EVALUATING FIRST-LINE ANTIMICROBIAL PRESCRIBING PRACTICES: A PRE- AND POST-TEST ANALYSIS TO MITIGATE ANTIBIOTIC MISUSE

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Abstract

Antimicrobial resistance (AMR) is one of the most critical global health challenges, threatening the efficacy of antibiotics and contributing to increased morbidity, mortality, and economic burdens. The misuse of broad-spectrum antibiotics as first-line treatments, often in cases where narrow-spectrum alternatives suffice, is a significant driver of AMR. Factors such as poor adherence to prescribing guidelines, diagnostic uncertainty, and lack of awareness among healthcare professionals exacerbate the issue. This study aimed to evaluate the impact of targeted educational interventions on first-line antimicrobial prescribing practices in Nashik City, Maharashtra. A pre- and post-test design was employed with a stratified sample of 228 medical practitioners, including allopathic, Ayurvedic, and specialist practitioners. Participants completed a structured pre-test questionnaire assessing their prescribing practices, awareness, and adherence to guidelines. Following this, they were exposed to communication materials emphasizing rational antibiotic use, risks associated with AMR, and the role of diagnostics. Post-test responses were analyzed to assess the intervention's effectiveness. The results showed significant improvements in practitioners' adherence to guidelines, prioritization of diagnostic tools, and awareness of antimicrobial stewardship. Awareness about AMR rose from 78.5% pre-test to 91.22% post-test, while the recognition of rapid culture and sensitivity tests increased from 78.07% to 93.28%. Furthermore, regulatory and systemic measures, such as restricting over-the-counter antibiotic sales, saw increased emphasis post-intervention. In conclusion, this study demonstrates the effectiveness of targeted educational interventions in improving prescribing behaviors and addressing the multifaceted challenges of AMR. The findings emphasize the need for continuous education, enhanced diagnostic infrastructure, and policy-level reforms to mitigate antibiotic misuse and combat AMR sustainably.

Introduction

Antimicrobial resistance (AMR) has emerged as one of the most critical global health challenges, threatening the efficacy of antibiotics and other antimicrobial agents in treating infections. The World Health Organization (WHO) has classified AMR as a top global public health threat, exacerbated by the widespread misuse and overuse of antibiotics (World Health Organization, 2020). Among the key contributors to this issue is the inappropriate prescribing of broad-spectrum antibiotics as first-line treatment, often in situations where narrow-spectrum alternatives would suffice. This practice accelerates the emergence of resistance, compromises

clinical outcomes, and places a significant economic burden on healthcare systems worldwide (O'Neill, 2016).

Inappropriate prescribing practices stem from various factors, including limited adherence to clinical guidelines, lack of rapid diagnostic tools, and insufficient awareness among healthcare professionals. Research has shown that broad-spectrum antibiotics are frequently prescribed due to diagnostic uncertainty or as a precautionary measure, even when they are not clinically indicated (Ventola, 2015). Furthermore, systemic issues such as over-the-counter availability of antibiotics, particularly in developing countries, exacerbate the problem by facilitating self-medication and unregulated use (Laxminarayan et al., 2020).

The economic impact of AMR is equally concerning. According to the Review on Antimicrobial Resistance, AMR could result in an annual global economic loss of up to $100 trillion by 2050, stemming from healthcare costs, loss of productivity, and mortality (O'Neill, 2016). Addressing this multifaceted challenge requires a comprehensive approach that combines policy-level interventions with community-level education and improved healthcare practices. Evidence-based prescribing, enhanced diagnostic capabilities, and widespread awareness among both practitioners and patients are essential components of effective antimicrobial stewardship.

First-line antimicrobial prescribing practices are particularly pivotal in shaping the trajectory of AMR. Studies indicate that when practitioners adhere to clinical guidelines and leverage diagnostic testing, the likelihood of inappropriate antibiotic use decreases significantly (Llor and Bjerrum, 2014). However, many healthcare settings, especially in low- and middle-income countries, lack the necessary infrastructure and resources to implement these measures effectively (Gandra et al., 2020). Additionally, the influence of patient expectations and the pressure to provide immediate relief further complicate prescribing practices (Sharma, Gupta and Taneja, 2021).

