Journal of Young Pharmacists, 2025; 17(3):669-678.
https://www.jyoungpharm.org

Original Article

Challenges and Strategies for Implementing Antimicrobial Stewardship Programs in India: Insights from Multiple Stakeholders

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ABSTRACT

Background: Hospitals routinely practise Antimicrobial Stewardship (AMS) to prevent antibiotic resistance and ensure medication safety. However, rising antibiotic resistance casts concern on AMS's usefulness. This study examines the main challenges to AMS program implementation from the perspectives of healthcare professionals, pharmacists, and the public. **Materials and Methods:** Mixed-methodologies research used quantitative and qualitative methods. In-depth simulated interviews were done with 90 participants (30 healthcare professionals, 30 pharmacist, and 30 general public members) in three antibiotic-free scenarios: non-bloody loose stool, common cold and cough, and direct antibiotic requests. The interviews were performed in two phases: a blinded phase for unbiased assessment and a follow-up phase to explore factors influencing AMS. It was registered with the Clinical Trials Registry of India (CTRI/2024/02/062204). **Results:** Irrational use of antibiotics was prevalent with 73.33% of physicians, 93.33% of pharmacists, and 100% of the general public. Thematic analysis identified several barriers to AMS implementation. From the physician's perspective, key challenges included adherence to guidelines, patient expectations and pressure, time constraints, and patient's reluctance to undergo diagnostic testing. Pharmacists highlighted patient preferences for specific antimicrobials, financial constraints, facility-level factors affecting dispensing, and inadequate monitoring and feedback mechanisms. For the general public, barriers included a lack of awareness, misconceptions about antibiotics, the influence of online information, and financial limitations. **Conclusion:** To overcome these obstacles, specific interventions are necessary, including the implementation of pharmacist-led patient education initiatives, the establishment of definitive procedures for diagnostic testing, and the assurance of sustainable financial frameworks. Comprehensive, evidence-based, and multi-stakeholder strategies are essential for optimising AMS adoption and addressing antimicrobial resistance.

Keywords: Antimicrobial stewardship, Implementation, Challenges, Pharmacists, General public, Physician.

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Received: 07-02-2025;
Revised: 24-06-2025;
Accepted: 19-08-2025.

INTRODUCTION

Antimicrobial Resistance (AMR) is a significant global health crisis, with the World Health Organisation (WHO) recognising it as one of the foremost ten dangers to public health globally. The epidemiology of antimicrobial resistance has undergone significant changes in recent decades, resulting in heightened morbidity, mortality, and healthcare expenditures. In 2019, drug-resistant bacterial infections accounted for over 4.95 million worldwide fatalities, with 1.27 million of these deaths directly linked to AMR (Murray *et al.*, 2022). The burden is most acute in Low- and Middle-Income Countries (LMICs), where resistance rates to essential antibiotics, including third-generation cephalosporins and fluoroquinolones, may surpass 70% (Laxminarayan *et al.*, 2013; Ventola, 2015). Elevated resistance rates contribute to a significant increase in mortality risk, especially in infections caused by Multidrug-Resistant (MDR) organisms, which are associated with up to double the mortality risk compared to infections with susceptible strains (Eliopoulos, 2003; Reyes, 2023). This grim reality underscores the pressing need for effective therapies to address resistant infections and reduce the related death rates.

DOI: 10.5530/jyp.20250133

Publishing Partner : Manuscript Technomedia. [www.mstechnomedia.com]

Antimicrobial stewardship (AMS) programs have become an essential approach in combating AMR. These initiatives seek to enhance the utilisation of antimicrobial agents by guaranteeing that patients are given the correct medication, dose, and therapy duration, thereby reducing superfluous antibiotic consumption. AMS programs aim to mitigate selected forces that facilitate the emergence and dissemination of resistance (Baur, 2017; Bennett, 2018). The execution of AMS projects encounters significant obstacles, especially in resource-constrained environments. The obstacles are complex and include insufficient resources, including diagnostic equipment and skilled workers, opposition to change among healthcare practitioners stemming from established prescription patterns and low knowledge, and the lack of localised recommendations (Seni, 2020; Khadse, 2023). The absence of adequate surveillance mechanisms to track antibiotic use and resistance trends hinders the efficacy of AMS initiatives (Howard, 2015; Davey, 2013).

This study was led by the following research question: From the viewpoints of healthcare professionals, pharmacists, and the general public, what were the primary challenges to the effective implementation of antimicrobial stewardship programs in healthcare settings? This research sought to investigate the particular obstacles faced by these primary stakeholders.

