

## The importance of antimicrobial stewardship (AMS) in the mitigation of antimicrobial resistance (AMR)

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### ABSTRACT

**Background:** Antimicrobials are a class of drugs used to treat infections caused by bacteria, fungi, viruses and protozoa. They are an extremely valuable resource across the spectrum of modern medicine. Their development has been linked with dramatic reductions in communicable disease mortality, and has facilitated technological advances in cancer therapy, transplantation, and surgery. But with the development of resistance to these antimicrobials, their usefulness is being threatened with associated worse outcomes for patients and higher costs of healthcare.

**Objectives:** For these reasons, there is a need for implementing antimicrobial stewardship programs or interventions. While antimicrobial resistance is on the increase, antimicrobial drug development is slowing down, hence the importance of AMS in ensuring optimal use of antimicrobials.

**Methods:** A search of existing literature on antimicrobial stewardship was carried out. Literature databases such as Google Scholar, Elsevier, PubMed, and Scopus were engaged in the review work.

**Results:** The formation of an antimicrobial stewardship team necessitates an interdisciplinary composition, comprising professionals such as infectious disease (ID) specialists, hospital pharmacists, and clinical microbiologists, each equipped with substantial expertise and professional commitment in the realms of infection diagnosis, prevention, and treatment.

**Conclusion:** Antimicrobial Stewardship will help in optimizing antimicrobial therapy and mitigating antimicrobial resistance. However, there is a need to ensure policy and guidelines formulation, enforcement and monitoring.

**Key words:** Antimicrobials, Stewardship, Pharmacists, Tools

## L'importance de la gestion des antimicrobiens (GAM) dans l'atténuation de la résistance aux antimicrobiens (RAM)

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### RÉSUMÉ

**Contexte:** Les antimicrobiens sont une classe de médicaments utilisés pour traiter les infections causées par des bactéries, des champignons, des virus et des protozoaires. Ils constituent une ressource extrêmement précieuse dans tout le spectre de la médecine moderne. Leur développement a été associé à des réductions spectaculaires de la mortalité due aux maladies transmissibles et a facilité les progrès technologiques dans le traitement du cancer, la transplantation et la chirurgie. Mais avec le développement de la résistance à ces antimicrobiens, leur utilité est menacée, avec pour corollaire des résultats plus mauvais pour les patients et des coûts de santé plus élevés.

**Objectif:** Pour ces raisons, il est nécessaire de mettre en œuvre des programmes ou des interventions de gestion des antimicrobiens. Alors que la résistance aux antimicrobiens augmente, le développement des médicaments antimicrobiens ralentit, d'où l'importance de la gestion des antimicrobiens pour assurer une utilisation optimale des antimicrobiens.

**Méthodes:** Une recherche de la littérature existante sur la gestion des antimicrobiens a été réalisée. Des bases de données bibliographiques telles que Google Scholar, Elsevier, PubMed et Scopus ont été utilisées pour le travail de revue.

**Résultats:** La formation d'une équipe de gestion des antimicrobiens nécessite une composition interdisciplinaire, comprenant des professionnels tels que des spécialistes des maladies infectieuses, des pharmaciens hospitaliers et des microbiologistes cliniques, chacun disposant d'une expertise substantielle et d'un engagement professionnel dans les domaines du diagnostic, de la prévention et du traitement des infections.

**Conclusion:** La gestion des antimicrobiens contribuera à optimiser le traitement antimicrobien et à atténuer la résistance aux antimicrobiens. Il est toutefois nécessaire de veiller à la formulation, à l'application et au suivi des politiques et des lignes directrices.

**Mots clés:** Antimicrobiens, gestion responsable, pharmaciens, outils

## INTRODUCTION

Antimicrobials are a useful class of drugs used to treat infections caused by bacteria, fungi, viruses, protozoa. They are an extremely valuable resource across the spectrum of modern medicine. Their development has been linked with dramatic reductions in communicable disease mortality and has facilitated technological advances in cancer therapy, transplantation and surgery. However, this resource is threatened by the global increase in antimicrobial resistance.<sup>1</sup> Due to the problems arising from resistance to antimicrobials, there is a need for implementing antimicrobial stewardship interventions in hospitals in order to optimize use of antimicrobials.<sup>2</sup>

Antimicrobial resistance is on the increase; however, antimicrobial drug development is slowing. Now more than ever before, antimicrobial stewardship is of utmost importance as it is a way to ensure optimal use of antimicrobials to prevent resistance from developing and as well improve patient outcomes.<sup>3</sup>

Antimicrobial Stewardship (AMS) is one of the three pillars of an integrated approach to strengthening the health care system. The other two include infection prevention and control (IPC) and patient and medicine safety.<sup>4</sup> The focus of this writeup is however on AMS.

