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Exploring the Relationship Between Antimicrobial Stewardship and the Rise of Multi-Drug Resistant Pathogens in Healthcare Settings

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ABSTRACT

The aim of this study was to examine the relationship between the antimicrobial stewardship (AMS) programs and the relationship between these programs and the incidence of multi-drug resistant (MDR) pathogens within a healthcare facility, and how healthcare practitioners are provoked in administering an AMS program. Multi-drug resistance has been a serious health concern of late with the infections more susceptible to healing and patients are at a higher risk. It was a descriptive cross-sectional research performed in a few out of the total number of the governmental and regional hospitals in the province of Punjab in Pakistan during the period between March 1, 2025 and May 15, 2025. A sample of 250 healthcare professionals, was chosen by simple random sampling. A structured questionnaire with self-report was used to carry the observation and measurements. Frequencies and percentages were used to report categorical data whereas the means and standard deviation (SD) were used to report numerical data. Associations and Comparing of Means were performed on chi-square and Independent Samples t-tests. The results showed a high correlation in use of AMS and the incidences of MDR ($p = 0.003$) with few MDR cases per hospital having AMS implemented to practice. The knowledge of AMS was significantly higher in the case of the public hospitals when compared to those in a private hospital ($p = 0.014$). There were higher scores of challenges in AMS implementation among nurses and the pharmacists. The results indicate that there is a need to enhance AMS programs.

INTRODUCTION

The multi-drug resistive (MDR) strains pathogens are fast becoming persistent in the clinics and hospitals in the form of an outbreak. These infections are lethal because they are unable to respond to ordinary antibiotics. As a result, doctors prefer not to use routine drugs in adopting these infections. The MDR patients will be prolonged in hospitals and should be complicated[1] .Improper and unneeded antibiotics are the principal cause of the occurrence of drug resistance. Most cases of antibiotic usage also include these rather needless implementations of antibiotics[2]. In other scenarios, doctors administer antibiotics on an extended period of time or they wrongly use the wrong ones and this causes them to be more resistive [3].With time the bacteria become stronger or incurable. This poses a problem of infection control among the medical practitioners. The MDR pathogens have currently become a significant risk to patient safety. This is the problem faced by the hospitals all over the world. It has also led to the increase in the healthcare expense and pressurizing the hospital facilities [4].

To address this serious problem, various hospitals have initiated the process to establish antimicrobial stewardship (AMS) programs. The programs are concerned with the development of the safe and prudent use of antibiotics in the hospitals and clinics. AMS programs can be helpful in both terms of guaranteeing patients that they will have antibiotics as and when they need them and in the required amount. They also provide guidance on the correct type of antibiotics and how long one should use it [5].This is aimed at taking care of the patients and reducing the spread of resistant bacteria. Studies show that successful implementation of AMS program has the effect of lowering the rates of inappropriate prescriptions of antibiotics [6].They also eliminate the occurrence of drug resistance because the administration of antibiotics is regulated. Following stewardship standards, the doctors will be capable to

protect their patients and decrease the prevalence rate of MDR contagion. Such programs involve the cooperation of antimicrobial stewardship team workers, the pharmacists and the doctors[7].It is quite important to understand how antimicrobial stewardship is linked to the MDR pathogens. Hospitals which do not monitor the use of antibiotics are recording an alarming figure of resistant infections. MDR infections increase the casualties of a patient, the costs incurred by the hospitals and the load on the health care facilities [8].The resistance has been reported in more cases in the hospitals which do not have antibiotic control policies. Good stewardship programs monitor the usage of antibiotics and provide guidance to the healthcare personnel. The doctors and the nurses also get trained in the use of caution when they use the antibiotics since such programs make sure this is instilled to the doctors and nurses [6]. Assisted with frequent audits and feedbacks, the hospitals will be capable of reducing the extent of antibiotic misuse. In order to avert the opposition to the increase, AMS programs are needed. They make the care of patients more effective and monitor the spread of dangerous infection [9].These programs should be followed to the letter in all respective hospitals as a way of ensuring the safety of the patients.

