The Social Impact of Antibiotic Misuse and Antimicrobial Resistance

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Abstract: The misuse of antibiotics and AMR (antimicrobial resistance) is a major instantaneous sociomedical threat that is more than just treatment-related failure in the clinic. Inappropriate use of antibiotics, self-medication, patient demand, weak regulation, misinformation, agriculture use and low public awareness are contributing to the emergence and spread of resistant microorganisms. This paper served to highlight such relevant finding. The impact of AMR results in more disease, and death and also creates uncertainties in diagnosis, extension of hospital stay, complicating treatment and increased health-care cost making it a burden on already stilted health systems. The social impact of resistance is most severe in low- and middle-income countries, where poverty, inadequate access to qualified health care, unregulated medicine markets and unsatisfactory sanitation favor its spread. The economic and labor consequences of antibiotic misuse include increased spending by patients, productivity loss, prolonged illness, and reallocation of public money to surveillance and infection control. Manuscripts are made on integrating humans, veterinary agriculture environmental behavior and proper humanity based one health approach, it is basically it to. Essential responses include antimicrobial stewardship, prescription regulations, public education and community engagement, surveillance systems, better diagnostics, responsible veterinary antibiotic use, new antimicrobials, and alternative therapies. The scientific innovation is important to address AMR. However, to ensure responsible and rational use of antibiotics, comprehensive social, behavioral, economic and policy interventions will be needed..

Keywords: Antimicrobial resistance; Antibiotic misuse; Public health; One Health; Antimicrobial stewardship.

Introduction

Antimicrobial resistance (AMR) describes the ability of microorganisms to withstand the effects of antibiotics and antimicrobials, posing a serious threat to global health and challenging the treatment of bacterial infections (1). AMR is compounded by antibiotic misuse—defined as the inappropriate use of antibiotics in situations where they are not needed, when a different class would suffice, or in an incorrect dose (2). Evidence indicates both phenomena are widespread in numerous countries, with social factors contributing significantly (3). Low awareness, misconceptions, and mistrust lead to excessive household demand, misinformed healthcare-seeking behaviors, and resorting to selfmedication, which is endemic in specific social and cultural settings (4-6). The consequences are felt in different areas: healthcare systems dealing with higher infection rates, loss of productivity and economic growth, differential access impeding equity, and diminished consumer and investor confidence stalling market dynamism (7, 8).

Therefore, this work considers the social impact of antibiotic misuse and antimicrobial resistance. The analysis seeks to clarify how these issues manifest and to identify agents of change (9). Addressing AMR without confronting the misuse that exacerbates it is difficult; the two challenges must be tackled simultaneously and comprehensively, paying due attention to their dimensions (10, 11).

The Genesis of Antimicrobial Resistance

Antimicrobial resistance (AMR), a worldwide health hazard, began with antibiotic use on a massive scale in the 1950s (12). Shortly thereafter, penicillin-resistant strains of Staphylococcus were already in circulation (13). Bacteria can resist antimicrobials through various mechanisms, including cellular efflux, enzyme production, DNA mutations, and horizontal gene transfer (14). The selective pressure of antimicrobial consumption promotes the emergence of resistant strains (15). In humans, excessive antibiotic use arises from unnecessary prescriptions, self-medication, and patient insistence (17). Farmers also employ antimicrobials in livestock feed for growth stimulation, thus further contributing to AMR development (12). The untreated infections or delays before adequate treatment that follow antibiotic treatment failures enhance AMR spread since resistant pathogens replicate even in the absence of antimicrobial use (18).

Diseases that would once have been innocuous can thus become lethal (19). Since bacteria easily exchange resistance factors of a few kilobases among cells within the same species and between different genera, a drug resistant to one antimicrobial compounds the problem (20). Such dynamics occur in several countries and deteriorate in regions with substandard sanitation (21). Bacteria also propagate between humans and animal reservoirs as farming and domestic animal husbandry advance (22). In BRICS, lower-middle-income, and African nations with the most rapid growth, the rampant migration of unregulated medicines can multiply resistance across the species continuum, a problem exacerbated by more than five billion prescriptions annually of self-medicated antibiotics (23-25).

Consumer Behaviors and Public Perception

A range of antibiotic-use behaviours exist at the household level, including homemaking, consumer, and business behaviours, all of which can significantly influence national antibiotic consumption (26). Awareness of antibiotic consumption and its consequences at the household level remains low; only a small minority of individuals associate unnecessary antibiotic use with the emergence of resistant pathogens (27). In turn, insufficient knowledge of risks associated with inappropriate use diminishes demand for antibiotics (28). Misinformed beliefs about the utility of antibiotics—whether to treat viral infections, as a general-purpose cure, or to share leftover prescriptions with friends—persist across countries, exposing vast swathes of the population to misinformation (29). In several nations, physician visits engender demand for antibiotic prescriptions, yet sweeping health policy reforms attempt to curtail this practice (30). Failure to revise policy, as well as the continued proliferation of anti-vaccination movements, drives further antibiotic demand (31). Distrust of health systems and providers, as evidenced by widespread disseminated misinformation, remains another important and growing factor fueling inappropriate antibiotic use (32). Individual household antibiotic-use behaviours are thus shaped by multi-dimensional influences that elude remedial efforts (33). Education reaffirming the individual and societal risks stemming from inappropriate antibiotic use, including provision of misinformation-free channels within health systems for general health-related queries, could alleviate some household demand (34-36).

