

Research Article

DOI: 10.62046/gijams.2025.v03i05.004

The Role of Antimicrobial Resistance in Infectious Disease Burden, the Effectiveness of Clinical Pharmacist-Led Consultation in Benghazi Libya

Hanan M Garalla, MBChB, MSc, PhD¹, Makpula Abdelaziz Tarhuni²

¹Department of Pathology, Faculty of Medicine, University of Benghazi, Libya

²Faculty of Pharmacy, Libyan International Medical University, Libya

| Received: 01.09.2025 | Accepted: 17.10.2025 | Published: 28.10.2025

Abstract: Background: The global health crisis posed by antimicrobial resistance (AMR) is largely due to the inappropriate use of antimicrobial medications, leading to higher rates of illness, death, and healthcare expenditures. Effective clinical pharmacy initiatives, particularly through Antimicrobial Stewardship Programs (ASPs), are crucial for optimizing the use of antibiotics and reducing AMR. **Aim:** This research aimed to evaluate the impact of AMR on the burden of infectious diseases in hospitals in Benghazi and to analyze the effectiveness of clinical pharmacy consultations in decreasing AMR, along with their influence on patient outcomes and antibiotic prescribing habits. **Materials and Methods:** A retrospective cross-sectional research design was employed, examining 200 inpatient medical records collected through patient data forms. Additionally, 300 self-administered questionnaires were distributed among clinical pharmacists, physicians, infection control experts, and nursing staff. The data were analyzed using SPSS Version 21 and Microsoft Excel, with results reported as means \pm standard deviation (SD), and comparisons utilizing non-parametric tests ($P < 0.05$). **Results:** Out of the 200 patients reviewed, 84.5% had not undergone culture swabs before the initiation of antibiotics, and documentation regarding culture outcomes was lacking in 84.5% of the instances. Among the healthcare professionals surveyed, 93.7% indicated that there was no ASP in place at their institutions, while 92.3% observed antibiotics being prescribed without adherence to established guidelines. The involvement of pharmacists in patient care was minimal, revealing significant deficiencies in tasks such as obtaining medical histories and monitoring for issues related to medication. **Conclusion:** The results indicate a critical impact on microbiological testing and pharmacist participation within hospitals in Benghazi. It is vital to address these concerns by improving microbiological testing, implementing stewardship programs, and standardized protocols, and enhancing interdisciplinary collaboration to better patient outcomes and combat AMR. **Keywords:** Antimicrobial resistance, clinical pharmacy, antimicrobial stewardship programs, pharmacist involvement, patient safety, healthcare practices.

Citation: Hanan M Garalla *et al.* The Role of Antimicrobial Resistance in Infectious Disease Burden, the Effectiveness of Clinical Pharmacist-Led Consultation in Benghazi Libya. Grn Int J Apl Med Sci, 2025 Sep-Oct 3(5): 264-270.

INTRODUCTION

Antimicrobial resistance (AMR) represents a significant challenge to global public health, greatly complicating the treatment of infectious diseases [1]. The traditional dependence on antibiotics, which began with the discovery of penicillin in 1928, is increasingly challenged by the rapid emergence of resistant pathogens and multi-drug resistant strains, making once-manageable infections harder to treat. Antimicrobial resistance (AMR) poses a serious threat to modern medicine, with predictions of 10 million deaths annually by 2050 if left unchecked [2]. One of the most pressing public health issues of our time is the evolution of bacteria that leads to genetic antibiotic resistance. Specifically, the prevalence of AMR varies by region, with South Asia and sub-Saharan Africa

having concerning death rates [3]. This emphasizes how urgently tailored measures are needed to fight AMR. Clinical pharmacist-led consultations are an essential strategy for optimizing the use of antibiotics and improving patient outcomes in the fight against infectious diseases and the broader impacts of antimicrobial resistance (AMR) on global health. Antimicrobial resistance (AMR) is a complicated global health challenge driven by excessive antibiotic use, inadequate infection control, and insufficient drug development, necessitating a coordinated One Health approach [4]. The rise of multidrug-resistant (MDR) infections among vulnerable populations highlights the urgent need for innovative treatment strategies and responsible antimicrobial stewardship, particularly through initiatives like clinical pharmacist-led

