Impact of COVID-19 on Antimicrobial Resistance, Stewardship Perceptions, National Action Plan Among Egyptian Clinicians

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ABSTRACT

Background: Antimicrobial resistance (AMR) is a significant global health threat, exacerbated by inappropriate antibiotic use and inadequate infection control measures. Understanding clinicians' perceptions and knowledge of AMR and antimicrobial stewardship programs (ASPs) is crucial for developing effective strategies to mitigate this challenge, especially in the context of the COVID-19 pandemic's impact on healthcare practices.

Aim: The main aims were to assess Egyptian clinicians' perceptions, attitudes, and knowledge related to antimicrobial resistance, stewardship programs, the national AMR action plan, and the effects of the COVID-19 pandemic on AMR in their clinical setting. **Subjects and Method:** A cross-sectional survey was conducted among 305 clinicians across multiple hospitals in Qalyubia Governorate, Egypt in December 2023. The questionnaire covered demographics, experience with AMR and ASPs, perspectives on causes and consequences of AMR, COVID-19's impact on AMR, and awareness of Egypt's National Action Plan on AMR (2018-2022).

Results: Most clinicians (95.4%) acknowledged AMR as a global problem, but awareness of ASPs was lower (35.7%). Key perceived factors driving AMR included antibiotic overuse, patient self-medication, lack of microbiology data, and poor infection control. The COVID-19 pandemic was seen to substantially increased total antibiotic prescribing (77.4%), antibiotic shortages (73.4%), and spread of resistant organisms (70.5%). However, 74.1% were unaware of Egypt's National AMR Action Plan.

Conclusion: Egyptian clinicians demonstrated good awareness of AMR's threat but lacked knowledge about stewardship efforts like ASPs and national initiatives. Educational programs highlighting prudent antibiotic use, robust surveillance, and policy implementation are needed to combat AMR effectively.

Keywords: Antimicrobial resistance (AMR), Antibiotic Stewardship, Antibiotic Misuse, Qalyubia, Egypt.

INTRODUCTION

For decades, one of the well-known facts that antimicrobials play a crucial role in treating infectious diseases [1]. Although an acceptable level of awareness of physicians about antibiotics as an essential antimicrobial, there is a lack of knowledge about antibiotics prescribing and this is evident in the excessive misuse and inappropriate prescribing of antimicrobial agents have led to antimicrobial resistance (AMR), which has been found to be responsible for a shocking number of deaths each year—more than 700,000—and has a negative effect on healthcare expenditures, morbidity, and mortality [2].

Optimal antimicrobial prescribing is a bewildering process for the physician. However, several factors influence the physician's choice of the suitable antimicrobial for the patient, such as patient opinion, secondary infections, diagnosis uncertainty and availability of antimicrobial agent in the hospital [3].

On the other hand, the coronavirus disease 2019 pandemic, also known as COVID-19, has spread to all nations, resulting in serious impact on the world economy, and causes many deaths [4].

Nevertheless, based on the evidence available, it is still unclear how COVID-19 infection influences antibiotic resistance [5]. Therefore, there are growing appeals for implementing antimicrobial stewardship (AMS) programs, which aim at achieving the best therapeutic outcome through the appropriate choice, dosage, and duration of antimicrobial therapy with a minimum of side effects on patients and of developing antimicrobial resistance, as well as preventing the spread of infection caused by multidrug-resistant organism [6,7]. Further, in 2018, the Egyptian Ministry of Health and Population (MOHP) acknowledged the presence and magnitude of the AMR in Egypt and started drafting its own National Action Plan, NAP AMR 2018–2022, in line with the commitment to the World Health Assembly and with the support of WHO [8].

There are limited studies in Egypt that have served to highlight physician's awareness and perception of factors and strategies that affect antimicrobial resistance and their attitude towards the strategies of antimicrobial stewardship (AMS) programs in hospitals, together with the Egyptian National Action Plan NAP AMR 2018–2022. This study aimed to highlight the perception of clinicians about factors and strategies impacting antimicrobial resistance, and their attitude towards strategies of antimicrobial stewardship programs in hospitals, to assess the standpoint of the clinicians' perception in Egypt about the impact of the COVID-19 pandemic on antimicrobial resistance, to evaluate the current knowledge of healthcare professionals about NAP AMR (2018-2022), and evaluation of the efforts of the Ministry of Health in implementing this program in Egypt.