The use of the term 'antimicrobial stewardship' has grown exponentially in recent years, typically referring to programmes and interventions that aim to optimize antimicrobial use.<sup>5</sup>

Antimicrobial stewardship programmes are a set of interventions that aim to ensure the judicious use of antimicrobials by preventing their unnecessary use, and by providing targeted and limited therapy in situations where they are warranted. It involves activities that help optimize antimicrobial therapy; that is, ensuring the best clinical outcome for the patient, while endeavouring to lower the risk of subsequent development of antimicrobial resistance.<sup>6</sup>

Implementation of antimicrobial stewardship programme has been found to reduce excessive antibiotic usage and has resulted in reduced resistance rates in many countries. Antimicrobial stewardship programmes have shown 22-36 % reduction in antimicrobial use and significant cost savings.<sup>7</sup>

Countries such as Australia, Chile, China, France, Scotland, South Africa, South Korea, Sweden, Taiwan,

USA and Vietnam have successfully implemented antibiotic stewardship programmes.<sup>8</sup>

Antimicrobial resistance occurs when microorganisms such as bacteria, viruses, fungi and parasites change in ways that render the medications used to cure the infections they cause ineffective. This is a major concern because a resistant infection may kill, can spread to others, and imposes huge costs to individuals and society.<sup>9</sup>

Antimicrobial stewardship programs have been shown to improve patient outcomes, reduce antimicrobial agent-related adverse events, and decrease antimicrobial resistance.

Antimicrobial stewardship refers to an ongoing effort by a health institution to optimize antimicrobial use among hospitalized patients in order to improve patient outcomes, ensure cost effective therapy, and reduce adverse sequelae of antimicrobial use.<sup>10</sup>

Antimicrobial stewardship program is an evidence-based approach which addresses the correct selection of antimicrobial agents, dosages, routes of administration and duration of therapy. In other words, an antimicrobial stewardship program necessitates the right drug, the right time, the right amount and the right duration.<sup>11</sup>

The 2007 definition by the Society for Healthcare Epidemiology of America (SHEA) defines Antimicrobial stewardship as a set of coordinated strategies to improve the use of antimicrobial medications with the goal to enhance patient health outcomes, reduce antibiotic resistance, and decrease unnecessary costs.<sup>7</sup>

According to Conan and Ron, the members of antimicrobial stewardship team are infectious disease physicians, clinical and hospital pharmacists, clinical microbiologists, infection control staff and hospital epidemiologists and hospital administrators.<sup>10</sup>

### History of antimicrobial stewardship

The term Antimicrobial Stewardship was coined in 1996 by two internists at Emory University School of Medicine, John McGowan and Dale Gerding, a specialist on *Clostridium difficile*.<sup>12</sup>

In 1997, Society for Healthcare Epidemiology of America (SHEA) and the Infectious Diseases Society of America (IDSA) published guidelines to prevent antimicrobial resistance arguing that appropriate antimicrobial

stewardship, that includes optimal selection, dose, and duration of treatment, as well as control of antibiotic use, will prevent or slow the emergence of resistance among microorganisms.<sup>13</sup>

Ten years later, in 2007, bacterial resistance had risen to such a degree that the Centers for Disease Control and Prevention, CDC rang the alarm. The same year, IDSA and SHEA published guidelines for developing an antimicrobial stewardship program.<sup>7</sup> Also in 2007, the first pediatric publication used the term antimicrobial stewardship.<sup>14</sup>

In 2012, the Society for Healthcare Epidemiology of America, SHEA and Infectious Diseases Society of America, IDSA published a joint policy statement on antimicrobial stewardship.<sup>27</sup>

#### **CDC components of antimicrobial stewardship program**

High performing antimicrobial stewardship programs have seven key components identified by the Centers for Disease Control and Prevention<sup>15</sup> and the Infectious Diseases Society of America (IDSA), 2019. They are:

- **Hospital Leadership commitment:**  
Dedicate necessary human, financial and information technology resources. Priority examples of hospital leadership commitment emphasize the necessity of antibiotic stewardship programs leadership having dedicated time and resources to operate the program effectively, along with ensuring that program leadership has regularly scheduled opportunities to report stewardship activities, resources and outcomes to senior executives and hospital board.
- **Accountability:**  
Appoint a leader or co-leaders, such as a physician and pharmacist, responsible for program management and outcomes.
- **Pharmacy Expertise (Drug expertise):**  
Appoint a pharmacist, ideally as the co-leader of the stewardship program, to lead implementation efforts to improve antibiotic use.
- **Action:**  
Implement interventions, such as prospective audit and feedback or preauthorization, to improve antibiotic use

- **Tracking:**  
Monitor antibiotic prescribing, impact of interventions, and other important outcomes like *C. difficile* infection and resistance patterns.
- **Reporting:**  
Regularly report information on antibiotic use and resistance to prescribers, pharmacists, nurses, and hospital leadership.
- **Education:**  
Educate prescribers, pharmacists, and nurses about adverse reactions from antibiotics, antibiotic resistance and optimal prescribing.

