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Review Article

Antimicrobial Resistance and Health Equity: Disproportionate Public Health Impacts in Resource-Limited Settings

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ABSTRACT

Antimicrobial resistance (AMR) is one of the most pressing global public health threats, compromising the effectiveness of antimicrobial therapies and increasing the burden of infectious diseases worldwide. Although AMR affects all populations, its impacts are disproportionately concentrated in resource-limited settings where poverty, inadequate healthcare infrastructure, poor sanitation, and limited access to quality medicines increase vulnerability to resistant infections. This narrative review examines the relationship between AMR and health equity, highlighting how social and structural determinants shape exposure, susceptibility, and health outcomes among disadvantaged populations. Literature published between 2015 and 2026 was identified through searches of PubMed, Scopus, Web of Science, and Google Scholar and synthesized using a thematic narrative approach. The review identifies poverty, inadequate water, sanitation and hygiene infrastructure, low health literacy, weak healthcare systems, limited diagnostic capacity, workforce shortages, and insufficient surveillance systems as major contributors to AMR vulnerability. Women, children, rural populations, refugees, migrants, and displaced communities experience disproportionate burdens due to overlapping social and healthcare disadvantages. A One Health perspective further demonstrates how human, animal, and environmental factors interact to accelerate resistance transmission. Addressing AMR requires equity-centered strategies that strengthen primary healthcare, improve access to diagnostics and treatment, enhance surveillance systems, expand water and sanitation infrastructure, and promote community engagement. AMR is not merely a biological phenomenon but a manifestation of broader social and structural inequities requiring integrated and sustainable public health responses.

Keywords: Antimicrobial Resistance; Health Equity; Global Health; Low-Resource Settings; Healthcare Access; Health Disparities; One Health.

Introduction

Antimicrobial resistance (AMR) has emerged as one of the most pressing public health challenges of the twenty-first century, threatening decades of progress in infectious disease prevention and treatment[1]. The effectiveness of antibiotics, antivirals, antifungals, and antiparasitic agents is increasingly undermined by the evolution and spread of resistant microorganisms, resulting in infections that are more difficult and costly to treat[2]. AMR compromises the management of common infectious diseases and threatens the safety of routine medical procedures, including surgery, cancer chemotherapy, organ transplantation, and intensive care interventions. As resistance continues to expand across human, animal, and environmental systems, it is increasingly recognized as a global crisis requiring coordinated and multisectoral responses [3].

Recent evidence demonstrates the substantial health burden associated with AMR worldwide. Resistant bacterial infections contribute to millions of deaths annually, with projections suggesting that the burden will continue to rise if current trends persist. Beyond mortality, AMR increases the duration and severity of illness, prolongs hospital stays, raises healthcare expenditures, and reduces productivity through disability and lost economic opportunities [4]. The consequences extend beyond individual patients to healthcare systems, national economies, and global development goals. While AMR affects all countries, its impacts are not distributed equally. Significant disparities exist in exposure, vulnerability, access to treatment, and health outcomes, resulting in disproportionate burdens among socially and economically disadvantaged populations [5].

Traditionally, AMR has been approached primarily as a microbiological or clinical problem driven by inappropriate antimicrobial use, pathogen evolution, and insufficient drug development. Although these factors remain important, growing evidence suggests that AMR is also fundamentally shaped by broader social, economic, and structural determinants of health[6]. Conditions such as poverty, inadequate housing, limited access to clean water and sanitation, weak healthcare infrastructure, educational inequalities, and constrained access to essential medicines influence both the emergence and consequences of resistant infections[7]. These determinants create environments in which infectious diseases spread more readily and where individuals face greater barriers to timely diagnosis, effective treatment, and preventive care.

The burden of AMR is particularly severe in low-income and resource-limited settings. Many countries face persistent shortages of healthcare professionals, diagnostic laboratories, surveillance systems, and quality-assured medicines. In such contexts, empirical antibiotic prescribing often replaces laboratory-guided treatment, increasing the likelihood of inappropriate antimicrobial use. Limited regulatory oversight may also facilitate the circulation of counterfeit or substandard medicines, further contributing to resistance development[8]. Simultaneously, inadequate water, sanitation, and hygiene infrastructure promotes the transmission of infectious pathogens and resistant organisms within communities[9]. These challenges frequently coexist with broader socioeconomic vulnerabilities, amplifying the risk of adverse health outcomes among already marginalized populations.

The relationship between poverty, weak health systems, and resistant infections creates a cycle of disadvantage that reinforces existing health inequities. Individuals with limited financial resources may delay seeking care, rely on informal drug markets, or discontinue treatment prematurely because of cost barriers. Such practices not only increase individual health risks but also contribute to the emergence and spread of resistance at the population level[10]. Consequently, AMR should be understood not only as a biological phenomenon but also as a manifestation of structural inequities that shape opportunities for health and access to healthcare services.

