

Antibiotics Stewardship: Challenges and One Health Approach



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Abstract

Healthcare systems must prioritize antibiotic stewardship to combat bacterial infections caused by resistant organisms and reduce inappropriate antibiotic usage. Implementing effective antibiotic stewardship programs in ambulatory and outpatient care settings faces various obstacles, including a lack of specialized staff, inadequate documentation and tracking capabilities. Addressing global health issues such as zoonotic diseases and emerging infections requires an approach that prioritizes the interdependence of human, animal, and environmental health, known as the One Health approach. Comprehensive strategies that address underlying issues contributing to antibiotic stewardship challenges are necessary considering the emergence of antibiotic resistance. Factors such as antibiotic self-medication and structural challenges in healthcare systems contribute to this problem. Public health control measures, such as the fight against cat-transmitted sporotrichosis, have also been successful because of the One Health approach. Appropriate antimicrobial therapy and stewardship greatly assist in improving patient outcomes and clinical prognosis in the context of sepsis. When antibiotic stewardship programs are properly implemented in healthcare facilities, they have the potential to reduce antibiotic overuse and enhance patient safety.

Keywords: Antibiotics Resistance; Antibiotics Stewardship; One Health; Public Health; Rapid Diagnostics; Digital Health Solutions

Abbreviations: AMR: Antimicrobial Resistance; IDSA: Infectious Diseases Society of America; SCI/D: Spinal Cord Injury/Disorder; LMICs: Low-and-Middle-Income Countries; AMR: Addressing Antimicrobial Resistance

Introduction

Antibiotics Stewardship

Considering the current COVID-19 pandemic, the importance of antibiotic stewardship in healthcare has become vital. Rational use of antibiotics is crucial in effectively managing bacterial and fungal coinfections in COVID-19 patients [1]. To enhance antimicrobial stewardship, it is essential to have a comprehensive understanding of COVID-19 and antimicrobial resistance (AMR), including antibiotic use, as this virus has the potential to cause AMR [2]. The goal of antibiotic stewardship is to reduce the prevalence of antibiotic resistance by conserving antibiotics and optimizing their use [3]. Antimicrobial stewardship programs play a crucial role in providing reasonable empirical antibiotic recommendations within the context of the pandemic [4]. The significance of adhering to guidelines recommended by the Infectious Diseases Society of America (IDSA) is highlighted by interventions in adult oncology and hematopoietic stem cell transplant populations, demonstrating that antibiotic stewardship is not limited to specific patient populations [5]. Evidence-based

strategies are needed to optimize antibiotic use, as evidenced by the implementation of antibiotic stewardship programs in various healthcare settings, such as ambulatory care and intensive care units [6,7]. Antibiotic stewardship is a multi-sector effort that begins in the healthcare system and extends to public education and awareness. Increasing public knowledge, sentiment, and behavior regarding antibiotic resistance is the initial step in establishing an effective antibiotic stewardship program [8,9].

To ensure accountability for antibiotic stewardship efforts in nursing homes, it is recommended to involve consultant pharmacists and nurses in these programs [10]. Antibiotic stewardship is equally important in pediatric care, with a focus on optimizing antibiotic use and its impact on antimicrobial resistance [11]. New competency frameworks for antibiotic stewardship in nursing education and practice emphasize the need for interdisciplinary collaboration to achieve optimal antibiotic use [12,13]. Addressing antibiotic resistance and prescribing antibiotics appropriately requires a multidisciplinary team consisting of clinicians, epidemiologists, nurses, and pharmacists

to work together in implementing antibiotic stewardship programs [14,15]. The utilization of antibiotic stewardship teams and interventions did not have a negative impact on patient

outcomes. Instead, it led to increased therapy that aligned with guidelines and decreased the total number of days of antibiotic therapy [16,17] (Figure 1).