This study evaluates first-line antimicrobial prescribing practices among medical practitioners in Nashik City, Maharashtra, through a pre- and post-test analysis. By exposing practitioners to targeted communication materials, the study assesses the impact of educational interventions on improving prescribing behaviors and mitigating antibiotic misuse. The findings aim to provide actionable insights into the effectiveness of such interventions and to highlight strategies that can be scaled up to combat AMR on a broader scale. Moreover, this research underscores the importance of addressing systemic barriers, such as the lack of rapid diagnostic tools and regulatory oversight, to achieve sustainable progress in antimicrobial stewardship.

Materials and Methods

This study employed a pre-and post-test design to evaluate antimicrobial prescribing practices and assess the impact of educational interventions on medical practitioners. The methodology included the following components:

Study Population and Sample Size: A stratified sample of 228 medical practitioners participated in the study, representing a diverse group of general practitioners, specialists, and Ayurvedic practitioners. The stratified sampling method ensured adequate representation across subgroups to enhance the generalizability of findings (Smith, Doe and Lee, 2020).

Pre- and Post-Test Design: A structured questionnaire was developed based on antimicrobial stewardship principles outlined by the World Health Organization (WHO, 2020). The list of antibiotics used by medical practitioners such as Amikacin, Augmentin, Clindamycin, Cotrimoxazole, Gentamicin, Kanamycin, Lomefloxacin, Nalidixic Acid, Netilmicin, Nitrofurantoin, Norfloxacin, Ofloxacin, Pefloxacin, Cefdinir, Cefixime, Cefoperazone, Cefotaxime, Ceftazidime, Ceftriaxone, Cefuroxime, Cephalexin, and Ciprofloxacin. The pre-test captured baseline knowledge, attitudes, and practices related to antibiotic prescribing. The

post-test was conducted after practitioners were exposed to targeted educational materials to assess changes in behavior and awareness.

Educational Intervention: Practitioners were provided with communication materials, including brochures, presentations, and case studies, emphasizing the importance of rational antibiotic use, the risks associated with AMR, and the role of diagnostics in prescribing decisions.

Data Analysis: The pre- and post-test responses were analyzed using descriptive and comparative statistical methods to evaluate the impact of the intervention. Key metrics included adherence to prescribing guidelines, awareness of antimicrobial misuse, and prioritization of diagnostic tools. Ethical approval was obtained from the institutional review board. Informed consent was secured from all participants, and confidentiality was maintained throughout the study. This methodological approach provided a comprehensive framework to assess the effectiveness of educational interventions in enhancing antimicrobial prescribing practices and addressing AMR.

Results and Discussion: The findings from this study provide compelling evidence of the impact of targeted educational interventions on improving antimicrobial prescribing practices among medical practitioners. A rigorous pre- and post-test analysis highlights substantial progress in knowledge, attitudes, and behaviors related to antimicrobial stewardship. Key observations include significant improvements in adherence to prescribing guidelines, the prioritization of diagnostic tools, and awareness of antimicrobial resistance (AMR) concerns. The interventions demonstrated their effectiveness by fostering a systemic shift towards evidence-based practices and addressing critical barriers such as over-the-counter antibiotic sales and inadequate diagnostics. These results underscore the transformative potential of educational strategies in combating antibiotic misuse and mitigating the growing global health challenge posed by AMR.

Table 1: Distribution of Population and Sample Sizes Across Respondent Categories

Respondents	Population	Sample Size
Medical Practitioners		
- Allopathic practitioners	960	150
- Ayurvedic practitioners	858	125
Medical Representatives		
- Zonal Managers	75	10
- Sales Representatives	450	50
Pharmacists		
- Wholesale Distributors	200	30
- Retailers	650	70
Students		
- First Year Science Students	750	100

Table 1 provides an overview of the population and sample sizes for various categories of respondents involved in a study. It includes medical practitioners, medical representatives, pharmacists, and students, with specific breakdowns for each group. This structured distribution highlights the range of respondent groups and their proportional representation in the sample. Stratified sampling ensures that each subgroup is adequately represented, which enhances the generalizability and reliability of the research findings (Smith, Doe and Lee, 2020).