Despite increasing global attention to AMR, discussions of health equity remain insufficiently integrated into many policy and research frameworks. Greater emphasis on equity is necessary to understand why certain populations experience disproportionate risks and to design interventions that address the root causes of vulnerability. This review examines how antimicrobial resistance disproportionately affects resource-limited populations through structural inequities in healthcare access, sanitation, surveillance, diagnostics, and treatment availability, while proposing equity-centered strategies for mitigation[11].

Methodological Approach

This study employed a narrative review methodology to synthesize current evidence on the intersection between antimicrobial resistance (AMR) and health equity in resource-limited settings. A narrative approach was selected because of the multidisciplinary nature of the topic, which spans public health, infectious disease epidemiology, health systems research, social determinants of health, and global health policy. This approach enabled the integration of evidence from diverse study designs and policy reports to provide a comprehensive understanding of the factors driving inequitable AMR burdens.

A structured literature search was conducted using four major electronic databases: PubMed, Scopus, Web of Science, and Google Scholar. Searches were performed using combinations of key terms including "antimicrobial resistance," "health equity," "health disparities," "low-income countries," "resource-limited settings," "access to healthcare," and "global health." Additional relevant publications were identified through reference list screening and targeted searches of reports from international organizations.

Studies were eligible for inclusion if they were published in English between 2015 and 2026 and addressed AMR within the context of healthcare access, social determinants of health, health disparities, or public health outcomes in low-resource environments. Peer-reviewed journal articles, systematic reviews, observational studies, policy analyses, and reports from the World Health Organization (WHO) and other recognized international agencies were considered. Publications lacking relevance to health equity dimensions of AMR were excluded.

The selected literature was analyzed using a thematic narrative synthesis approach. Evidence was organized into key themes, including social determinants of vulnerability, health system inequities, impacts on vulnerable populations, One Health considerations, and equity-focused strategies for AMR mitigation.

Following database retrieval, titles and abstracts were screened for relevance to antimicrobial resistance and health equity themes. Full-text articles deemed potentially eligible were subsequently reviewed. Preference was given to studies addressing social determinants of health, healthcare access, vulnerable populations, One Health perspectives, and policy responses within low- and middle-income countries. The final body of evidence was synthesized thematically to identify recurring patterns, knowledge gaps, and implications for equity-oriented antimicrobial resistance interventions. Although the review followed a structured search process, formal quality appraisal and quantitative meta-analysis were not undertaken because of the heterogeneous nature of the included evidence.

Social and Structural Determinants of AMR Vulnerability

Poverty and Economic Inequality

Poverty is a fundamental determinant of vulnerability to antimicrobial resistance (AMR) because it influences access to healthcare, treatment quality, and exposure to infectious diseases. Individuals living in economically disadvantaged settings often face substantial barriers to healthcare services, including consultation fees, transportation costs, and shortages of healthcare facilities. These barriers frequently delay treatment seeking, allowing infections to progress and increasing the likelihood of inappropriate or incomplete antimicrobial use[11].

Economic constraints also contribute to reliance on informal healthcare markets where antibiotics may be purchased without prescriptions or professional guidance. In many low-resource settings, informal drug vendors serve as a primary source of healthcare due to their affordability and accessibility[12]. However, antibiotics obtained through these channels are often used inappropriately, with incorrect drug selection, inadequate dosing, or premature treatment discontinuation. Self-medication practices are similarly common among populations facing financial hardship, particularly when formal healthcare services are inaccessible or unaffordable[13]. These behaviors create favorable conditions for the emergence and spread of resistant microorganisms while reinforcing health disparities among vulnerable populations.

Inadequate Water, Sanitation, and Hygiene (WASH)

Deficiencies in water, sanitation, and hygiene (WASH) infrastructure significantly contribute to AMR transmission and persistence. Poor sanitation systems facilitate the circulation of resistant pathogens through environmental contamination, particularly in densely populated communities lacking adequate waste management services. Human and animal waste containing resistant bacteria and antimicrobial residues can enter soil and water systems, creating reservoirs for resistance genes and facilitating their dissemination across populations[14].

Contaminated water sources represent a particularly important transmission pathway in resource-limited settings. Communities lacking access to safe drinking water may be repeatedly exposed to resistant organisms through household consumption, agricultural activities, and recreational water use. Inadequate sanitation infrastructure further increases exposure risks by promoting the spread of enteric infections, which often require antimicrobial treatment and contribute to selective pressure for resistance development. Consequently, weak WASH systems not only increase infectious disease burden but also accelerate the environmental transmission of antimicrobial resistance[15].

Educational and Health Literacy Gaps

Educational attainment and health literacy strongly influence antimicrobial use behaviors and understanding of resistance. Limited awareness regarding the appropriate use of antibiotics contributes to widespread misuse in many low-resource settings. Individuals may incorrectly use antibiotics to treat viral infections, discontinue therapy once symptoms improve, or share medications among family members and community members. Such practices reduce treatment effectiveness and increase opportunities for resistant organisms to emerge[16,17].