consultations [5]. Clinical pharmacy, as defined by the European Society of Clinical Pharmacy, refers to actions that try to optimize drug use in order to meet public health goals. In developing countries, clinical pharmacy services are frequently underutilized [6]. Clinical pharmacists' integration into healthcare teams has been found to minimize antibiotic use and hospital stays by driving ASP initiatives, giving therapeutic guidance, and ensuring proper antibiotic selection [7]. The World Health Organization emphasizes the role of ASPs in promoting optimal antibiotic use. Despite the awareness of their critical role, many healthcare settings, particularly in low- and middle-income countries, do not adequately integrate clinical pharmacists in ASPs, highlighting the need for more collaboration to improve health outcomes and reduce AMR [8,9].

The World Health Organization emphasizes several essential techniques for combating antimicrobial resistance (AMR), including cautious antibiotic prescribing, increased patient education, and strong antimicrobial stewardship programs. The comprehensive action plan outlines five strategic goals: increasing awareness of AMR, improving research and surveillance, implementing effective infection prevention measures, optimizing antimicrobial use in human and animal health, and promoting long-term investment in new antimicrobial agents and diagnostic technologies [10-12]. In Libya, the impact of AMR is poorly documented, emphasizing the need for increased surveillance and national efforts [13]. Furthermore, the changing role of pharmacists in Libya requires considerable adjustments in education and practice to enhance patient-centered care and improve healthcare outcomes [14]. Addressing these challenges is critical for advancing clinical pharmacy services and effectively combating AMR in the local context. This study aims to evaluate the impact of antimicrobial resistance on infectious diseases in Benghazi hospitals and assess the effectiveness of clinical pharmacy consultations in reducing AMR and improving patient outcomes.

MATERIALS AND METHODS

In order to determine how much antimicrobial resistance (AMR) contributes to the burden of infectious diseases in Benghazi hospitals and how well clinical pharmacy consultations affect patient outcomes and antibiotic prescribing practices, this descriptive study used mixed-methods quantitative and qualitative approaches through survey data collection. The retrospective cross-sectional study data were collected from 200 inpatient medical files using standardized patient data collection forms, focusing on individuals with documented infectious disorders. The data for the cross-sectional study a total of 300 self-administered questionnaires were distributed to healthcare professionals, including doctors, pharmacists, infection

control specialists, and nurses, within public hospitals in Benghazi.

All data were captured using a standardized patient data collection form, adhering to ethical and confidentiality guidelines throughout the study period from June to December 2024 from Benghazi hospitals, specifically Benghazi Medical Center and Al-Kuwaifeya Hospital. Ethical approval for the research was obtained before the study's commencement. Statistical analyses were conducted using SPSS Version 21 and Microsoft Excel. Data were expressed as means \pm standard deviation (SD). Comparisons between groups were performed using non-parametric analysis. A p-value of < 0.05 was considered statistically significant.

RESULTS

The study included 200 participants, comprising 107 males (53.5%) and 93 females (46.5%), indicating a slight predominance of male participants. Among the 200 participants, the mean age was ± 54.73 years, with 51% (n=102) aged 51 years and above, 46% (n=92) aged 26-50 years, and only 3% (n=6) aged 18-25 years reflecting a bias toward older age groups (Table 1). Table 1 displays the distribution of respondents across medical departments. The Chest Department had the most participants among the 300, accounting for 25.3%, followed by the Medicine Department, which had 19.3%. Other departments included surgery (15.3%), gynecology (13.7%), and orthopedics (6.3%), with smaller contributions from the intensive care unit (5%), pediatrics (5%), neurology (5%), and nephrology (1.7%). This varied representation enhances the study's findings across multiple medical specialties. The data show considerable deficits in renal and liver function monitoring among antibiotic-treated individuals. Specifically, 78% of patients did not undergo renal function testing, and 78.5% Lacked liver function tests when receiving antibiotics such as Gentamicin IV and Vancomycin. The link between the absence of renal and liver function tests and use the alternative of antibiotics was statistically significant (p-value 0.0001). The data revealed that 84.5% of samples indicated that no sample (swab, blood) culture was taken before starting antibiotic treatment. Moreover, the results demonstrated a statistically significant association ($p < 0.001$) between swab testing before the initiation of antibiotic therapy and long-term duration of antibiotic use (7+ days), in 109 patients (54.5%) (Table 2). The study of 300 healthcare professionals found a diverse distribution of expertise, with nurses accounting for the largest group (42.3%), followed by physicians (35.3%). In terms of experience, the majority of respondents indicated having 1–5 years (36.7%) or 6–15 years (34.7%) of experience. This suggests that the workforce is primarily made up of professionals in the early to mid stages of their careers. (Figure 1 A, B).