In the last two years, national policy of AMS has already been worked in several countries to solve this problem. The World Health Organization (WHO) has even guided the countries into taking the hassle of initiating the stewardship programs in the hospitals [10].The research suggests that the best results of the patients can be secured in the hospitals that implement good policies of AMS. The MDR cases also decrease in frequency besides spending less time on the hospital bed [8]. The AMS programs have enabled minimization of the abuse of the antibiotics and therefore they have devised clear guidelines and operating principles. They also preach on-job training to its employees and episodical infections controls. With adequacy in maintenance the hospitals will hold themselves capable of saving the patients as well as reducing infections. The implementation of the committees of the AMS is already attained in several health care facilities [11].

These initiatives have been successful, and still more needs to be done. Although there are still certain difficulties to be faced in implementing stewardship activities despite these programs. This is particularly so in the poor and the middle income countries. These are also regions where the healthcare system is usually poor and the available resources are scarce[12].They are also suffering such problems as poor infection control and easy availability of antibiotics without prescription. Therefore, resistance is transmittable more quickly on such occasions. It is of great importance to educate healthcare workers on the attentive use of antibiotics. Drug stewardship can also be enhanced by frequent auditing of prescription patterns in the hospitals [13].Further studies are required to discover the impact of stewardship activities on resistance in various hospitals. The MDR infections need to be fought with proper funding, education, and good hospital policies. Hospitals and other medical institutions can contribute to the safeguard of patients and the overall health of the general population through enhancing stewardship plans [14].

Not only the matter of the hospital but the whole problem of the community is connected with antibiotic resistance. After entering the environment, the people going in their daily living features the resistant bacteria. This makes it difficult to treat against common infections like pneumonia and urinary infection. The patients of such infections are in greater need of and expensive medicines. It happens as well that none of the drugs will help and the patients develop serious complications. Regulation of usage of the antibiotics in and out of most medical facilities is therefore very important [15]. Many people cease to take medicine too soon or need antibiotics where it is unnecessary[16]. This is a resistant action and the infections prove to be hard to cure. The stewardship programs enhance the awareness projects so that the people can be educated about the hazards of antibiotics. Regular training is also carried out to enlighten the hospital staff in any emerging treatment of the patients. The joint use of these initiatives enables the reduction of the inadequate use of antibiotics and resistant infections [17].The healthcare workers as well as the community shall be educated on how to effectively deal with this healthcare problem.

Multi-drug resistant (MDR) pathogen emergence has become a serious medical problem in the majority of fields or sectors in the world[18]. The biggest risk of these infections is that they are barely responsive to the generally applied antibiotics thus problematic and costly to cure. Some of the research studies have shown that the incidence of MDR infections has increased exponentially over the past ten years. Reasons why this issue occurs are quite a lot because there is the inappropriate use of antibiotics, ineffective infection control, and the weak hospital policies. It has also been stated that over half of antibiotics are unnecessary in hospital and this leads to development of stronger, more resistant bacteria [19].The emergence of antibiotic resistant agents has been at the cost of causing more morbidity to the patients and extending their length of stay and even death in the medical institutions[20]. This is not only a problem of patients but also a management issue in the hospital as more and more advanced and expensive medicines are required to treat infections that in the past could easily be treated[21]. To stem this rising problem, antimicrobial stewardship (AMS) programs have been implemented in hospitals and clinics worldwide. The curriculums are directed towards making sure that the employment of antibiotics is not excessive and wrongfully. The benefits of the AMS programs have been confirmed through the results of other research studies when applied in the process of dealing with the problem of antibiotic resistance[22].