Poor adherence to prescribed antimicrobial regimens is often linked to inadequate understanding of treatment instructions and the consequences of incomplete therapy. Furthermore, awareness of AMR remains relatively low in many communities, limiting public engagement with stewardship initiatives and infection prevention measures. Educational disparities therefore contribute not only to individual-level treatment challenges but also to broader population-level patterns of resistance. Strengthening health literacy is increasingly recognized as a critical component of AMR prevention strategies, particularly in settings where access to formal healthcare information remains limited[18].

Housing and Environmental Conditions

Housing quality and environmental conditions play an important role in shaping exposure to infectious diseases and resistant pathogens. Overcrowded living environments facilitate person-to-person transmission of communicable diseases, increasing the frequency of infections and the subsequent demand for antimicrobial treatment. Repeated exposure to infectious pathogens can create cycles of antimicrobial use that contribute to resistance development within households and communities[19].

Urban informal settlements are especially vulnerable due to the convergence of overcrowding, inadequate sanitation, poor waste disposal systems, and limited healthcare access. Residents often experience higher rates of infectious diseases, creating conditions that increase both antimicrobial consumption and the transmission of resistant organisms. Environmental pollution from untreated wastewater, industrial discharge, and inadequate waste management may further contribute to the persistence and spread of resistance determinants in these settings. As rapid urbanization continues across many low-income regions, the relationship between housing conditions and AMR vulnerability is becoming increasingly significant[20].

Critical Analysis

The evidence demonstrates that exposure to antimicrobial resistance is socially patterned rather than randomly distributed. Individuals and communities experiencing poverty, inadequate sanitation, limited educational opportunities, and poor living conditions face disproportionately higher risks of infection, inappropriate antimicrobial use, and adverse health outcomes. These determinants interact synergistically, creating environments where resistance can emerge, spread, and persist. Consequently, AMR should not be viewed solely as a microbiological challenge but as a manifestation of broader social and structural inequities. Addressing the global AMR crisis therefore requires interventions that extend beyond antimicrobial stewardship to include investments in poverty reduction, education, housing, and WASH infrastructure, particularly in resource-limited settings where vulnerability is greatest. The interconnected pathways through which social and structural inequities contribute to antimicrobial resistance and adverse health outcomes in resource-limited settings are illustrated in Figure 1.

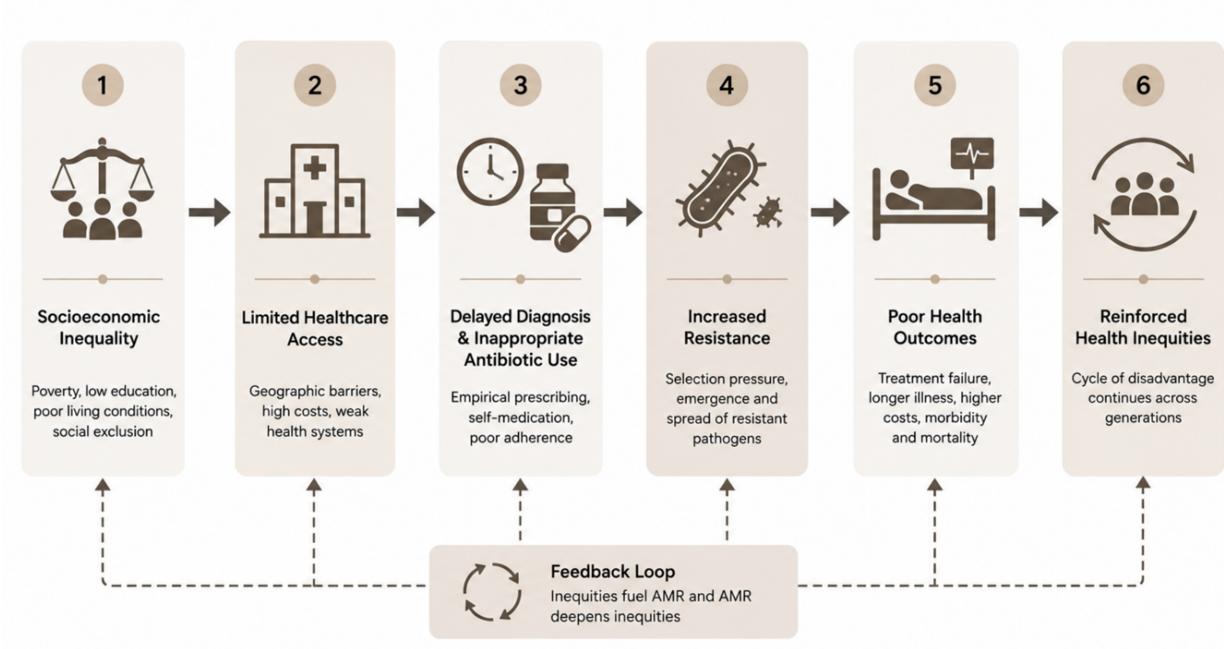

Figure 1. Health Equity Pathways Linking Structural Determinants to Antimicrobial Resistance Burden in Resource-Limited Settings. Figure 1 illustrates the progression from socioeconomic inequality and structural disadvantage to limited healthcare access, delayed diagnosis, inappropriate antibiotic use, and increased antimicrobial resistance. The resulting burden of resistant infections contributes to poorer health outcomes and reinforces existing health inequities, creating a cyclical feedback loop that disproportionately affects vulnerable populations in resource-limited settings.