SUBJECTS AND METHODS

The study was conducted in Egypt, in Qalyubia Governorate, which has a population of 5.878.030 with 5.9% of Egypt population.

Three hospitals were included mainly in the study; Toukh Central Hospital has 29 beds, Qaha General Hospital has

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92 beds and Abou Al Monagga Central Hospital has 39 beds, but also clinicians from other health care facilities of Egyptian Ministry of Health and Population (MOHP) and /or Ministry of Higher Education and Scientific Research (MOHSER) have participated as included in our protocol and for adding diversity of clinicians from different governmental sections.

Study Design

This multi-center cross sectional descriptive analytical study aimed to obtain in-depth understanding about perception of clinicians towards AMR and AMSPs and how COVID-19 pandemic impacts AMR from their point of view.

Eligibility Criteria

All respondents had to accept participation in the study should be not less than 25 years old and on their jobs in primary unit or hospital of Egyptian MOHP and or MOHESR, with no exclusion criteria.

Sample Size

Using epi-info STATCALC software from CDC we calculated the sample size. 305 was the minimum number of participants that was required to obtain 80% power with confidence level 95%. The responses with multiple or missing values have been removed from SPSS database before analysis [9].

Recruitment and Data Collection

As the study was multi-center and to make it easier, an online version of questionnaire through "Google Forms" had been designed then questionnaire link was distributed through study team to target participants.

At the first page of the questionnaire a consent form was added. It provided clarification on study's title, aim, benefits and risks, we made it clear that the goal of this questionnaire was the research. Clinicians were asked at the end of first page if they agreed to participate or not, if they agreed they had been directed to the next pages of questionnaire. The form also included a clear statement that their completion of the questionnaire signifies their agreement to participate. Anonymized data collection was done.

Survey Instrument

The questionnaire was developed after extensive review of relevant literature [1 - 4, 10].

Then a decision for the selection of questions by multidisciplinary experts. And for more validation for the questionnaire a consultation was conducted from an author of one of the relevant studies [10]. The standardized questionnaire included 4 different sections. Section 1 included demographic information and background details (gender, age, education level, work experience). Section 2 included the clinicians' experiences and perceptions regarding antimicrobial resistance (AMR) and antimicrobial stewardship programs (AMSPs). Section 3 included questions to show the perceived impact of the COVID-19 pandemic on antibiotic consumption and the spread of antimicrobial resistance (AMR) and multidrug-resistant organisms. Section 4 assessed the awareness among Egyptian clinicians about the National Action Plan (NAP) for antimicrobial resistance (AMR) 2018-2022 and their perceptions of its impact.

Pilot Study: Before the main survey deployment, the questionnaire was piloted with a group of study participants to determine language and usability of the questions and to evaluate the questionnaire's feasibility. Their recommendations and remarks were taken into consideration. The final analysis did not include the pilot study's data.

Data Analysis

Version 27.0 of IBM SPSS Statistics was used to analyze the data. Chi-squared testing was used to compare frequencies and percentages (Descriptive Statistics) for categorical data. An analysis of variance (ANOVA) test was conducted to compare the means of multiple groups to determine if there are any statistically significant differences among them. Correlation analysis was performed to assess the strength and direction of the relationship between two continuous variables. The Shapiro-Wilk and Kolmogrov-Smirnov tests were used to check for normality of data; a p-value of less than 0.05 indicated that the data were not regularly distributed. Median + interquartile range (IQR) were used to represent non-normally distributed quantitative data. On using statistical tests, P value < 0.05 was considered significant.

Ethical consideration:

An official permission to conduct the study was obtained from Research Ethics Committee of Central Directorate for Research and Health Development of Egyptian MOHP (Reference 12-2022/14). The study was carried out in adherence to the ethical norms set forth by the Helsinki Declaration of 1964, any revisions to the declaration, or comparable standards.

Since participation in the study was entirely voluntary, ethical considerations included giving each participant a clear explanation of the purpose and nature of the research as well as the ability to withdraw at any time.