MATERIALS AND METHODS

Study design

A mixed-methods study, combining qualitative and quantitative approaches, was conducted to systematically examine the specific obstacles faced by key stakeholders, including healthcare professionals, pharmacists, and the general public, regarding antimicrobial stewardship programs. The qualitative component utilised a convenience sampling method to recruit participants from Sri Venkateswara Institute of Medical Sciences (SVIMS) and the general populace in Tirupati, enabling in-depth interviews and focus group discussions to obtain detailed, context-specific insights into the challenges encountered by these groups. Simultaneously, the quantitative aspect used a checklist for the judicious use of antimicrobials and statistical analysis to measure the occurrence and effects of these obstacles within the specified population.

Sample size

In a systematic analysis of qualitative health research (Vasileiou, 2018), a sample size of 30 participants was deemed sufficient for interview-based qualitative studies. Accordingly, our study adopted this sample size for each key stakeholder group: healthcare professionals, pharmacists, and the general public, resulting in a total sample of 90 participants.

Study population

The participants were evenly distributed into three groups: 30 treating physicians, 30 pharmacists, and 30 members of the general public. The research included individuals aged 20 years and older, concentrating on individuals who had defined responsibilities in healthcare decision-making or antibiotic use. Physicians involved in treatment, including as consultants, resident doctors, and MBBS interns, were chosen for their direct role in antibiotic prescription, providing essential insights on the difficulties of maintaining antimicrobial stewardship guidelines. Pharmacists from both hospital and community settings were involved to investigate the challenges they have in dispensing antibiotics. Furthermore, individuals of the general public were incorporated to get consumer insights and behaviours concerning antibiotic use. Participants were recruited from varied backgrounds within hospital and community environments. Individuals under 20 years of age were eliminated to ensure a concentration on individuals capable of offering genuine insights. Individuals with mental health disorders or communication impediments, including those who are deaf or mute, were excluded to prevent possible complications in data collecting.

Data collection procedure

The data collection process entailed executing simulated interviews utilising a structured interview guide, which was developed based on critical themes aligned with the research objectives and subsequently reviewed and refined through expert feedback and pre-testing with five participant samples. This was conducted across three meticulously selected scenarios where antibiotic use was generally inappropriate: non-bloody loose stools, the common cold and cough, and direct requests for antibiotics. These scenarios were created to reflect real-world encounters and pinpoint issues in the proper use of antibiotics. Investigators, posing as simulated customers, engaged with treating physicians dispensing pharmacists, and members of the general public in various settings. The simulated role-play was conducted in two phases: the initial phase was blinded (conducted during the first visit), wherein the investigators concealed their identities, facilitating an impartial, systematic evaluation of attitudes and practices concerning antibiotic utilisation, utilising a checklist modified from established antimicrobial stewardship program guidelines. During the second phase, conducted during the follow-up visit, the investigators revealed their names to further explore the variables affecting the application of antimicrobial stewardship. The exchanges were documented with the participants' express assent to guarantee data accuracy. The audio recordings were transcribed verbatim, enabling thorough examination. Data saturation was attained when no more themes or insights surfaced from the transcriptions, indicating that the sample size and data collection were enough to thoroughly address the study issues about antibiotic usage and stewardship problems.

Assessment of rational practice

Rational practice was characterised by complete compliance with a systematic five-item checklist created for each participant group (physicians, pharmacists, and the general public) derived on existing Antimicrobial Stewardship Program (AMSP) guidelines. The checklists were designed to embody the fundamental concepts of judicious antibiotic use, including diagnostic tests prior to prescription, suitable indications, compliance with dose and duration, prohibition of non-prescription distribution, and patient follow-up or education. The objects were customised to the distinct duties and responsibilities of each group. A subject was deemed to be practicing logically only if they satisfied all five checklist criteria. Responses were evaluated in a binary (Yes/No) manner during organised interviews or surveys, guaranteeing an objective assessment of compliance with AMSP requirements.

Data management and analysis

Qualitative data

The transcribed data underwent a meticulous coding procedure. The data were first reviewed many times to get a thorough comprehension, and pertinent statements aligned with the study's goals were found. An open coding technique was used to methodically code these remarks, assigning labels to significant words or ideas that encapsulated crucial aspects of the participants' answers. Subsequent to the first coding, the codes were examined for trends and categorised into preliminary themes that included wider categories of challenges.

Quantitative data

Data were entered into MS Excel and analysed with SPSS version 26. The continuous data were expressed as mean and standard deviation, while the categorical variables were represented by frequency, percentage, and proportion.