The findings show a significant lack of implementation of the Antibiotic Stewardship Program (ASP) in



hospital settings. Among 300 respondents, only 6.3% (n = 19) stated that the ASP is rarely applied, while a striking 93.7% (n = 281) said it is never implemented. Furthermore, adherence to the hospital-specific protocol for antibiotic dispensing is alarmingly low, with only 7.7% (n = 23) of respondents stating that antibiotics are dispensed according to established protocols. In contrast, 92.3% (n = 277) claimed that antibiotics are not prescribed by any specific guidelines (Table 3).

The study results indicate that pharmacists play a limited role in clinical consultations regarding patient care. Only (n=32) 10.7% of Pharmacists reported that

pharmacists actively provide health care and take patients' medical history, whereas (n = 234) 78% do not. Only (n = 9) 3% of participants reported that pharmacists collaborate with the medical team to make antibiotic selection decisions. And 3.7% (n = 11) monitored for medication-related issues. Furthermore, just 1% (n = 3) of adjusted antibiotic prescriptions were due to drug-related issues, and similarly, only 1% (n = 3) of modified dosages were based on kidney and liver function tests. These findings reveal a considerable gap in the utilization of pharmacists' knowledge in medication management (Table 4).

Table-1: Characteristics of study participants

Variable	Frequency	Percentage
Gender (N=200)		
Male	107	53.5
Female	93	46.5
Age (N=200)		
18-25	6	3
26-50	92	46
≥51	102	51
The overall mean age is ±54.73		

Survey Distribution by Departments (N-300)

Intensive Care Unit	15	5%
Cardiac Care Unit	10	3.3%
General Surgery Department	46	15.3%
Pediatric Department	15	5%
Neurology Department	15	5%
Gynecology Department	41	13.7%
Respiratory Department	76	25.3%
Internal Medicine Department	58	19.3%
Orthopedic Department	19	6.3%
Nephrology Department	5	1.7%

Kidney function

Normal	11.5%
Abnormal	10.5%
No test done	78%
P value= <0.0001*	

Liver function

Normal	11.5%
Abnormal	10%
No test done	78.5
P value= <0.0001*	

Table-2: Association Between Swab Testing and Antibiotic Use Duration

Duration of Antibiotic Use	Swab Testing	
	Yes (N=31,15.5%)	No (n=169, 84.5%)
Short-term (3-5 days)	16 (8%)	60 (30%)
Long-term (7+ days)	15(7.5%)	109 (54.5%)
Undocumented	2(1%)	0
Overall Total		