Healthcare System Consequences

Infection-control measures following surgery or invasive procedures have become more difficult, leading to longer hospital stays and increased rates of morbidity and mortality (37). Diagnostic delays allow infection to progress and increase the likelihood of treatment failure (38). Antibiotic resistance is burdening clinicians with more complex decisions about therapies to initiate or switch to (39). This directly imposes additional costs because of both the extra resources needed for longer hospital stays, and the more labour-intensive nature of cases that required a switch to alternative therapies (40). In healthcare settings, effective antimicrobials are still considered “the highest priorities”; many antimicrobials are already used inappropriately, and “despite increased awareness by governmental and other organisation worldwide, the impact of AMR is still underestimated” (41). When resources are constrained, the emergence of AMR may force a shift of financial investment from activities that improve healthcare provision to those focused upon detecting and responding to AMR (42-44).

Economic and Labor Implications

Patients' expenditures on antimicrobials are significant and increase the economic burden of AR (45, 46). The annual budgetary burden of AR on the public health sector in Bangladesh is estimated to be approximately $27.44 million, which is comparable to the total budgetary allocation for TB, malaria, VBD, and HIV/AIDS control combined (48). Furthermore, the subsequent loss in labor productivity around $215.4 million per annum related to only extended sick and leave period due to AR makes the challenge even more alarming in a developing country where the public health sector is under severe stress (49). Such economic loss will surely remain a threat for decades to come if appropriate measures to curb AR, which is mainly driven by the misuse of antimicrobials, are not taken urgently and widely (50-51).

Tackling AR poses multifaceted challenges due to its negative economic indices for society in general and the health sector in particular (52). The economic burden derived from antibiotic resistance appears not to have received adequate attention commensurate with its negative ramifications (53). Approximately 50% of the current antibiotics available in Bangladesh are perceived to be misused; therefore, there is an urgent need to rectify the situation at an early stage (54). Immediate steps are needed to establish a national antibiotic policy in conjunction with international health organizations, followed by the introduction of an adhesive set of steps including improvement in existing regulatory frameworks for local manufacturers and drug importers, public awareness, and communication, selection of an appropriate design of educational mass media campaign, screening, and education for patients on the rational use of antibiotics, and monitoring (55-57).

Equity and Global Health Disparities

As demonstrated over the past decades, the disparity in the affordable and timely access to effective antimicrobials bears significant social and health consequences (58). High-income nations still face a substantial proportion of the disease burden attributable to AMR-linked infections, yet low- and middle-income countries confront a much larger health threat (59). Besides the immediate risk of AMR transmission, patients without access to effective antimicrobials experience serious exposure to residual AMR infection risk from already treated patients and are more likely to resort to self-medication or seek treatment from unregulated providers (60-62). The poor maternal and child health outcomes resulting from this scenario trigger an adverse long-term amplification of the overall disease burden (63, 64). Access to essential medicines, instruments that underpin the prevention and control of AMR, is also hindered by the local unavailability of relevant disease-specific surveillance information, which in turn shapes the risk perception of AMR and deters engagement in robust surveillance and response initiatives (65, 66).

Policy, Stewardship, and Responsible Use

Policies aimed at combating antibiotic misuse typically emphasize the need for regulating and restricting the availability of such substances, complemented by various prescriptions and audits (6770). The considerable effort spent on stewardship highlights the complex health and economic challenges societies face when tackling prescription practices (71-73).

Despite the public perception of progress, antibiotic overuse remains a major threat in both human and veterinary health (74-78). Misuse occurs in multiple situations, encompassing the need for antibiotics in colds, flu, cough, and some infections left unattended after hospital discharge (79). Access models have widely evolved in many countries, focusing on prescription capacity, regulation, and easy access to broad-spectrum antibiotics (80-81).

Recognizing the widespread misuse of antibiotics, several nations have developed strategies to combat the dissemination of mischief practices (82). The development of public policies to regulate antibiotics, renew production, and develop partnerships is critical for action (83, 84).

Communication, Education, and Community Engagement

The social significance of antibiotic misuse and antimicrobial resistance prompts the need for robust communication strategies directed toward both the public and healthcare professionals (85). The concept of risk communication encompasses the characterization of a risky situation, the factors influencing behavioral changes, and the formulation of targeted messages to reach desired audiences (86). Current knowledge on public understanding of risk and on how to stimulate behavioral change represents a solid foundation for developing effective communication strategies (87). In Mongolia, the local understanding of tórr was earlier investigated to identify knowledge gaps as a prerequisite (88). Information about other commonly used anti-microbials will be gathered for a similar analysis (89). In addition, some antibiotics are consumed with other products (e.g. some topical ointments are used with "spiritual" or "wind" medicine to cure specific diseases) and the meaning attached to these products should be collected to help identify channels to stimulate the demand for the right product on its own (90, 91). A wider survey in is planned to evaluate knowledge around antibiotic use and antimicrobial resistance among primary school students, to assess the desirability of an intervention in this area (92). The choice of schools is still under discussion, to ensure that they cover different socio-economic settings (93).