RESULTS

In table 1 of the survey, a diverse group of Egyptian clinicians provided their demographic information and background details as in table 1. Most of the respondents were females (60.3%), indicating a significant representation of women in the medical field. The age distribution showed a concentration in the 36-50 years range (56.4%), with a smaller proportion above 50 years (5.6%), suggesting that the respondents were largely experienced clinicians. Educational backgrounds varied, with the most common being a master's degree (53.4%), followed by bachelor's degrees (14.1%). This diversity in educational qualifications reflects a broad spectrum of expertise and experience. In terms of work experience, the largest group had more than 10 years of experience (44.9%), followed by those with 5-10 years (33.1%), indicating a respondent pool with substantial professional experience. Specialties were diverse as in the fig. 1, the majority was pediatrics and neonates 93 (30.5%) then GP with 34 (11.1%).

Table 1: Demographic information

	Variable	No. (%)
Gender	Female	184(60.3%)
	Male	121(39.7%)
Age	Median (IQR):	36
	25 - 35 years	116(38.0%)
	36 - 50 years	172(56.4%)
	more than 50 years	17(5.6%)
	p-value:	0.00067
Educational Background	Bachelor's Degree	43(14.1%)
	Diploma	38(12.5%)
	Doctorate	31(10.2%)
	Fellowship	30(9.8%)
	Master	163(53.4%)
Work experience	Median (IQR):	10
	1-5 years	67(22.0%)
	5-10 years	101(33.1%)
	More than 10 years	137(44.9%)
	p-value:	<0.00001
Hospital	Tookh Central Hospital	94(30.8%)
	Abou Al Monagga Central Hospital	57(18.7%)
	Qaha Specialized Hospital	71(23.3%)
	other	94(30.8%)