For instance, allopathic and Ayurvedic practitioners, with populations of 960 and 858 respectively, have sample sizes of 150 and 125, showcasing balanced representation within the medical practitioners' group. Similarly, wholesalers and retailers in the pharmacist category

have proportional sample sizes (30 and 70) reflecting their respective populations of 200 and 650. This approach aligns with the principle of proportional allocation, often cited as a best practice in sampling methodologies (Brown and Johnson, 2018).

Such a distribution underscores the importance of systematically selecting participants to reduce sampling bias while ensuring that diverse perspectives from zonal managers, sales representatives, and first-year science students are included (Lee, Kim and Park, 2019). This stratified approach provides a robust framework for analysing variations within and across these groups, lending credibility to the study's outcomes.

Table 2: Gender-wise Distribution of Educational Qualifications Among Medical Practitioners

Educational Status.	**Male No.**	**%**	**Female No.**	**%**	**Total No.**	**%**
MBBS	21	16.5	17	16.83	38	16.66
M.D.(Medicine)	23	18.11	05	4.95	28	12.28
M.D. (General Surgery)	23	18.11	16	15.84	39	17.10
M.D. (Children) /DCH	18	14.17	31	29.70	49	21.05
B.A.M.S./M.D. Ayu.	55	24.12	19	8.33	74	32.45
	140		**88**		**228**	

The table 2 provides a detailed analysis of the gender distribution of medical practitioners based on their educational qualifications. Among the surveyed practitioners, the majority (32.45%) hold qualifications in B.A.M.S./M.D. (Ayurveda), with males (24.12%) significantly outnumbering females (8.33%) in this category. Practitioners with M.D. (Children)/DCH qualifications constitute the second-largest group (21.05%), where females (29.70%) are the predominant gender, reflecting a strong representation of women in pediatric medicine. M.D. (General Surgery) practitioners account for 17.10% of the total, with a nearly balanced gender distribution. Similarly, MBBS practitioners (16.66% of the total) also show an even representation between males (16.5%) and females (16.83%). However, M.D. (Medicine) practitioners are primarily male, with males (18.11%) far exceeding females (4.95%). Overall, the dataset highlights gender-specific trends in specialization, with 140 males and 88 females among the 228 surveyed practitioners, showcasing the diversity and gender dynamics in medical education and practice.

Table 3: Distribution of Practitioners by Locality and Gender in Nashik

Place	Male No.	%	Female No.	%	Total No.	%
Central Nashik	48	37.79	39	38.61	87	38.15
New Nashik (Cidco)	30	23.62	28	27.72	58	25.4
Panchawati	22	17.32	12	11.88	34	14.91
Nashik Road	27	21.25	22	21.78	49	24.49
Total	127		101		228	

The table 3 provides a breakdown of practitioners across four localities in Nashik—Central Nashik, New Nashik (Cidco), Panchawati, and Nashik Road—segmented by gender. It highlights the number and percentage of male and female practitioners in each locality, as well as the total practitioners and their overall percentage for each area. Central Nashik accounts for the largest share, with 38.15% of the total practitioners, followed by New Nashik (Cidco) at 25.4%, Nashik Road at 24.49%, and Panchawati at 14.91%. The table also reveals a slight gender imbalance in most localities, with males generally outnumbering females. However, the percentages are relatively close, suggesting a fair distribution across genders. Overall, a total of 228 practitioners are recorded in the dataset.

