Review

Curbing the menace of antimicrobial resistance in Nigeria: an integrative review of social action approaches

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Abstract

The advent of antimicrobial resistance has compromised our ability to effectively manage common infectious diseases and control life-threatening complications. In Nigeria, indiscriminate antibiotic use, poor clinical care, lack of proper regulations, lack of robust antimicrobial resistance surveillance programs, and the burden of communicable diseases have further aggravated the problem of antimicrobial resistance. A social action perspective highlights social interdependence and interaction in personal control of health-endangering behavior. The aim of this study is to explore the impact of social action approaches on mitigating antimicrobial resistance in Nigeria. It suggests mechanisms by which environmental structures influence cognitive action schemas, self-goals, and problem-solving activities essential to sustained behavioral change.

Keywords: AMR surveillance, Antibiotics, awareness program, multidrug-resistant, public health

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Introduction

In simple terms, antimicrobial resistance (AMR) is a microbe's ability to evade the effects of antimicrobials (antibiotics, antivirals, and antimalarials).[1,2] It is exacerbated by antibiotic abuse and overuse, as well as inadequate infection prevention and control strategies.[3] Traditional treatments may become ineffective as a result, and infections may persist, raising the risk of continued transmission. Concerning nosocomial infections caused by antibiotic-resistant bacteria, Margaret Chan, WHO Director, remarked that the "post-antibiotic age signifies, in effect, the end of modern medicine as we know it. Things as basic as strep sickness or a skinned knee in a youngster could kill again".[4,5] Many international health organizations are increasingly recognizing AMR as a worldwide public health concern and a challenge to the present health-care system, with the potential to stymie the control of several infectious diseases and regress modern medicine substantially. The "selective pressure" induced by incorrect use of antimicrobials in humans and animals is often related to the developing global prevalence of AMR.[6]

AMR contributes to about seven hundred thousand deaths annually, and this death rate is anticipated to rise by as many as ten million by the year 2050.[7] It is demanding to determine the global frequency of antimicrobial resistance (AMR); however many research studies propose that antimicrobial resistance is an increasing global problem; but the utmost impact is in the developing nations, including Nigeria[8] This is a severe issue in Nigeria because of the poor economic and social standard of living of a vast proportion of the populace. People who are less fortunate on one or more of these crossing social axes are more likely to become sick and need antibiotics. Regrettably, the rate at which AMR is developing in Nigeria surpasses the rate at which new antimicrobials are being discovered, placing humankind on a very unsafe condition.[9]

Antimicrobial resistance and other health-related challenges which have proven hard to deal with through science and technology only, have persisted or emerged in recent years. It is now widely acknowledged that one of the major barriers to improving health outcomes and living standards around the world is the systematic disregard of social, economic, and cultural variables.[10] Therefore, it is important to pay attention to the social and cultural factors that influence the patterns and experiences of health and illness. As a result, the purpose of this article is to critically assess the impact of social determinants of health on the control of antimicrobial resistance, and how the earlier mentioned approaches can be used by public health practitioners in Nigeria to combat the occurrence and spread of antimicrobial resistant pathogens.

Individuals develop and experience health in the contexts of their daily lives, including the places they learn, work, play, and reside.[11] Whitehead and Dahlgren[12] developed a model for the social determinants of health while examining the social factors that affect health outcomes. The model, which illustrates the key elements influencing a person's health, is composed of concentric layers of arcs.[13] Individual factors like age, gender, marital status, genetic predisposition, and education level are among these determinants. Other factors are working and living conditions, environmental and biological factors, and lifestyle choices.

Method

This integrative review synthesizes existing literature on antimicrobial resistance (AMR), focusing on its prevalence, contributing factors, mechanisms, and strategies for mitigation in Nigeria. The review adopts a systematic approach to gather and analyze relevant research articles, reports, and publications from various databases such as PubMed, Scopus, and Google Scholar. The search terms include "antimicrobial resistance," "AMR," "Nigeria," "prevalence," "factors," "mechanisms," and "strategies." Studies published in peer-reviewed journals, grey literature, and commissioned reports are included to provide a comprehensive understanding of the topic. Data extraction and synthesis are conducted to identify key themes, patterns, and implications related to AMR in Nigeria.