#### **Benefits of antimicrobial stewardship**

*Clostridium difficile* is a major threat to patients in hospitals. Antimicrobial stewardship has proven to be a highly effective strategy in combating *C. difficile* in hospitals. Several single-center studies in the United States have shown significant reductions in *C. difficile* that follow the implementation of stewardship programs.<sup>16</sup>

Stewardship programs have also demonstrated effectiveness in improving the use of antibiotics in surgical prophylaxis and in helping clinicians optimize dosing in patients with renal insufficiency.<sup>17</sup>

Also, there is the most important patient safety issue - the proper treatment of infections. A study by Fishman showed that infections that were managed with the assistance of an antimicrobial stewardship program resulted in a 70 % increase in infection cures and an 80 % decrease in treatment failures.<sup>18</sup>

Antimicrobial stewardship further ensures that appropriate treatment guidelines are followed in the treatment of infections for optimal therapy.

Microbial Culture Sensitivity (MCS) test is critical for a patient to benefit from antimicrobial therapy. Antimicrobial stewardship therefore ensures that MCS tests are conducted to allow for the right dose of drug to be tailored to the specific causative organism thereby optimizing therapy.

#### **Goals of AMS**

Antimicrobial stewardship has been defined as "the optimal selection, dosage, and duration of antimicrobial treatments that results in the best clinical outcome for the treatment or prevention of infection, with minimal

toxicity to the patient and minimal impact on subsequent resistance".<sup>19</sup>

Antimicrobial stewardship is a systemic approach to educate and support healthcare professionals to follow evidence-based guidelines for prescribing and administering antimicrobials. World Health Organization recognizes Antimicrobial Stewardship as one of the most cost-effective interventions to optimize the use of antimicrobial medicines, improve patient outcomes and reduce AMR and health care-associated infection. Therefore, WHO guides countries to develop and implement Antimicrobial Stewardship Programmes.<sup>20</sup>

#### **Antimicrobial stewardship has a 3-fold goal**<sup>3,19,21</sup>

First, is to empower healthcare practitioners help each patient receive the most appropriate antimicrobial with the correct dose and duration. This considers the "5 Ds of optimal antimicrobial therapy": Right Drug, Right Dose, Right Drug route, De-escalation to pathogen-directed therapy, and Right Duration of therapy.

Second Goal is to prevent antimicrobial overuse, misuse, and abuse. Overuse in both hospital and outpatient setting such as use when they are not necessary. Misuse, such as in the very common scenario of the use of broad-spectrum antibiotics. Abuse might refer to the use of particular antibiotics preferentially over others by a physician as a result of previous known therapeutic efficacy or as a result of aggressive detailing by the pharmaceutical representative or because of cost.

The third and most important goal is to minimize the development of resistance both at the individual patient level and the community level.

#### **Antibiotic stewardship tools - AWaRe**

The AWaRe classification of antibiotics was developed in 2017 by the WHO Expert Committee on Selection and Use of Essential Medicines as a tool to support antibiotic stewardship efforts at local, national and global levels, Antibiotics are classified into three groups, Access, Watch and Reserve, taking into account the impact of different antibiotics and antibiotic classes on antimicrobial resistance, to emphasize the importance of their appropriate use. It is updated every 2 years.

The AWaRe classification is intended as a tool for monitoring antibiotic consumption, defining targets and monitoring the effects of stewardship policies that aim to optimize antibiotic use and curb antimicrobial resistance.

The WHO 13th General Programme of Work 2019-2023 includes a country-level target of at least 60 % of total antibiotic consumption being Access group antibiotics.<sup>22</sup>

#### **Access group antibiotics**

This group includes antibiotics that have activity against a wide range of commonly encountered susceptible pathogens while also showing lower resistance potential than antibiotics in the other groups. Some examples include: Amikacin; amoxicillin; amoxicillin + clavulanic acid; ampicillin; benzathine benzylpenicillin; benzylpenicillin; cefalexin; cefazolin; chloramphenicol; clindamycin; cloxacillin; doxycycline; gentamicin; metronidazole; nitrofurantoin; phenoxymethylpenicillin; procaine benzylpenicillin; spectinomycin.