Health System Inequities and AMR Burden

Diagnostic Inequities

Accurate and timely diagnosis is essential for effective antimicrobial stewardship and appropriate treatment decisions. However, substantial diagnostic inequities persist across many resource-limited settings, contributing significantly to the growing burden of antimicrobial resistance (AMR). Access to microbiology laboratories remains limited in numerous low-income countries, particularly in rural and underserved regions where healthcare infrastructure is underdeveloped. Many healthcare facilities lack the equipment, personnel, and financial resources required to perform routine culture and sensitivity testing, forcing clinicians to make treatment decisions without microbiological confirmation[21].

The absence of antimicrobial susceptibility testing further constrains the ability of healthcare providers to identify resistant pathogens and select effective therapies. Without laboratory evidence, clinicians frequently rely on empirical prescribing based on symptoms, clinical judgment, or local treatment practices. While empirical therapy is sometimes necessary, excessive dependence on this approach increases the risk of inappropriate antimicrobial use and exposes patients to treatments that may be ineffective against resistant organisms[22].

Delayed diagnosis also contributes to poorer clinical outcomes and greater antimicrobial consumption. Patients may receive multiple courses of broad-spectrum antibiotics before a definitive diagnosis is established, increasing selective pressure for resistance development. In addition, diagnostic delays prolong infectious periods, facilitating community transmission of resistant pathogens[23]. These challenges disproportionately affect vulnerable populations who already face barriers to healthcare access, reinforcing existing health inequities.

Healthcare Workforce Constraints

Healthcare workforce limitations represent another major driver of inequitable AMR outcomes. Many low-resource health systems experience chronic shortages of healthcare professionals, including physicians, pharmacists, microbiologists, infection prevention specialists, and infectious disease experts. Workforce shortages are often most severe in rural and marginalized communities, where access to specialized care is already limited[24].

The scarcity of infectious disease specialists reduces opportunities for evidence-based management of complex infections and resistant pathogens. Clinicians working in overstretched healthcare facilities may be required to manage large patient volumes with limited diagnostic support, increasing reliance on broad-spectrum antimicrobials and reducing adherence to stewardship principles. Furthermore, healthcare workers frequently face competing priorities that limit their ability to implement infection prevention and control measures effectively[25].

Antimicrobial stewardship programs, which are recognized as essential tools for optimizing antimicrobial use, remain underdeveloped or absent in many low-income settings. Resource limitations, insufficient institutional support, and shortages of trained personnel hinder program implementation and sustainability. Weak professional training systems further exacerbate these challenges. Many healthcare workers receive limited education on antimicrobial resistance, diagnostic stewardship, and evidence-based prescribing practices[26]. Consequently, deficiencies in workforce capacity contribute to inappropriate antimicrobial use and hinder efforts to control resistance at both facility and community levels.

Access to Effective Antimicrobials

Access to safe, effective, and quality-assured antimicrobial medicines is a critical component of equitable healthcare. However, substantial disparities exist in the availability and affordability of effective treatments across resource-limited settings. Medicine shortages are common in many low-income countries due to fragile supply chains, inadequate procurement systems, limited manufacturing capacity, and financial constraints. As a result, patients may experience delays in treatment initiation or receive alternative therapies that are less effective against specific pathogens[27].

The circulation of counterfeit and substandard medicines presents an additional challenge. Poor regulatory oversight and fragmented pharmaceutical distribution systems increase the likelihood that ineffective or poor-quality antimicrobial products enter healthcare markets. These medicines may contain insufficient active ingredients or fail to meet quality standards, leading to treatment failure and promoting the selection of resistant microorganisms[28].

Interrupted treatment courses are also common among economically disadvantaged populations. Patients may discontinue therapy because of medication costs, limited drug availability, or transportation barriers that prevent follow-up care. Incomplete treatment not only compromises individual patient outcomes but also creates opportunities for resistant organisms to survive and proliferate. Consequently, inequitable access to effective antimicrobials contributes directly to the persistence and expansion of AMR in vulnerable populations[29].

Weak Surveillance Systems

Effective AMR control depends on robust surveillance systems capable of monitoring resistance patterns, identifying emerging threats, and informing public health responses. However, surveillance capacity remains highly uneven across global regions. Many low-income countries lack comprehensive national surveillance networks, resulting in substantial underreporting of resistance trends and limited understanding of the true burden of AMR[30].

Data gaps are particularly pronounced in resource-constrained settings where laboratory infrastructure and information systems are inadequate[31]. Many healthcare facilities are unable to routinely collect, analyze, or share microbiological data, limiting the availability of reliable evidence for decision-making. As a result, national and global estimates of AMR frequently underrepresent the experiences of populations living in the most vulnerable settings[32].