Antimicrobial resistance in Nigeria

Antimicrobial exposure in agriculture, health care, and the environment influences antimicrobial resistance selection. The emergence of antimicrobial resistance in Nigeria is driven by socioeconomic growth, antibiotic misuse, and influence of cultural elements. Oloso et al.[14] conducted a review of studies aimed at detecting the presence and extent of antimicrobial resistance (AMR) in collected samples using a selected panel of antibiotics. The AMR studies focused on 18 genera of organisms, with species or serovars

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appearing at least once. The five primary pathogens tested for AMR were *E. coli, Salmonella* serovars, *Staphylococcus aureus, Pseudomonas* spp., and *Klebsiella* spp. Additional microbes included in the AMR studies were *Enterococcus* spp., *Vibrio* spp., *Proteus* spp., and *Listeria* spp. Figure 1 illustrates the number of reports per organism annually across the geopolitical zones of Nigeria. The geographical distribution of reports revealed the highest number from South West Nigeria (44 studies), followed by South South (28), North West (16), North Central (10), North East (4), and South East (1), indicating a limited distribution of studies in the North East and South East regions.

Socioeconomic status

Several studies have sought to determine the impact of social influences on health. In Nigeria, behavioural causes account for a large portion of all diseases and fatalities, and these health-related behaviours are heavily influenced by socio-economic factors such as money, education, and employment. The majority of Nigerians, according to the Nigeria Centre for Disease Control (NCDC), live on or less than $3.10 USD a day. In the report of the AMR status study, which was done in conjunction with the Federal Ministry of Agriculture, Environment, and Health, poverty was noted as a major contributor to Nigeria's health difficulties.[15] Due to financial constraints, some Nigerian families practice using leftover antibiotics or sharing antibiotics with others. As a result, the correct dose of medicines is not taken, resulting in antibiotic resistance. Auta, Hadi[16] discovered that 48% of respondents utilizing four community pharmacy stores exchanged antibiotics in a survey conducted in Jos, Nigeria. This supports the theory that most people who abuse antibiotics do so because they are readily available over-the-counter. Therefore, antibiotic resistance could be reduced by enforcing efficient regulation of pharmacies and dispensaries.

Antibiotic misuse

Drug misuse and abuse by individuals has also been identified as a common behavioural factor that has ensured the persistence of these resistance genes in the population of microbes.[17] Self-medication is practised in developing and developed countries, ranging from 3% to 75% of the population.[18,19] In 2015, the WHO projected that 23% of Nigerians used self-medication, but recently Chukwu, Oladele[20] assessed that 31.1% did. Self-medication is exacerbated by the availability of less expensive/counterfeit, broad-spectrum antibiotics, over-the-counter without a prescription. Ngbede, Raji[21] has identified this as a catalyst for the prevalence of drug resistant bacteria in Nigeria. Similarly, it has been suggested that pharmaceutical companies' production and import of counterfeit pharmaceuticals contribute to the creation and spread of antibiotic resistance strains.[22] This is because microorganisms can rapidly develop resistance to antibiotics given in sub-therapeutic doses, which is common with counterfeit antibiotics and drugs in general.

In a study to evaluate the antibiotics consumption patterns of respondents from several Nigerian states, it was discovered that some people do not take their medications exactly as prescribed. A total of 126 (26.1%) of respondents from the six states surveyed stated they would stop taking antibiotics when they felt better, rather than when the prescribed duration was complete. However, responses to this question varied by state, with those in Borno (30.3%), Jigawa (32.0%) and Lagos (41.5%) being more likely to stop taking antibiotics once they felt better.[23] Igbeneghu[24] conducted a similar study on the knowledge and habits of using antibiotics among a group of students in a Nigerian University and found a significant rate of antibiotic misuse among this group. The authors state that they get their antibiotics from unauthorised sources without a doctor's prescription and that they do not finish their antibiotic treatment.