These have been working out successfully and much is yet to be achieved. In any case, there are still a number of concerns that must be addressed when carrying out stewardship activities regardless of these programs. This especially happens to the poor countries or the middle income ones[23]. Either, they are not the places where the worst developed healthcare system is likely to exist and they have little sources to tackle [9]. Other disadvantages

that they face today are improper control of infection and easy access to acquire the antibiotics without prescription. By doing so, one can disseminate the resistance faster in such a scenario. The issue of training on how to organize the use of antibiotics by the medical personnel is closely anticipated. The other means through which the drug stewardship may be improved is regular analysis of the prescription patterns within the hospitals [24].The wider range of study is needed to determine the implications of stewardship in resistances in different hospitals. The MDR infections should be fought against proper funding, education and good policies of the hospitals. The part played by the hospitals and other medical establishments should be accomplished as much as possible in protection of the patients and health increments of the rest of the population by augmentation of stewardship plans [25].

The other advantage of AMS programs is that the outcome of the treatment is documented as well as the cost spent on rounds in hospitals based on preventing the infection, which necessitates more and longer treatment. This relationship points out to the extent to which AMS activities affect the prevalence of MDR pathogens within healthcare[26]. The AMS programs promote the learning process among health workers and patients in addition to the regulation of antibiotics. The reason is that as it had been emphasized in some studies, there is lack of enough knowledge among doctors, nurses, and patients contributing to the abuse of antibiotics[26]. In one study they found out that about 40 percent of the people who have been admitted in hospitals requested antibiotics even when they did not need it [27].Such a behavior enhances this scenario by giving bacteria more chances to develop appropriately in regard to resistance. AMS programs also conduct frequently training workshops, awareness meetings and even educational programs to create awareness about the safe use of antibiotics. Finally, the education of the healthcare workers about the new patterns of treatment and resistance is improving the quality of care. This is to assist the hospitals in controlling the MDR pathogens and avoiding the outbreaks[28].

As other studies indicate, it has been observed that the guidance of government policies and the national health provisions are one of the key determiners of AMS programs. In countries where the government has given authority to guide national stewardship provisions, hospitals achieve better results in their handling of MDR infections control[29]. In one of the recent surveys, there have been less cases of hospital-acquired infection in the hospitals which were following the national recommendations on AMS [30].These policies help in the capacity of the hospitals to strive to have the practices of AMS working in the right way. They also help them with controlling the sale of antibiotics in the market in such a way that the medicines can only be utilized after a doctor prescribes them. This will be a joint effort on the part of the hospitals and the health authorities and will be of saving the health of the patients and the rest of the population against the rising threat of drug-resistant infections[31].

Research Objectives

1. To assess the relationship between antimicrobial stewardship programs and the occurrence of multi-drug resistant pathogens in healthcare settings.
2. To identify how the correct and safe use of antibiotics through stewardship practices affects the rates of drug-resistant infections in hospitals.
3. To explore the challenges faced by healthcare facilities in implementing antimicrobial stewardship programs for controlling antibiotic resistance.

The infection of multi-drug resistant (MDR) pathogens that spread into the healthcare facility has become a serious concern to the safety and the health of the patients. These infections are a problem to treat as they resist common antibiotics, and this contributes to treatment failures, prolonged hospitalization, and health care costs. The growing resistance to drugs is one of the biggest problems caused by overuse and misuse of the antibiotics in hospitals and clinics. Although growth of antimicrobial stewardship (AMS) programs has been carried out so as to develop safe and effective use of antibiotics, proper implementation of programs continues to be a problem in most healthcare organizations. Such features of MDR infections have been climbing at an alarming rate mainly because of lack of competent people, equipment and expertise on proper usage of antibiotics. The proposed study aims at investigating the relationship between the anti-microbial stewardship programs and the rise in multi-drug resistant pathogens in the healthcare settings and how hospitals are facing hardships in achieving successful stewardship programs.