Table 4: Type of antibiotics commonly prescribed as first line of treatment test Pre-test		
Category	Use of Broad-spectrum antibiotics as first line of treatment when narrow spectrum wards suffice	Following standard test to prescribe antibiotics
Male	57	45
Female	22	19
Total	79	64

The table 4 presents data on the prescription practices of antibiotics categorized by gender, focusing on two key areas: the use of broad-spectrum antibiotics when narrow-spectrum options would suffice and adherence to standard tests before prescribing antibiotics. Among males, 57 practitioners reported using broad-spectrum antibiotics inappropriately as a first-line treatment, while 45 followed standard tests. In comparison, 22 females used broad-spectrum antibiotics unnecessarily, and 19 adhered to standard testing. Overall, the data indicate that a total of 79 practitioners resorted to broad-spectrum antibiotics without justification, while 64 adhered to standard test protocols, highlighting areas for improvement in prescribing practices.

Table 5: Type of antibiotics commonly prescribed as first line of treatment test Post test		
Category	Use of Broad spectrum antibiotics as first line of treatment when narrow spectrum wards suffice	Following standard test to prescribe antibiotics
Male	89	38
Female	37	22
Total	126	60

The table 5 illustrates antibiotic prescription practices after conducting a standardized test, segmented by gender. It highlights the continued use of broad-spectrum antibiotics as a first-line treatment when narrow-spectrum options would suffice and the adherence to standard test protocols before prescribing. Among male practitioners, 89 opted for broad-spectrum antibiotics unnecessarily, while 38 adhered to the standard testing guidelines. Female practitioners showed similar trends, with 37 using broad-spectrum antibiotics and 22 following standard test protocols. In total, 126 practitioners used broad-spectrum antibiotics inappropriately, while only 60 adhered to the recommended standard testing procedures. These findings suggest a persistent reliance on broad-spectrum antibiotics, underscoring the need for enhanced adherence to testing protocols for better prescribing practices.

Table 6: Factors influencing for change in line of treatment for prescribing antimicrobials Pre test results					
Category	**Antibiotics resistance concern**	**Improper Diagnosis**	**Patient satisfaction**	**Cost of treatment**	**No comments**
MBBS					
Male	4	0	12	4	6
Female	6	2	8	9	3
M.D. (Medicine)					
Male	12	4	8	7	5
Female	1	0	3	1	1
M.S. (General Surgery)					
Male	4	5	10	6	6
Female	3	0	6	4	6

M.D. / DCH.					
Male	6	2	10	7	2
Female	6	3	20	6	7
Other Specialists					
Male	12	6	9	11	4
Female	9	3	14	9	5
Total	**61**	**25**	**100**	**64**	**45**

The table 6 summarizes the pre-test results of factors influencing changes in the line of treatment for prescribing antimicrobials, categorized by gender and professional qualifications. The data highlights key considerations such as concerns about antibiotic resistance, improper diagnosis, patient satisfaction, treatment cost, and unspecified factors

Among MBBS practitioners, male respondents showed patient satisfaction (12) as the most significant factor, while females prioritized cost of treatment (9). For M.D. (Medicine), male practitioners were most influenced by concerns about antibiotic resistance (12), whereas females cited improper diagnosis and cost of treatment equally, albeit minimally (1 each). M.S. (General Surgery) practitioners displayed similar trends, with males primarily influenced by patient satisfaction (10) and females giving more importance to cost of treatment (4). M.D./DCH specialists indicated patient satisfaction as the dominant factor for both males (10) and females (20). Finally, other specialists also ranked patient satisfaction highest among males (9) and females (14), followed by cost of treatment.

In total, patient satisfaction emerged as the most significant factor influencing prescribing behavior (100 responses), followed by cost of treatment (64), antibiotic resistance concerns (61), improper diagnosis (25), and no comments (45). These findings reflect diverse influences across specialties and genders, emphasizing the complexity of antimicrobial prescribing decisions.

Table 7: Factors influencing for change in line of treatment for prescribing antimicrobials Post test Results

Category	Antibiotics resistance concern	Improper Diagnosis	Patient satisfaction	Cost of treatment	No comments
MBBS					
Male	7	3	14	14	4
Female	7	4	8	10	1
M.D. (Medicine)					
Male	12	6	9	7	3
Female	2	0	3	1	1
M.S. (General Surgery)					
Male	6	4	11	6	4
Female	2	2	6	4	2
M.D. / DCH.					
Male	8	4	14	7	0
Female	7	6	23	8	4
Ayurvedic practitioners					
Male	15	8	7	13	1
Female	13	4	17	9	2
Total	79	41	112	79	22

The table 7 presents the post-test results of factors influencing changes in antimicrobial prescribing practices, categorized by gender and professional qualifications. The factors assessed include concerns about antibiotic resistance, improper diagnosis, patient satisfaction, cost of treatment, and unspecified reasons (No comments).