Weak surveillance systems also create challenges for evidence-based policy development. Policymakers require accurate and timely data to allocate resources, design stewardship programs, and evaluate intervention effectiveness. When surveillance information is incomplete or unavailable, public health responses may be delayed, poorly targeted, or insufficient to address local resistance patterns. These limitations hinder national preparedness and contribute to widening disparities in AMR outcomes between high-income and low-income regions[33].

Critical Discussion

Health-system weaknesses transform antimicrobial resistance from a microbiological challenge into a profound equity crisis. Diagnostic limitations, workforce shortages, inadequate access to quality medicines, and weak surveillance systems collectively shape who is most vulnerable to resistant infections and who has access to effective treatment. These deficiencies disproportionately affect populations already experiencing social and economic disadvantage, creating a cycle in which structural barriers increase both exposure to resistance and the severity of its consequences. Addressing AMR therefore requires more than improving antimicrobial stewardship alone; it necessitates strengthening health systems, expanding equitable access to diagnostics and treatment, investing in healthcare workforce development, and building surveillance infrastructures capable of supporting evidence-based action. Without addressing these systemic inequities, efforts to control AMR will remain incomplete and the burden of resistance will continue to fall most heavily on the world's most vulnerable populations. Table 1 summarizes the principal health equity determinants that contribute to antimicrobial resistance, their mechanisms of action, associated public health consequences, and potential intervention strategies.

Table 1. Major Health Equity Determinants Contributing to Antimicrobial Resistance in Resource-Limited Settings

Health Equity Determinant	Mechanism Influencing AMR	Public Health Consequence	Potential Intervention
Poverty and Economic Inequality	Delayed healthcare seeking, self-medication, informal drug markets	Increased inappropriate antimicrobial use and resistance development	Universal health coverage, financial protection programs[7]
Limited Healthcare Access	Reduced access to diagnosis and treatment	Delayed treatment and higher infection burden	Strengthened primary healthcare systems[34]
Weak Diagnostic Capacity	Empirical prescribing and lack of susceptibility testing	Inappropriate antibiotic use and treatment failure	Laboratory expansion and point-of-care diagnostics[35]
Inadequate WASH Infrastructure	Increased pathogen transmission and environmental contamination	Higher infectious disease burden and antimicrobial demand	Water, sanitation, and hygiene investments[36]
Educational and Health Literacy Gaps	Misuse of antibiotics and poor treatment adherence	Increased resistance selection pressure	Community education and health literacy programs[37]
Healthcare Workforce Shortages	Limited stewardship and infection control capacity	Poor antimicrobial management	Workforce training and capacity building[38]
Poor Access to Quality Medicines	Counterfeit drugs, medicine shortages, interrupted treatment	Treatment failure and resistance emergence	Pharmaceutical regulation and supply chain strengthening[39]
Weak Surveillance Systems	Underreporting and limited AMR monitoring	Ineffective policy responses and delayed interventions	National and regional AMR surveillance networks[5]
Overcrowded Housing and Informal Settlements	Increased transmission of infectious diseases	Higher antimicrobial consumption and resistance spread	Housing improvement and urban health interventions[40]
Environmental Contamination	Dissemination of resistant organisms and resistance genes	Community exposure to AMR reservoirs	Wastewater treatment and environmental regulation[41]

Disproportionate Impacts on Vulnerable Populations

Antimicrobial resistance (AMR) does not affect all populations equally. While resistant infections pose a global threat, their consequences are particularly severe among groups already experiencing social, economic, and healthcare disadvantages. Vulnerable populations often face increased exposure to infectious diseases, reduced access to preventive and curative services, and greater barriers to timely diagnosis and effective treatment[42]. As a result, AMR frequently amplifies existing health inequities, leading to disproportionately poor outcomes among women, children, rural populations, and displaced communities.

Women and Maternal Health

Women, particularly those living in low-resource settings, face unique vulnerabilities to the consequences of AMR. Resistant obstetric and gynecological infections can complicate pregnancy, childbirth, and postpartum recovery, increasing risks for both mothers and newborns. Conditions such as postpartum sepsis, urinary tract infections, and surgical site infections following cesarean delivery may become more difficult to treat when resistant pathogens are involved[43].

Limited access to quality maternal healthcare further exacerbates these risks. Many women in resource-constrained settings encounter barriers related to cost, transportation, healthcare availability, and cultural factors that delay access to antenatal and obstetric services. Inadequate infection prevention practices and delayed treatment can increase the likelihood of severe complications associated with resistant infections. Consequently, AMR may contribute to higher maternal morbidity and mortality rates, particularly in regions where healthcare systems are already struggling to provide comprehensive maternal care. These challenges underscore the importance of integrating AMR considerations into maternal health programs and reproductive healthcare policies[44].

Children

Children bear a substantial share of the global burden of infectious diseases and are particularly vulnerable to the consequences of AMR. Common childhood illnesses such as pneumonia and diarrheal diseases remain major causes of morbidity and mortality in many low-income countries. The emergence of resistant pathogens threatens the effectiveness of standard treatments, increasing the likelihood of treatment failure and prolonged illness.