#### **Watch group antibiotics**

This group includes antibiotics that have higher resistance potential and includes most of the highest priority agents among the Critically Important Antimicrobials for Human Medicine and/or antibiotics that are at relatively high risk of selection of bacterial resistance. Antibiotics in Watch group should be prioritized as key targets of stewardship programs and monitoring. Some examples include: Azithromycin; cefixime; cefotaxime; ceftazidime; ceftriaxone; cefuroxime; ciprofloxacin; clarithromycin; meropenem; piperacillin + tazobactam; and vancomycin.

#### **Reserve group antibiotics**

This group includes antibiotics and antibiotic classes that should be reserved for treatment of confirmed or suspected infections due to multi-drug-resistant organisms. Antibiotics in Reserve group should be treated as "last resort" options, which should be accessible, but their use should be tailored to highly specific patients and settings, when all alternatives have failed or are not suitable. These medicines could be protected and prioritized as key targets of national and international stewardship programs involving monitoring and utilization reporting, to preserve their effectiveness (WHO, 2019). Examples include: Aztreonam, Cefiderocol (not listed in the model list for children); ceftazidime + avibactam; colistin; fosfomycin; linezolid; meropenem + vaborbactam (not listed in the model list for children); plazomicin (not listed in the model list for children); and polymyxin B.

#### **ANTIMICROBIAL STEWARDSHIP IN NIGERIA**

The major contributors to the growing threats of antimicrobial resistance (AMR) to global health are

antimicrobial prescribing practices and use. Developing countries including Nigeria lack crucial information on these topics which are pivotal for antimicrobial stewardship programs. Reports have it that inappropriate use of antibiotics is estimated to be 20-50% in Nigeria.<sup>23</sup>

'Inappropriate use' in Nigeria, comprises the use of antibiotics to treat all forms of infections, incomplete dosage regimen during treatment, and sharing of antibiotics with others without prescription by a physician.

Nigeria along with many countries in low-middle-income-countries (LMIC) is yet to fully implement the GAP and One Health Approach programs especially in the healthcare facilities. But in line with the global call for action plan on tackling AMR, the Federal Government of Nigeria through the Ministry of Health established the country's AMR coordinating body at the Nigerian Centre for Disease Control (NCDC) with key stakeholders to provide support and guidance for AMR control activities in the country.

The National Action Plan (NAP) was developed from weaknesses identified as a road map to curbing AMR; A 5-Focus strategy which incorporates the one health approach is adopted in the plan to address the problem of AMR within a 5-year period (2017-2022).<sup>24</sup> The focus areas are;

1. Increasing awareness and knowledge on AMR and related topics
2. One health AMR surveillance and research
3. Infection Prevention and Control
4. Promote rational access to antibiotics and antimicrobial stewardship
5. Invest in research to quantify the cost of resistance and develop new antimicrobials and diagnostics (Federal Ministry of Agriculture and Rural Development, 2017)

In LMICs, it is observed that the presence of policies may not guarantee their implementation due to lack of strong leadership commitment to enforce these policies. This problem can trickle down to the healthcare facility level and this compounds with other barriers to impede the implementation of Antimicrobial Stewardship and IPC programs across the country. It is therefore imperative that individual healthcare facilities take measures to implement AMS/IPC programs until the expected national input reinforces their effort.<sup>24</sup>

Recently the Federal Government inaugurated the National Antimicrobial Stewardship (AMS) Task Force in Abuja on the 27th August, 2024. The Honourable Minister of State for Health and Social Welfare, Dr. Tunji Alausa urged members of Antimicrobial Stewardship Taskforce (AMS) to carry out their assignment with urgency and unwavering commitment to stem the tide of antimicrobial resistance and safeguard the lives of Nigerians. He also emphasized that the challenge requires multisectoral coordination and dedicated sector-specific approaches.<sup>25</sup> The Honourable Minister of State lamented that currently, there was no Antimicrobial Stewardship program to monitor the pattern of antimicrobials use and antimicrobials sensitivity across the country. The Terms of Reference (ToR) of the taskforce have three thematic areas, which include

- Coordinate AMR surveillance and research activities in Nigeria
- To create AMR data platform
- To promote Enlightenment and education on AMR

#### **Role of pharmacists in antimicrobial stewardship**

Antimicrobial stewardship involves healthcare practitioners ensuring that antimicrobial agents such as antibiotics, antivirals, and antifungals are used responsibly in order to strike a balance between maximum effectiveness and the development of resistance and toxicity.<sup>26</sup> It is a set of coordinated interventions aimed at improving and measuring the proper use of antimicrobial agents by encouraging the selection of the best antimicrobial treatment regimen, which includes dose, length of therapy, and mode of administration.<sup>27</sup>

