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Barriers to Implementation of Antibiotic Stewardship Program in Iranian Hospitals: A Descriptive Qualitative Study

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Abstract

Background: Antimicrobial resistance (AMR) is a growing global threat. Antimicrobial stewardship programs (ASPs) represent a key strategy to combat AMR and to minimize the adverse effects associated with antibiotic use. Implementing ASPs in hospital settings faces significant challenges and barriers, particularly in low- and middle-income countries (LMICs). This study aims to identify the barriers to the implementation of ASPs in Iranian hospitals.

Methods: This qualitative study was conducted in 2023-2024, involving 41 stakeholders in antibiotic prescription within five public hospitals in Iran. The participants included physicians, administrators, pharmacologists, pharmacists, the secretary of the stewardship committee, microbiologists, laboratory managers, ICU nurses, nurse managers, quality improvement managers, infection control officers, and information technology managers. Participants were recruited using a convenience sampling method. Data were collected through semi-structured interviews and analyzed using conventional content analysis techniques.

Results: The barriers to implementing ASPs were categorized into three main categories, nine subcategories as follows: (1) Deficiencies in intelligent surveillance and monitoring of antibiotics prescribing (including inadequate health information technology for ongoing collection, collation and analysis of antibiotic prescribing pattern, and poor audit, and feedback mechanisms in HIS); (2) Deficiencies in health system governance, policies, and regulatory frameworks (including weak policy framework and clinical guidelines, limited policy learning and contextual adaptation and legal and regulatory gaps affecting clinical practice); and (3) Deficiencies in hospital-wide management and support

structure (including poor organizational governance and structural capacity, ineffective interprofessional collaboration, weak leadership commitment and low stakeholder engagement, and inadequate professional competencies and limited technical skills).

Conclusion: The study underscores the multifaceted and heterogeneous nature of barriers to the implementation of ASPs in a LMIC. Enhancing information technology infrastructure, optimizing antibiotic prescribing practices, engaging physicians, strengthening financial and human resource capacity, and fostering supportive management attitudes were identified as potential effective strategies for facilitating successful ASP implementation in hospital settings in a LMIC.

Keywords: Antibiotic stewardship program, Antimicrobial stewardship program, barriers, antimicrobial resistance, Low- and middle-income countries

Background

Antimicrobial resistance (AMR) is a growing global threat and according to the World Health Organization (WHO), one of the ten major global health threats in the 21st century (1–3). It is projected that by 2050 AMR will cause more deaths than cancer (1). If strategies to curb the growth of resistant organisms are not implemented worldwide, approximately 10 million people could die annually from AMR organisms, with about 90% of these fatalities occurring in low- and middle-income countries (LMICs)(4,5). In 2019, approximately 1.3 million deaths were directly attributable to AMR (6). The published data underscores the imperative need for widespread antimicrobial stewardship in LMIC hospital settings (7).

Antimicrobial stewardship programs (ASPs) represent a key strategy to combat AMR, optimize clinical outcomes, and minimize adverse effects associated with antibiotic use (1). ASPs are programs that enable healthcare systems to strategically manage antibiotic use through the implementation of evidence-based interventions (8). ASPs are increasingly being adopted by health care professionals (HCPs) to improve antibiotic prescribing practices, reduce the threat posed by multidrug-resistant (MDR) organisms, and generally enhance patient safety and health outcomes (9). A successful ASP not only monitors prescribing patterns and practices but also plays a role in minimizing the toxic effects of antibiotics. Moreover, ASPs facilitate the selection of disease-specific antibiotics and enforce laws and regulations to rationalize antibiotic use (10). The WHO's Global Action Plan on AMR identifies effective hospital ASP implementation as a key priority for safeguarding the effectiveness of antibiotics (11,12). ASPs promote prudent antibiotic use by optimizing dose, duration, and route of administration, (10) and ASP tactics can improve rational antibiotic use within hospital settings (13,14). Implementing ASPs is one of the recommended strategies to prevent the ongoing rise of AMR (15,16). These programs provide guidelines and stringent constraints for rational use (8,17,18). Today, ASPs have gained broad acceptance and have been embraced at national and international levels (19), with WHO underscoring them as some of the most important public health interventions of the 21st century (11,16).