Influence of cultural elements

Cultural element that controls food production, animal relationships, and infection control play a role in the spread of AMR in both clinical and non-clinical settings (Fig II). Identifying and limiting AMR transmission channels in agricultural settings requires an understanding of the dynamics of food and livestock production. Where there is frequent and close contact, there is a higher danger of transmission or spillover of resistant organisms between humans and animals (and vice versa). Bonds with companion animals are some of the most personal human-animal interactions that exist today.[27] In a survey to assess the dog population in several residential areas of Makurdi, Nigeria, it was found that the average dog-human ratio was 1: 4[28] Currently, 62 % of small dogs and 62 % of cats in the United States sleep in beds with their owners.[29] The status of companion animals is changing, and this is mirrored in veterinary practices as well. The lifespan extension of pets and the creation of long-

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lasting, simple-to-use antibiotics have increased the possibility of resistance spreading. *Staphylococcus aureus* and/or MRSA have been found in a variety of animal species, including dogs, sheep, donkeys, bats, pigs, and monkeys, as well as in animal-derived foods in African nations.[30] This is similar to a report published jointly by the European Centre for Disease Prevention and Control (ECDC), the European Medicines Agency (EMA), and the European Food Safety Authority (EFSA), MRSA infections in companion animals are on the rise, and the MRSA strains found there are frequently the same as those found in the neighborhood's hospitals. This is also in line with research conducted in Europe, where it was discovered that dogs living in urban settings had a high incidence of vancomycin-resistant Enterococci (VRE) (7–23%) (PFMA, 2017). Additionally, it has been shown that most canine VRE isolates show resistance to a variety of antibiotics, including macrolides and aminoglycosides.[31] VRE was found in 23% of the pet isolates tested in Spain. This is far greater than the reported pig prevalence of 4%.[32] This was attributed to human-to-animal transmission rather than animal-to-human transmission, however, it was observed that the animals could later serve as reservoirs for AMR bacteria.[33]

The supplementation of cattle feeds with antibiotics is another prominent practice that contributes greatly to resistance.[34] Domestic animals such as swine, poultry, and beef have been linked in several investigations as reservoirs of drug-resistant food-borne pathogens. Interactions with these livestock's waste materials transmit resistant genes to free-ranging wildlife, resulting in an additional reservoir of resistant organisms in the ecosystem.[35] It is probable that the propensity to keep animals alive longer on hobby farms and at homes will enhance the likelihood of transmission and resistance due to more rigorous animal handling procedures. Consequently, there is need to ensure precautionary measures to break the chain of animal to human transmission of AMR organisms from farm animals or pets.

Antibiotic-resistant strain infections are linked to metastatic bacterial infections, a lower quality of life, chronicity and increased opportunistic infections recurrence rates.[36] The major mechanism of transfer of resistance genes and antibiotic-resistant bacteria from the farm to humans is through food.[37] Many studies have shown that consumers are exposed to antibiotic resistant bacteria through animal-derived foods. Drug-resistant *E. coli* was identified on the surfaces of beef carcasses after dissection and 24 hours in the chiller, as well as in ground beef refrigerated for one to eight days.[38] The rise in the isolation of resistant human pathogens such as *Salmonella* spp. *Escherichia coli* and *Vibrio* spp., *Campylobacter* and *Aeromonas* spp.[39] has been linked to a high frequency of therapeutic failures, increased risk of complications, worsening of pathology and in some cases death. AMR bacteria's capacity to develop comparable resistance to food-processing-related environmental stressors (heat, refrigeration, pH and Aw) is an intriguing characteristic that is now under investigation and may provide fresh information on the extensive resistance mechanisms of food-associated pathogens. When compared to susceptible *S. typhimurium* and *S. enteritidis* strains, *S.* Typhimurium DT104 strains had a higher heat tolerance.[40] Similarly, bacteria with fluoroquinolone resistance mutations showed acquired resistance to environmental stressors. Injured bacteria may operate to lessen the impact of stress by adopting phenotypic and genotypic adjustments after sub-lethal treatments.[41] These stress-adapted cells may endure different stages of the food production process, posing a threat to the food industry; conversely, as several *in vitro* investigations have shown, the adaptation may be linked to antibiotic cross-protection.[11,42] Processing stressors, as was discovered in later investigations, can promote the horizontal transfer of antibiotic resistance genes.[6]