Neonatal sepsis represents one of the most serious manifestations of AMR in pediatric populations. Newborns are highly susceptible to severe bacterial infections, and resistance to first-line antibiotics can significantly reduce survival rates. In healthcare facilities with limited diagnostic and therapeutic capacity, resistant neonatal infections often present major clinical challenges[45].

Beyond immediate health effects, recurrent or inadequately treated infections may contribute to long-term growth and developmental consequences. Frequent illness can impair nutritional status, cognitive development, educational attainment, and overall well-being. Children living in poverty are particularly vulnerable because they are more likely to experience crowded living conditions, malnutrition, and limited access to healthcare services. Thus, AMR not only threatens child survival but may also undermine broader developmental outcomes across the life course[46].

Rural and Remote Communities

Rural and remote populations frequently experience disproportionate AMR burdens because of persistent healthcare access barriers. Healthcare facilities are often sparsely distributed, requiring individuals to travel long distances to obtain medical care. Transportation challenges, financial constraints, and shortages of healthcare professionals can delay diagnosis and treatment of infectious diseases.

Geographic isolation also limits access to diagnostic services, including microbiology laboratories and antimicrobial susceptibility testing. As a result, healthcare providers in rural settings frequently rely on empirical prescribing, which may increase inappropriate antimicrobial use and contribute to resistance development. Delayed diagnosis and treatment can worsen disease severity, increase transmission, and reduce the effectiveness of available therapies[47].

In many regions, rural communities also face inadequate water, sanitation, and hygiene infrastructure, creating additional exposure to infectious diseases and resistant pathogens. The combination of environmental vulnerabilities and healthcare limitations places these populations at heightened risk of adverse AMR-related outcomes.

Refugees, Migrants, and Displaced Populations

Refugees, migrants, and internally displaced persons represent some of the most vulnerable populations affected by AMR. Humanitarian crises, armed conflict, natural disasters, and forced displacement frequently result in overcrowded living environments with poor sanitation and limited access to healthcare services[48]. These conditions facilitate the transmission of infectious diseases and increase demand for antimicrobial treatment.

Healthcare disruptions commonly experienced during displacement can interfere with routine medical care, treatment continuity, vaccination programs, and infection prevention efforts. Individuals may be unable to complete prescribed antimicrobial courses or access appropriate diagnostic services, increasing the risk of treatment failure and resistance development[49].

Population mobility may also contribute to the cross-border spread of resistant pathogens, particularly when surveillance systems are weak or fragmented. However, displaced populations should not be viewed solely as sources of transmission; rather, they are often among the primary victims of structural vulnerabilities that increase AMR risks. Addressing AMR within humanitarian settings therefore requires coordinated public health responses that prioritize equitable access to healthcare, sanitation, and essential medicines[50].

Key Argument

The burden of antimicrobial resistance falls disproportionately on populations already facing significant social and health disadvantages. Women, children, rural communities, and displaced populations encounter unique vulnerabilities that increase both exposure to resistant infections and the likelihood of adverse outcomes. These disparities demonstrate that AMR is not merely a biological or clinical challenge but also a profound issue of health equity. By magnifying existing inequalities in healthcare access, living conditions, and socioeconomic opportunity, AMR reinforces cycles of vulnerability and disadvantage. Effective responses must therefore prioritize the needs of vulnerable populations and incorporate equity-centered strategies into national and global AMR policies.

The One Health Equity Perspective

Antimicrobial resistance (AMR) is increasingly recognized as a complex challenge that extends beyond healthcare settings and encompasses interactions among human, animal, and environmental systems. The One Health framework provides a comprehensive approach for understanding these interconnected pathways and highlights how resistant microorganisms and resistance genes move across sectors. While AMR affects populations globally, resource-limited communities often experience disproportionate exposure to risks arising from all three domains simultaneously[5]. Consequently, a One Health perspective is essential for understanding the equity dimensions of AMR and for developing effective and sustainable interventions.

Human Health

Within the human health sector, inappropriate antimicrobial use remains one of the primary drivers of resistance. Antibiotic misuse occurs through self-medication, non-prescription purchases, inappropriate prescribing, and poor adherence to treatment regimens. These practices are particularly common in settings where access to qualified healthcare providers and diagnostic services is limited. The resulting selective pressure promotes the emergence and spread of resistant pathogens within communities and healthcare facilities.

Healthcare-associated resistance also poses a growing challenge. Inadequate infection prevention and control measures, overcrowded hospitals, shortages of healthcare personnel, and limited diagnostic capacity contribute to the transmission of resistant organisms within healthcare environments. These risks are often amplified in under-resourced health systems where infrastructure and infection control programs remain insufficient[51].

Animal Health

The widespread use of antimicrobials in livestock production represents another important pathway contributing to AMR. Antibiotics are frequently used for disease prevention, treatment, and growth promotion in food-producing animals. Excessive or inappropriate use can facilitate the development of resistant bacteria that may be transmitted to humans through direct animal contact, food consumption, or environmental contamination.

Food-production systems can further contribute to resistance dissemination when biosecurity measures and veterinary oversight are inadequate. In many low- and middle-income countries, regulatory systems governing antimicrobial use in agriculture may be limited, increasing the risk of resistance emergence within animal populations and subsequent transfer to human communities[1].