However, hospital-based ASP implementation faces significant challenges and barriers, especially in LMICs. In our previous study, currently under review in another journal and titled *"Barriers to Rational Antibiotics Prescription in Hospitals: A Qualitative Study in a Developing Country,"* we concluded that addressing the barriers to rational antibiotic prescribing requires the implementation of ASPs and improvements in hospital information technology infrastructure. The aim of this study is to identify the barriers to implementing ASPs for hospitalized patients in Iran, a developing country.

Methods

The researchers developed a guide for conducting semi-structured interviews. They then purposively selected the study setting and participants to facilitate a comprehensive investigation of the perceived barriers to ASP. This approach allowed the researchers to explore and describe little-known people and gather diverse experiences and perspectives, thereby enhancing the understanding of the existing challenges. The study follows a qualitative content analysis approach based on the method of Graneheim and Lundman (20).

Participants

The participants consisted of 41 stakeholders involved in antibiotic prescribing, including physicians, deputies and directors of medical affairs at medical universities, hospital directors, pharmacologists, pharmacists, the secretary of the hospital ASP committee, microbiologists, laboratory managers, ICU nurses, nurse managers, quality improvement managers, infection control officers, and IT managers. Participants were purposefully selected based on criteria such as age, gender, educational background, work experience, and organizational position. In purposive sampling, participants are selected based on two main criteria: alignment between experience and the research question, and the availability of key informant characteristics(21). To be eligible to participate in this study, individuals must have a direct role in prescribing and administering antibiotics in a hospital, have more than five years of work experience in a hospital setting, Additionally, all participants provided verbal informed consent for participation in the study.

Setting

The study was conducted in five specialized and sub-specialized, educational and therapeutic and public hospitals located in Zanjan province, specifically the 540-bed Ayatollah Mousavi hospital and the 313-bed Valiasr hospital in Zanjan city, the 136-bed Emdadi hospital, and the 235-bed Alghadir hospital in Abhar city, as well as the 591-bed Shahid Beheshti hospital in Kashan city, Isfahan province. Additionally, the study involved the medical treatment deputy at Zanjan University of Medical Sciences.

Given that in Iran, the Ministry of Health has issued guidelines for the rational prescription of antibiotics to government hospitals, the criterion for selecting the study setting was that hospitals were government-owned and had active antibiotic stewardship program committees. The hospitals selected for this study had broad-spectrum ASP committees. The ASP committee responsible for this oversight includes the hospital director, an infectious disease specialist (IDS), an infection control nurse, a clinical pharmacist, an epidemiologist, and an IT specialist, with additional relevant members added as needed. The reason for choosing the medical treatment deputy at Zanjan University of Medical Sciences was that it had an ASP committee that oversaw hospital ASP committees.

Data Collection

Data were collected through semi-structured interviews between November 2023 and April 2024. A semi-structured interview guide was developed specifically for this study based on the study objectives and a review of relevant literature. The guide was refined through discussions within the research team and was reviewed by an experienced qualitative researcher (the second author) to assess the relevance, clarity, and comprehensiveness of the questions. The English version of the interview guide is provided in Additional file 1.

The interview guide included open-ended questions addressing participants' views and experiences regarding the implementation of the antibiotic stewardship program (ASP) and its barriers. Examples of interview questions included: "What are your experiences with the implementation of the ASP in your hospital?", "What challenges or barriers hinder the effective implementation of the ASP in your clinical setting?", and "How do you perceive the organizational and administrative support for ASP activities?" Additional questions were formulated in response to participants' answers to the primary questions. Probing questions, such as "What are your reasons for this response?", "Could you explain this further?", "Why?", "How?", and "Could you provide an example?" were used to explore participants' experiences in greater depth.