MATERIALS AND METHODS

The study was a descriptive cross-sectional research conducted in Departments of both Infectious Diseases and Pharmacy Services of the selected public and private hospitals of Punjab, Pakistan during the period between March 1, 2025 and May 15, 2025. This experiment was aimed to evaluate the correlation of the development of multi-drug resistant (MDR) pathogens in healthcare facilities with the implementation of the antimicrobial stewardship (AMS) programs and identify the difficulty of the healthcare professionals in the realization of AMS practices. A total of 250 healthcare professionals were picked to form the sample size. The sample size was estimated based on the WHO sample size calculator with assuming a study power of 80 percent and a 95 percent confidence level with an expected proportion of 60 percent of the number of cases of antibiotic misuse with 10 percent as a margin of error. The choice of participants was made by utilizing a simple random sampling method that allowed gathering people and individuals within the target population who had an equal opportunity to become participants of the study.

The population being sampled was described by the people in the field of healthcare, including doctors, nurses, pharmacists, and infection control workers. All the participants were involved in the treatment or interminglement of the cases of infections and prescription and dispensing of drugs in their hospitals with regard to antimicrobial treatment. The inclusion criteria comprised the healthcare workers in the clinical areas with at least one year of clinical experience in the management of infectious diseases, infection control or

antibiotic prescribing practice. The inclusion and exclusion criteria included the healthcare personnel in an administrative role, personnel who were not in clinical duties and those who were not willing to participate in the study. The purpose of the study also guided each participant and assured them the confidentiality of the information and each participant has given written permission that he or she has agreed to take part in the study.

The instrument was a self-administered questionnaire structured and pre-validated. The instrument was based upon three major sections of the questionnaire: The survey was conducted during a period of six weeks. Questionnaires served and filled were then collected, coded, and imported to SPSS version 26.0 to analyze the data. The categorical data like gender, profession, AMS awareness and the presence of MDR pathogen was summarized in terms of frequencies and percentages. Numerical data such as the age of the participants, the years of experience, the awareness scores of AMS and their scores on challenges were reported in the format of mean and standard deviation (SD). To analyze the data, the Chi-square test was applied to investigate the relationship between categorical variables, i.e., the connection between the status of AMS implementation and the percentage of incidences of MDR pathogens. Independent Sample t-test was used to compare the mean AMS awareness and challenge across the categories of professionals (doctors, nurses, pharmacists, infection control officials). Values p that were less than 0.05 were taken as statistically significant.

RESULTS

The research population consisted of 250 medical workers aged between 23 and 58 years, and the average age equaled 36.42 +/- 8.71. Out of this number, 140 (56%) were men and 110 (44%) were women. Most participants belonged to the public hospitals and constituted 155 (62%), whereas 95 (38%) participants belonged to the private hospitals. At their work, 100 (40%) were doctors, 80 (32%) were nurses, 40 (16%) were pharmacists, and 30 (12%) were the infection control personnel. The average clinical experience of participants was 8.9 y.With regard to the awareness of antimicrobial stewardship (AMS) programs, 185 (74%) participants knew about the AMS policies, whereas 65 (26%) respondents did not. One hundred and sixty-five (66) percent of participants across the settings in the hospital experienced multi-drug resistant (MDR) occurrence of pathogen in the past 6 months, as opposed to 85 participants (34) who had no case of an MDR within the same time period. The average AMS awareness was 7.8 ± 2.1, and the average score related to the challenge of implementing the AMS program was 5.9 ± 1.7.A chi-square test indicated that there was a significant relationship between AMS implementation status and MDR pathogen occurrence (p-value = 0.003), where an active AMS program in hospitals reported lower occurrence of MDR than the one with no AMS program. There was a statistically significant difference between the mean scores in AMS awareness between public and private hospitals (p-value 0.014), as the staff in the former had the highest scores (8.1 ± 1.9) compared with the staff in the latter, whose mean scores were lower (7.3 ± 2.3).