Further needs assessment activities were also proposed (94). The current "drive for knowledge" requires the identification of and collaboration with knowledgeable partner organisations in order to gather and pass on sound information about antimicrobial related issues (95). The range of practices followed by traditional healers in relation to antibiotics is very broad, and monitoring these practices is needed in order to target effectively the relevant messages (96). Dissemination of information through videos has proven useful and is of high interest (97). In Mongolia, permit to shoot medicines in original packaging is still waiting for approval. Other possible communication media include the dissemination of stickers with written and video messages and the organisations of training aimed at key groups already collaborating with NGOs (98). A two-way communication channel (consultation) has demonstrated high interest, and training in communication skills is proposed to ensure relevance in the related interactions (99, 100).

Research, Innovation, and Alternative Strategies

Despite the urgent need for new antimicrobials and diagnostic tests, there are substantial gaps in research, development, and access to these critical products (101). Few novel antibiotics have entered the clinical pipeline; these antibiotics are primarily targeted at Gram-negative pathogens or highly resistant organisms but are not designed for ubiquitous pathogens (102). The vaccine pipeline is also sparse, and most vaccines that are in development target biofilm-related infections or infections caused by Gram-negative pathogens that are rarely prescribed antibiotics (103). Foodborne pathogens and oral biofilm have also received limited attention (104). Furthermore, the options for non-antibiotic therapy remain narrow, even as multi- and extensively drug-resistant organisms proliferate (105). Research that is simultaneously focused on development and access must encouraged for publicly funded antibiotics and vaccines (106). In CleanQ, a robust status/translational level assessment model enables projects to be characterized according to six key parameters covering scientific, technical, and socio-economic dimensions, and to be compared without scores or subjective judgments (107). In conjunction with the global health domain, this model assists in directing monitoring and funding either along the development pathway or toward a more radical paradigm shift (108). All antimicrobial stewardship research—both social science and integrated techno-economic—also requires significantly broader funding support than it currently attracts (107). An alternative antibacterials funding ecosystem has been outlined that couples the translation of novel laboratory leads with an emphasis on outputs beyond the technical (WHO prioritization and incentivization through pre-commercial agreements) and also identifies oversight, stakeholder engagement, and integration with complementary
initiatives as key enablers (108). Funders are being actively encouraged to adopt translation of nonincremental interventions as an explicit priority (59).

Conclusion

In the 20th century, the discovery of antibiotics brought about enormous benefits to humanity by saving lives from infectious diseases. Communities infected with diseases such as tuberculosis, bacterial pneumonia,

gonorrhea, and syphilis experienced significant transformations. However, resistance to antibiotics has been inadvertently selected due to the preferences or demands of individuals and households as well as patients not adhering to regimens prescribed by the health-care system. On a national scale, the health-care system faces major challenges across infection-control levels. Extended duration of hospital stays due to multi-drug resistant bacterial infections aggravates existing conditions, causing increased mortality. These complex challenges strain the health-care system, forcing a disproportionately large share of resources to combat emerging pathogens and treatment-resistant diseases. As a result, a major portion of public funds is diverted to address antimicrobial resistance because of rising patient demand for investment on surveillance and preventive activities.

On a macroeconomic and labor market scale, direct and indirect costs for managing antibiotic resistance place a severe burden on patients, insurers, governments, and society at large. Efforts to address the problem of chronic use of antibiotics by patients require considerable resources and financial investment. Uncontrolled chronic use of these and other medicines causes significant financial loss in countries facing economic pressures. Widespread production of antibiotics at significantly lower prices in Asia further hinders additional investments in alternative therapies and next-generation antibiotics to combat emerging pathogens. Demand for antibiotics remains consistently strong because of their effectiveness, without incentives to incentivize fundamentally new solutions. High incumbent production capacity limits investment attractiveness for sponsors and public funding as the overall market maintains steady growth, magnified by supply constraints arising from new-generation antibiotics.

The impact on equity and the wider effect on global health and human development is of particular importance, especially in low- and middle-income countries where effective antimicrobials is still a key prerequisite for ensuring good health and for preventing maternal and child mortality. Furthermore, vulnerable and underprivileged groups in both industrialized and developing countries are most affected by drug resistance to essential medicines. The debate also highlights the accessibility of antimicrobial surveillance systems and the capability of countries to monitor and control the emergence and dissemination of resistance.