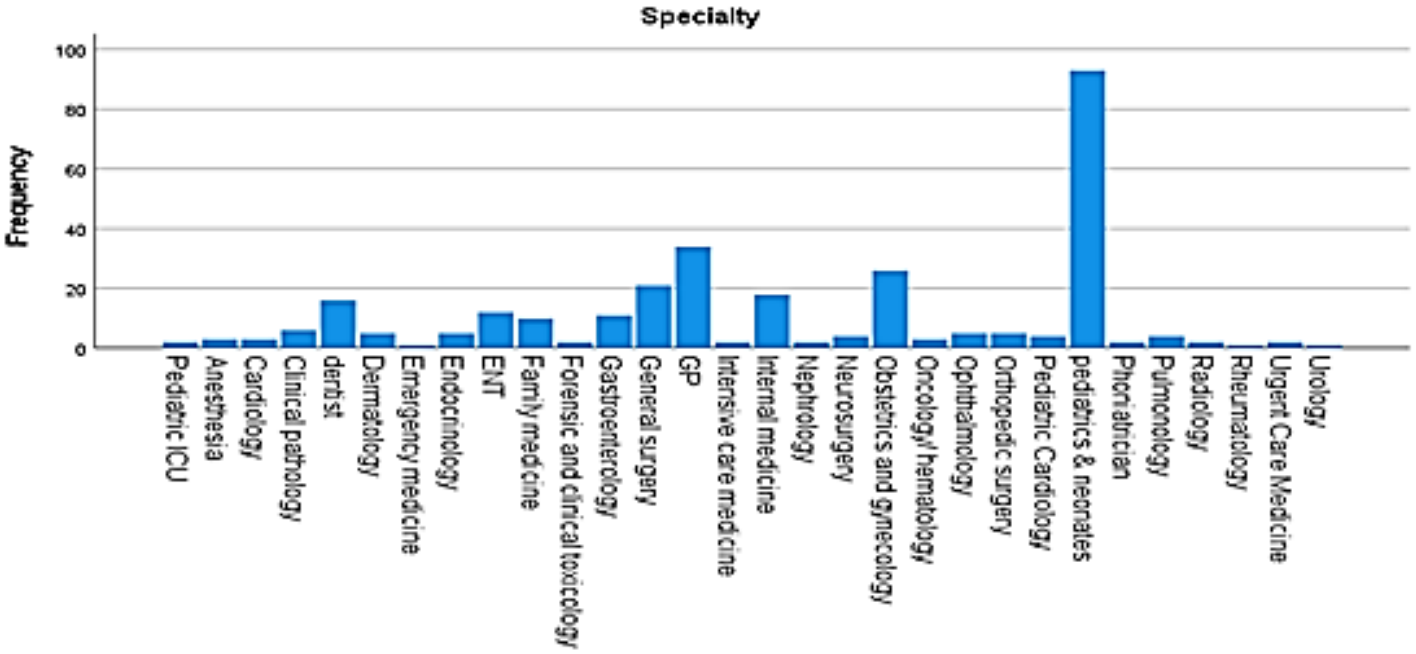

Fig. 1: Egyptian clinician's specialty bar chart.

In table 2.1 of the survey, the clinicians' experiences and perceptions regarding antimicrobial resistance (AMR) and antimicrobial stewardship (AMS) programs were explored. Most respondents (95.4%) agreed that antimicrobial resistance is a global problem, while a slightly lower percentage (82.3%) perceived it as a problem in their daily practice. This indicates a high level of awareness among clinicians about the broader impact of AMR, though slightly fewer see it as an immediate concern in their day-to-day work.

Awareness of AMS programs and their components was lower, with only 35.7% agreeing that they were aware, and 45.6% uncertain, suggesting a gap in knowledge or dissemination of information about these programs. Previous experience with AMS was reported by 28.5% of respondents, while a significant portion (43.6%) remained uncertain about their experience. The increasing trend of antimicrobial-resistant infections over the last 5 years was noted by 82.6% of the clinicians, highlighting the growing concern of AMR in clinical settings. Additionally, a majority had been involved in the care of patients with antibiotic-resistant infections, further underscoring the practical implications of AMR in clinical practice. This section highlights the urgent need for increased awareness and education on AMS programs among clinicians, despite their high acknowledgment of AMR as a critical issue

Table 2.1: Previous involvement and experience with antimicrobial resistance and antimicrobial stewardship (AMS) programs

Question	Agree	Disagree	Uncertain
1. Antimicrobial resistance is a problem worldwide	291(95.4%)	1 (0.3%)	13 (4.3%)
2. Antimicrobial resistance is a problem in my daily practice	251 (82.3%)	8 (2.6%)	46 (15.1%)
3. Are you aware of antimicrobial stewardship (AMS) programs and their components?	109 (35.7%)	57 (18.7%)	139 (45.6%)
4. Do you have previous AMS experience?	87 (28.5%)	85 (27.9%)	133 (43.6%)
5. Have you noticed an increasing number of antimicrobial-resistant infections over the last 5 years?	252 (82.6%)	11 (3.6%)	42 (13.8%)
6. Have you ever been involved in the care of patients with an antibiotic-resistant infection?	193 (63.3%)	29 (9.5%)	83 (27.2%)
7. Have you worked in health care facilities with AMS programs?	99 (32.5%)	77 (25.2%)	129 (42.3%)
8. Have you received specialized training in AMS programs?	114 (37.4%)	114(37.4%)	77 (25.2%)
9. Does your hospital provide guidelines/policy for the diagnosis and management of patients with infective problems?	166 (54.4%)	32 (10.5%)	107 (35.1%)
10. Do you follow the recommendations of your hospital antimicrobial guidelines/policy?	228 (74.8%)	17 (5.6%)	60 (19.7%)
11. Do you believe that antimicrobials are used too much in clinical settings?	242 (79.3%)	8 (2.6%)	55 (18.0%)
12. Have you ever been forced to choose antibiotics you feel are inappropriate because of the antibiotic approval program?	155 (50.8%)	33 (10.8%)	117 (38.4%)
13. Do you believe that activation of the Antibiotic Committee in your hospital will be helpful in controlling antibiotics prescribing?	237 (77.7%)	18 (5.9%)	50 (16.4%)
14. Does your hospital contain drug information services/centers?	162 (53.1%)	36 (11.8%)	107 (35.1%)