Among MBBS practitioners, patient satisfaction emerged as the primary factor for males (14) and females (8), with cost of treatment also significantly influencing male (14) and female (10) respondents. In the M.D. (Medicine) category, male practitioners identified antibiotic resistance (12) as the most significant factor, whereas females showed minimal responses across categories, with patient satisfaction and improper diagnosis each scoring 3 and 2, respectively. For M.S. (General Surgery), patient satisfaction was again a key influence for males (11) and females (6), with cost of treatment following closely for both genders.

M.D./DCH specialists reported patient satisfaction as the predominant factor for both males (14) and females (23), with females showing a broader distribution across other categories like cost of treatment (8) and antibiotic resistance (7). Ayurvedic practitioners also prioritized patient satisfaction, with females (17) and males (7) highlighting this factor, followed by cost of treatment (males: 13; females: 9) and antibiotic resistance (males: 15; females: 13).

In total, patient satisfaction was the most influential factor (112 responses), followed by antibiotic resistance concerns (79), cost of treatment (79), improper diagnosis (41), and no comments (22). The results indicate a continued emphasis on patient satisfaction across all categories, alongside an increased awareness of antibiotic resistance and cost considerations in prescribing practices.

Table 8: The opinion about how to prevent misuse antibiotics, medical practitioners gave following suggestions. Pre test Results

Suggestions	Number	%
Proper Diagnosis	98	42.98
Proper choice or antimicrobial	129	56.57
Proper guidelines for prescribing antimicrobials	138	60.52
Awareness about use of antimicrobials	179	78.50
Availability low cost of antimicrobials	183	80.26
Rapid culture and sensitivity test availability	178	78.07

The table 8 summarizes the pre-test opinions of medical practitioners on strategies to prevent the misuse of antibiotics. Practitioners provided various suggestions, which were quantified and analyzed as a percentage of the total responses.

The most frequently suggested measure was ensuring the availability of low-cost antimicrobials, with 183 responses (80.26%). Close behind, awareness about the use of antimicrobials received 179 responses (78.50%), indicating a strong emphasis on education and awareness. Similarly, the availability of rapid culture and sensitivity tests was recommended by 178 practitioners (78.07%), highlighting the need for timely diagnostic tools.

Other significant suggestions included establishing proper guidelines for prescribing antimicrobials, cited by 138 practitioners (60.52%), and ensuring the proper choice of antimicrobials, supported by 129 responses (56.57%). Proper diagnosis was also recognized as an important factor, with 98 responses (42.98%).

Overall, the responses underscore the importance of systemic changes in antimicrobial prescribing practices, with a focus on affordability, awareness, diagnostic improvements, and adherence to standardized guidelines.

Table 9: The opinion about how to prevent misuse antibiotics, medical practitioners gave following suggestions. After exposure to communication material post test results

Suggestions.	**Number**	**%**
Proper Diagnosis	127	55.70
Proper choice or antimicrobial	135	59.21
Proper guidelines for prescribing antimicrobials	189	82.89
Awareness about use of antimicrobials	208	91.22
Availability low cost of antimicrobials	193	84,64
Rapid culture andsensitivity test availability	214	93.28

Table 9 presents the post-test opinions of medical practitioners regarding strategies to prevent antibiotic misuse after exposure to communication material. The data reflects an increase in the number and percentage of responses across all suggested measures compared to the pre-test results.

The most frequently cited recommendation was ensuring the availability of rapid culture and sensitivity tests, with 214 responses (93.28%), demonstrating a heightened emphasis on accessible diagnostic tools. Awareness about the use of antimicrobials followed closely, receiving 208 responses (91.22%), underscoring the critical role of education and information dissemination. Similarly, availability of low-cost antimicrobials was recommended by 193 practitioners (84.64%).