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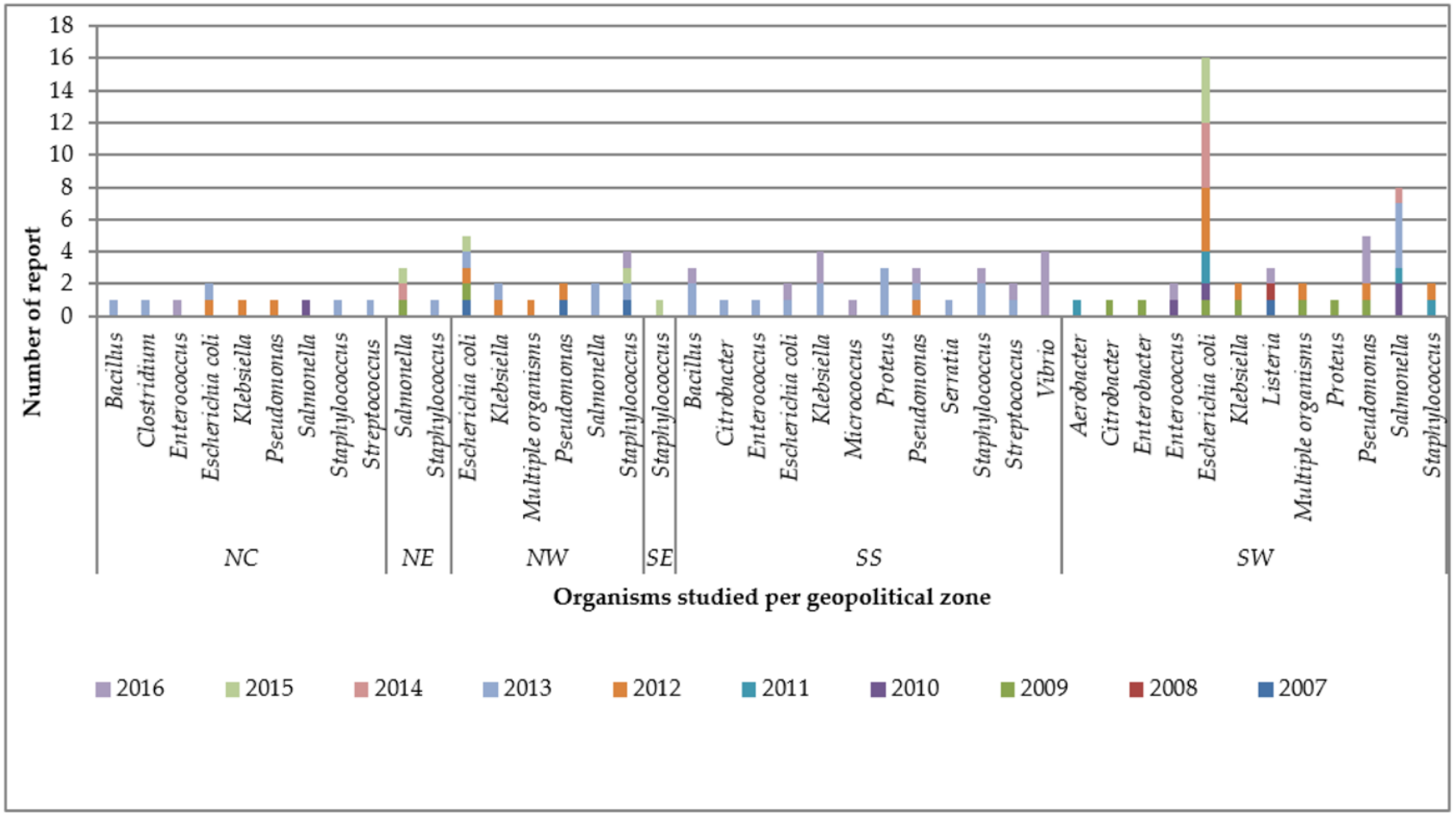