Environmental Health

The environment serves as an important reservoir and transmission pathway for antimicrobial resistance. Wastewater generated from hospitals, households, agricultural facilities, and pharmaceutical manufacturing sites often contains resistant microorganisms, antimicrobial compounds, and resistance genes. Inadequate wastewater treatment allows these contaminants to enter rivers, lakes, groundwater systems, and agricultural lands.

Pharmaceutical residues released into the environment can create selective pressures that encourage the persistence and evolution of resistant organisms. Environmental reservoirs of resistance genes may subsequently contribute to the spread of AMR across human and animal populations, highlighting the interconnected nature of resistance transmission pathways[52].

Equity Lens

From a health equity perspective, resource-limited communities frequently experience cumulative exposure across human, animal, and environmental domains. Poor access to healthcare promotes inappropriate antibiotic use, while dependence on livestock for livelihoods increases contact with antimicrobial-treated animals. Simultaneously, inadequate sanitation infrastructure and weak environmental regulation increase exposure to contaminated water and environmental reservoirs of resistance. These overlapping vulnerabilities create conditions in which disadvantaged populations bear a disproportionate share of AMR risks and consequences. Therefore, effective AMR mitigation requires equity-centered One Health strategies that simultaneously strengthen healthcare systems, promote responsible antimicrobial use in agriculture, and improve environmental management. Addressing only one domain in isolation is unlikely to reduce the unequal burden of AMR experienced by resource-constrained populations[11].

Policy and Public Health Strategies for Equity-Oriented AMR Control

Addressing antimicrobial resistance (AMR) requires interventions that extend beyond clinical management and directly confront the structural inequities that drive vulnerability to resistant infections. Equity-oriented AMR control strategies should prioritize populations with the greatest disease burden and the least access to healthcare resources. Strengthening health systems, improving access to diagnostics, enhancing environmental health infrastructure, and promoting community engagement are essential components of a comprehensive public health response[11].

Strengthening Primary Healthcare

Strong primary healthcare systems provide the foundation for equitable AMR prevention and control. Universal access to healthcare services can reduce delays in diagnosis and treatment while limiting dependence on informal healthcare markets and self-medication practices. Ensuring that healthcare services are geographically accessible and financially affordable is particularly important in resource-limited settings where barriers to care remain substantial.

Affordable diagnostic services should be integrated into primary healthcare systems to support evidence-based treatment decisions and reduce unnecessary antimicrobial use. Community-based interventions can further enhance healthcare access by bringing prevention, education, and treatment services closer to underserved populations. Community health workers, mobile clinics, and local outreach programs have demonstrated value in improving healthcare utilization and promoting responsible antimicrobial practices, particularly in rural and marginalized communities[53].

Expanding Diagnostic Capacity

Improved diagnostic capacity is essential for reducing inappropriate antimicrobial prescribing and strengthening antimicrobial stewardship efforts. Point-of-care testing technologies offer significant potential in resource-constrained settings by enabling rapid identification of infectious conditions without requiring extensive laboratory infrastructure. Timely diagnostic information can help healthcare providers distinguish between bacterial and non-bacterial infections, reducing unnecessary antibiotic use[54].

Investment in laboratory infrastructure is equally important. Expanding microbiology services, antimicrobial susceptibility testing, and laboratory quality assurance systems can improve treatment accuracy and strengthen national AMR monitoring efforts. Diagnostic stewardship programs should also be incorporated into healthcare systems to ensure that diagnostic tools are used appropriately and effectively. By supporting targeted treatment decisions, expanded diagnostic capacity can improve patient outcomes while reducing selective pressures that drive resistance[1].

Improving WASH Infrastructure

Investments in water, sanitation, and hygiene (WASH) infrastructure represent a critical but often underemphasized component of AMR control. Access to safe drinking water reduces exposure to infectious pathogens and decreases the demand for antimicrobial treatment. Improved sanitation systems help prevent environmental contamination with resistant microorganisms and antimicrobial residues, limiting opportunities for resistance transmission.

Sanitation investments are particularly important in informal settlements, rural communities, and healthcare facilities where inadequate waste management remains common. Infection prevention measures, including hand hygiene promotion, environmental cleaning, and safe waste disposal, can substantially reduce infection rates and lower antimicrobial consumption. Strengthening WASH systems therefore contributes not only to broader public health goals but also to long-term AMR mitigation[14].

Strengthening Surveillance Systems

Robust surveillance systems are necessary for understanding resistance trends and guiding evidence-based policy responses. National AMR monitoring programs should be strengthened to improve the collection, analysis, and reporting of resistance data across healthcare settings. Reliable surveillance information enables policymakers to identify emerging threats, allocate resources efficiently, and evaluate intervention effectiveness.

Regional collaborations can further enhance surveillance capacity by facilitating the sharing of technical expertise, laboratory resources, and epidemiological information. Because resistant pathogens frequently cross national borders, coordinated regional approaches are essential for effective control. Data-sharing frameworks that promote timely exchange of surveillance findings can strengthen preparedness and support more targeted public health interventions[55].