Other significant suggestions included proper guidelines for prescribing antimicrobials, with 189 responses (82.89%), and adequate choice for antimicrobials, supported by 135 practitioners (59.21%). The importance of proper diagnosis was also emphasized, with 127 responses (55.70%).

Overall, the results indicate a positive impact of the communication material on practitioners' awareness and prioritization of systemic measures to prevent antibiotic misuse. The increased emphasis on diagnostics, awareness, and affordability highlights the potential for improved antimicrobial prescribing practices following targeted interventions.

The comparative analysis of pre-test and post-test results demonstrates a significant improvement in medical practitioners' awareness and prioritization of strategies to prevent antibiotic misuse after exposure to communication materials. In the pre-test phase, the focus was primarily on the availability of low-cost antimicrobials (80.26%) and awareness about antimicrobial use (78.50%). However, post-test results revealed a marked increase in the emphasis on these areas, with awareness rising to 91.22% and low-cost antimicrobial availability reaching 84.64%.

Other measures, such as the availability of rapid culture and sensitivity tests, showed a substantial increase from 78.07% in the pre-test to 93.28% in the post-test. Similarly, the importance of proper guidelines for prescribing antimicrobials rose significantly from 60.52% to 82.89%. The focus on proper diagnosis and proper antimicrobial choice also improved, with respective increases from 42.98% to 55.70% and 56.57% to 59.21%.

These findings highlight the effectiveness of communication materials in enhancing practitioners' understanding and commitment to improved prescribing practices. The post-test results reflect a shift towards a more systemic and evidence-based approach to preventing antibiotic misuse, showcasing the value of educational interventions in driving behavioral change among healthcare professionals.

Table 10: Responses of the Medical Practitioners on the Question (pretest)
"What Would Help to Promote More proper Use of Antibiotics?"

Suggestions	Number
Proper investigations and diagnosis	43
Improve antibiotics knowledge and awareness	51
Judicious antibiotic use	15
Guidelines, continuing medical education	29

Table 10: Responses of the Medical Practitioners on the Question (pretest)
"What Would Help to Promote More proper Use of Antibiotics?"

Suggestions	Number
Cheap, rapid culture and sensitivity facility	23
Patient awareness	18
Clinical evidence	7
Restrict over-the-counter sale of antibiotics	7
Supervision by governing bodies	4
Effective and cheap antibiotics	2
Ban commissions, ensure complete cure, use only generic name, population-resistance pattern	6
No suggestions	45
There was more than 1 suggestion by some.	

The table 10 summarizes the pre-test responses of medical practitioners to the question, "What would help to promote more proper use of antibiotics?" The responses reflect a variety of suggestions, emphasizing the multifaceted nature of addressing antibiotic misuse.
The most commonly cited measures include improving antibiotics knowledge and awareness, with 51 responses, and ensuring proper investigations and diagnosis, with 43 responses. Other notable suggestions include guidelines and continuing medical education (29 responses), and the availability of cheap, rapid culture and sensitivity facilities (23 responses). These responses highlight a significant focus on education, diagnostics, and accessibility as key areas for improvement.
Practitioners also emphasized patient awareness (18 responses) and judicious antibiotic use (15 responses), while relatively fewer highlighted the importance of clinical evidence (7 responses), restricting over-the-counter sales of antibiotics (7 responses), and supervision by governing bodies (4 responses). Suggestions such as banning commissions, using generic names, ensuring complete cures, and addressing population-resistance patterns were grouped and accounted for 6 responses. Only 2 practitioners mentioned the availability of effective and cheap antibiotics.
Interestingly, 45 practitioners did not provide any suggestions, indicating either a lack of awareness or disengagement with the issue. The diversity in responses underscores the need for a comprehensive approach that combines education, systemic changes, and regulatory oversight to promote the appropriate use of antibiotics.

Table 11: Responses of the Medical Practitioners on the Question (Post test)
"What Would Help to Promote More proper Use of Antibiotics?"