Table 1

Demographic Characteristics of Participants (n = 250)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	20–29	70	28.0
	30–39	100	40.0
	40–49	60	24.0
	50 and above	20	8.0
Gender	Male	140	56.0
	Female	110	44.0
Profession	Doctor	100	40.0
	Nurse	80	32.0
	Pharmacist	40	16.0
	Infection Control Staff	30	12.0
Hospital Type	Public	155	62.0
	Private	95	38.0
Years of Experience	1–5 years	90	36.0
	6–10 years	85	34.0
	11–15 years	50	20.0
	16 years and above	25	10.0

The number of participants who took part in the research was 250 healthcare professionals. The greatest percentage of the participants were found to be 30-39 years old, followed by 20-29 years old (28.0-28.0%). The sample consisted of 56.0 percent male and 44.0 percent female. In profession, 40.0%, 32.0%, 16.0%, and 12.0 percent of the respondents were doctors, nurses, pharmacists, and infection control, respectively. A large majority of them (62.0 percent) worked in government hospitals, whereas 38.0 percent worked in privately held hospitals. As far as indicators of clinical experience were concerned, 36.0 percent had between one and five years, 34.0 percent between six and ten years, 20.0 percent between 11 and 15 years, and 10.0 percent had 16 or more years. Such distribution means a proportional representation of healthcare professionals with diverse job types, hospitals, and levels of experience.

Figure 1

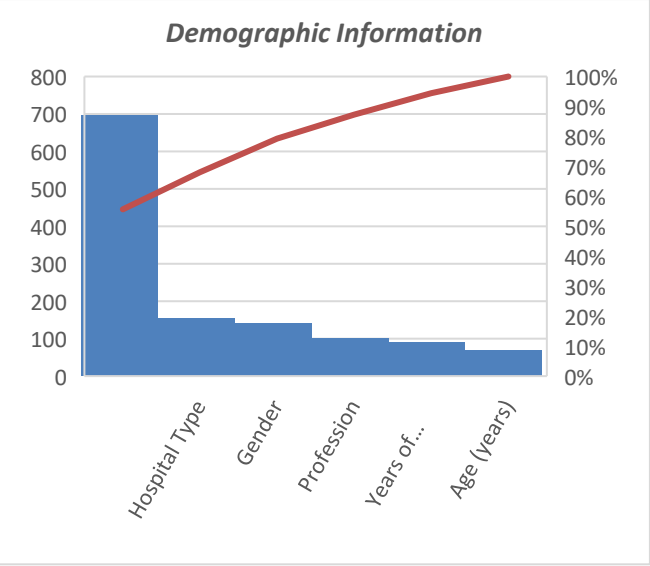


Table 2
Chi-square Test

Chi-Square Tests	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.953	1	0.003
Continuity Correction	8.251	1	0.004
Likelihood Ratio	9.124	1	0.003
Fisher's Exact Test	—	—	—

Chi-square was used to determine the relationship between the implementation status of antimicrobial stewardship (AMS) and presence of multi-drug resistant (MDR) pathogen in healthcare facilities. The results indicated a statistically significant relationship between an AMS program in a hospital and fewer MDR pathogen cases (Pearson Chi-Square = 8.953, p = 0.003) that is, the fewer the cases of MDR pathogens were reported in a particular hospital, the higher the chances that the hospital had an active AMS program. CC value = 8.251 (p = 0.004) that confirmed the significance in the 2x2 table. This finding was also supported by the Likelihood Ratio (9.124, p = 003). Such observations indicate that the better control of antibiotic resistance and a decline in the rates of MDR infections are linked to the successful implementation of AMS practices.

