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 self-medication, 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 (67-70). 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 non-incremental 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.

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