References

Tassew A. An Overview on the Rise of Antimicrobial Resistance and Its Potential Threat in the Control of Diseases in Developing Countries. 2016. [PDF]

Mathew P, Sivaraman S, Chandy S. Communication strategies for improving public awareness on appropriate antibiotic use: Bridging a vital gap for action on antibiotic resistance. 2019. ncbi.nlm.nih.gov

Haldar J. Confronting the rising threat of antimicrobial resistance: A global health imperative. ACS Infectious Diseases. 2023. acs.org

Aljeldah MM. Antimicrobial resistance and its spread is a global threat. Antibiotics. 2022. mdpi.com

Salam MA, Al-Amin MY, Salam MT, Pawar JS, Akhter N, Rabaan AA, Alqumber MA. Antimicrobial resistance: a growing serious threat for global public health. InHealthcare 2023 Jul 5 (Vol. 11, No. 13, p. 1946). MDPI. mdpi.com

Patra M, Gupta AK, Kumar… D. Antimicrobial resistance: a rising global threat to public health. … and Drug Resistance. 2025. tandfonline.com

Walsh TR, Gales AC, Laxminarayan R, Dodd PC. Antimicrobial resistance: addressing a global threat to humanity. PLoS medicine. 2023. plos.org

Aijaz M, Ahmad M, Ansari MA, Ahmad S. Antimicrobial resistance in a globalized world: current challenges and future perspectives. Int. J. Pharm. Drug Des. 2023. researchgate.net

Hansson K, Brenthel A. Imagining a post-antibiotic era: a cultural analysis of crisis and antibiotic resistance. Medical Humanities. 2022. bmj.com

Davis MDM, Lohm D, Flowers P, Whittaker A. Antibiotic assemblages and their implications for the prevention of antimicrobial resistance. Social Science & Medicine. 2022. strath.ac.uk

Melaku T, Assegid L. Prescription in peril: the sociology of antibiotics and antimicrobial resistance in low resource settings. Discover Social Science and Health. 2025. springer.com

Collignon P, J. Beggs J. Socioeconomic Enablers for Contagion: Factors Impelling the Antimicrobial Resistance Epidemic. 2019. ncbi.nlm.nih.gov

Dyary H, Faraj G, Saeed N. History, current situation, and future perspectives on antibiotics and antibiotic Resistance. One Health Triad; Unique Scientific Publishers: Faisalabad, Pakistan. 2023;2:109-18. researchgate.net

Muteeb G, Rehman MT, Shahwan M, Aatif M. Origin of antibiotics and antibiotic resistance, and their impacts on drug development: A narrative review. Pharmaceuticals. 2023. mdpi.com

Brüssow H. The antibiotic resistance crisis and the development of new antibiotics. Microbial Biotechnology. 2024. wiley.com

Zhou X. Antibiotic culture: a history of antibiotic use in the second half of the 20th and early 21st century in the People's Republic of China. Antibiotics. 2023. mdpi.com

Iskandar K, Murugaiyan J, Hammoudi Halat D, Hage SE, Chibabhai V, Adukkadukkam S, Roques C, Molinier L, Salameh P, Van Dongen M. Antibiotic discovery and resistance: the chase and the race. Antibiotics. 2022 Jan 30;11(2):182. mdpi.com

Kazanjian PH. Efforts to regulate antibiotic misuse in hospitals: A history. Infection Control & Hospital Epidemiology. 2022. [HTML]

Besedovsky HO, Del Rey A. To protect or to kill: a persisting Darwinian immune dilemma. Brain. . researchgate.net

Caughey B, Standke HG, Artikis E, Hoyt F, Kraus A. Pathogenic prion structures at high resolution. PLoS pathogens. 2022 Jun 30;18(6):e1010594. plos.org

Almagro-Moreno S. How Bacterial Pathogens Emerge. American Scientist. 2022. [HTML]

Green J. Everything is tuberculosis: the history and persistence of our deadliest infection. 2025. frankbrowncloud.com

Khairullah AR, Kurniawan SC, Effendi MH, Widodo A, Hasib A, Silaen OS, Moses IB, Yanestria SM, Gelolodo MA, Kurniawati DA, Ramandinianto SC. Anthrax disease burden: Impact on animal and human health. International Journal of One Health. 2024 Feb;10(1):45-55. academia.edu

Kadiyala KG, Goutham K, Katari NK, Vanipenta Y. Vaccines, Diagnosis, and Treatment of Infectious Diseases. Sustainable Nanomaterials for Treatment and Diagnosis of Infectious Diseases. 2025 Feb 26:113-38. [HTML]

Gaynor KM, Green JR. Human–wildlife conflict. Current Biology. 2026. cell.com

Castro-Sánchez E, S. P. Moore L, Husson F, H. Holmes A. What are the factors driving antimicrobial resistance? Perspectives from a public event in London, England. 2016. ncbi.nlm.nih.gov

Khan FU, Mallhi TH, Khan Q, Khan FU, Hayat K, Khan YH, Ahmad T, Fang Y. Assessment of antibiotic storage practices, knowledge, and awareness related to antibiotic uses and antibiotic resistance among household members in post-conflict areas of Pakistan: bi-central study. Frontiers in medicine. 2022 Sep 8;9:962657. frontiersin.org

Otaigbe II, Elikwu CJ. Drivers of inappropriate antibiotic use in low-and middle-income countries. JACantimicrobial resistance. 2023. oup.com