Pharmacists are core members of the AMS team. They help develop and manage antimicrobial guidelines, review individual patient regimens to optimize therapy, educate healthcare staff on appropriate antimicrobial use, and monitor and audit antimicrobial usage outcomes.<sup>28</sup>

The formation of an antimicrobial stewardship team necessitates an interdisciplinary composition, comprising professionals such as infectious disease (ID) specialists, hospital pharmacists, and clinical microbiologists, each equipped with substantial expertise and professional commitment in the realms of infection diagnosis, prevention, and treatment.<sup>7,29</sup>

Pharmacists play a pivotal role within the antimicrobial stewardship (AMS) team, primarily involved in the formulation and management of antimicrobial guidelines, meticulous review of individual patient regimens to enhance therapeutic efficacy, dissemination of knowledge among healthcare personnel regarding judicious antimicrobial utilization, and diligent monitoring and assessment of outcomes pertaining to antimicrobial usage.<sup>28</sup> Pharmacists contribute significantly to the mitigation of antimicrobial resistance through multifaceted AMS strategies encompassing prescription optimization, surveillance of antimicrobial utilization, infection prevention and educational initiatives, as well as engagement in training programs and public outreach efforts.<sup>30</sup>

### **Prescription optimization and surveillance of antimicrobial utilization**

Optimization of prescriptions and monitoring of antimicrobial usage are essential components of effective antimicrobial stewardship (AMS) programs. It involves a comprehensive assessment of patients undergoing antimicrobial therapy, considering various factors such as appropriateness of indication, drug selection, dosage, administration route, and duration. Notably, the implementation of prospective audits, facilitated by intervention and feedback mechanisms, overseen by professionals with specialized training in infectious diseases (ID) or clinical pharmacology with AMS expertise, has demonstrated significant improvements in treatment outcomes.<sup>26</sup>

Pharmacists play a crucial role in these endeavors, employing strategic patient selection criteria for audit procedures, focusing on specific infectious conditions (e.g., respiratory tract infections), patient care settings (e.g., intensive care or medical units), or culture results. Their interventions may include therapeutic adjustments such as transitioning from intravenous to oral formulations, de-escalating antimicrobial therapy, seeking infectious disease consultations, and conducting therapeutic drug monitoring. Concurrently, the feedback loop established within this process facilitates clinical education and insights dissemination among healthcare providers.<sup>26</sup> A review of five studies on medication prescribing for older adults receiving primary care found that interventions led by pharmacists, such as providing access to health records and performing medication reviews, along with giving feedback to physicians and using computer alerts to identify inappropriate medications, can improve the appropriateness of

prescribing.<sup>31</sup>

Despite the availability of numerous resources aimed at optimizing prescriptions and monitoring antibiotic utilization, challenges persist, particularly in community healthcare settings, where limited access to such resources impedes effective implementation of antimicrobial stewardship strategies.<sup>30</sup>

### **Education, training and public involvement.**

In the ongoing battle against antimicrobial resistance, educational intervention emerges as a cornerstone. It is impossible to isolate the effect of education from other interventions; hence, pharmacists strategically incorporate educational components to effectively influence prescribing behaviors.<sup>32</sup> Pharmacists assume a pivotal role in imparting knowledge on appropriate antimicrobial prescribing practices and resistance patterns. Their educational endeavors encompass a spectrum of approaches, including multidisciplinary collaboration with the formulation of local guidelines, engagement in academic detailing sessions, facilitation of continuing education programs targeting healthcare providers and nurses, as well as patient education initiatives.<sup>26</sup> Various methods are employed by pharmacists to disseminate educational content, with one-time seminars and online e-learning modules emerging as predominant modalities. Additionally, innovative approaches such as leveraging social media platforms, educational video games, and problem-based learning modules are being explored to enhance the effectiveness of educational interventions.<sup>26</sup>

### **Community pharmacists' involvement in antimicrobial stewardship.**

Given the widespread use of antibiotics in community settings, community pharmacists play a crucial role in implementing and advocating for strategies to combat antimicrobial resistance.

Community pharmacists can play a role in reducing antibiotic resistance, since they are one of the most accessible healthcare professionals.<sup>33</sup> This can be made possible by actively engaging in antimicrobial stewardship.

Community pharmacists are often regarded as key healthcare providers for AMS programs due to their role in dispensing of antimicrobials. They also bring their exclusive knowledge of pharmacokinetic, pharmacodynamic, and pharmacoeconomic principles to

antimicrobial therapy, which ultimately improves patients' health outcomes.

