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The Role of Physicians and Pharmacists in Antimicrobial Stewardship Programs and How to Control Antibiotics Bacterial Resistance

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Abstract— **Background:** Antibiotic resistance is one of the most serious global health threats of the 21st century, leading to higher mortality rates, prolonged illness, and increased healthcare costs. This crisis is primarily driven by the misuse of antibiotics, lack of awareness, and suboptimal prescribing practices. In response, Antimicrobial Stewardship Programs (ASPs) have emerged as a key strategy to reduce bacterial resistance by promoting the rational use of antibiotics. **Objective:** This study aims to evaluate the role of physicians and pharmacists in ASPs and how their actions influence the appropriate use of antibiotics and help combat resistance. **Methods**: A cross-sectional study was conducted using a paper-based questionnaire distributed to 207 healthcare professionals, including physicians, pharmacists, and laboratory technicians, across healthcare institutions in Tripoli and surrounding areas between May 24 and June 19, 2023. The collected data revealed varying levels of knowledge and practices regarding antibiotic use, highlighting the need for improved awareness and continuous professional education. research emphasizes the complementary roles of physicians and pharmacist in the successful implementation of ASPs and advocates for multidisciplinary collaboration, enforcement of local and international policies, and the adoption of evidence-based strategies to tackle the growing threat of antimicrobial resistance. Antimicrobial stewardship (AMS) is a critical strategy in combating antimicrobial resistance (AMR), particularly in healthcare settings with limited resources. This cross-sectional study examined the engagement, knowledge, and perceptions of healthcare professionals including physicians, pharmacists, and laboratory staff toward AMS practices in a multidisciplinary context. **Results**: Showed high overall participation in stewardship activities, with 70% of respondents involved in decision-making processes. However, a significant portion (30%) remained uninvolved, pointing to possible gaps in communication or institutional structure. **Conclusion:** The majority of participants (74.6%) acknowledged a perceived decline in antibiotic effectiveness, underscoring the urgency of addressing AMR. Although interest in research was limited, the expressed demand for further training—particularly in the safe use of antibiotics and resistance mechanisms—suggests a strong potential for capacity building.

***Keywords*—**Antibiotic resistance, misuse, bacterial resistance, physicians and pharmacists.

Introduction

Antibiotic resistance is one of the most critical global health threats of the 21st century. It leads to prolonged illnesses, increased mortality rates, higher healthcare costs, and reduced effectiveness of treatments. This crisis stems primarily from the misuse and overuse of antibiotics, poor prescribing practices, and a general lack of public awareness (Allen, H *et al*., 2010). Resistance development is a natural biological process, but it has been dramatically accelerated by human activities. Key mechanisms of resistance include: Enzymatic inactivation: Bacteria produce enzymes that degrade or modify the antibiotic molecule, rendering it inactive (e.g., beta-lactamases breaking down penicillin) (Barlam, T *et al*., 2016). Alteration of drug target: Mutations in bacterial genes can modify the site where the antibiotic binds, reducing its affinity and effectiveness (e.g., altered penicillin-binding proteins in MRSA) (Bond, C *et al*., 2007). Efflux pumps: Bacterial cells develop specialized protein pumps that actively expel the antibiotic from within the cell, preventing it from reaching its target concentration (e.g., pumps for tetracyclines, fluoroquinolones) (Blair, J *et al*., 2015). Reduced permeability: Changes in the bacterial cell membrane or outer membrane can decrease the entry of antibiotics into the cell. Bypass mechanisms: Bacteria develop alternative metabolic pathways to circumvent the one inhibited by the antibiotic (Dellit, T. H *et al*., 2007) and (Cassini, A *et al*., 2019). Crucially, resistance genes can spread rapidly among bacterial populations, not only through vertical transmission (from parent to offspring) but also horizontally, via plasmids, transposons, and bacteriophages (Dellinger, R. P *et al*., 2013). This horizontal gene transfer allows resistance to spread between different bacterial species, including those that are clinically significant, further complicating treatment options and accelerating the global spread of resistance (Dyar, O. J *et al*., 2017). The selective pressure exerted by widespread antibiotic use favors the survival and proliferation of these resistant strains, creating a vicious cycle where increasing resistance necessitates the use of broader-spectrum

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antibiotics, which, in turn, drives further resistance (Fleming, A. 1945) and (Davies, J *et al*., 2010). This study aims to evaluate the role of physicians and pharmacists in antimicrobial stewardship programs and their impact on reducing antibiotic resistance. Specifically, it seeks to assess the effectiveness of different stewardship strategies, identify key challenges faced by healthcare, and propose best practices for optimizing antimicrobial use while minimizing resistance development.