RESULTS

Quantitative

The gender distribution differed throughout each group, with male representation being greatest among pharmacists (66.67%), followed by physicians (53.33%), and the public (46.67%). The mean age varied significantly, with the public group averaging 40.1±13.23 years, while pharmacists and physicians had average ages of 31.4 ±10.31 and 33.1±8.08 years, respectively (Table 1).

Rational practice was noted in just a minority of participants. Among pharmacists, 2 out of 30 (6.7%) displayed appropriate practices, while 8 out of 30 physicians (26.67%) showed similar behaviour. Remarkably, no rational behaviour was seen among the general public (Tables 1 and 2).

Qualitative

Physician prospectives

Following the thematic analysis, codes related to physician's prescribing behaviours were grouped under themes such as:

1. Adherence to antimicrobial stewardship guidelines.
2. Patient expectations and pressure.
3. Time constraints and workload.
4. Patient reluctance towards diagnostic testing.

Adherence to antimicrobial stewardship guidelines

The theme of adherence to antimicrobial stewardship guidelines were emerged as a central factor influencing prescribing behaviours among physicians. The findings revealed significant variability in physician's adherence to AMS guidelines, which can be attributed to several interconnected factors such as institutional support and clarity of guidelines, personal beliefs and experiences, and institutional culture and peer influence:

1. Institutional support and clarity of guidelines.
2. Personal beliefs and experiences.
3. Institutional culture and peer influence.

Institutional support and clarity of guidelines

The study participants revealed that there was weaker support from their respective institutions in ensuring adherence to AMS guidelines. Several participants admitted they were unaware of the bio-gram, which is a critical resource for guiding antibiotic selection based on local patterns of antimicrobial resistance. The lack of awareness about the bio-gram suggests a gap in communication and training within the institution, hindering physician's ability to make informed decisions about appropriate antibiotic use. Without access to or knowledge of such vital information, physicians are less equipped to adhere to AMS guidelines, potentially leading to the inappropriate prescription of antibiotics. This deficit of institutional support manifested in several key areas, impacting the effectiveness of AMS implementation. One significant issue was the absence of structured programs to educate or inform healthcare professionals about essential tools such as the hospital's antimicrobial bio-gram.

"There's a lot of talk about antimicrobial resistance and how we need to be cautious with antibiotics, but I don't feel like we're given the right tools or enough guidance to follow the stewardship protocols effectively. I feel like we're more likely to fall back on what's convenient or what we know, rather than strictly adhering to the guidelines. And that's not good for patient care or for fighting antimicrobial resistance." (Physician participant no. 5).

"I recently realized that I've never actually seen the hospital's antimicrobial bio-gram. I didn't even know we had one... How

am I supposed to make informed decisions on antibiotic use if I don't even know the local resistance patterns? It's not something that's readily available." (Physician participant no. 18).

Personal beliefs and experiences

The study participants reported that adherence to AMS guidelines was significantly influenced by physician's personal beliefs and clinical experiences, particularly in life-threatening scenarios where empirical therapy was prioritized to ensure immediate patient safety. They highlighted that the urgency of life-saving interventions often took precedence over strict guideline adherence, leading physicians to initiate empirical therapy until diagnostic results enabled a transition to more targeted and adequate therapy. This practice could contribute to overprescribing, especially in vulnerable populations. Additionally, participants noted that defensive medicine, driven by concerns about missing serious infections, and skepticism regarding the applicability of frequently updated AMS guidelines further complicated adherence.

"There's always a fear of missing a serious infection, which drives me to err on the side of caution. If I don't prescribe antibiotics and the patient worsens, it could have serious consequences, both for the patient and for me professionally." (Physician participant no.18).

"In life-threatening scenarios, my primary focus is ensuring the immediate safety of the patient. I prioritize empirical therapy. Most often, empirical therapy transitions to more targeted and adequate therapy once diagnostic results are available." (Physician participant no.8).

Institutional culture and peer influence

The participants revealed that antibiotic prescribing practices among physician were predominantly influenced by the prescribing patterns of senior consultants rather than adherence to AMS guidelines. Participants reported that antibiotic selection was often guided by the preferences and established practices of consultants, with each unit within the department developing its own standard or "brand" of antibiotics. Junior doctors were expected to follow these unit-specific practices, reflecting the prevailing norms within their specific unit rather than evidence-based guidelines.

"In our unit, we usually follow the prescribing patterns of the senior consultants. Their preferences and established practices tend to dictate what antibiotics we use." (Physician participant no.24).