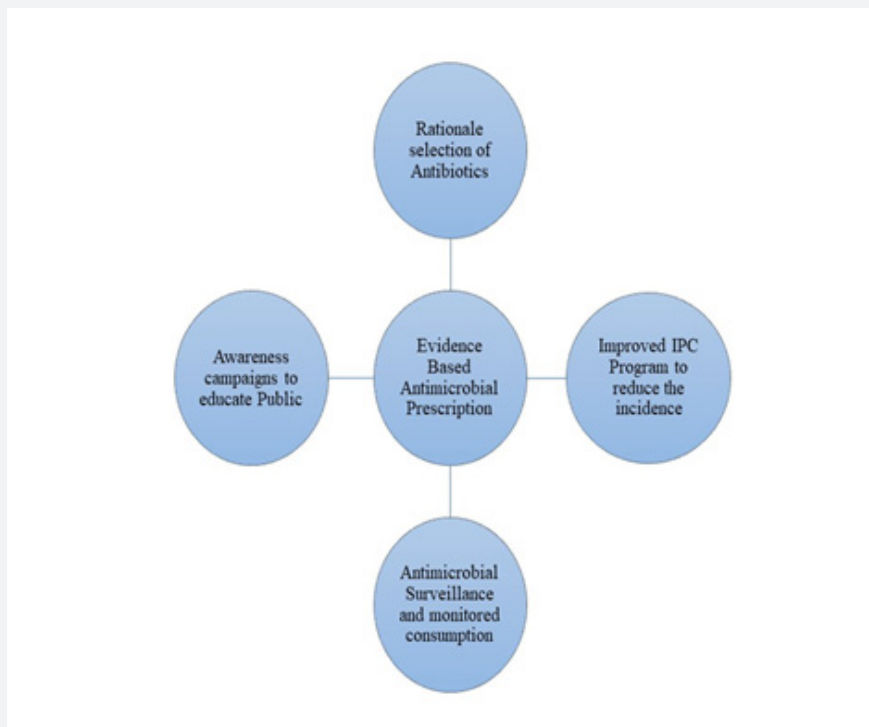


Figure 1: Core Features of Antimicrobial Stewardship.

Challenges in Practicing Antibiotics Stewardship

Various healthcare settings present unique challenges to antibiotic stewardship. Antimicrobial stewardship programs face difficulties in outpatient care due to factors such as a lack of specialized staff, inaccurate records, and inadequate monitoring capabilities [18]. It is also challenging to reduce the administration of unnecessary medications in neonatal care, particularly to neonates [19]. A major obstacle to implementing antimicrobial stewardship programs in primary care settings is the detection of unnecessary antibiotic prescriptions [20].

Furthermore, small independent clinics find it difficult to allocate the necessary financial and technical resources to implement antibiotic stewardship initiatives [21]. The attitudes of primary care physicians towards outpatient antibiotic stewardship and antibiotic resistance reveal challenges in addressing antibiotic resistance and inappropriate prescribing [22]. The absence of dedicated time for stewardship, despite leadership commitment to antibiotic stewardship, is another obstacle faced by pharmacists [23]. Implementing effective antibiotic stewardship presents unique challenges in specialized

care settings, such as those involving spinal cord injury/disorder (SCI/D) [24]. Despite the reported positive effects in reducing antibiotic use, hospitals in low- and middle-income countries face challenges when trying to implement antibiotic stewardship interventions [25].

Misuse of Antibiotics

One of the biggest obstacles to effective antibiotic stewardship is the overuse and misuse of antibiotics. Antibiotic resistance is becoming an increasingly serious problem due to the dramatic rise in antibiotic consumption worldwide [26]. Studies have shown that unprescribed use, storing antibiotics for later use, and not finishing courses are common patterns of antibiotic misuse [27]. The desire for a faster recovery with fewer side effects has also been associated with antibiotic overuse [28]. Effective stewardship is particularly challenging in ambulatory care settings due to a lack of specialized staff, inadequate documentation, and insufficient tracking capabilities, all of which pose problems for antimicrobial stewardship programs [18]. Antibiotic misuse is also common regardless of socioeconomic status or level of education [29,30]. Neonatal care faces issues with antibiotic

administration, knowledge of antibiotic stewardship, and the availability of antibiotic education and resources [19,23].

Business practices contribute to the problem of antibiotic misuse as they are involved in the marketing and distribution systems [31]. Challenges in post-discharge antibiotic stewardship have been identified, including antibiotic overuse, prolonged use of antibiotics, and inefficient use of specific antibiotic treatments [32,33]. While antibiotic stewardship initiatives have proven effective in reducing antibiotic use, their implementation in low- and middle-income countries remains difficult. Systematic reviews and meta-analyses have shown that both developed, and less developed regions have high rates of antibiotic misuse among university students and the general population [30,34]. This suggests that the misuse of antibiotics is not limited to specific regions. Implementing effective stewardship practices is crucial because antibiotic misuse is a key factor in the rise of antibiotic resistance [35].