Materials and Methods

This study employed a cross-sectional design, using a paper-based questionnaire to assess healthcare professionals' knowledge, attitudes, and practices regarding antibiotic use and bacterial resistance. The questionnaire was carefully developed by the research team after reviewing relevant literature to ensure it aligned with validated tools and addressed the local context. In addition to assessing core knowledge and practices, the questionnaire also included demographic questions (e.g., job title, years of experience, and place of work) to allow subgroup analysis and better understanding of response patterns across different professional groups.

Study Population and Setting

The study targeted a diverse group of healthcare professionals, including physicians, pharmacists, laboratory technicians, and other medical staff actively involved in patient care or pharmaceutical services. Participants were selected from healthcare institutions located in Tripoli and nearby areas. A total of 207 questionnaires were collected, representing a suitable sample size that provides a good representation of the target population. This sample size enhances the reliability of the findings and allows for meaningful comparative analyses across specialties and geographic locations.

Data Collection Period and Distribution Sites

Data collection took place over a four-week period, from May 24 to June 19, 2023. Questionnaires were distributed manually by the research team to ensure proper delivery and encourage participation. Distribution sites included a variety of healthcare facilities such as: **Hospitals:** Al-Sbeea Hospital, Janzour Hospital, Al-Khadra Hospital, Tripoli Medical Center (Oncology, Internal Medicine, Emergency departments), Mitiga Military Hospital, and Shari' Al-Zawiya Hospital (Infectious Diseases and Internal Medicine units). **Pharmacies and Medical Laboratories:** Located in Al-Zawiya, Warshafana, Jodaem, Ghot Al-Shaal, Tajoura, Al-Najila, and Qasr Road. **Clinics and Health Centers:** Iwan Clinic, Al-Afia Clinic, Qaddour Clinic – Tajoura, AlNajah Clinic – Souq Al-Khamis (Amsihel), Dahmani Clinics Complex, and Masar AlTaqaddom Clinic. **Educational Institutions:** Questionnaires were also distributed inside the Faculty of Pharmacy to some faculty members and teaching assistants, to include academic perspectives. **Other Locations:** Additional pharmacies, clinics, and laboratories in remote areas around Tripoli were included to enhance geographic diversity

Ethical Considerations

Before completing the questionnaire, participants were informed about the study's purpose and assured that participation was completely voluntary. They were also guaranteed anonymity and that no personal identifying information would be collected.

Data Entry and Analysis

After collection, responses were coded and entered into SPSS software for analysis. Descriptive statistics such as frequencies and percentages were used alongside comparative analyses to identify trends and differences across professional groups and geographic regions. The goal of this analysis was to detect common misconceptions or inappropriate practices, highlight areas needing awareness, and support future interventions aimed at reducing antibiotic resistance and promoting rational use of antibiotics**.**

Results

Antimicrobial stewardship programs (AMS) aim to optimize the use of antibiotics to combat bacterial resistance and improve patient outcomes. This survey collected data from various medical professionals, including physicians, pharmacists, lab technicians, and other staff, to assess their experience, knowledge, and involvement in AMS activities. This report summarizes the statistical results and interpretations from a survey conducted among healthcare professionals involved in antimicrobial stewardship programs. The data covers participants' demographics, knowledge levels, roles, and attitudes toward antibiotic use and resistance. The findings highlight areas of strength and opportunities for training and research engagement.

Distribution of participants based on their job title.

The distribution of participants based on their job title shows that physicians constituted the largest proportion (47.8%), followed by pharmacists (29.5%), lab technicians (15.9%), and others (6.8%). As shown in figure 1.

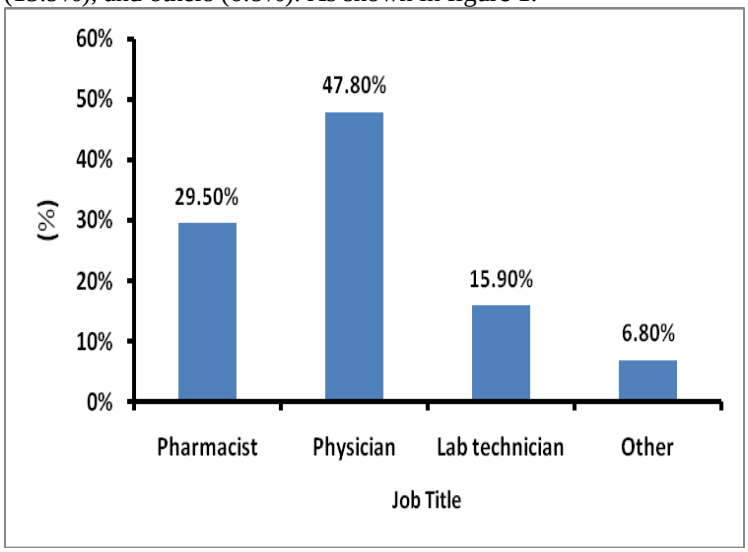

Figure 1. Distribution of participants based on their job title

Distribution of participants based on their years of experience.