Community pharmacists have an important role to play to promote and improve the appropriate use of antibiotics.<sup>34</sup> According to Hancock and Mellor, the role of the community pharmacists in antimicrobial stewardship can be simplified into two main objectives: ensuring antimicrobials are prescribed appropriately when needed and ensuring they educate patients to improve the chances of them using their antimicrobial properly.<sup>35</sup> Given most antimicrobials being prescribed and dispensed in the community, the use of antimicrobial stewardship (AMS) programs is essential in this setting to address AMR.<sup>36</sup>

Studies have been carried out within and outside Nigeria to assess community pharmacists' knowledge, views, perception and practices concerning antimicrobial stewardship.<sup>34,38,39</sup>

#### Challenges in development of pharmacists-led AMS program.

Pharmacists encounter a myriad of challenges in developing interventions for antimicrobial resistance. These obstacles encompass a range of issues including; lack of policies, an absence of an AMS multidisciplinary team, poor documentation, weak laboratory and technological infrastructure, and limited time for stewardship.

- ❖ **Lack of policies and guidelines:** Pharmacists reported a lack of clear guidelines, which made it difficult for them to assess how patients were being managed with antibiotics. This was observed in both private and public hospitals, where antibiotic policies were non-existent and had to be created at the start of the pilot project.<sup>40</sup>
- ❖ **Lack of AMS multidisciplinary team:** Some studies found that AMS teams were either non-existent, poorly reconstituted or not functioning properly, with certain disciplines not being included.<sup>41</sup> It was noted that pharmacists couldn't operate in isolation and required the support of well-reconstituted AMS teams.
- ❖ **Poor documentation:** Poor documentation of antibiotic indications was observed during pharmacists' surveillance of antimicrobial prescribing patterns, thus making it difficult for

pharmacists to evaluate patients' antibiotic management.<sup>42</sup>

- ❖ **Weak laboratory and technological infrastructure:** The lack of availability of microbiological results made it difficult for pharmacists to assess the appropriateness of antibiotic treatment. This was a significant issue, particularly in public hospitals where pharmacists had to participate in developing antibiograms to provide guidance for empirical prescribing. The lack of electronic data collection and the use of manual systems prolonged the time taken for data entry by pharmacists.<sup>40,43</sup>

#### CONCLUSION

There is no gainsaying that Antimicrobial Stewardship will help in optimizing antimicrobial therapy and mitigating antimicrobial resistance. There is a need to ensure policy and guidelines enforcement and monitoring.

#### REFERENCES

1. Jill D, Christopher J (2014). Importance of Antimicrobial Stewardship to the English National Health Service. *Infection Drug Resistance*. 7: 145-152. . doi: 10.2147/S39185. PMID: 24936131.
2. Oduyebo O, Olayinka A, Iregbu K, Versporten A, Goossens H, Jimoh O, Nwajiobi P, Jimoh O, Ige T (2017). A point prevalence survey of Antimicrobial prescribing in Four Nigerian Tertiary Hospitals. *Annals Tropical Pathology*. 8:42-6.
3. Shira D, Nadkarni L, Price L, Kenneth L, Davidson L, Evans J, Garber C, David R, (2011). A Nationwide Survey of Antimicrobial Stewardship Practices. *Clinical Therapeutics* 35(6):758-765. doi.org/10.1016
4. Shrestha J, Zahra F, Cannady, Jr P (2024) Antimicrobial Stewardship. [Updated 2023 Jun 20]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK572068/>
5. Dyar OJ, Huttner B, Schouten J, Pulcini C (2017). What is antimicrobial stewardship? *Clinical Microbiology and Infection* 23(11): 793-798.
6. Cotta M, Robertson M, Tacey M, Kann A, Danny L, Kirsty L (2013). Attitudes towards antimicrobial stewardship: results from a large private hospital in Australia. *Healthcare infection* 19(3):89-94.
7. Dellit T, Owens R, McGowan J, Timothy C (2007). Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America guidelines for developing an institutional program to