Campaigns for Public Awareness

One of the most pressing problems in healthcare today is the general public's underestimation of the importance of antibiotic stewardship [36]. Prescribers' actions can be impacted by patient demands and expectations, and most antimicrobials are prescribed in community settings. Community pharmacists continue to face obstacles in raising public awareness due to a lack of resources, including time, personnel, training, and technology, which prevents them from practicing antimicrobial stewardship effectively [37]. There may be a deficiency in public education and awareness initiatives if some members of the community pharmacy team are unaware of European Antibiotic Awareness Day [38].

Lack of understanding about the role of nurses in combating antibiotic resistance may be attributed, in part, to the fact that nursing prelicensure programs do not adequately teach students about stewardship interventions or the seriousness of antibiotic resistance [39]. Antimicrobial stewardship is an important topic, but interns and doctors in Nigeria don't seem to understand it [40]. Medical students and residents lack awareness of the importance of antibiotic stewardship, and there is a need to improve the effectiveness of educational campaigns targeting this demographic on social media [41]. Stewardship activities can be hindered by a lack of education and by the culture of the hospital or unit, highlighting the necessity for increased educational initiatives to overcome these obstacles [42].

Discrepancies in Global Regulation

Antibiotic resistance is a growing concern worldwide due to increased antibiotic consumption. Therefore, it is essential to monitor antibiotic consumption globally to support policies aimed at reducing consumption and resistance while ensuring access to these essential medications [26]. However, issues such as unregulated over-the-counter sales, low-quality antibiotics,

and limited access to necessary antibiotics continue to be major concerns, especially in low- and middle-income countries (LMICs) [43]. The fact that over half of all antibiotics are available over the counter exacerbates the problem, particularly in underdeveloped nations with poor drug control [44].

Optimizing the use of antimicrobials is crucial for preventing the emergence of resistant strains and protecting patients from the unnecessary harms of medication. This is particularly important in pediatric care, where antibiotic stewardship presents both challenges and opportunities, such as in the case of preterm infants [45]. Healthcare utilization disparities influence antibiotic use. To prevent underserved populations from experiencing reduced appropriate antibiotic use, it is important to consider the varying rates of antibiotic-treatable diseases and healthcare-seeking behaviors among different populations [46]. Exploring workarounds and their perceived impact on antibiotic stewardship in healthcare settings has revealed the complexities and barriers encountered in these efforts [47]. Challenges in antibiotic stewardship go beyond access alone. Targeted action is needed to reduce antibiotic overuse in vulnerable populations, such as individuals with spinal cord injuries or disorders (SCI/D), who face unique challenges in antibiotic stewardship [24].

The One Health Approach

The goal of the One Health strategy is to achieve optimal health outcomes for all living things by recognizing the interdependence of humans, animals, and plants with their shared environment [48]. This strategy operates at different levels, including local, subnational, national, regional, and global, with the objective of achieving optimal health through interdisciplinary collaboration [49]. The One Health strategy has received support from various groups, such as the WHO, Public Health England, and the American Medical Association [49] and has been incorporated into the plans of many nations and international organizations to address pressing issues like antibiotic resistance [50]. It has been recognized as a realistic, durable, and cost-effective approach to achieving high standards of health for all living things [21].

The One Health approach has been instrumental in understanding, preventing, and managing zoonotic diseases, both emerging and long-standing, by coordinating efforts between the public health and animal health sectors [51]. It has also been successfully utilized in collaboration with medical and veterinary institutions to study zoonotic diseases, demonstrating its effectiveness in addressing health issues across human, animal, and environmental domains [52]. Due to the interconnectedness of human, animal, and environmental health, a systems approach to One Health is necessary, highlighting the importance of considering the environment as an integral part of the One Health framework [53]. As a framework with guiding principles, the One Health approach facilitates cross-sectoral collaboration with various stakeholders to holistically control diseases, such as Q fever [54]. It has also been recognized as crucial in addressing

global health concerns beyond zoonoses and has played a key role in responding to unprecedented pandemics like COVID-19 [55]. Many regions, including Kenya, have documented both the successes and failures of the One Health approach, with Kenya utilizing the approach to adopt and implement strategies for controlling and preventing zoonotic diseases [51].