Figure 2

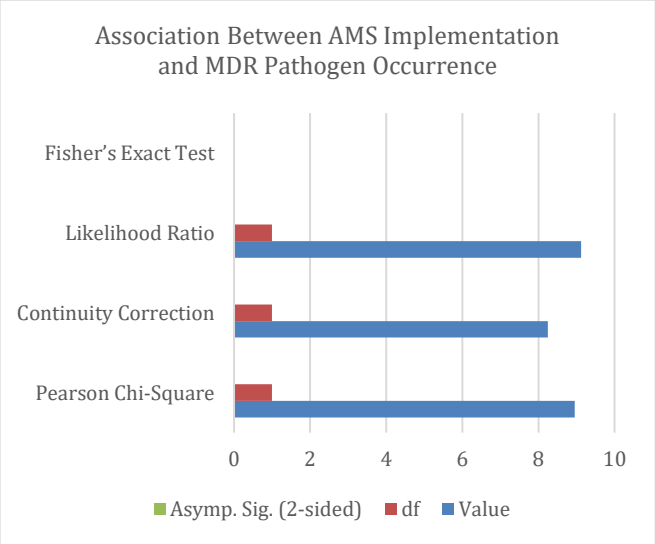


Table 3
Independent Samples t-test

Hospital Type	Mean ± SD	N	t	df	p-value
Public Hospitals	8.1 ± 1.9	155	2.473	248	0.014
Private Hospitals	7.3 ± 2.3	95			

Independent Samples t-test was used to test the difference of the AMS awareness score between individuals that work in both private and public hospitals. Analysis of results indicated a significant chance (t = 2.473, df = 248, p = 0.014) of differences between mean scores of awareness. The average AMS awareness score of the staffs of public hospitals was 8.1 + 1.3 that was greater than the 7.3 + 2.3 average score of the staffs of the private hospitals. This means that health workers in local hospitals were much more knowledgeable about the practices of antimicrobial stewardship than in the private sector.

Figure 3

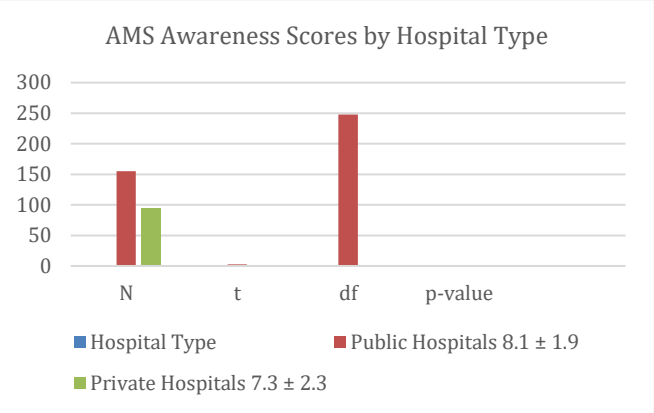
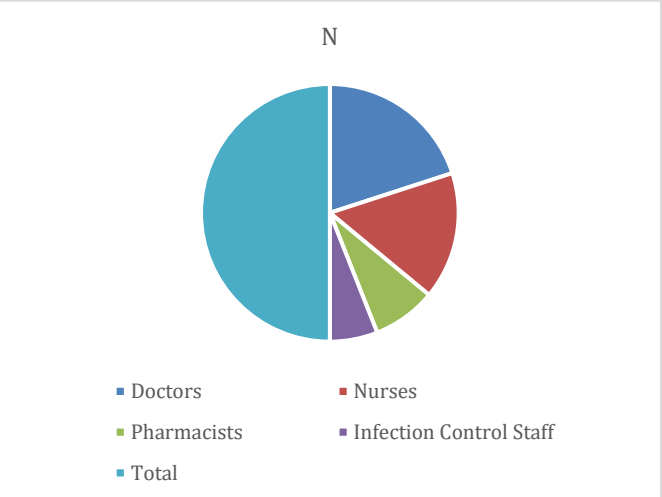


Table 4
One-Way ANOVA Comparing AMS Challenge Scores Among Professional Groups

Professional Group	Mean ± SD	N
Doctors	5.5 ± 1.8	100
Nurses	6.2 ± 1.6	80
Pharmacists	6.0 ± 1.7	40
Infection Control Staff	5.7 ± 1.5	30
Total	5.9 ± 1.7	250

The analysis of the AMS program implementation challenge score of various professional groups showed that there was a significant variation in the mean scores. The mean score of the challenge was highest amongst the nurses (6.2 1.6), followed by pharmacists (6.0 1.7), infection control personnel (5.7 1.5) and doctors (5.5 1.8). The mean challenge score of all the participants was 5.9 1.7. This evidence implies that nurses and pharmacists believed there would be greater barriers if an antimicrobial stewardship program is introduced as opposed to the doctors and staff of infection control. This implies professional role has an effect in the perception of challenges experienced in the implementation of AMS practices in healthcare institutions.