Most participants had less than 5 years of experience (45.4%), followed by 5–10 years (29.5%), and more than 10 years (25.1%). As shown in figure 2.

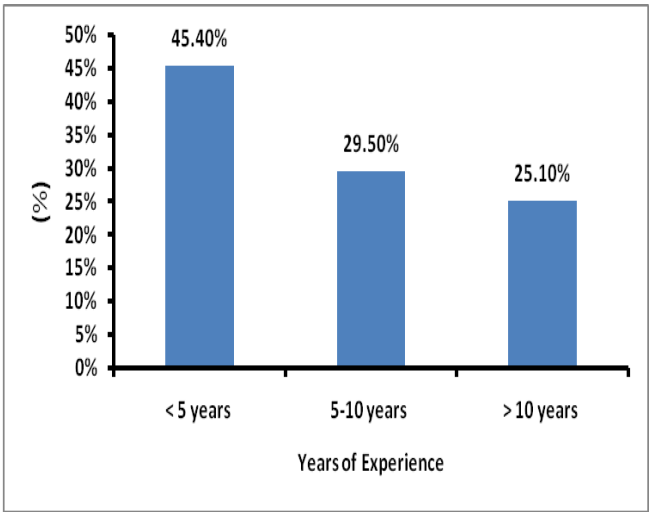

Figure 2: Distribution of Participants by Years of Experience.

Decision-Making Involvement

About 70.5% of participants reported being involved in antibiotic-related decision-making processes, while 29.5% reported not being involved. As shown in figure 3.

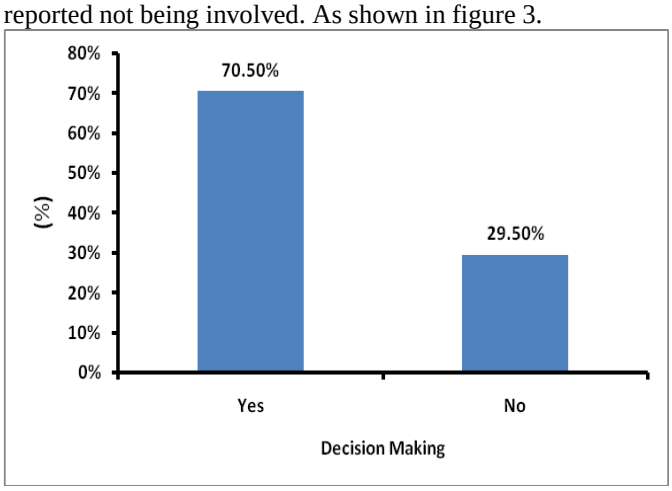

Figure 3: Involvement in Decision-Making

Roles of Medical Staff in Antibiotic Use.

Participants identified their roles in antibiotic use as follows: 37.4% in assessing patient need, 31.4% in guiding proper usage, 15.6% in monitoring drug interactions, and 15.6% in reviewing lab test results. As shown in figure 4.

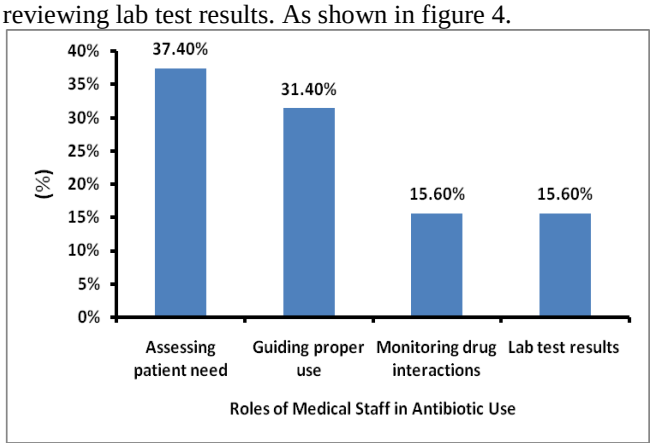

Figure 4: Roles of Medical Staff in antibiotic use

Knowledge of Antibiotic Stewardship Programs.

physicians had the highest mean knowledge score (M = 2.93, SD = 1.439), followed by Pharmacists (M = 2.10, SD = 1.206), Lab technicians (M = 1.48, SD = 0.968), and 'Others' (M = 0.67, SD = 0.888). As shown in figure 5.