"Each unit has its own standard, or what we often call a "brand" of antibiotics. It's like a tradition that's passed down from the consultants. We're expected to follow these practices closely." (Physician participant no.7).

"We are afraid that if we try to use the consultants' suggested strategies in a different way, we may receive a bad response. We run the risk of receiving criticism or developing a poor opinion of ourselves." (Physician participant no.30).

Patient expectations and pressure

The participants revealed that patient expectations and pressure impact adherence to AMS in the following ways:

1. Influence of patient demands on prescribing decisions.
2. Balancing clinical judgment with patient expectations.

The participants stated that patient's demands for antibiotics often compelled physicians to prescribe them, even in cases where antibiotics were not clinically warranted. This pressure to meet patient demands frequently overridden clinical judgment, making it difficult for physicians to adhere to best practices for antibiotic prescribing. Also reported that they commonly faced the complex task of balancing their clinical judgment with patient expectations. Although clinical guidelines might have recommended against the use of antibiotics for certain conditions, the desire to satisfy patients and avoid potential dissatisfaction sometimes led to conflicting decisions.

"I often find myself in a tough spot. Patients come in with symptoms of a cold or flu, and they strongly insist on getting antibiotics. Even when I explain that antibiotics won't help with…, they're still not satisfied" (Physician participant no.5).

"I've had patients practically demand antibiotics, and it's challenging to say no, especially when they seem so convinced that they need them…. Even though I know antibiotics aren't necessary, the pressure makes me wonder if I'm being too rigid. I sometimes find myself thinking, 'Maybe I should just give in this time' even though I know it's not the best practice." (Physician participant no.8, 18).

Time constraints and workload

1. Shortcuts in clinical decision-making.
2. Influence of workload on follow-up and monitoring.

Physicians reported experiencing chronic high work pressure, which often necessitated rapid clinical decisions, frequently leading to default antibiotic prescriptions. They noted that antibiotics were perceived as a safer option for managing patient symptoms and mitigating potential complications, particularly in situations of diagnostic uncertainty. Physicians emphasized that, under significant stress, they were more likely to choose the path of least resistance, opting for antibiotics rather than engaging in the more complex and time-consuming decision-making process required for effective antimicrobial stewardship. Additionally, they highlighted that high workload also hindered their ability to

conduct proper follow-up and monitoring, further contributing to prolonged or unnecessary antibiotic use due to insufficient time for reassessment and adjustment of treatment plans.

"We often have a large number of patients to see in a short period. We need to make decisions quickly. And antibiotics are perceived as a safer option to manage patient symptoms and avoid potential complications, especially when we're in high workloads and unsure about a diagnosis." (Physician participant no.12, 26).

Patient reluctance towards diagnostic testing

A physician highlighted that many patients had refused culture and sensitivity tests due to factors such as the high cost, the time required to obtain results, and the discomfort involved, particularly when large blood samples were needed. Additionally, delays in receiving test results had increased the pressure to make immediate treatment decisions, frequently leading to broader antibiotic use than necessary.

"I've been encountering a recurring issue with my patients refusing culture and sensitivity tests. It's becoming quite a challenge." (Physician participant no.5).

"There was one patient, a young woman with a severe infection. She was hesitant to undergo the culture test due to the cost and the thought of multiple blood draws. I advised her to get the test, but she was still reluctant," (Physician participant no.11).

Pharmacist prospectives

Following the thematic analysis, codes related to pharmacist's prescription handling behaviors were grouped under themes such as:

1. Patient's preference for specific antimicrobials.
2. Financial constraints facing patients.
3. Facility-level factors influencing dispensing practices.
4. Inadequate monitoring and feedback mechanism.

Patient's preference for specific antimicrobials

In this study, pharmacists reported that patients frequently requested specific antimicrobials, often influenced by past experiences shared by relatives or friends, or due to misconceptions about the efficacy of these medications. Participants noted that patients believed certain antibiotics could treat a wide range of symptoms, making them reluctant to accept advice from healthcare providers. According to the pharmacists, these demands placed significant pressure on them to dispense antibiotics, sometimes without conducting thorough assessments or verifying valid prescriptions. The over-the-counter availability of antibiotics and patients' familiarity with specific brands further exacerbated these challenges, ultimately compromising the objectives of AMS.

"…patients often come in asking for specific antibiotics… They believe that if it worked for someone else, it will work for them too…" (Pharmacist participant no.1).