Fig I. Number of reports yearly per organism for the geopolitical zones of Nigeria. NC = North central, NE = North east, NW = North West, SE = South East, SS = South South, SW = South West[14]

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These circumstances may have aided the formation and spread of AMR through food consumption.

The antibiotic resistance profile of Gram-negative bacteria obtained from food and other sources in Northwest Nigeria has been reported.[43] Overall, amoxicillin resistance was the most common, with 86.6% of the isolates being resistant. This was followed by an equally significant resistance to cephalosporins of the first generation, cephalothin (76.0%). Resistance to third and fourth generation cephalosporin medicines - ceftriaxone (46.2%) and cefepime (46.2%) - was moderately high (44.4%). The isolates had a high resistance to amoxicillin-clavulanate (77.2%) but a low resistance to piperacillin-tazobactam (22.5%), a different β-lactam/β-lactamase inhibitor combination. Other antibiotic resistance was also high, including gentamicin (32.5%), ciprofloxacin (50.5%), and trimethoprim-sulfamethoxazole (55.9%). Amikacin remained the most potent antibiotic in all isolates, with only 5.5% resistance. By disc diffusion test, one strain of *Klebsiella pneumoniae* and one isolate of *E. coli* demonstrated reduced susceptibility to colistin. All isolates of *Proteus* spp., *M. morganii* and *Providencia* species, as well as *S. marcescens*, were completely resistant to colistin, as expected. *Klebsiella pneumoniae* is a crucial antibiotic-resistant pathogen according to the WHO. Afolayan, Oaikhena[17] investigated the Klebsiella lineages that were circulating in Nigeria. Whole genome sequencing was performed on 141 Klebsiella isolates from clinical specimens at three AMR sentinel surveillance of tertiary institutions in south western Nigeria between 2016 and 2018. The bulk of the 5 *K. quasipneumoniae* and 134 *K. pneumoniae* isolates studied in Nigeria were observed to be closely linked to globally dispersed multidrug-resistant clones, according to phylogenetic analysis.

Mechanisms of antimicrobial resistance

To manage the threat antimicrobial resistance poses to human health and biological security, it is essential to understand its mechanisms and driving factors. AMR is a natural phenomenon used by the microorganisms to live. The following are examples of the basic bacterial strategies for resisting antimicrobials:[44] antibacterial drug enzymatic breakdown (e.g., manufacture of beta-lactamases by some organisms), generation of novel metabolic pathways (e.g., altered enzyme synthesis), antimicrobials penetrating the cell are removed by the efflux pump, and bacterial proteins that act as antimicrobial targets are altered (e.g., via altering antimicrobial intracellular receptors, such as ribosomal changes), and antibiotic-induced alterations in membrane permeability (e.g., Gram-negative bacteria, such as *E. coli*, have an outer membrane that prevents hydrophobic chemicals like macrolide antibiotics and beta-lactam antibiotics from passing through). This resistance feature might be innate and intrinsically linked to the overall anatomy or physiology of a microorganism, which provides resistance through intrinsic or acquired means.[36]