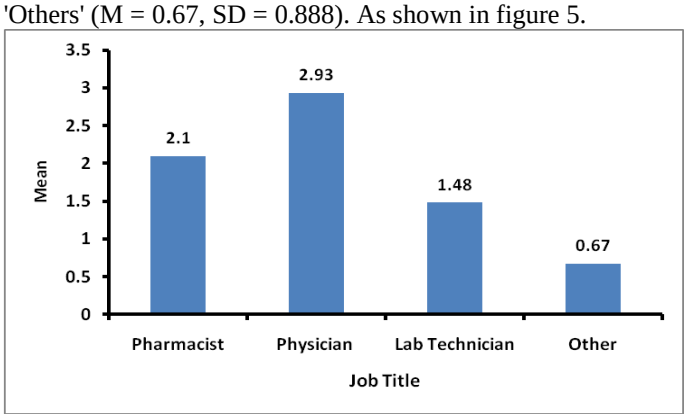

Figure 5: Knowledge of Antibiotic Stewardship Programs.

Topics of Research Interest

Among those interested in research, the most frequently chosen topic was 'Safe antibiotic use' (39.9%), followed by 'Bacterial resistance analysis' (24.3%), 'Infection diagnosis' (20.2%), and 'Infection prevention' (15.6%). As shown in figure 6.

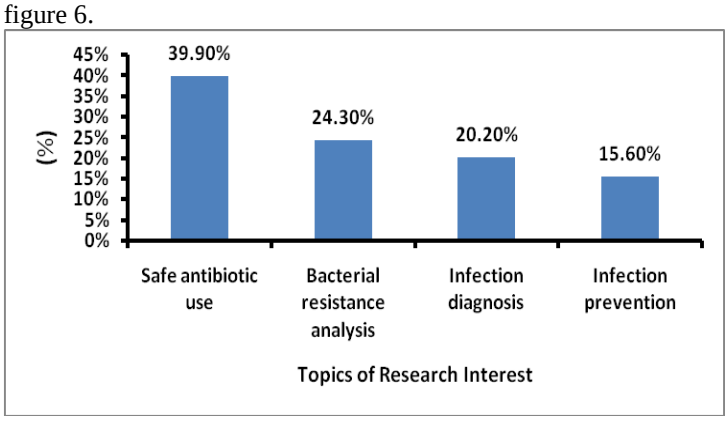

Figure 6: Topics of Research Interest.

DISCUSION

The current survey highlights a diverse representation across roles and experience levels, similar to previous research emphasizing multisector involvement in AMS programs. For example, In the Journal of the American Medical Association (JAMA) noted the importance of multidisciplinary teams, including physicians, pharmacists, and microbiologists, in effective AMS implementation (Dellit, T. H *et al.*, 2007). The distribution of roles seen here aligns with international standards recommending inclusive team-based approaches, Centers for Disease Control (CDC, 2019). Previous studies have shown that increased stakeholder engagement correlates positively with AMS success (Kallen, A. J *et al.*, 2019). The high involvement (70%) in decision-making in our survey reflects this trend, suggesting organizational maturity in the surveyed setting. Despite the high level of participation found in this survey, nearly 30% of staff are not involved in AMS decision-making. This gap may reflect organizational hierarchy or gaps in communication that warrant targeted interventions,

such as multidisciplinary case reviews or stewardship rounds, which have been shown to improve engagement and adherence to stewardship protocols (Kandra, K *et al*., 2019). The data indicates that less experienced staff (<5 years) are actively involved, yet physicians scored lower on AMS knowledge compared to lab technicians and 'Others.' This aligns with findings study that reported that prescribers often exhibit underwhelming knowledge of resistance mechanisms, which hampers stewardship efforts (Laxminarayan, R *et al*., 2013). A systematic review emphasized that targeted education significantly improved physicians' knowledge and prescribing behavior, particularly in low-resource settings (Liew, D *et al*., 2020). Our findings suggest that tailored training could be impactful, especially for physicians. Developing continuous medical education (CME) programs focusing on local resistance patterns and stewardship principles could fill these gaps. Incorporating case-based learning, antimicrobial stewardship audits, and feedback mechanisms have proven effective (Mehtar, S *et al*., 2018).

CONCLUSION

The survey underscores a diverse and engaged multidisciplinary workforce integral to antimicrobial stewardship (AMS), with high levels of participation in decision-making, though gaps remain among less involved staff. Knowledge disparities, especially among physicians, highlight the need for targeted education and continuous medical training to bolster understanding of resistance mechanisms and stewardship practices. The widespread awareness of rising antimicrobial resistance (AMR) underscores the urgency for reinforced surveillance and integrated infection control measures. While there is limited interest in research participation, strong demand for training presents an opportunity to build capacity and foster a research-friendly culture. Promoting inclusive, team-based approaches, along with structured protocols and collaborative reviews, can optimize antimicrobial use and improve AMS outcomes. Future efforts should prioritize education, multidisciplinary collaboration, and incentivizing research engagement to sustain and advance antimicrobial stewardship initiatives.

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