Addressing antimicrobial resistance (AMR) and promoting responsible use of antibiotics requires a strong connection between antibiotic use in animals and humans within the One Health approach, as well as antibiotic stewardship. A collaborative, multisectoral strategy is needed to address antimicrobial resistance (AMR). This strategy incorporates antibiotic use in both animals and agriculture, in addition to human use [56]. This approach shows how the animal and human health sectors can work together more effectively. Antibiotic resistance can be better understood by taking a One Health approach, since research has shown that people, animals, and the environment are all interdependent [57]. The extensive use of antibiotics in animals, including protected antibiotics and crossover-use, highlights

the importance of community-level interventions that promote responsible antibiotic use in animals through a One Health approach [58].

In addition, to promote antimicrobial stewardship, legislation, and advocacy, as well as to limit the dissemination cycle of antibiotic resistance, worldwide multidisciplinary and integrated approaches grounded in One Health principles are necessary [59]. An even more compelling argument in favor of a One Health strategy is the fact that antibiotic use in livestock raises the risk of antibiotic resistance and contaminates human food with antibiotic residues [60]. The goal of antibiotic stewardship is to ensure that antibiotics are prescribed sparingly and used appropriately by implementing evidence-supported interventions [61]. To standardize antibiotic use and prevent drug-resistant bacterial infections, stewardship guidelines have been developed by governments and health organizations worldwide [61]. Antibiotic stewardship and public health initiatives face obstacles, such as the improper prescription of antibiotics in ambulatory care clinics [62].

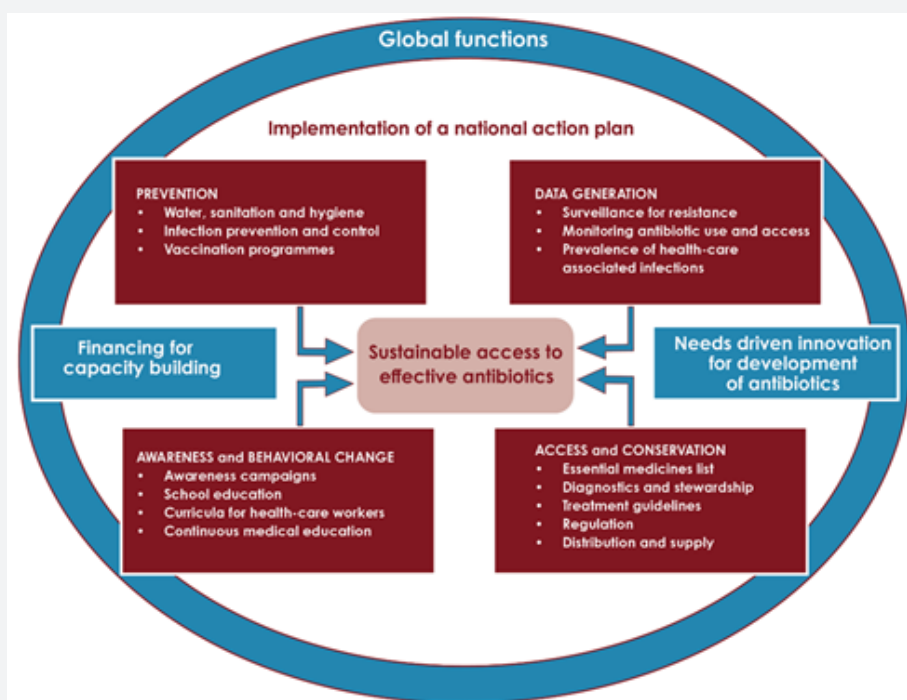


Figure 2: Antimicrobial stewardship and one health action plan [66].

The urgency of antibiotic stewardship in maximizing antibiotic use is underscored by the fact that antibiotic resistance is significantly accelerated by inappropriate antibiotic use [63]. There needs to be action to combat the simultaneous pandemics of COVID-19 and antibiotic resistance since antibiotic use in

treating the virus has compromised antibiotic stewardship [64]. ASPs are vital in encouraging responsible antibiotic use and have a significant impact on antibiotic use [65]. A team consisting of clinicians, epidemiologists, nurses, and pharmacists could be an effective way to encourage responsible antibiotic

use [14]. To combat the rise of antibiotic-resistant microbes and encourage their responsible use, it is crucial to establish a connection between the One Health approach's emphasis on animal and human antibiotic use and antibiotic stewardship. Antimicrobial resistance must be tackled through a collaborative, multisectoral strategy, as the One Health approach acknowledges the interdependence of human, animal, and environmental health. The promotion of responsible antibiotic use and improvement of antibiotic use are both greatly aided by antibiotic stewardship programs (Figure 2) [66].