In table 2.2, the physicians asked about their perceptions of certain factors and their association with antimicrobials, as depicted in table 2.2. The use of antimicrobials in hospitals is a major concern among physicians, with 56.4% strongly agreeing and 33.8% agreeing. This stresses the significance of rationalizing antibiotics in hospitals. Patient pressure for prescribing antibiotics is another important factor associated with AMR, where 49.5% of physicians strongly agree and 29.5% agree. This emphasizes the importance of increasing public awareness about the appropriate use of antibiotics. Moreover, the availability of antibiotics for the public without a prescription from a physician is one of the main factors associated with AMR from the perspective of physicians. They strongly agree (25%) and agree (50.8%), which suggests legalizing over-the-counter availability of antibiotics. As for the usage of antimicrobials in animals and poor infection control practices by healthcare professionals, there was an association with AMR, with a combined percentage of strongly agree and agree equal to 76%.

Table 2.2: The association of antimicrobial resistance with certain factors

Question	Agree	Disagree	Strongly Agree	Strongly Disagree	Uncertain
1. Use of antimicrobials in animals/agriculture sectors	97(31.8%)	29 (9.5%)	140 (45.9%)	2 (0.7%)	10 (3.3%)
2. Use of antimicrobials in community	123(40.3%)	30 (9.8%)	84 (27.5%)	2 (0.7%)	31 (10.2%)
3. Use of antimicrobials in hospitals	103(33.8)	51(16.7%)	172 (56.4%)	12 (3.9%)	46 (15.1%)
4. Patient pressure for antibiotics as part of treatment	90 (29.5%)	81 (26.6%)	151 (49.5%)	62 (20.3%)	11 (3.6%)
5. Patients can buy antibiotics without a prescription from a physician	155 (50.8%)	33 (10.8%)	77 (25.2%)	2 (0.7%)	31 (10.2%)
6. Poor infection control practice by healthcare professionals	102 (33.4%)	19 (6.2%)	133 (43.6%)	6 (2.0%)	44 (14.4%)

Section 3 of the survey included two parts; the first part delved into the perceived impact of the COVID-19 pandemic on antibiotic consumption and the spread of antimicrobial resistance (AMR) and multidrug-resistant organisms as shown in table 3.1. Most respondents (77.4%) felt that the COVID-19 pandemic had a large impact on the total prescribing of antibiotics. Additionally, many clinicians (73.4%) perceived a substantial impact on the availability of antibiotics, indicating potential changes in supply or demand patterns during the pandemic. Concerning the spread of resistant microorganisms, 70.5% of the respondents acknowledged a large impact, highlighting an increased awareness or actual rise in resistant infections during this period. The emergence of new resistance patterns was also a concern, with 52.5% noting a significant impact, pointing to the evolving nature of AMR in the context of a global health crisis.

Table 3.1: The impact on antibiotic consumption because of COVID-19 in your country

Question	I Don't Know	Large Impact	Low Impact	No Impact
1. Total prescribing of antibiotics	10 (3.3%)	236 (77.4%)	49 (16.1%)	10 (3.3%)
2. Availability of antibiotics	17 (5.6%)	224 (73.4%)	53 (17.4%)	11 (3.6%)
3. Spreading of resistant micro-organisms	41 (13.4%)	215 (70.5%)	34 (11.1%)	15 (4.9%)
4. Emergence of new resistance pattern	68 (22.3%)	160 (52.5%)	65 (21.3%)	12 (3.9%)

In table 3.2, respondents were given predetermined options to be more specific about AMR. Due to the diversity in responses and the large number of answers in this section, we include only highest two % of responses for each question. The first question conclusion provides an in-depth understanding of the factors affecting physician decision when prescribing antibiotics. A noteworthy (7.9%) acknowledged the importance of reading scientific materials. Which demonstrates the critical role of ongoing education and updated knowledge in shaping the decision-making process of physicians.

The second question statistics showed that 19.0% of respondents identified a mix of relevant variables, which highlighted the multifaceted nature of incorrect antibiotic usage. The combination of inadequate training and expertise, unfettered access to antibiotics, physician disinterest, inefficient hospital protocols, overburdened medical staff, and inadequate microbiology laboratory resources underscores how difficult it will be to handle this problem in its entirety. This understanding emphasizes the importance of a comprehensive approach that includes education, policy formulation, resource allocation, and cultivating a culture of careful antimicrobial prescription.