Community Engagement and Education

Sustainable AMR control requires active participation from communities and the public. Health literacy campaigns can improve understanding of appropriate antimicrobial use, treatment adherence, and infection prevention practices. Educational initiatives should be culturally appropriate and accessible to diverse populations, particularly those with limited access to formal healthcare information.

Behavior change interventions can help address practices that contribute to resistance, including self-medication, inappropriate antibiotic demand, and incomplete treatment courses. Public awareness campaigns should emphasize the collective consequences of AMR while promoting responsible antimicrobial use. In addition, antibiotic stewardship awareness programs can empower individuals and communities to participate in AMR prevention efforts. By strengthening public knowledge and engagement, community-centered approaches can complement health system interventions and contribute to more equitable and sustainable AMR control strategies[16].

Future Directions and Research Priorities

Despite growing recognition of antimicrobial resistance (AMR) as a major global health threat, important knowledge gaps continue to limit the development of effective and equitable interventions. One of the most significant challenges is the limited availability of high-quality evidence from low-income and resource-constrained settings, where the burden of resistant infections is often greatest. Much of the existing AMR literature originates from high-income countries, potentially limiting the applicability of findings to populations facing different social, economic, and healthcare realities.

There is also a notable shortage of research explicitly examining AMR through a health equity lens. While numerous studies investigate resistance patterns, antimicrobial use, and stewardship strategies, fewer explore how social determinants of health shape vulnerability to resistant infections and influence treatment outcomes. As a result, important inequities in exposure, access to care, and disease burden remain insufficiently understood.

Vulnerable populations, including women, children, rural communities, migrants, refugees, and displaced persons, are frequently underrepresented in AMR research. Greater inclusion of these groups is necessary to generate evidence that can inform targeted and context-specific interventions. Future studies should also incorporate implementation science approaches to evaluate how AMR policies and interventions perform in real-world settings, particularly in resource-limited environments[56].

Integrated One Health surveillance systems represent another critical research priority. Strengthening data collection across human, animal, and environmental sectors can improve understanding of resistance transmission pathways and support coordinated responses. Additionally, growing evidence suggests that climate change may influence infectious disease patterns, antimicrobial use, and environmental dissemination of resistance determinants. Further research is therefore needed to examine the complex interactions among climate change, AMR, and health equity, particularly in populations facing multiple forms of vulnerability.

Beyond evidence gaps, substantial implementation barriers continue to hinder equity-oriented AMR interventions in low-resource settings. Financial constraints, weak governance structures, fragmented surveillance systems, workforce shortages, and competing public health priorities often limit the sustainability of stewardship programs and diagnostic expansion initiatives. International policy frameworks frequently advocate equitable responses; however, insufficient local adaptation and inadequate investment may reduce their effectiveness. Future implementation research should therefore examine context-specific strategies capable of translating equity principles into sustainable health-system interventions.

Limitations

This narrative review has several limitations. First, the inclusion of English-language publications may have excluded relevant evidence reported in other languages, particularly from regions disproportionately affected by antimicrobial resistance. Second, publication bias may have favored studies reporting significant findings or successful interventions, potentially underrepresenting unsuccessful or context-specific experiences. Third, the heterogeneous nature of the included literature precluded formal quality assessment and quantitative synthesis. Finally, much of the available evidence originates from high-income settings, limiting the generalizability of some findings to resource-constrained environments. Despite these limitations, the review provides an integrated and equity-focused synthesis of current evidence and identifies critical priorities for future research and policy development.

Conclusion

Antimicrobial resistance (AMR) represents one of the most significant public health challenges of the modern era, with consequences that extend far beyond the biological evolution of resistant microorganisms. As this review demonstrates, the burden of AMR is deeply influenced by social, economic, and structural determinants that shape patterns of exposure, vulnerability, healthcare access, and treatment outcomes. Poverty, inadequate water and sanitation infrastructure, limited educational opportunities, weak healthcare systems, and environmental risks collectively contribute to the unequal distribution of AMR across populations and regions. Consequently, AMR should be understood not only as a microbiological or clinical problem but also as a manifestation of broader health inequities.

The impacts of resistant infections are particularly severe among vulnerable populations, including women, children, rural communities, and displaced populations living in resource-limited settings. These groups often face overlapping disadvantages that increase both the likelihood of infection and the consequences of treatment failure. Addressing AMR therefore requires a broader perspective that recognizes the interconnected roles of human health, animal health, environmental conditions, and social determinants within a One Health framework.

Reducing the global burden of antimicrobial resistance requires moving beyond pathogen-focused approaches toward equity-centered public health strategies that strengthen healthcare systems, improve access to diagnostics and effective treatment, address underlying social determinants of health, and promote sustainable One Health interventions. Without deliberate efforts to reduce these structural inequities, progress in controlling AMR will remain limited, and the heaviest burden will continue to fall on the world's most vulnerable populations. An equitable response to AMR is therefore not only a public health necessity but also a global social justice imperative.

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