from the soil to people. Certain antimicrobials, such as carbapenems, are designated only for human usage, while others are restricted solely to use in animals, like flavophospholipol and ionizing radiation. Additional antimicrobials for therapeutic application, including tetracycline and streptomycin, are utilized for prevention and therapy against microorganisms responsible for fruit infections. The dosages of antimicrobials used in aquaculture exceed those recommended for animals. Antibiotic residues persist in fish products and can endure in aquatic settings for extended periods via excretion [15]. The leftovers disseminate swiftly in marine environments, imposing specific pressure. Antimicrobial drugs are extensively utilized as growth enhancers, accounting for the substantial quantities of antimicrobials employed in the animal feed business.

Proper cleanliness and sanitation are essential for infection control in medical settings, particularly in hospitals, minimizing the transmission of AMR or resistance genes from institutions to the outside world. In veterinarian and agricultural environments, alongside biosecurity measures, the judicious application of antibiotics for medicinal or prophylactic purposes must be adhered to. The transmission of resistant microorganisms and AMR genes from the atmosphere to humans can be mitigated by enforcing control measures to enhance water and food standards, particularly in Low- and Middle-Income Countries (LMIC).

#### **Obstacles in Executing Plans to Combat AMR**

Numerous difficulties obstruct the mitigation of AMR. This study examines notable barriers that hinder the effective execution of AMR initiatives.

### The Burden of Illness

The battle against AMR is formidable, particularly in resource-constrained environments, where the significant prevalence of bacterial illnesses, poverty, inadequate governance, fragile healthcare systems, and little understanding of drug-resistant infections provide considerable obstacles. These concerns are especially prominent in numerous methods, presenting significant barriers in the battle against AMR. Strategies must improve their health structures using laws and regulations against illegal antimicrobial use, the application of AmR programs, standard treatment guidelines for common infections, and the launch of feasible public awareness campaigns to change health-seeking behavior and address these systematic challenges effectively. Crucially, to counteract the current trends in AMR is increased investment in vaccine research and growth, new pharmaceuticals, improvements in sanitation, hygiene, and access to water to prevent common diseases, and advancing tests for early identification and treatment of diseases.

### 3.2 Human Resources and Insufficient Capacity Development for AMR

Especially in LMIC, inadequate human resources are a significant issue in implementing strategies to fight AMR. These countries often have limited resources and insufficient staff to carry out effective AMR campaigns and address local diseases. There is a dearth of trained medical professionals competent to identify and treat AMR disorders precisely. Inadequate finance for antimicrobial management and a lack of microbiologists, chemical engineers, infectious disease experts, and technical assistance for intervention implementation define resource limitations. The dearth of manpower calls for specialized experts for AMR control initiatives and Infection Prevention and Control (IPC), which neither country has. According to a National Board of Health survey, awareness of IPC programs was lacking. To keep antibiotics effective, the AMR counsels prioritize staffing for stewardship programs.

The deficiency in the capacity development of healthcare professionals hinders effective antimicrobial resistance surveillance and AMR implementation. A worldwide deficit of AMR personnel with the requisite knowledge and skills has emerged. These issues persist in delaying the effective execution of successful methods for fighting AMR.

### 3.3 Financial Obstacles for AMR

Acquiring adequate financing for AMR programs frequently presents a considerable obstacle. Some countries deprioritize funding for these programs, viewing them as less critical than other healthcare issues. The problem is especially significant in countries with low or middle incomes because most nations rely on external financing to plan and execute AMR programs. The decision to prioritize health in certain countries is a political matter. The participation of many government entities in AMR programs might complicate cooperation and expenditure monitoring. The involvement of the private sector is frequently constrained by insufficient monetary incentives for investing in the study and manufacture of novel antimicrobials. Although global coordination and collaboration are essential to tackle AMR, achieving this is sometimes challenging due to conflicting interests and objectives among many nations.

### 3.4 Behavioral Change Challenges Regarding Antimicrobial Utilization

As humans manage and employ antimicrobials, their behavior influences all aspects of AMR, including its avoidance. AMR is caused by the overuse and improper use of antimicrobials in humans and animals, often stemming from behavioral factors. Therefore, the absence of behavioral modification leads individuals to persist in self-prescription customs, which are significant contributors to the rise of AMR diseases. Altering behavior is arduous, and persuading individuals to embrace new routines and habits can be formidable. The research asserts that the improper prescription, dispensing, management, and utilization of antibiotics will persist if behavioral modification is not tackled.

### 3.5 Laboratory Limitations and Inefficient Monitoring Systems

LMIC encounters considerable obstacles in ensuring supply chain integrity and distributing supplies such as machinery, testing, and consumables. Ecological, practical, and financial limitations exacerbate these obstacles. Regulatory challenges, including stringent rules for air shipment shipping, can result in significant delays and impact secure cold chain preservation. Guidelines for selecting, collecting, and transporting laboratory samples are sometimes lacking. Resulting in an absence of quality control and a lack of regular oversight of quality metrics. In numerous LMICs, fundamental prerequisites for an operational laboratory infrastructure are still unfulfilled.