N=200



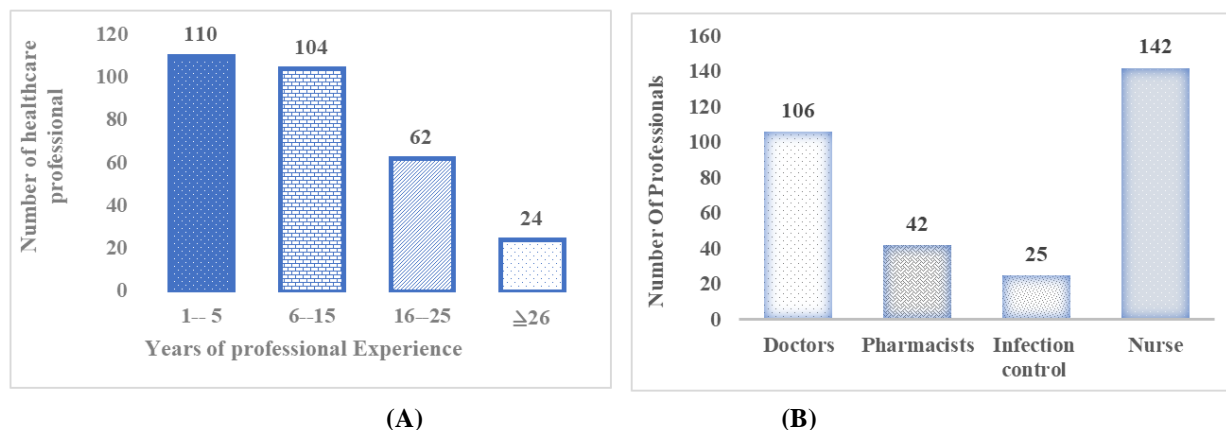


Figure-1: Experience Levels (A) and Specialization Distribution (B)

Table-3: Use of Practice guideline for Antibiotic Dispensing

Variable	Frequency	Percentage%
Implementation of the Antibiotic Stewardship Program		
Implemented	19	6.3%
Not Implemented	281	93.7%
Adherence to Hospital-Specific Protocol for Antibiotic Dispensed		
Dispensed According to Protocol	23	7.7%
Not Dispensed According to protocol	277	92.3%
Overall Total		

N=300

Table-4: Assessment of Pharmacist-Led Consultations in Clinical Practice

Pharmacist led consultation	Yes (N) %	No (N) %	Sometimes (N) %
The pharmacist participates in providing health care and takes the patient's medical history	32 10.7%	(234) 78%	(34) 11.3%
The pharmacist is involved in deciding on the type of antibiotic in cooperation with the medical team	(9) 3%	(289) 96.3%	(2) 0.7%
The pharmacist monitors the patient for any problem related to the medication	(11) 3.7%	(283)94.3%	(6) 2%
The pharmacist intervenes to change the type of antibiotic when he notices a drug-related problem in the patient	(3) 1%	(295) 98.3%	(2) 0.7%
The pharmacist intervenes and determines the appropriate dose based on an analysis of kidney function and liver enzymes	(3) 1%	(297) 99%	(0) 0%
Overall Total			

N=300

DISCUSSION

This study investigated the impact of antimicrobial resistance (AMR) on the burden of infectious diseases and evaluated the effectiveness of clinical pharmacy interventions in addressing these critical health issues within hospitals in Benghazi. The main finding of this study was an increasing prevalence of antimicrobial resistance due to the lack of swab testing before antibiotics are dispensed, particularly for infectious illnesses. This leads to a long-term duration of antibiotic use, driving the need for alternative antibiotics. This study found that limited implementation of antibiotic stewardship programs (ASP), and adherence to hospital-specific protocol for

antibiotic dispensed in hospital settings represent a critical gap in clinical practice in institutional approaches to the fight against antimicrobial resistance (AMR). The data indicated a perceived deficiency in pharmacist-led consultations in patient care.

In our study, the characteristics of the participants (200 inpatient medical files) revealed a slight predominance of male patients (53.5%), while females accounted for 46.5%. The age distribution indicated that the vast majority of patients were older, with 51% aged 51 and over and only 3% aged 18 to 25. This demographic profile suggests that infectious diseases affect older individuals more frequently, which may be attributed to



age-related factors such as comorbidities and declined immunity. This observation aligns with findings from previous studies by Chen, R *et al.*, [14]. Furthermore, the questionnaire distribution across several medical departments revealed the diversity of cases, with the Chest Department having the highest representation (25.3%), followed by Internal Medicine (19.3%). This distribution highlights the wide-ranging nature of infectious diseases and the importance of a multidisciplinary approach to treatment which is similarly emphasized in other research, (Silal, S. P. 2021), which highlights the beneficial effects of collaborative care in managing such a diversity of illnesses [15].