Successful One Health Initiatives

Recognized as the most effective method for controlling diseases like rabies, the One Health approach emphasizes ecological concerns and large-scale oral vaccination campaigns. In 2020, Acharya and colleagues further supported this approach [21]. The importance of health system resilience and collaborative learning initiatives has also led to the recognition of the One Health concept as a critical framework for tackling global health challenges [67]. The One Health initiative has highlighted the importance of global partnerships in addressing public health issues, such as controlling antibiotic resistance through international collaborations [68]. A multidisciplinary approach is crucial in combating pandemics and public health threats. In Indonesia, the One Health concept has been successfully implemented to address the spread of zoonotic diseases [69].

One Health Approach & Technology Innovation

There is significant hope that rapid diagnostic testing can improve antibiotic prescribing behaviors and serve as an effective diagnostic antibiotic stewardship tool [70]. Diagnostic stewardship initiatives within healthcare systems can address infectious syndromes such as UTIs, GERDs, COVID-19, and bloodstream infections [71]. Antibiotic stewardship programs should involve the microbiology lab, and new diagnostic tools may assist doctors in prescribing the appropriate medication more quickly and accurately [72]. One-way diagnostic stewardship works by reducing tests with a high likelihood of false positive results [33]. Regardless of illness severity, similar approaches should be considered for individuals with pathogen-negative sepsis due to the positive outcomes observed when antimicrobial stewardship programs and molecular rapid diagnostic testing are utilized together [73].

Digital health solutions have completely transformed the tracking of antibiotic usage and resistance patterns. Studies indicate that healthcare providers can make better decisions regarding antibiotic prescribing and stewardship through real-time data on antibiotic consumption and resistance provided by digital health solutions [5,74]. Telemedicine and mobile applications can be utilized to educate patients on the proper use of antibiotics and encourage their participation in stewardship initiatives [75,76]. Rapid diagnostics and digital health solutions

have made substantial contributions to antibiotic stewardship efforts by improving bacterial infection identification, reducing unnecessary antibiotic prescriptions, and providing real-time data on antibiotic use and resistance patterns. These technological innovations have the potential to greatly enhance antibiotic stewardship practices and patient care.

Conclusion & Future Recommendations

The One Health approach and antibiotic stewardship play pivotal roles in addressing global health challenges, including antimicrobial resistance and zoonotic diseases. The One Health approach emphasizes the interconnectedness of human, animal, and environmental health, highlighting the need for collaborative, multisectoral strategies. Antibiotic stewardship focuses on promoting responsible use of antibiotics, reducing unnecessary prescriptions, and combating antimicrobial resistance. The success of these initiatives requires breaking down interdisciplinary barriers and fostering collaboration between healthcare professionals, veterinarians, environmental scientists, and other stakeholders. Future research should focus on evaluating the effectiveness of the One Health approach, developing specific evaluation methods and tools, and addressing the challenges associated with interdisciplinary collaboration. Additionally, efforts are needed to increase awareness and understanding of antibiotic stewardship programs among healthcare professionals and students. Technological innovations, such as rapid diagnostics and digital health solutions, should be further integrated into antibiotic stewardship efforts to improve the accuracy of bacterial infection identification, reduce unnecessary antibiotic prescriptions, and monitor antibiotic use and resistance patterns in real time.

The implementation of antibiotic stewardship programs in various healthcare settings, including emergency departments, urgent care centers, and long-term care facilities, has shown promising results. However, there is a need for continued efforts to overcome barriers and obstacles to antibiotic stewardship, such as the inappropriate use of antibiotics and the lack of awareness among healthcare professionals. In the future, collaborative learning initiatives, such as the Joint Initiative for Teaching and Learning on Global Health Challenges and One Health, can provide valuable opportunities for multidisciplinary education and research. These initiatives can foster impactful collaborations and support an interconnected/integrated approach to health. Moreover, the role of social media in guiding One Health initiatives and the potential of clinical One Health as a novel healthcare solution for underserved communities should be further explored.

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