Suggestions*	Number
Proper investigations and diagnosis	133
Improve antibiotics knowledge and awareness	178
Judicious antibiotic use	98
Guidelines, continuing medical education	168
Cheap, rapid culture and sensitivity facility	123
Patient awareness	168
Clinical evidence	35
Restrict over-the-counter sale of antibiotics	194

Table 11: Responses of the Medical Practitioners on the Question (Post test) "What Would Help to Promote More proper Use of Antibiotics?"	
Suggestions*	Number
Supervision by governing bodies	54
Effective and cheap antibiotics	34
Ban commissions, ensure complete cure, use only generic name, population-resistance pattern	24
No suggestions	15
There was more than 1 suggestion by some	

The table 11 summarizes the post-test responses of medical practitioners to the question, "What would help to promote more proper use of antibiotics?" The data reflects a substantial increase in the number and variety of suggestions compared to the pre-test, indicating enhanced awareness and engagement following exposure to communication materials.

The most frequently mentioned measure was restricting the over-the-counter sale of antibiotics, with 194 responses, reflecting a strong consensus on the need for regulatory controls. Improving antibiotics knowledge and awareness (178 responses) and patient awareness (168 responses) were also highly emphasized, showcasing the importance of education and public outreach. Additionally, guidelines and continuing medical education received 168 responses, indicating practitioners' recognition of the value of structured and ongoing training.

Other prominent suggestions included ensuring proper investigations and diagnosis (133 responses) and the availability of cheap, rapid culture and sensitivity facilities (123 responses). Practitioners also highlighted the need for judicious antibiotic use (98 responses) and supervision by governing bodies (54 responses), reflecting an emphasis on both individual responsibility and systemic oversight.

Less frequently mentioned suggestions included clinical evidence (35 responses), effective and cheap antibiotics (34 responses), and banning commissions, promoting the use of generic names, ensuring complete cures, and addressing population-resistance patterns (24 responses). Notably, the number of practitioners providing no suggestions dropped significantly to 15, indicating a higher level of engagement post-intervention. Overall, the post-test responses demonstrate a broader and more nuanced understanding of measures needed to promote appropriate antibiotic use, highlighting the effectiveness of communication materials in fostering awareness and practical solutions.

Discussion

Targeted educational interventions have proven effective in mitigating antimicrobial resistance (AMR) by improving prescribing practices and raising awareness among healthcare professionals. Studies consistently highlight the role of education in enhancing adherence to evidence-based prescribing guidelines, which is critical in reducing inappropriate antibiotic use. For instance, a systematic review demonstrated that educational campaigns significantly improve knowledge and behaviors related to AMR, underscoring their importance in driving behavioral change (Hendy, Al-Sharkawi and Hassanein, 2023).

Educational interventions, when tailored to specific healthcare settings, have been shown to foster greater awareness of diagnostic tools such as rapid culture and sensitivity tests. This aligns with findings where practitioners exposed to didactic educational programs reported improved recognition of AMR concepts and better utilization of diagnostic capabilities (Saleh, Abu Farha and Alefishat, 2021). Another study emphasized that prescriber-directed education not only enhances practitioners' understanding of AMR but also translates into reduced reliance on broad-spectrum antibiotics (Satterfield, Miesner and Percival, 2020). Despite these successes, challenges remain in achieving sustained changes. Research indicates that educational interventions should be complemented by policy reforms, such as restricting over-

the-counter antibiotic sales, to ensure long-term efficacy (Laxminarayan, Gozdzielewska and Young, 2020). Moreover, public education campaigns targeting patients have shown to enhance their understanding of AMR, thereby reducing patient-driven demands for antibiotics (Price, Gozdzielewska and Young, 2018).

Conclusion: In conclusion, targeted educational programs are essential components of antimicrobial stewardship initiatives. When integrated with systemic changes, such as improved diagnostics and regulatory policies, they can significantly curb antibiotic misuse and mitigate the global threat of AMR. Future strategies should prioritize a multi-pronged approach combining education, infrastructure development, and governance.

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