Recommended strategies for curbing antimicrobial resistance in Nigeria

To mitigate AMR, both a top-down and bottom-up strategy can be used; regulation is a top-down method that aims to set quality standards. The Nigerian Centre for Disease Control (NCDC), in partnership with other institutions, has worked to build an evidence-based top-down approach to address AMR. Meanwhile, the Roy and NCDC[45] indicated that antimicrobial resistance has been widespread in humans in Nigeria, particularly in sepsis, respiratory infections, and diarrhoeal illnesses. These include childhood-related life-threatening disorders, which are backed up by empirical evidence found in commissioned publications, as well as peer-reviewed and grey literature.[14] Similarly, the bottom-up approach which will involve the general public is also required. Proper health literacy is critical to achieving this aim. The ability to receive, understand, and act on information related to maintaining and promoting good health is characterised as health literacy.[4] The Ottawa Charter recognised the need of empowering and enabling individuals to strengthen their control over their health and well-being, and this has been reinforced at successive health promotion conferences. According to a survey of different communities in Jos, Nigeria, consumers have low antibiotic awareness and negative attitudes toward antibiotic use.[46] This shows that there is need for serious public enlightenment and education on antibiotics use. Therefore, in order to reduce the prevalence of AMR across the country, public health professionals should work in concert with the government to promote policies aimed at increasing the literacy levels of the general public. More importantly, public health professionals should support health education initiatives and advocacy in areas where there is a high prevalence of antimicrobial resistance. This will help to inform community members about the importance of improved health awareness and health-seeking behaviour.

Social action approaches in curbing the menace of antimicrobial resistance

These non-medical factors that influence health outcomes are referred to as the social determinants of

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health (SDH). These systems and dynamics encompass social exclusion, public health initiatives, employment conditions, and socio-economic factors that affect housing, nutrition, and educational opportunities.[47] People who are less fortunate on one or more of these crossing social axes are more likely to become sick and need antibiotics. Tackling these upstream causes of infections, antimicrobial usage, and antibiotic resistance can decrease the problem of antibiotic resistance while resolving some of the most significant ethical challenges related to misuse of antimicrobials. Therefore, solution to the menace of AMR will also increase by utilizing social action approaches such as communication and community participation, educating and empowering the affected and vulnerable communities, correcting predisposing social norms, adopting, and putting into practice relevant policies and taking part in fruitful partnerships.

Communication and community participation

Communication and community participation are relevant tools in reneging public health challenges. Communication is a deliberate, conceived, transactional procedure and it is considered successful when the intended audience responds to the intended message.[48] Community participation on the other hand, is a broad term generally used to describe different types and levels of involvement arising from different levels of power between communities and decision-makers.[49] In low-resource countries, the dearth of regular drug sensitivity surveillance leads to irrational antibiotic usage, leading to the current antimicrobial resistance crisis.[50] A health asset approach can be engaged to achieve a high level of community engagement. Instead of focusing on addressing health issues, a health asset strategy invites community participation in all aspects of achieving targeted health outcomes. This is a system that builds young people's capacities to actively participate in their own development and develops their capacity to connect to a variety of networks that facilitate improvements in the health and well-being of themselves and others.[19] In Friedli[51] analysis, it was suggested that this strategy's fatal flaw has been the inability to question the distribution of power among communities, public services, and corporate interests. Asset-based strategies therefore signal a retreat from the statutory, state-run provision of both public services and public health.