The results revealed an alarming gap in renal and liver function testing. Before taking antibiotics, 78% of patients did not have renal function tests, and 78.5% did not have liver function tests. Additionally, the lack of renal & liver function tests and the use of alternative antibiotics was statistically significant p-value = 0.0001

These findings emphasize the necessity of standardizing patient evaluation techniques before antibiotic medication in order to improve infectious disease management safety and effectiveness. Several antibiotics, including cephalosporins and vancomycin, were found to affect liver and renal function tests. Elevated liver enzymes, such as AST and ALT, in patients taking cephalosporins, may cause misinterpretation of liver function and needless anxiety about hepatotoxicity (Andrade, R. J *et al.*, 2022). Similarly, the effect of vancomycin on renal indicators, such as serum creatinine, makes it difficult to appropriately determine renal health. These findings highlight the difficulty of interpreting organ function tests in patients on antibiotic therapy and recommend that clinicians contextualize test results with a full awareness of the patient's drug history [16,17].

This study highlights those 169 out of 200 patients (84.5%) had no swab testing done before receiving antibiotics. Just 15.5% of patients had swab testing done before receiving antibiotics, indicating a serious gap in diagnostic procedures and this is causing antimicrobial resistance (AMR) to develop more quickly, especially in hospital environments where resistant organisms are more common. These findings are consistent with earlier reports [18,19].

The results of this study show a worrying lack of Antibiotic Stewardship Program (ASP) adoption in the hospital environment under investigation. Only 6.3% of the 300 respondents said the program is occasionally executed, compared to a startling 93.7% who said it is not done at all. 92.3% of respondents said that there is no consistent protocol in place for the dispensing of antibiotics. Similar findings were reported by Jarab *et al.*, 2024 in Jordan found that healthcare providers were

unaware of the specific guidelines and objectives of ASPs [20].

Our study revealed that pharmacists were not actively engaged in patient care or decision-making with medical professionals at an alarmingly high percentage. This finding indicated a perceived deficiency in pharmacist intervention. This finding aligns with another study by Hamrouni *et al.* 2024 reported that 96.3% of respondents in the United Arab Emirates found insufficient integration of pharmacists into healthcare teams [21]. Multidisciplinary collaboration among healthcare workers such as nurses, pharmacists, and physicians has also proven to be a better means of achieving better patient care.

Our data showed that an overwhelming 98.3% of respondents indicated that pharmacists do not play an active role in monitoring or intervening to substitute antibiotics in cases of drug-related complications. This lack of pharmacist involvement is consistent with research by Nelson, N. R., *et al.* 2021, which reported that a majority of healthcare professionals believe that pharmacists are underutilized in addressing medication-related issues [22]. In contrast, a study by Lee *et al.* 2019 demonstrated the positive impact of pharmacist-led interventions on patient outcomes [23].

CONCLUSION

In conclusion, the findings of this study reveal the underutilization of microbiological testing and organ function monitoring this raises concerns about the overuse of broad-spectrum agents, which could further accelerate AMR development. Additionally, this study reveals a substantial gap in the awareness, implementation, and institutional support for Antibiotic Stewardship Programs (ASPs) among healthcare professionals, and the absence of structured antibiotic prescribing protocols despite widespread recognition of the global threat posed by antimicrobial resistance (AMR). Our study provides powerful evidence for the limited role of pharmacists, combined with inconsistent adherence to dosing schedules and prophylactic guidelines, pointing to systemic weaknesses in policy enforcement and clinical practice.

Strengths and Limitations of the Study

Strengths of the Study:

- 1. Practical insights:** The study offers insightful information about the current status of antimicrobial stewardship and diagnostic methods in Benghazi hospitals, an understudied setting.
- 2. Comprehensive scope:** It looks at a number of aspects of antibiotic use, such as pharmacist engagement, documentation procedures, prescribing trends, diagnostic tests, and institutional support for antimicrobial stewardship programs (ASPs).
- 3. Finding systemic gaps:** The study tackles more general systemic problems like data management,



interdisciplinary communication, and institutional responsibility in addition to highlighting clinical practices.

4. Relevance to global health priorities: By concentrating on antimicrobial resistance (AMR), the research highlights the pressing need for action in response to a widely acknowledged healthcare issue.

5. Actionable Strategies to Improve Stewardship Practices: Implementing microbiological testing, enhancing documentation systems, and fortifying pharmacist responsibilities are just a few of the specific, doable suggestions the study makes for enhancing stewardship.