Dankar I, Hassan H, Serhan M. Knowledge, attitudes, and perceptions of dairy farmers regarding antibiotic use: Lessons from a developing country. Journal of Dairy Science. 2022. sciencedirect.com

Paredes JL, Navarro R, Watanabe T, Morán F, Balmaceda MP, Reateguí A, Elias R, Bardellini M, Ochoa TJ. Knowledge, attitudes and practices of parents towards antibiotic use in rural communities in Peru: a cross-sectional multicentre study. BMC Public Health. 2022 Mar 7;22(1):459. springer.com

Green DL, Keenan K, Fredricks KJ, Huque SI, Mushi MF, Kansiime C, Asiimwe B, Kiiru J, Mshana SE, Neema S, Mwanga JR. The role of multidimensional poverty in antibiotic misuse: a mixed-methods study of self-medication and non-adherence in Kenya, Tanzania, and Uganda. The Lancet Global Health. 2023 Jan 1;11(1):e59-68. thelancet.com

Fuller W, Kapona O, Aboderin AO, Adeyemo AT, Olatunbosun OI, Gahimbare L, Ahmed YA. Education and awareness on antimicrobial resistance in the WHO African region: a systematic review. Antibiotics. 2023 Nov 10;12(11):1613. mdpi.com

Edessa D, Assefa N, Dessie Y, Asefa F, Dinsa G, Oljira L. Non-prescribed antibiotic use for children at community levels in low-and middle-income countries: a systematic review and meta-analysis. Journal of Pharmaceutical Policy and Practice. 2022 Dec 31;15(1):57. tandfonline.com

Mudenda S, Mukosha M, Godman B, Fadare J, Malama S, Munyeme M, Hikaambo CN, Kalungia AC, Hamachila A, Kainga H, Bumbangi FN. Knowledge, attitudes, and practices of community pharmacy professionals on poultry antibiotic dispensing, use, and bacterial antimicrobial resistance in Zambia: implications on antibiotic stewardship and WHO AWaRe classification of antibiotics. Antibiotics. 2022 Sep 7;11(9):1210. mdpi.com

Klein EY, Impalli I, Poleon S, Denoel P, Cipriano M, Van Boeckel TP, Pecetta S, Bloom DE, Nandi A. Global trends in antibiotic consumption during 2016–2023 and future projections through 2030. Proceedings of the National Academy of Sciences. 2024 Dec 3;121(49):e2411919121. pnas.org

Moyo P, Moyo E, Mangoya D, Mhango M, Mashe T, Imran M, Dzinamarira T. Prevention of antimicrobial resistance in sub-Saharan Africa: What has worked? What still needs to be done?. Journal of Infection and Public Health. 2023 Apr 1;16(4):632-9. sciencedirect.com

Dadgostar P. Antimicrobial Resistance: Implications and Costs. 2019. ncbi.nlm.nih.gov

Jansen WTM, van der Bruggen JT, Verhoef J, Fluit AC. Bacterial resistance: A sensitive issue: Complexity of the challenge and containment strategy in Europe. 2006. ncbi.nlm.nih.gov

Tarrant C, Krockow EM. Antibiotic overuse: managing uncertainty and mitigating against overtreatment. BMJ quality & safety. 2022. researchgate.net

Puri B, Vaishya R, Vaish A. Antimicrobial resistance: Current challenges and future directions. Medical Journal Armed Forces India. 2025. [HTML]

Theodorakis N, Feretzakis G, Hitas C, Kreouzi M, Kalantzi S, Spyridaki A, Boufeas IZ, Sakagianni A, Paxinou E, Verykios VS, Nikolaou M. Antibiotic resistance in the elderly: mechanisms, risk factors, and solutions. Microorganisms. 2024 Sep 30;12(10):1978. mdpi.com

ALJOHANI MS, ALHARBI YA, ASR NS, ARABI AA, ALRHELY AS, SHUOKR AA, ALQAYIDI WM, ALSAEDI NH, ALMUTAIRI GA, AZONI WM. ANTIBIOTIC RESISTANCE STRATEGIES FOR CONTAINMENT: MECHANISMS, DRIVERS AND ITS GLOBAL IMPACT. TPM–Testing, Psychometrics, Methodology in Applied Psychology. 2025 May 12;32(S1 (2025): Posted 12 May):1484-98. tpmap.org

Almatroudi A. Biofilm resilience: molecular mechanisms driving antibiotic resistance in clinical contexts. Biology. 2025. mdpi.com

Rynkiewich K, Jump RL. Stewardship recommendations at your fingertips: a smartphone application for hospitalbased antibiotic decision-making. Clinical Microbiology and Infection. 2025 Jul 1;31(7):1100-2. [HTML]

Shahidul Islam M, Golam Rabby T, A. Hakim M. Misuse of Antibiotics and Potential Economic Loss in Bangladesh. 2017. [PDF]

Sultana S, Hossain ME, Khan MA, Saha SM, Amin MR, Prodhan MM. Effects of healthcare spending on public health status: An empirical investigation from Bangladesh. Heliyon. 2024 Jan 15;10(1). cell.com