Figure 4



DISCUSSION

The results of this research associated the experience of implementation of antimicrobial stewardship (AMS) program and the presence of multi-drug resistant (MDR) pathogens in healthcare organizations. Without the active

AMS program there were higher cases of MDR pathogens in hospitals as opposed to the hospitals with the active AMS program. Such a result accentuates the inevitableness of AMS in decreasing the transmission of drug-resistant infections by maintaining safe and reasoned use of antibiotics. The findings are concordant with an article by Saleem et al., who also found out that stewardship interventions were linked to a reduction in case rates of hospital-acquired infections and antibiotic resistance [32].It was also shown that AMS practices were known more by the members of the staff of the public hospital than in the staff of the private hospital with the awareness scores having a statistically significant difference between the two groups. This implies that the stewardship policies, training programs to staff, and infection control procedures could be better developed in the case of the public hospitals. The disparity may be perhaps attributed to the government surveillance treatment and health campaigns that are usually existent within an ATD patient presentation.

The same results were observed by Ahmed et al., who found that the level of awareness was higher in relation to AMS amongst the professionals of the public sector of healthcare in their study on stewardship awareness in Pakistan[33]The other important result was that the perceived threats to implementation of AMS programs varied across professional groups. The higher mean challenge score was observed in nurses and pharmacists in comparison to doctors and infection control personnel. It means that support staff meet much more challenges, e.g., they cannot make decisions about prescriptions, have no prompt guidelines to practice, and are not engaged in AMS committee dialogues. The results correspond to the research conducted by Ali et al. where the researchers identified that non-physician staff faced more barriers to their active involvement in AMS programs [34].The demography of the study population was well distributed on the basis of the age, gender, type of hospital working at, and the years of experience in the healthcare. Such diversity could be used to have a wide picture of AMS awareness and implementation challenges among various professional roles and/or situations. Similar scores as those in this study were also recorded in earlier studies by Hassan et al. who found that stewardship awareness and hindrances of its implementation were also experienced in hospitals in developing countries in the same tendencies as it was in this study [35].Finally, the paper also discusses the potential need of more AMS trainings, visceral antibiotic policies, and inter-sectorial collaborations that will have to be provided to increase stewardship endeavors in health-care institutions. These findings demonstrate that an AMS intervention modelled well and continuous professional education are significant in preventing the escalation of MDR pathogens. This conclusion can also be supported by the findings of Khan et al. as they mentioned that the key responses of the antibiotic resistance management in clinical practice are AMS education that focuses on a particular field and pattern formation of policies [36].

CONCLUSION

This study discovered that implementation of antimicrobial stewardship (AMS) programs plays an instrumental role in the efforts to curb the presence of multi-drug resistant (MDR) pathogens inside the health care facilities. The hospitals with AMS being executed reported considerably fewer cases of MDR, and it should show not just the concern towards the proper use of antibiotics but also infection prevention measures. It has also been found out through the results that the staffs in the public hospitals were better aware of the practices of AMS than those in the private hospitals and that nurses and pharmacists faced greater challenges in implementation of the program. These results highlight the necessity to introduce regular AMS training, clear antibiotic guidelines, and more active involvement of every health professional in stewardship activities. There can be improvement of AMS activities and reduction of the identified issues to curb the problem of antibiotic resistance and ensuring the safety of individuals who receive health care.

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