The statistics of the third question demonstrated that antibiotic abuse is causing resistance, which is a troubling trend. This can occur because of inappropriate prescribing, inadequate courses, duplicate treatments, self-medication, and over-the-counter access without a prescription. To encourage effective antibiotic use, stewardship initiatives throughout medical education and health systems are required. The information provided by fourth question indicates that overusing antibiotics might result in resistance development, unfavorable responses, resource waste, and illness recurrence.

This emphasizes how important it is to implement stewardship programs to safeguard and maximize the prescription of antibiotics. Addressing the root causes of overuse requires collaboration. The statistics of fifth question showed that evidence-based stewardship interventions can reduce resistance by properly treating infections, improving provider education, utilizing expertise and guidelines, tailoring therapy based on microbiology data, limiting antimicrobials, removing unnecessary devices, and targeting likely pathogens. To put these significant reforms into action, a multidimensional strategy spanning politics, medical education, and health systems is needed. A concentrated effort is required to protect antibiotic effectiveness.

The statistics in question sixth showed that individuals utilize a variety of resources to learn about antimicrobials. Only 15.7% believe that the job of hospital/clinical chemists or medication information centers is vital. This emphasizes the need of collaboration among healthcare providers and the use of centralized information centers to facilitate informed antimicrobial prescription decisions. In addition to recommendations, internet resources, and peer interactions, collaborative channels can aid in the dissemination of antimicrobial knowledge within healthcare settings. These findings highlight the necessity of interdisciplinary collaboration and several avenues for antimicrobial information dissemination.

Table 3.2: Clinician's perception towards the impact of COVID-19 pandemic on antimicrobial resistance and multi-drug resistant micro-organisms		
V.1- Factors influence your choice during antimicrobial prescribing?	Reading scientific materials (such as, books, articles, and internet)	24(7.9%)
	Reading scientific materials (such as, books, articles, and internet). Cost of antibiotic. Effectiveness and previous experience with the antimicrobial drugs. The knowledge gained during undergraduate or postgraduate training. Availability of the antibiotic in the hospital formulary.	30(9.8%)
V.2- Which of these do you think are important causes of inappropriate use of antimicrobials?	Poor skills and knowledge. Unrestricted availability of antimicrobials. Inadequate supervision. Lack of physician interest in the subject of antimicrobial prescribing and infection management. Lack of effective hospital policies. Overworked/busy health care providers. Lack of microbiology lab facilities (lack of antimicrobial susceptibility test results).	27(8.9%)
	Poor skills and knowledge. Unrestricted availability of antimicrobials. Lack of physician interest in the subject of antimicrobial prescribing and infection management. Lack of effective hospital policies. Overworked/busy health care providers. Lack of microbiology lab facilities (lack of antimicrobial susceptibility test results).	58(19.0 %)
V.3- What are the causes of antimicrobial resistance?	Using antimicrobial when they are not necessary. Not completing the full course of antimicrobial. Using antimicrobials without physician prescription (self-medication). Using broad spectrum antimicrobial, as a common practice. Patient pressure asking for antibiotics as part of treatment, Patients are able to buy antibiotics over the counter	27(8.9%)
	Using antimicrobial when they are not necessary. Not completing the full course of antimicrobial. Using the same antimicrobial with a different brand. Using antimicrobials without physician prescription (self-medication). Patients are able to buy antibiotics over the counter	56(18.4 %)
V.4- Which of these do you think are important consequences of antimicrobial overuse?	Antimicrobial resistance.	29(9.5%)
	Antimicrobial resistance. Adverse drug reactions and medication errors. Waste of resources. Recurrence of infections.	105 (34.4%)
V.5- Which of the following do you think may help control antimicrobial resistance?	Treating infection, not contamination or colonization. Physician education on appropriate antimicrobial therapy. Consulting with infectious diseases experts. Providing local antimicrobial guidelines. Knowledge of pathogens and antimicrobial susceptibility test results. Obtaining local antibiotic resistance profiles. Practicing antimicrobial restriction. Removing catheters when not essential. Targeting antimicrobial therapy to likely pathogens.	68(22.3 %)
	Treating infection, not contamination or colonization. Physician education on appropriate antimicrobial therapy. Providing local antimicrobial guidelines. Obtaining local antibiotic resistance profiles. Practicing antimicrobial restriction. Removing catheters when not essential. Targeting antimicrobial therapy to likely pathogens.	18(5.9%)
V.6- What are the most commonly resources used for knowledge toward antimicrobials?	National/Egyptian guidelines. Smart phone medical applications. Other guidelines by professional organizations (IDSA, CDC, etc.). Colleagues or seniors from your own team or specialty. Hospital/Clinical pharmacists or drug information centers. Medical/Pharmaceutical representatives	17(5.6%)
	National/Egyptian guidelines. Hospital/internal guidelines. Lexicomp/Sanford guide/UPTODATE or other online resources. Smart phone medical applications. Colleagues or seniors from your own team or specialty. Hospital/Clinical pharmacists or drug information centers.	48(15.7 %)