Limitations of the Study:

1. Limited microbiological data: The absence of routine swab testing limits the ability to correlate prescribing practices directly with pathogen profiles or resistance patterns.

2. The study was conducted on a few centers within a specific region: it was limited to some hospitals in Benghazi because approval could not be obtained from certain hospitals to conduct this research, so its findings may not be generalizable to other regions or countries with different healthcare systems or resource levels.

RECOMMENDATION

1. Establish clear and standardized protocols for documenting comorbidities and medication histories within patient records to enhance the accuracy of clinical decision-making.
2. Implement Electronic Medical Records (EMR) systems that incorporate mandatory fields for comorbidities, medication history, and antimicrobial use to facilitate comprehensive patient data management.
3. Ensure that clinical sample collection occurs before the initiation of antibiotic therapy to enable targeted treatment and minimize unnecessary reliance on broad-spectrum antibiotics.
4. Integrate routine assessments of organ function into patient care protocols, particularly for individuals receiving potentially nephrotoxic or hepatotoxic medications, to monitor and mitigate risks.
5. Mandate Antibiotic Stewardship Programs (ASPs) as a core component of hospital policy, ensuring leadership support and integration into daily clinical workflows, while enhancing pharmacist involvement in antibiotic selection, dosing adjustments, and monitoring for adverse drug events to optimize interdisciplinary collaboration and promoting evidence-based prescribing practices.

DECLARATION OF INTERESTS

The author declares that he has no conflicts of interest.

Funding: The present research was not funded institutionally or by anyone else.

Acknowledgments: We would like to express our gratitude to the individuals who assisted with data collection at Benghazi Medical Center and Al-Kuwaifeya Hospital. We also extend our heartfelt thanks to the Pharm D program Director Professor **Salma Bukhatwa** at the Faculty of Pharmacy, Libyan International Medical University, for her unwavering support and assistance in making this research possible.

REFERENCES

1. Salam, M. A., Al-Amin, M. Y., Salam, M. T., Pawar, J. S., Akhter, N., Rabaan, A. A., & Alqumber, M. A. (2023, January). Antimicrobial resistance: a growing serious threat for global public health. In *Healthcare* (Vol. 11, No. 13, p. 1946). Multidisciplinary Digital Publishing Institute.
2. Osagie, A. E., & Olalekan, S. H. (2019). Multiple Drug Resistance: A fast-growing threat. *Bio Med, 21*, 2574-1241.
3. Totaro, V., Guido, G., Cotugno, S., De Vita, E., Asaduzzaman, M., Patti, G., ... & Saracino, A. (2025). Antimicrobial Resistance in Sub-Saharan Africa: A Comprehensive Landscape Review. *The American Journal of Tropical Medicine and Hygiene, 1*(aop).
4. Gatechan, T., Nakaranurack, C., Plongla, R., Chuenjit, T., & Gross, A. E. (2025). The impact of pharmacist-led education and prospective audit and feedback on antibiotic dose optimization within medical intensive care units in Thailand: a retrospective study. *Journal of Pharmaceutical Policy and Practice, 18*(1), 2467456.
5. Wade, A., Egbujor, D., Spalvieri, A., Fox, O., Petrunich, M., Honaker, J., ... & Landin, K. (2025). Addressing Socioeconomic Disparities in the Treatment of Antimicrobial-Resistant Infections: The Role of Pharmacists in Mitigating Barriers. *Pharmacy and Wellness Review, 16*(2), 1
6. Dreischulte, T., van den Bemt, B., & Steurbaut, S. (2022). European Society of Clinical Pharmacy definition of the term clinical pharmacy and its relationship to pharmaceutical care: a position paper. *International Journal of Clinical Pharmacy, 44*(4), 837-842.
7. Dighriri, I. M., Alnomci, B. A., Aljahdali, M. M., Althagafi, H. S., Almatrafi, R. M., Altwairqi, W. G., ... & Alharthi Sr, H. (2023). The role of clinical pharmacists in Antimicrobial Stewardship Programs (ASPs): a systematic review. *Cureus, 15*(12).
8. Rahman, M. M., Alam Tumpa, M. A., Zehravi, M., Sarker, M. T., Yamin, M. D., Islam, M. R., ... & Cavalu, S. (2022). An overview of antimicrobial stewardship optimization: the use of antibiotics in