"Many patients seem to think that antibiotics are a cure-all for any illness. They'll come in with cold or flu symptoms and insist on getting antibiotics. When I try to explain, they get frustrated. Some even refuse to listen or think I'm trying to deny them treatment." (Pharmacist participant no.5).

Financial constraints facing patients

Pharmacists observed that a considerable number of patients often requested cheaper alternatives or incomplete antibiotic courses due to financial constraints, which limited their ability to afford full treatments. Pharmacists reported feeling pressured to accommodate these financial limitations, sometimes dispensing antibiotics without a valid prescription in an effort to meet the patient's immediate financial needs. Participants also expressed concern that this practice not only undermined the effectiveness of treatment but also increased the risk of an AMR.

"…I've seen patients asking for only 2 or 3 tablets of antibiotics… For instance, I recently had a patient who needed a full course of ciprofloxacin for a urinary tract infection, but they could only afford a few tablets…" (Pharmacist participant no.9).

"I have encountered with some patients who are very needy they can only offer ether for consultant fee or medication, forcing them to choose between the two. …best on their symptoms we often have to suggest antibiotics hoping they will recover. We are helpless…" (Pharmacist participant no.9).

Facility-level factors influencing dispensing practices

Participants indicated that the dispensing of antimicrobials was significantly influenced by business perspectives, particularly the focus on profitability. They observed that chronic understaffing, high workloads, and limited resources constrained pharmacist's capacity to thoroughly review prescriptions and deliver comprehensive patient education. They added, the high volume

Table 1: Demographics and rational antibiotic practice among pharmacists, physicians, and the public based on AMSP checklist adherence.

Participants	Gender (% Male)	Average age in years	No. of Rational Practice	Proportion of rational practice	Rational practice
Pharmacist	20 (66.67%)	31.4±10.31	2	0.067	6.70%
Physician	16 (53.33%)	33.1±8.08	8	0.267	26.67%
Public	14 (46.67%)	40.1±13.23	0	0	0%

Table 2: Checklist responses and rational antibiotic use among stakeholders based on AMSP criteria.

Stakeholders	Question	Yes	No
Physician	Was a relevant specimen collected for culture or other diagnostic tests before initiating antibiotic therapy?	22	8
	Was the decision to prescribe antibiotics based on strong clinical evidence, such as diagnostic test results or established clinical guidelines?	19	11
	Is the patient provided with clear and detailed instructions on how to correctly use the prescribed antibiotics, including dosage, duration, and what to do in case of side effects?	20	10
	Was the prescribed antibiotic regimen reviewed and adjusted based on culture results or changes in the patient's clinical condition?	18	12
	Was there a plan for monitoring the patient's response to the antibiotics (e.g., clinical assessment, follow-up)?	18	12
	Rational use (if all yes).	8 (26.67%)	25 (73.33%)
Pharmacist	Was the antibiotic dispensed only after verifying that a valid and appropriate prescription was provided?	10	20
	Did the pharmacist dispense antibiotic only with prescription?	8	22
	Was the prescribed antibiotic evaluated for its appropriateness in terms of indication, dosage, route of administration, and duration based on current antimicrobial stewardship guidelines?	17	13
	Did the pharmacist dispense antibiotics for: Common cold, flu, or other viral infections? Non-infectious conditions (e.g., allergies, fatigue)?	12	18
	Did the pharmacist document the details of antibiotic dispensing and suggest a follow-up with the prescribing doctor if necessary?	15	15
	Rational use (if all yes).	2 (6.7%)	28 (93.33%)
General public	Is the antibiotic taken only when prescribed by a qualified healthcare provider?	13	17
	Antibiotic did not share with family members, relatives, or friends.	9	21
	Antibiotic was not saved or stored for potential future use instead of completing the prescribed course.	10	20
	Sample given for (e.g., urine, blood) test before starting antibiotic treatment.	7	23
	I do not demand antibiotics from healthcare providers, even when not necessary or advised.	15	15
	Rational use (if all yes).	0 (0%)	30 (100%)

of prescriptions and the pressure to manage costs and operational efficiency frequently led to reduced time allocated for each patient interaction. Pharmacists reported that the fast-paced work environment and elevated patient volumes often impeded their ability to conduct detailed consultations, thereby negatively impacting the quality of care and the effectiveness of antimicrobial stewardship efforts.

"…. we're constantly trying to maintain a loyal customer base. If I don't fulfill a patient's request…., they'll often just go to a different pharmacy where they might get the medication without the same level of scrutiny." (Pharmacist participant no.16).