Table 4.1 assessed the awareness among Egyptian clinicians about the National Action Plan (NAP) for Antimicrobial Resistance (AMR) 2018-2022 and their perceptions of its impact. The findings revealed a concerning gap in awareness, with a significant 74.1% of respondents unaware of the NAP AMR 2018-2022. Only 9.2% confirmed their awareness, while 16.7% were uncertain. This lack of awareness underscores the need for more robust dissemination and education efforts regarding national initiatives to combat AMR.

Table 4.1: Clinician's awareness about Egypt National Action Plan NAP AMR 2018-2022 program

Variable	No. (%)
Do you know about this National program (NAP AMR 2018-2022)?	
Maybe	51(16.7%)
No	226(74.1%)
yes	28(9.2%)

In evaluating the impact of national efforts to limit AMR, as in table 4.2, responses indicated a perceived need for more efforts across various domains. For instance, 34.8% felt more efforts were needed to improve public awareness and understanding of antibiotic use, and 50.8% believed that optimizing the use of antimicrobials to slow the emergence of new resistance patterns required more focus. Similarly, strengthening National One-Health Surveillance efforts to combat resistance was viewed as needing more efforts by 49.8% of respondents. These perceptions point to a critical need for enhancing and intensifying national strategies in the battle against AMR, especially in areas such as public education, antimicrobial optimization, surveillance, and evidence-based infection control practices.

Table 4.2: The impact of the following national efforts in limiting AMR

Efforts	No. (%)
1. Improve public awareness and understanding of antibiotic use	
Need More	106(34.8%)
Obviously Clear	60(19.7%)
Uncertain	139(45.6%)
2. Optimizing the use of antimicrobials to slow the emergence of new resistance patterns	
Need More	155(50.8%)
Obviously Clear	80(26.2%)
Uncertain	70(23.0%)
3. Strengthen National One-Health Surveillance efforts to combat resistance	
Need More	152(449.8%)
Obviously Clear	78(25.6%)
Uncertain	75(24.6%)
4. Implement evidence-based infection control practice that can prevent spreading of resistant pathogens	
Need More	143(46.9%)
Obviously Clear	83(27.2%)
Uncertain	79(25.9%)

Table 5: Firstly, there appears to be no significant gender difference in awareness of antimicrobial resistance (AMR). However, a notable disparity emerges concerning the awareness of antimicrobial stewardship (AMS) programs across different educational levels, indicating a significant difference. Additionally, the analysis suggests a very weak, non-significant correlation between educational level and AMR awareness, alongside a similarly weak and non-significant correlation between work experience and AMS program awareness. Finally, the data showed no significant difference in AMR awareness across various medical specialties. These findings underscore the importance of educational interventions tailored to different educational levels to enhance awareness of AMR and AMS programs.

Table 5: Demographic associations and comparisons

Test Type	Variable Pair	Statistic	p-value
Chi-Square	Gender vs. Awareness of (AMR)	1.123	0.570
Chi-Square	Educational Level vs. Awareness of AMS Programs	17.719	0.023
Correlation	Educational Level vs. Awareness of AMR	0.022	0.706
Correlation	Work Experience vs. Awareness of AMS Programs	0.099	0.083
ANOVA	Different Specialties vs. AMR Awareness	0.821	0.751

DISCUSSION

This cross-sectional descriptive study aimed to understand clinicians' perceptions about antimicrobial resistance (AMR) in Egypt, strategies of antimicrobial stewardship programs (AMSPs) in hospitals, and the impact of the COVID-19 pandemic on AMR. The study population included clinicians from Toukh, Qaha, and Abou Al Monagga Central Hospitals, as well as other healthcare facilities under the Egyptian Ministry of Health and Population (MOHP) and the Ministry of Higher Education and Scientific Research (MOHESR).