- humans and animals to prevent resistance. *Antibiotics*, 11(5), 667.
9. Shamas, N., Stokle, E., Ashiru-Oredope, D., & Wesangula, E. (2023). Challenges of implementing antimicrobial stewardship tools in Low to Middle-Income Countries (LMICs). *Infection prevention in practice*, 5(4), 100315.
 10. Mudenda, S., Chabalenge, B., Daka, V., Mfunne, R. L., Salachi, K. I., Mohamed, S., ... & Matafwali, S. K. (2023). Global strategies to combat antimicrobial resistance: a one health perspective. *Pharmacology & Pharmacy*, 14(8), 271-328.
 11. Kolawole, T. O., Mustapha, A. Y., Mbata, A. O., Tomoh, B. O., Forkuo, A. Y., & Kelvin-Agwu, M. C. (2023). Innovative strategies for reducing antimicrobial resistance: A review of global policy and practice. *Journal Name Missing*.
 12. Schinas, G., Dimopoulos, G., & Akinosoglou, K. (2023). Understanding and implementing diagnostic stewardship: a guide for resident physicians in the era of antimicrobial resistance. *Microorganisms*, 11(9), 2214.
 13. Atia, A., Hosien, B., & Belhaj, H. (2022). Antimicrobial resistance in Libya: A systematic literature review of two decades. *Biomedical and Biotechnology Research Journal (BBRJ)*, 6(4), 473-482.
 14. Chen, R., Zou, J., Chen, J., Wang, L., Kang, R., & Tang, D. (2024). Immune aging and infectious diseases. *Chinese Medical Journal*, 137(24), 3010-3049.
 15. Silal, S. P. (2021). Operational research: A multidisciplinary approach for the management of infectious disease in a global context. *European journal of operational research*, 291(3), 929-934.
 16. Andrade, R. J., & Tulkens, P. M. (2011). Hepatic safety of antibiotics used in primary care. *The Journal of Antimicrobial Chemotherapy*, 66(7), 1431-1446. <https://doi.org/10.1093/jac/dkr159>
 17. Alanazi, A. A., Alrewaili, F. S., Alshammari, Y. M., Alenazi, K. H., Alanazi, H. M., & Alanazi, F. S. (2024). Understanding Antibiotic Influence on Medical Test Outcomes: A Systematic Review. *Journal of Ecohumanism*, 3(7), 2853-2861.
 18. Solomon, S., & Ijaz, K. (2015). Surveillance and monitoring of antimicrobial resistance (AMR). *Carlet J, Upham G. AMR Control*, 34-39.
 19. Okeke, I. N. *Laboratory systems as an antibacterial resistance containment tool in Africa. Afr J Lab Med*. 2016; 5: 497.
 20. Jarab, A. S., Al-Alawneh, T. O., Alshogran, O. Y., Heshmeh, S. A., Mukattash, T. L., Naser, Y. A., & Alefishat, E. (2024). Knowledge and attitude of healthcare prescribers and pharmacists toward antimicrobial stewardship program and the barriers for its implementation. *Antimicrobial Resistance & Infection Control*, 13(1), 35.
 21. Hamrouni, A. M., Sharif, S. I., Abduelkarem, A. R., & Hassanein, M. M. (2023). Integration of clinical pharmacy services in primary healthcare in the United Arab Emirates: Indicators and impacts. *Pharmacy Practice*, 21(4), 1-6.
 22. Nelson, N. R., Armistead, L. T., Blanchard, C. M., & Rhoney, D. H. (2021). The pharmacist's professional identity: Preventing, identifying, and managing medication therapy problems as the medication specialist. *Journal of the American College of Clinical Pharmacy*, 4(12), 1564-1571.
 23. Lee, H., Ryu, K., Sohn, Y., Kim, J., Suh, G. Y., & Kim, E. (2019). Impact on patient outcomes of pharmacist participation in multidisciplinary critical care teams: a systematic review and meta-analysis. *Critical care medicine*, 47(9), 1243-1250.