"Hmm, I recall a day when we were overwhelmed with patients, and one person came in insisting on antibiotics, even though

they didn't have a valid prescription. …but because we were so busy and the line was getting longer. I ended up dispensing the antibiotics, even though we don't always have the luxury of doing things by the book when we're stretched so thin." (Pharmacist participant no. 30).

Inadequate monitoring and feedback mechanism

Pharmacists reported that there had been no proper system in place to regularly check their knowledge or update policies, which had led to the risk of following outdated practices. They also mentioned that, without feedback on their performance, it had been difficult to know if their efforts were making a difference or where they needed to improve. Poor communication with doctors had further limited their ability to influence treatment decisions. Additionally, pharmacists faced challenges with limited opportunities for continuing education, inadequate systems for tracking data, and inconsistencies in how AMS policies were applied across departments. These issues, combined with their heavy workload, had made it harder for them to fully contribute to AMS programs.

"We were trying to make changes, but we had no way to tell if they were actually helping or making any improvements. It felt like we were just going through the motions without knowing if we were making a difference." (Pharmacist participant no. 17).

"Honestly, I started getting a bit lazy about keeping up with new information since there was no pressure to stay informed. Without regular check-ins or feedback, it's easy to become complacent. Why bother putting in extra effort when no one is watching or giving us feedback?" (Pharmacist participant no. 17).

General public prospectives

Following the thematic analysis, codes related to general public prospective grouped under themes such as:

1. Lack of awareness.
2. Misconceptions and myths.
3. Influence of internet.
4. Financial constraints.

Lack of awareness

Participants reported that they often began treatment by obtaining medication from a nearby pharmacy and only sought a doctor's consultation if their symptoms did not improve. They noted that they tended to stop taking antibiotics once their signs and symptoms resolved. This behavior reflected a significant lack of awareness regarding the importance of completing prescribed antibiotic courses and adhering to healthcare providers' instructions.

"...Well, if I have symptoms like a bad cough or fever, I'll go to the pharmacy and get something…usually it cure, me." He added "If my symptoms go away, I think I don't need to keep taking it" (Public participant no.2).

"...I work for daily wages, and when I'm at work, I often forget to take my medicine. I didn't really think it was a big deal as long as I feel okay." (Public participant no.16).

Misconceptions and myths

The participants in the study commonly believed that sharing antibiotics among individuals with similar symptoms was safe. They perceived that if someone else, such as a family member or friend, had a similar illness and recovered using certain antibiotics, the same medication would work for them. The participants also underestimated the potential dangers of self-medicating without proper diagnosis, assuming that antibiotics were universally effective for various illnesses, including those caused by viruses like the common cold or flu, where antibiotics were ineffective.

"(Laughing) sometimes I don't go to the doctor. If a family member or a friend had the same symptoms and used a certain antibiotic, I'll just take that. If it worked for them, it should work for me too, right?" (Public participant no.18).

Influence of internet

Participants highlighted that they often searched for their symptoms on search engines and followed the advice they found online, rather than consulting a healthcare provider. This reliance on unverified online information and the convenience of obtaining antibiotics without medical guidance led to misuse, increasing the potential for inappropriate antibiotic use and resistance.

"Oh, it's pretty simple. If I feel something coming on, like a cough or fever, I just Google my symptoms. Google usually gives me everything I need, even which medicine. Why wait?" (Public participant no.28).

Financial constraints

Participants noted that financial limitations significantly influenced their decisions around antibiotic use. Many reported opting for cheaper, over-the-counter antibiotics or self-medicating with leftover medications to avoid the expense of visiting a healthcare provider. In some cases, they purchased antibiotics online or from informal sources at lower prices, despite the potential inappropriateness for their condition. Additionally, some individuals saved antibiotics from previous prescriptions for future use to avoid the cost of obtaining new medications.

"Usually, if I feel like I have an infection, like a cold or fever, I just use the antibiotics I have at home." (Public participant No.20).

"…working on daily wages, every little bit helps. If I can save on doctor consultation fees, I can use that money for medicine." (Public participant No.11).