Rahman MM, Alam N, Ullah S, Rahman M. The Prospects and Challenges of Internet of Things (IoT)-based Public Healthcare System in Bangladesh. BUFT J. Bus. Econ. 2024. researchgate.net

Sarker AR, Hasan A, Islam R. Disease-specific distress healthcare financing and catastrophic out-of-pocket expenditure for hospitalization care in Bangladesh. Cost Effectiveness and Resource Allocation. 2025. springer.com

Gautam S, Setu S, Khan MG, Khan MB. Analysis of the health, economic and environmental impacts of COVID-19: The Bangladesh perspective. Geosystems and Geoenvironment. 2022 Feb 1;1(1):100011. sciencedirect.com

Islam MS, Nabi SG, Hasan M, Akter F, Hawlader MM, Sajib MA, Rashid MM. Challenges and Opportunities in Bangladesh's Healthcare System: A Comprehensive Analysis. Journal of Dentistry and Allied Science. 2024 Jan 30;7(1):29-34. banglajol.info

Weerahewa J, Wickramaarchchi T. Food losses in international trade of agricultural commodities: a case study in Sri Lanka. 2023. econstor.eu

Raihan MA, Islam MS, Islam S, Islam AM, Ahmed KT, Ahmed T, Islam MN, Ahmed S, Chowdhury MS, Sarker DK, Lamisa AB. Knowledge, attitudes, and practices regarding antibiotic use in Bangladesh: Findings from a crosssectional study. Plos one. 2024 Feb 12;19(2):e0297653. plos.org

Ahsan AH, Rumi MH, Makhdum N. A pill for every ill? Unpacking antibiotic misuse among Bangladeshi university students. International Journal of Qualitative Studies on Health and Well-being. 2025 Dec 31;20(1):2509346. tandfonline.com

Hossain MJ, Jabin N, Ahmmed F, Sultana A, Abdur Rahman SM, Islam MR. Irrational use of antibiotics and factors associated with antibiotic resistance: findings from a cross-sectional study in Bangladesh. Health science reports. 2023 Aug;6(8):e1465. wiley.com

Islam MW, Shahjahan M, Azad AK, Hossain MJ. Factors contributing to antibiotic misuse among parents of schoolgoing children in Dhaka City, Bangladesh. Scientific Reports. 2024. nature.com

Al Rakib A, Sultana Toma DJ, Akhtar DM, Hasnat MA, Rana MS, Haque Aubhi RU, Mishad NA, Rahman F, Sharmin S. Exploring factors contributing to antibiotic resistance: A cross-sectional empirical study in Bangladesh. PloS one. 2026 May 18;21(5):e0344449. plos.org

MITU E, Banik S, ZIMI S, Khondoker NI, HAQUE H. Recent Physician's Perception on Self-Medication and Antibiotic Abuse in Bangladesh. INTERNATIONAL JOURNAL OF RESEARCH. 2025;12:56-64. researchgate.net

Ackers L, Ackers-Johnson G, Welsh J, Kibombo D et al. Introduction to Antimicrobial Resistance and the Maternal Sepsis Intervention. 2020. ncbi.nlm.nih.gov

Charani E, McKee M, Ahmad R, Balasegaram M et al. Optimising antimicrobial use in humans – review of current evidence and an interdisciplinary consensus on key priorities for research. 2021. [PDF]

Qin W, Wang H, Lv K, Liu S, Ma T, Sang S, Chen Y. Global burden of antimicrobial resistance in lower respiratory infections: A systematic analysis for the Global Burden of Disease Study 2021. International Journal of Antimicrobial Agents. 2026 Mar 20:107786. researchgate.net

Lewnard JA, Charani E, Gleason A, Hsu LY, Khan WA, Karkey A, Chandler CI, Mashe T, Khan EA, Bulabula AN, Donado-Godoy P. Burden of bacterial antimicrobial resistance in low-income and middle-income countries avertible by existing interventions: an evidence review and modelling analysis. The Lancet. 2024 Jun 1;403(10442):2439-54. [HTML]

Tang KW, Millar BC, Moore JE. Antimicrobial resistance (AMR). British journal of biomedical science. 2023 Jun 28;80:11387. frontierspartnerships.org

Aslam B, Asghar R, Muzammil S, Shafique M, Siddique AB, Khurshid M, Ijaz M, Rasool MH, Chaudhry TH, Aamir A, Baloch Z. AMR and sustainable development goals: at a crossroads. Globalization and Health. 2024 Oct 17;20(1):73. springer.com

Sulis G, Sayood S, Gandra S. Antimicrobial resistance in low-and middle-income countries: current status and future directions. Expert review of anti-infective therapy. 2022 Feb 1;20(2):147-60. [HTML]

Antimicrobial Resistance Collaborators. Global burden of bacterial antimicrobial resistance in 2019: a systematic analysis. Lancet (London, England). 2022 Jan 19;399(10325):629. nih.gov

Levitch E, Matthews L, Choi E, Thushiyenthan S, Hall L, Tickner J, Dyda A. The impact of socioeconomic status on the prevalence of antimicrobial resistance in high-income nations: a systematic review. Antimicrobial Stewardship & Healthcare Epidemiology. 2025 Jan;5(1):e264. cambridge.org