AMR is linked to communal norms that influence infection settings and, consequently, the spread of resistance. Community involvement, which focuses on how much communities are involved in defining their own needs as well as solutions to address those needs, is conceptually important to health promotion.[52] Through encouragement, facilitation, and support, community development creates an environment where involvement is possible. This encourages the expression of community needs and supports them in taking action as a whole. Infection control is probably going to rely too heavily on the usage of antibiotics if proper sanitation and hygiene procedures are not followed. Furthermore, a lack of hygienic practises might foster the development, survival, and spread of bacteria that are resistant to treatment. There have been reports which indicate that people who are not currently taking antibiotics or who do not live near other people who are on them, two circumstances that are frequently linked to fostering AMR, can contract antibiotic-resistant organisms in communal settings.[53] This has prompted researchers to look into how household antibacterial hygiene practises and cleaning routines affect AMR in the neighbourhood. According to research, antibacterial substances used in cleaning products can lead to development of cross-resistance.[54] In this situation, the use of specific cleaning products and cultural practises related to cleanliness may co-select for resistance and boost community transmission. This is especially true of the antimicrobial agents present in biocides commonly used in homes. When *Salmonella enterica* and *Escherichia coli* O157 were pre-exposed to sub-lethal quantities of biocides, their susceptibility to erythromycin, imipenem, tetracycline, trimethoprim, and chloramphenicol increased.[54]

Educating and empowering the affected and vulnerable communities

Education, a social determinant of health, is a reflection of the knowledge depth and usage pattern of antimicrobial agents.[55] Numerous researchers have found that education level has a significant impact on self-medication, where people buy their antibiotics from, and how closely dosage instructions are followed.[56-58] However, Badger-Emeka, Emeka[59] got a contrary result in a study to determine how respondents' levels of education affected their patterns of antibiotic use. According to the demographic data collected from their study, factors including age, gender, and education levels did not appear to have any bearing on respondents' inclination to use antibiotics. Worthy of note in this research however is that the sample was collected from a population with similar education level, University students. This would have apparently been responsible for the non-effect of education level in antibiotics consumption. Consequently, government at all levels and other relevant stake holders should enrich the educational sector as a tool to combat the challenge of AMR.

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Antibiotic prescribing behaviour of healthcare workers (HCWs) in Nigeria has contributed to the threat of antimicrobial resistance. Promoting AMR knowledge among health workers is one of the techniques for reducing the rate of AMR emergence and transmission. Chukwu, Oladele[60] investigated HCWs' attitude, knowledge, and antibiotic prescribing practice in Nigeria. About half of the respondents (50.3%) agreed that their prescribing practices might contribute to antibiotic resistance. Antibiotics were administered for a variety of viral diseases, including sore throats (75.7%), measles (33.7%), and the common cold and flu (21.2 %) by several participants. As a result, efforts must be undertaken to increase rational antimicrobial prescription among Nigerian HCWs.

Implication of the findings

The findings of this review have several implications for addressing antimicrobial resistance in Nigeria. Firstly, the prevalence of AMR poses a significant public health challenge, requiring urgent attention and intervention from policymakers, healthcare professionals, and the general public. Secondly, factors contributing to AMR, such as antibiotic misuse, socioeconomic disparities, and cultural practices, highlight the need for multi-sectoral approaches that address both medical and social determinants of health. Thirdly, understanding the mechanisms of AMR transmission and dissemination is essential for designing targeted interventions and surveillance programs. Lastly, strategies for curbing AMR, including top-down regulation and bottom-up community engagement, underscore the importance of collaborative efforts and tailored approaches to combat this global health threat.

Limitations of the study

Despite the comprehensive nature of this integrative review, several limitations should be acknowledged. Firstly, the reliance on published literature may introduce publication bias, as studies with significant findings are more likely to be published. Secondly, the heterogeneity of study designs, methodologies, and settings across included studies may limit comparability and generalizability of findings. Thirdly, the dynamic nature of AMR and its evolving patterns may render some findings outdated or less relevant over time. Lastly, the review may not capture all relevant studies or perspectives on AMR in Nigeria, particularly those in inaccessible databases. These limitations highlight the need for ongoing research and updated evidence to inform effective strategies for addressing AMR in Nigeria.

Conclusion

Antimicrobial resistance is a major public health issue in Nigeria, with a variety of causes. The best tool for controlling infection and thus AMR is still prevention. Social behavioural change could be a powerful instrument in achieving this objective. To combat the spread of antimicrobial resistance around the world, patients, public health professionals, and individuals must work together with local and international regulators and policy makers.

Declarations

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