- enhance antimicrobial stewardship. *Clinical Infectious Diseases*, 44:159-77.
8. Huttner B, Harbarth S, Nathwani D (2014). Success stories of implementation of antimicrobial stewardship: a narrative review. *Clinical Microbiology Infectious Disease* 20: 954-962.
  9. World Health Organization (2014). WHO's first global report on antibiotic resistance reveals serious, worldwide threat to public health. <https://www.who.int/southeastasia/news/detail/30-04-2014-who-s-first-global-report-on-antibiotic-resistance-reveals-serious-worldwide-threat-to-public-health>. Accessed Oct 7th 2024.
  10. Conan M, Ron E (2005). Antimicrobial Stewardship Programs in Health Care Systems. *Clinical Microbiology Reviews*. 18(4): 638-656. doi: 10.1128/CMR.
  11. Roula B, Marquetta F, Eddie G, Danny Z (2015). The Importance of an Antimicrobial Stewardship Program. 32(9): 20-24. PMID: 30766084
  12. McGowan JE, Gerding DN (1996). Does antibiotic restriction prevent resistance? *New Horizons*. 1996 Aug. 4(3):370-6. [PubMed] [Reference list]].
  13. Shlaes DM, Gerding DN, John JF, Craig W, Bornstein D, Duncan R, Eckman M, Farrer M, Greene W, (1997). Society for healthcare epidemiology of America and infectious diseases society of America Joint Committee on the prevention of antimicrobial resistance: Guidelines for the prevention of antimicrobial resistance in hospitals. *Clinical Infectious Diseases*, 25(3): 584-599. doi.org/10.1086/513766.
  14. Patel SJ, Larson EL, Kubin CJ, Saiman L (2007). A review of antimicrobial control strategies in hospitalized and ambulatory pediatric populations. *Pediatric Infectious Diseases Journal*. 26 (6): 531-7. doi:10.1097/inf.0b013e3180593170. PMID 17529873
  15. Center for Disease control and Prevention, (2019). Core Elements of Hospital Antibiotic Stewardship Program. Atlanta, GA: US Department of Health and Human Services. Available at <https://www.cdc.gov/antibiotic-use/hcp/core-elements/hospital.html> Accessed October 7, 2024
  16. Malani A, Richards P, Kapila S, Otto M, Czerwinski J, Singal B (2013). Clinical and economic outcomes from a community hospital's antimicrobial stewardship program. *America Journal Infectious Control* 41(2):145-8.
  17. File T, Solomkin J, Cosgrove S, (2011). Strategies for improving antimicrobial use and the role of antimicrobial stewardship programs. *Clinical Infectious Diseases*; 53 Suppl 1: S15-22.
  18. Fishman N (2006). Antimicrobial stewardship. *America Journal Infectious Control*; (S55-63-73).
  19. Doron S, Davidson LE (2011). Antimicrobial stewardship. *Mayo Clinic Proceedings*, 86(11), 1113-1123. <https://doi.org/10.4065/mcp.2011.0358>
  20. WHO 2024 Promoting antimicrobial stewardship to tackle antimicrobial resistance (who.int) available at <https://www.who.int/europe/activities/>
  21. Dyar OJ, Huttner B, Schouten J, Pulcini C (2017) ESGAP (ESCMID Study Group for Antimicrobial Stewardship). What is antimicrobial stewardship? *Clinical Microbiology Infectious Disease*. 23(11):793-798. [PubMed: 28882725]
  22. World Health Organization (2023) AWaRe classification of antibiotics for evaluation and monitoring of use, 2023 available at <https://www.who.int/publications/i/item/WHO-MHP-HPS-EML-2023.04> (Accessed Oct 5th 2024)
  23. Umeokonkwo CD, Madubueze UC, Onah CK, Okedo-Alex IN, Adeke AS, Versporten A, Goossens H, Igwe-Okomiso D, Okeke K, Azuogu, B. N, Onoh R (2019). Point prevalence survey of antimicrobial prescription in a tertiary hospital in South East Nigeria: A call for improved antibiotic stewardship. *Journal of Global Antimicrobial Resistance* 17: 291-295. <https://doi.org/10.1016/j.jgar.2019.01.013>
  24. Aika IN, Enato E (2022). Health care systems administrators perspectives on antimicrobial stewardship and infection prevention and control programs across three healthcare levels: a qualitative study. *Antimicrobial Resistance and Infection Control* 11(1): 157. <https://doi.org/10.1186/s13756-022-01196-7>
  25. Press Release 2024. Antimicrobial Stewardship TaskForce. Available at [https://www.health.gov.ng/Bpg\\_info/154/PRESS-RELEASE](https://www.health.gov.ng/Bpg_info/154/PRESS-RELEASE)
  26. Parente DM, Morton J (2018) Role of the Pharmacist in Antimicrobial Stewardship. *Medical Clinical North America*. 102(5):929-936.
  27. Fishman N (2012) Policy statement on antimicrobial stewardship by the Society for Healthcare Epidemiology of America; Infectious Diseases Society of America; Pediatric Infectious Diseases Society. (2012) Policy statement on antimicrobial stewardship by the Society for Healthcare Epidemiology of America (SHEA), the Infectious Diseases Society of America (IDSA), and the Pediatric Infectious Diseases Society (PIDS).