Ehsan H. Antibiotic resistance in developing countries: emerging threats and policy responses. Public Health Challenges. 2025. wiley.com

Capuozzo M, Zovi A, Langella R, Ottaiano A, Cascella M, Scognamiglio M, Ferrara F. Optimizing antibiotic use: Addressing resistance through effective strategies and health policies. Antibiotics. 2024 Nov 21;13(12):1112.
mdpi.com

Adebisi YA. Balancing the risks and benefits of antibiotic use in a globalized world: the ethics of antimicrobial resistance. Globalization and Health. 2023. springer.com

Kolawole TO, Mustapha AY, Mbata AO, Tomoh BO, Forkuo AY, Kelvin-Agwu MC. Innovative strategies for reducing antimicrobial resistance: A review of global policy and practice. Journal name missing. 2023 Jan. researchgate.net

Bhandari RK, Pandey AK, Malhotra S, Kakkar AK, Singh S, Cohn J, Holmes A, Charani E, Shafiq N. Addressing challenges in antibiotic access: barriers, implications and strategies for solution. Pharmaceutical Medicine. 2024 Nov;38(6):387-97. [HTML]

Dimuccio MM, Conforti V, Celentano FE, Circella E, Salvaggiulo A, Bozzo G, Corrente M. Regulation of Antibiotic Use in Livestock: European and International Strategies to Prevent and Control Antimicrobial Resistance and Ensure Animal Welfare. Antibiotics. 2026 Jan 8;15(1):67. mdpi.com

Sulis G, Sayood S, Gandra S. How can we tackle the overuse of antibiotics in low-and middle-income countries?. Expert Review of Anti-infective Therapy. 2023 Nov 2;21(11):1189-201. [HTML]

The Core elements of human antibiotic stewardship programs in resource-limited settings : national and hospital levels. 1970. [PDF]

Caneschi A, Bardhi A, Barbarossa A, Zaghini A. The use of antibiotics and antimicrobial resistance in veterinary medicine, a complex phenomenon: a narrative review. Antibiotics. 2023. mdpi.com

Sana SS, Atuahene D, Nagy V, Shaikh AM et al. The Rising Threat of Antibiotic Resistance in Poultry: Veterinary and One Health Perspectives. Veterinary Sciences. 2025. mdpi.com

Endale H, Mathewos M, Abdeta D. Potential causes of spread of antimicrobial resistance and preventive measures in one health perspective-a review. Infection and drug resistance. 2023. tandfonline.com

Ghimpețeanu OM, Pogurschi EN, Popa DC, Dragomir N, Drăgotoiu T, Mihai OD, Petcu CD. Antibiotic use in livestock and residues in food—A public health threat: A review. Foods. 2022 May 16;11(10):1430. mdpi.com

Pandey S, Doo H, Keum GB, Kim ES, Kwak J, Ryu S, Choi Y, Kang J, Kim S, Lee NR, Oh KK. Antibiotic resistance in livestock, environment and humans: One Health perspective. Journal of animal science and technology. 2024 Mar 31;66(2):266. nih.gov

Haddaji N. Environmental contaminants and antibiotic resistance as a One Health threat. One Health. 2022. sciencedirect.com

Tiamiyu AM, Okocha RC, Adesina IA, Okon EM, Olatoye IO, Adedeji OB. Antimicrobial resistance: A significant public health issue of both human and veterinary concern. Open Health. 2024 Oct 7;5(1):20230046. degruyterbrill.com

GULEE SD, MICAH M, YAYOCK E. Developing Strategy to Tackle the Challenge of Examination Mismanagement and Malpractice in Colleges of Education in the North-West Geo-Political Zone, Nigeria. International Journal of Convergent and Informatics Science Research. 2025 Mar 31. harvardpublications.com

Tsegyu S, Garba S, Muhammad U. Utilising public relations to combat misinformation and promote evidenceBased policies for sustainable development. 2024. researchgate.net

Arechar AA, Allen J, Berinsky AJ, Cole R, Epstein Z, Garimella K, Gully A, Lu JG, Ross RM, Stagnaro MN, Zhang Y. Understanding and combatting misinformation across 16 countries on six continents. Nature Human Behaviour. 2023 Sep;7(9):1502-13. nsf.gov

Regan Á, Sweeney S, McKernan C, Benson T, Dean M. Consumer perception and understanding of the risks of antibiotic use and antimicrobial resistance in farming. Agriculture and Human Values. 2023 Sep;40(3):989-1001. qub.ac.uk

Gilham EL, Pearce-Smith N, Carter… V. Assessment of global antimicrobial resistance campaigns conducted to improve public awareness and antimicrobial use behaviours: a rapid systematic review. BMC Public Health. 2024. springer.com

Parveen S, Garzon-Orjuela N, Amin D, McHugh P, Vellinga A. Public health interventions to improve antimicrobial resistance awareness and behavioural change associated with antimicrobial use: a systematic review exploring the use of social media. Antibiotics. 2022 May 16;11(5):669. mdpi.com