DISCUSSION

This study explored the specific barriers encountered by healthcare providers, pharmacists, and the general public in the successful implementation of antimicrobial stewardship programs in healthcare settings. The study revealed that 73.33% of the antimicrobial prescriptions made by physicians were classified as irrational. The majority of these irrational prescriptions occurred during the review and adjustment of antimicrobial regimens or in the context of patient education (Tables 1 and 2). These irrational prescriptions were often driven by diagnostic uncertainties and external pressures. Four key domains emerged as significant factors influencing AMS implementation from the physician's perspective: 1) adherence to AMS guidelines, 2) patient expectations and external pressure, 3) time constraints and workload, and 4) patient reluctance to undergo diagnostic testing. The study identified physician adherence to guidelines was a key factor, with substantial variability influenced by institutional support, personal beliefs, and peer influence. Previous studies have also shown that physician guidelines are broadly influenced by various factors (McKinlay *et al*., 2007; Brolliar *et al*., 2016; Catho *et al*., 2020; Halm *et al*., 2000). Brolliar *et al*., (2016) reported guideline implementation strategies, dissemination methods, and local protocol development, play a crucial role. Halm *et al*., (2000), and Brolliar SM *et al*., (2016), agreed that clinical experience, personal beliefs, and attitudes towards standardized care of physician also impact adherence. Moreover, in the study we observed physician's prescribing behaviours were largely influenced by the practices and preferences of senior consultants, with antibiotic selection often reflecting the established norms within each department unit. Junior doctors often rely more on the practices of senior colleagues than on established hospital protocols or their undergraduate training (De Souza *et al*., 2006). This hierarchical guidance may restrict active engagement with infectious disease specialists and impede clinical autonomy, posing challenges to independent decision-making (Broom *et al*., 2016). Moreover, patient pressure to prescribe antibiotics despite clinical indications significantly impacted physician's decisions. This aligns with existing literature, where patient demands often supersede adherence to clinical guidelines, creating ethical dilemmas (Rodrigues *et al*., 2013). The struggle to balance clinical judgment with patient satisfaction was particularly evident, resonating with the findings of McKay R *et al*., (2016) who noted that the desire to meet patient expectations can lead to inappropriate antibiotic use. Addressing these barriers is critical for optimizing AMS effectiveness. Strategies such as strengthening institutional support, enhancing junior doctors' training, and implementing robust patient education initiatives could mitigate these challenges, ultimately contributing to more rational antimicrobial use.

The study revealed that 93.33% of antimicrobial dispensing by pharmacists was classified as irrational (Tables 1 and 2). The predominant issues contributing to this irrational dispensing included inadequate verification of prescription appropriateness, failure to confirm whether diagnostic testing (e.g., culture collection) was conducted prior to dispensing, and insufficient patient education on the risks associated with antimicrobial resistance. Four key domains emerged as significant factors influencing AMS implementation from the pharmacist's perspective: a) patient preferences for specific antimicrobials, b) financial constraints facing patients, c) facility-level factors influencing dispensing practices, and d) inadequate monitoring and feedback mechanisms. Similar to our findings, Broom *et al*., (2016) identified significant barriers to effective AMS, such as resource constraints, interprofessional dynamics, and the limited presence of pharmacists on hospital wards. Likewise, Rizvi *et al*., (2018) and Saha *et al*., (2019) reported challenges like inadequate training, limited access to patient records, insufficient collaboration with general practitioners, and the absence of reimbursement models, all of which hinder pharmacist's active participation in AMS initiatives. In this study, pharmacists noted that patient preferences and financial constraints significantly influenced dispensing practices. The impact of patient demands on antibiotic selection is well-documented (Ferdiana *et al*., 2021; Jones *et al*., 2018), with patients often insisting on specific antibiotics based on prior experiences or misconceptions regarding efficacy. Economic limitations, as also noted by Sono *et al*., (2023) and Nepal *et al*., (2021), frequently drive patients to request incomplete antibiotic courses or engage in self-medication, which complicates pharmacist's efforts to promote appropriate antibiotic use. This highlights the urgent need for enhanced patient education on the responsible use of antibiotics. Furthermore, strengthening teamwork and communication between pharmacists and other healthcare providers is crucial for optimizing AMS efforts. However, facility-level factors, particularly the lack of stringent regulatory frameworks for antibiotic dispensing in community pharmacy settings, pose significant challenges. Despite the existence of policies, enforcement remains weak, leading to non-prescription antibiotic sales, especially in regions like India (Barker *et al*., 2017). Addressing these regulatory gaps is essential to support pharmacists in adhering to AMS guidelines. To overcome these barriers, targeted interventions are required, such as implementing pharmacist-led patient education programs on the risks of antibiotic misuse, establishing clear protocols for diagnostic testing prior to dispensing, and ensuring sustainable financial models to support AMS activities.