- Infectious Control Hospital Epidemiology*; 33(4):322-7. doi: 10.1086/665010. PMID: 22418625.
28. Gilchrist M, Wade P, Ashiru-Oredope D, Howard P, Sneddon J, Whitney L, et al. (2015) antimicrobial stewardship from policy to practice: experiences from UK antimicrobial pharmacists. *Infectious Diseases Therapeutics*. 4(Suppl 1):51-64.
  29. European Centre for Disease Prevention and Control (ECDC) (2017) Proposals for EU guidelines on the prudent use of antimicrobials in humans. <http://ecdc.europa.eu/en/publications/Publications/EU-guidelines-prudent-use-antimicrobials.pdf>. Accessed Jan 2024. Stockholm.
  30. Garau J, Bassetti M. (2018) Role of pharmacists in antimicrobial stewardship programmes. *International Journal Clinical Pharmacy*. 40(5):948-952. doi: 10.1007/s11096-018-0675-z. Epub 2018 Sep 22. PMID: 30242589.
  31. Riordan DO, Walsh KA, Galvin R, Sinnott C, Kearney PM, Byrne S (2016) The effect of pharmacist-led interventions in optimizing prescribing in older adults in primary care: a systematic review. *SAGE Open Med*. 2016; 4:2050312116652568.
  32. Satterfield J, Miesner AR, Percival KM (2020) The role of education in antimicrobial stewardship. *Hosp Infect*. 105(2):130-141. doi: 10.1016/j.jhin.2020.03.028. Epub 2020 Mar 31. PMID: 32243953.
  33. Bishop C, Yacoob Z, Knobloch MJ, Safdar N (2019). Community pharmacy interventions to improve antibiotic stewardship and implications for pharmacy education: a narrative overview. *Research in Social and Administrative Pharmacy* 15(6): 627-631.
  34. Abubakar U (2020). Practices and perception of Nigerian community pharmacists towards antimicrobial stewardship program. *International Journal of Pharmacy and Pharmaceutical Sciences*, 12 (4): 37-42. doi:<https://doi.org/10.22159/ijpps.2020v12i4.36505>.
  35. Hancock L, Mellor C, (2016) "An evaluation of antimicrobial stewardship in community pharmacy", Fields: *Journal of Huddersfield Student Research* 2(1). doi: <https://doi.org/10.5920/fields.2016.2123>
  36. Saha SK, Barton C, Promite S, Mazza D, (2019). Knowledge, perceptions and practices of community pharmacists towards antimicrobial stewardship: a systematic scoping review. *Antibiotics*, 8(4), p.263.
  37. Khan MU, Hassali MA, Ahmad A, Elkalmi RM, Zaidi ST, Dhingra S (2016) Perceptions and Practices of Community Pharmacists towards Antimicrobial Stewardship in the State of Selangor, Malaysia. *PLoS One*. Feb 22; 11(2):e0149623. doi: 10.1371/journal.pone.0149623. PMID: 26901404; PMCID: PMC4764324
  38. Amorha KC, Chima OM, Ugochukwu EJ, Sabastine RN (2024). Assessment of Community Pharmacists' Knowledge, Perception and Practice Regarding Antimicrobial Stewardship in Ebonyi State, Southeastern Nigeria. *African Journal of Biomedical Research*, 27(1), pp. 65-72. doi:10.4314/ajbr.v27i1.8.
  39. Erku DA (2016) Antimicrobial Stewardship: A Cross-Sectional Survey Assessing the Perceptions and Practices of Community Pharmacists in Ethiopia. *Interdisciplinary Perspectives Infectious Diseases*. 2016;2016:5686752. doi: 10.1155/2016/5686752. Epub 2016 Nov 22. PMID: 27994621; PMCID: PMC5138470.
  40. Otieno PA, Campbell S, Maley S, Obinju Arunga T, Otieno Okumu M. (2022) A Systematic Review of Pharmacist-Led Antimicrobial Stewardship Programs in Sub-Saharan Africa. *International Journal Clinical Practice*. Oct 13;2022:3639943. doi: 10.1155/2022/3639943. PMID: 36311485; PMCID: PMC9584722.
  41. Brink AJ, Messina AP, Feldman C (2016) antimicrobial stewardship across 47 South African hospitals: an implementation study. *The Lancet Infectious Diseases*. 16(9):1017-1025.
  42. Momanyi L, Godman B, Opanga S, Nyamu D, Oluka M, Kurdi A (2019) Antibiotic prescribing patterns at a leading referral hospital in Kenya: a point prevalence survey. *Journal of Research in Pharmacy Practice*. 8(3): 149.
  43. Sneddon J, Afriyie D, Sefah I, (2020) Developing a sustainable antimicrobial stewardship (Ams) programme in Ghana: replicating the scottish triad model of information, education and quality improvement. *Antibiotics*. 9(10): 636