### 3.6 Ineffectual Leadership, Management, and Integrated AMR Initiatives

The insufficient commitment among governmental authorities to address AMR is a significant issue. The execution of National Action Plans on AMR necessitates the engagement of decision-makers at all tiers, a condition often unmet in numerous healthcare institutions and governmental entities. Executing all AMR initiatives necessitates governmental commitment; without such dedication, the battle against AMR will fail. Regrettably, confident leaders lack awareness of AMR programs. This renders the beginning and execution of AMR operations arduous.

Unorganized or inconsistently executed AMR initiatives hinder the battle against AMR. Pathogenic teams of professionals have been identified as obstacles to implementing AMR programs in healthcare institutions. Certain hospitals lack operational AMR programs, which facilitate illogical prescribing, distribution, and administration of antibiotics. Certain facilities lack procedures for treatment to assist prescribers in logical prescribing practices. As a result, most institutions do not possess dependable antibodies for properly monitoring AMR trends. The research asserts that addressing these difficulties will facilitate the mitigation of AMR across various industries. The study underscores the necessity for increased cooperation, managerial dedication, and capacity enhancement to combat AMR effectively.

### **OH's strategy to address AMR**

The OH strategy is comprehensively included in worldwide initiatives to tackle the issue of AMR. Numerous challenges include the conflicting interests of several industries and groups engaged in animal, human, and ecological well-being. These stakeholders must reach a consensus on essential goals for action, optimal methods for monitoring AMR and controlling infections, and the rules that should regulate antimicrobial usage. Crucial methods for tackling AMR using the OH framework are delineated:

1. Implement a worldwide public awareness initiative to inform society of the detrimental effects of antibiotic excess and abuse. Executing efficient public relations efforts can diminish the quantity of prescribed antibiotics.
2. Enhance and fortify hygiene protocols to mitigate the transmission of pathogens. Enhancing healthcare systems and living conditions can substantially diminish the demand for antimicrobials, hence mitigating the danger of developing new resistant strains.
3. Minimize the superfluous application of antimicrobials to crops and their release into the natural world. The highest quantities of antimicrobials are utilized in agriculture and aquaculture worldwide. The administration of antibiotics for prophylactic purposes and as growth enhancers ought to be regarded as perilous and superfluous. It has been shown that animals excrete a substantial proportion (75%-90%) of antibiotics unaltered, releasing them into the atmosphere.
4. Enhance global monitoring of medication resistance. The healthcare and scientific communities require an in-depth knowledge of current and past information on AMR to elucidate new processes of resistance acquiring it, ascertain present cases, and anticipate future risks. Achieving this necessitates an in-depth knowledge of three domains: antibiotic usage in both people and animals, prevailing rates of resistance to antibiotics, and an enhanced comprehension of the molecular processes underlying AMR.

5. Advocate for innovative and expedited diagnostic procedures. Incorrect diagnoses occurring in public or private clinics result in unwarranted antibiotic prescriptions. The creation of swift and precise tests for diagnosis will enable physicians to provide antimicrobials to those in need.
6. Advocate for the advancement and utilization of vaccinations and substitutes. The creation of vaccinations targeting resistant bacteria to antibiotics responsible for severe illnesses will decrease the incidence of infected people requiring antimicrobial therapy. Further investments are needed to develop novel vaccines and alternative antibiotic alternatives, including phage treatment, antibiotics, antigens, and lysins.
7. Acknowledge and augment the workforce engaged in infectious disease management. Combating AMR necessitates the expertise of specialists like microbiologists, pharmacies, contagious disorder experts, nursing staff control of infections experts, doctors, and epidemiologists. Countries must allocate resources toward the education of this human capital.
8. A worldwide innovation grant supporting nascent research on novel therapies. Increased public and commercial funding in drug discovery studies is essential for developing novel treatments. A global breakthrough fund is necessary to finance research that lacks economic viability.
9. Establish enhanced incentives to encourage investment in developing new pharmaceuticals and improving existing ones. Creating new antibiotics is unappealing to medicine companies due to the presence of highly efficient antimicrobial drugs currently available in marketplaces—the unpredictability of AMR's development challenges pharmaceutical businesses in their decision-making processes.

Establish a global alliance for effective action towards AMR. International intervention is crucial for substantial advancement in combating AMR. Incorporating AMR into the worldwide political agenda and dealing with it through an OH approach is essential for instigating action.

### Conclusion

To address AMR, it is essential to endorse an "OH" strategy that includes human, animal, plant, and ecological wellness. This necessitates expediting global advancement, innovating to ensure future security, partnering for enhanced efficacy, engaging in environmentally friendly solutions, and fortifying international oversight and accountability. Most antibiotic categories are accessible for application in humans and animals. AMR can be mitigated when antibiotics are utilized solely for therapeutic purposes, infrequently for prophylactic measures, and never as growth enhancers. Success necessitates stringent and effective regulation of the kinds and levels of antimicrobials utilized in medical execution, as well as tracking and keeping track of the expansion of resistant microbes disseminating into the surrounding atmosphere.

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