Section 1 revealed that most respondents were females (60.3%), like other studies [11]. The age distribution showed a concentration in the 36-50 years range (56.4%), indicating experienced clinicians. Educational backgrounds varied, with the most common being a master's degree (53.4%), followed by bachelor's degrees, diplomas, doctorates, and fellowships. Work experience was substantial, with the largest group having more than 10 years of experience (44.9%). Specialties were diverse, with the majority being pediatrics and neonates (30.5%) and general

practitioners (11.1%).

In section 2, an overwhelming majority (95.4%) agreed that AMR is a global problem, aligning with other studies [12,13]. However, a slightly lower percentage (82.3%) perceived it as a problem in their daily practice. Awareness of AMSPs was lower, with only 35.7% agreeing they were aware and 45.6% uncertain, suggesting a knowledge gap [14,15]. Over 75% believed that patients' ability to buy antibiotics without a prescription contributes to AMR, necessitating governmental intervention [16,17].

Section 3 revealed that a significant majority (77.4%) felt that COVID-19 pandemic had a substantial impact on overall antibiotic prescribing, potentially due to increased secondary bacterial infections or precautionary measures [18]. However, another study [19] suggested heightened infection control awareness during the pandemic could reduce long-term AMR dissemination. Many clinicians (73.4%) perceived a substantial impact on antibiotic availability during the pandemic, indicating potential changes in supply or demand patterns [15,17].

In section 3 A significant majority of respondents (77.4%) felt that the COVID- 19 pandemic had a large impact on the total prescribing of antibiotics. This high percentage suggests a notable shift in antibiotic prescribing practices during the pandemic, possibly due to the increased incidence of secondary bacterial infections or as a precautionary measure against potential co-infections. This comes in agreement with **study** [18]. which concluded that secondary infections are common after COVID 19 infection and usually have very high rate of antibiotic resistance. Also, another study [19] found that AMR was relatively high during the first 18 month of COVID19 pandemic in patients with bacterial co-infection. On the other hand, a study [20] says that "beneficial consequence of the COVID-19 pandemic is a heightened awareness about general infection prevention and control measures, such as hand hygiene, surface disinfection, and social distancing, which may help reduce the long-term dissemination of AMR". Many clinicians (73.4%) perceived a substantial impact on the availability of antibiotics, indicating potential changes in supply or demand patterns during the pandemic. Concerning the spread of resistant microorganisms, the study of **Jorge** [17], agrees with that as they state that the empirical use of antibiotic and self-medication during COVID 19 pandemic leads to emergence of AMR and worsening of resistance of the already known resistant strains.

In section 4, a concerning gap was observed, with 74.1% of respondents unaware of the National Action Plan (NAP) for AMR 2018-2022, highlighting the need for increased efforts by the Ministry of Health to disseminate the NAP more widely.

CONCLUSION AND RECOMMENDATIONS

There is an importance of increasing awareness and education among clinicians about antimicrobial stewardship (AMS) programs, suggesting that more efforts are needed in this area. Additionally, there's a call for the Egyptian Ministry of Health to do more to spread awareness about the National Action Plan (NAP). It's also suggested that strict laws should be put in place to control the availability of antibiotics without a doctor's prescription. Furthermore, the role of mass media is highlighted as a valuable tool for educating the public about the proper use of antibiotics. In conclusion, the global issue of antimicrobial resistance (AMR) requires strong AMS programs and efforts to educate both medical professionals and the public about antibiotic use. The findings indicate that while many people recognize AMR as a problem, a significant portion are unaware of the NAP, emphasizing the need for increased efforts to make it more widely known.

LIMITATION

Despite the diversity of specialties in our study, more specialties should be in included such as intensivist, pulmonologist and internist.

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