The study identified that 100% of antimicrobial use among the general public was deemed irrational (Tables 1 and 2). The majority engaged in improper antibiotic practices driven by convenience, persistent misconceptions, and financial limitations. This finding aligns with reports by Mboya *et al*., (2018) and Lima *et al*., (2015) who observed that 76.3-88.8% of antibiotic purchases were irrational, driven by lack of public knowledge, easy access

to antibiotics without prescriptions, financial limitations and misunderstandings about antibiotic use. Notably, internet access emerged as a double-edged sword: while Anderson, (2018) highlighted its potential for AMS improvement, Licata *et al*., (2021) warned of its role in promoting self-medication. Our findings align with this duality, as many participants cited online resources as their primary information source, which may either educate or mislead users (Licata *et al*., 2021; Zucco *et al*., (2018). The study also found that many participants tended to self-medicate by obtaining antibiotics directly from pharmacies without consulting healthcare providers. Studies across multiple countries have revealed a high prevalence of self-medication with antibiotics, ranging from 40% to 60.8% of participants (Abasaeed *et al*., 2009; Elmahi *et al*., 2022; Horumpende *et al*., 2018; Grigoryan *et al*., 2008). We observed factors contributing to self-medication include previous experience, advice from pharmacists or friends, and perceived appropriateness for certain conditions, which align with the finding reported by Grigoryan *et al*., (2008). Notably, many individuals who self-medicate tend to discontinue treatment prematurely upon symptom improvement, rather than completing the prescribed course. Similar was reported by Kianmehr *et al*., (2019). These behaviours underscore the need for multifaceted AMS interventions targeting public education, stringent antibiotic regulations, and strategic use of digital platforms.

To improve the implementation of AMS, it is essential to focus on several key areas based on physician, pharmacist, and general perspectives. Among physician, key barriers include insufficient institutional support, inconsistent adherence to AMS guidelines, and hierarchical prescribing practices. Addressing these barriers requires enhancing institutional infrastructure, such as ensuring access to updated bio-grams, and fostering a culture of adherence to evidence-based AMS protocols. Furthermore, mitigating the influence of senior consultant's prescribing patterns and promoting a more uniform approach across departments can reduce variability in antibiotic prescribing practices. For pharmacists, challenges such as inadequate prescription verification, poor interprofessional collaboration, and operational constraints, including understaffing and high workload, necessitate the implementation of standardized diagnostic protocols, continuous professional education, and better resource allocation. In addition, addressing systemic issues within healthcare facilities, such as inadequate time for consultations, is crucial to improving the quality of AMS efforts. The public's misconceptions, reliance on self-medication, and inadequate regulation of antibiotics contribute to inappropriate use, which could be mitigated through targeted educational campaigns, stricter regulatory policies, and responsible use of digital platforms for antibiotic-related information. Overall, a multifaceted approach, incorporating improvements in healthcare provider practices, interprofessional collaboration, and public education, is essential for optimizing AMS efforts and combating the global threat of AMR.

CONCLUSION

This study identified critical barriers to effective AMS across healthcare providers, pharmacists, and the general public. Irrational antimicrobial prescriptions (40%) among physicians were influenced by diagnostic uncertainties, patient pressures, and hierarchical prescribing norms, emphasizing the need for improved adherence to AMS guidelines, institutional support, and patient education. Pharmacists displayed a high prevalence of irrational dispensing (73.3%), driven by inadequate prescription verification, limited diagnostic oversight, and insufficient patient counselling, necessitating stronger regulatory enforcement and enhanced interprofessional collaboration. Among the general public, irrational antimicrobial use (76.7%) was primarily associated with misconceptions, financial constraints, and self-medication practices, highlighting the importance of public education, stringent regulatory frameworks, and responsible use of digital platforms. These findings underscore the need for comprehensive, evidence-based, and multi-stakeholder strategies to optimize AMS implementation and mitigate antimicrobial resistance.

ACKNOWLEDGEMENT

We sincerely thank Sri Venkateswara Institute of Medical Sciences (SVIMS) for granting us permission to conduct this study within their premises. We are deeply grateful for the institutional support, infrastructure, and resources provided, which were instrumental in the successful completion of this research.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ABBREVIATIONS

AMSP: Antimicrobial Stewardship Program; **ANR:** Antimicrobial Resistance; **WHO:** World Health Organisation; **MDR:** Multidrug-Resistant; **LMICs:** Low- and Middle-Income Countries; **SVIMS:** Sri Venkateswara Institute of Medical Sciences.

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Cite this article: Shrestha Y, Kularia S, Devarasan T, Lavanya V, Thennarasi V, Sreekar VS. Challenges and Strategies for Implementing Antimicrobial Stewardship Programs in India: Insights from Multiple Stakeholders. J Young Pharm. 2025;17(3):669-78.