Meszaros M. # AMR: Mapping Digital Antimicrobial Resistance Discourses-A Complex Systems Analysis for Leveraging Social Media in Antimicrobial Resistance Communication. 2025. usask.ca

Ferraz MP. Antimicrobial resistance: the impact from and on society according to one health approach. Societies. 2024. mdpi.com

Alejandro AL, Leo WWC, Bruce M. Opportunities to improve awareness of antimicrobial resistance through social marketing: a systematic review of interventions targeting parents and children. Health communication. 2023. [HTML]

Afifi H. The Effectiveness of Health Campaigns on Antibiotic Resistance: A Media and Pharmacy Practice Perspective. Infection and Drug Resistance. 2025. tandfonline.com

Virhia J, Laurie E, Lembo T, Seni J, Pollack R, Davis A, Mapunjo S, Mshana SE, Mmbaga BT, Hilton S. Developing a logic model for communication-based interventions on antimicrobial resistance (AMR). PLOS Global Public Health. 2024 Jun 13;4(6):e0002965. plos.org

Nordvall AC, Ancillotti M, Oljans E, Nilsson E. Antimicrobial resistance and the non-accountability effect on consumers' behaviour. Social Responsibility Journal. 2025 Mar 19;21(5):1125-43. emerald.com

Mwaka AD, Achan J, Orach CG. Traditional health practices: A qualitative inquiry among traditional health practitioners in northern Uganda on becoming a healer, perceived causes of illnesses, and …. Plos one. 2023. plos.org

Torres NF, Solomon VP, Middleton LE. "Antibiotics heal all diseases"; the factors influencing the pratices of selfmedication with antibiotics in Maputo City, Mozambique. Journal of Public Health. 2023. [HTML]

Tan S, Guo H, Chow A. Complementary and alternative medicine (CAM) use and its association with antibiotic usage practices: A nationally representative population study. International Journal of Antimicrobial Agents. 2023. [HTML]

Sun-Waterhouse DX, Chen XY, Liu ZH, Waterhouse GI, Kang WY. Transformation from traditional medicine-food homology to modern food-medicine homology. Food Med. Homol. 2024 Sep 1;1(1). researchgate.net

Rizvi SAA, Einstein GP, Tulp OL, Sainvil F et al. Introduction to traditional medicine and their role in prevention and treatment of emerging and re-emerging diseases. Biomolecules. 2022. mdpi.com

Breijyeh Z, Karaman R. Antibacterial activity of medicinal plants and their role in wound healing. Future Journal of Pharmaceutical Sciences. 2024. springer.com

Ashraf MV, Pant S, Khan MH, Shah AA, Siddiqui S, Jeridi M, Alhamdi HW, Ahmad S. Phytochemicals as antimicrobials: prospecting Himalayan medicinal plants as source of alternate medicine to combat antimicrobial resistance. Pharmaceuticals. 2023 Jun 15;16(6):881. mdpi.com

Butler MS, Gigante V, Sati H, Paulin S, Al-Sulaiman L, Rex JH, Fernandes P, Arias CA, Paul M, Thwaites GE, Czaplewski L. Analysis of the clinical pipeline of treatments for drug-resistant bacterial infections: despite progress, more action is needed. Antimicrobial agents and chemotherapy. 2022 Mar 15;66(3):e01991-21. asm.org

Al-Tawfiq JA, Momattin H, Al-Ali AY, Eljaaly K, Tirupathi R, Haradwala MB, Areti S, Alhumaid S, Rabaan AA, Al Mutair A, Schlagenhauf P. Antibiotics in the pipeline: A literature review (2017–2020). Infection. 2022 Jun;50(3):55364. nih.gov

Theuretzbacher U. Evaluating the innovative potential of the global antibacterial pipeline. Clinical Microbiology and Infection. 2025. [HTML]

Walesch S, Birkelbach J, Jézéquel G, Haeckl FJ, Hegemann JD, Hesterkamp T, Hirsch AK, Hammann P, Müller R. Fighting antibiotic resistance—strategies and (pre) clinical developments to find new antibacterials. EMBO reports. 2023 Jan 9;24(1):EMBR202256033. springer.com

Butler MS, Henderson IR, Capon RJ, Blaskovich MA. Antibiotics in the clinical pipeline as of December 2022. The Journal of Antibiotics. 2023 Aug;76(8):431-73. nature.com

Frost I, Sati H, Garcia-Vello P, Hasso-Agopsowicz M, Lienhardt C, Gigante V, Beyer P. The role of bacterial vaccines in the fight against antimicrobial resistance: an analysis of the preclinical and clinical development pipeline. The Lancet Microbe. 2023 Feb 1;4(2):e113-25. thelancet.com

Blaskovich MAT, Cooper MA. Antibiotics re-booted—time to kick back against drug resistance. npj Antimicrobials and Resistance. 2025. nature.com

Theuretzbacher U. The global resistance problem and the clinical antibacterial pipeline. Nature Reviews Microbiology. 2025. [HTML].