Data collection and interviews were conducted by the first author. At the beginning of each interview, participants were informed that the purpose of the study was to explore their opinions, perceptions, and experiences related to the barriers to ASP implementation. Sampling and data collection continued until data saturation was achieved, defined as the point at which no new information emerged from the interviews. The time and location of the interviews were arranged in coordination with participants. Interviews lasted 25–50 minutes and were audio-recorded. The first author transcribed each interview verbatim within 48 hours of its completion. The transcripts were then imported into MAXQDA 2020 software for data management and analysis.

Data Analysis

For data analysis, the principal researcher first listened to the audio recordings and subsequently read through the transcripts multiple times to gain a comprehensive understanding of the main ideas. The researcher then reformulated the content. While coding the data using MaxQDA-2020 software, the principal researcher conducted thematic categorization, which was subsequently submitted for final verification to the first and second researchers.

The data were analyzed collaboratively by the first, second and eighth authors using the conventional content analysis approach as proposed by Graneheim and Lundman. The core classification within this qualitative content (22) analysis involves organizing codes based on similarities and interrelationships. Subcategories were similarly grouped into larger categories based on their interconnections and commonalities (23).

The five stages of conventional content analysis outlined by Graneheim and Lundman are as follows: immediate transcription of each interview, comprehensive reading of the text to obtain an overall understanding of the data, identification and coding of meaning units, categorization of codes, and determination of the main categories (24).

Trustworthiness

Trustworthiness, which is equal to validity and reliability in quantitative studies, was ensured through the four criteria proposed by Guba and Lincoln, namely credibility, dependability, confirmability, and transferability (25). Credibility was ensured through member checking, in which the transcripts of the first six interviews and their codes were provided to the respective participants to assess the alignment between the codes and their experiences. All participants confirmed that the codes generated by our analysis matched their experiences. Dependability and confirmability were ensured through an audit by the second author, a qualitative methods expert, who evaluated and confirmed the accuracy of the data

analysis. Additionally, transferability was addressed by employing maximum variation sampling and by providing clear descriptions of the participants and the study setting to facilitate judgments about applicability to other contexts.

Results

Participants had various educational backgrounds and positions within the healthcare system. A total of 19 participants were female, and 22 were male, with an average age of 50.24 ± 5.85 years. Their professional work experience was distributed as follows: 16 participants had more than 20 years of experience, while 25 had between 10 and 20 years (see Table 1). The ASP implementation barriers were categorized into three main categories, which are as follows: (1) Deficiencies in intelligent surveillance and monitoring of antibiotics prescribing; (2) Deficiencies in health system governance, policies, and regulatory frameworks; (3) Deficiencies in hospital-wide management and support structure, which are detailed below (see Table 2). These categories include eleven subcategories and 25 codes or subsets.

Table 1*:* Participants' characteristics

Characteristic	Category	n (%)
Gender	Male	22 (53.7)
	Female	19 (46.3)
Age (years)	Mean ± SD	50.24 ± 5.85
	Range	38–62
Professional background	IDS	2 (4.9)
	Intensivist	2 (4.9)
	Internist	3 (7.3)
	General practitioner	3 (7.3)
	Pharmacist/Clinical Pharmacist/Pharmacologist	6 (14.6)
	Master of Nursing/ Nurse	8 (19.5)
	Laboratory sciences	3 (7.3)
	EMS	3 (7.3)
	Other specialists	11 (26.9)
Professional experience	10–20 years	25 (61)
	>20 years	16 (39)
Leadership role	Head/Dean/Department director	8 (19.5)
	Faculty member	12 (29.3)
	Hospital management	2 (4.9)
	Other	19 (46.3)

* **IDS:** Infectious disease specialist, **Intensivist:** ICU specialist, **Internists:** Internal specialist, **EMS:** Emergency medicine specialist

Table 2: The categories and subcategories of the barriers of ASP implementation.

Categories	Sub-categories	Codes
1. Deficiencies in intelligent surveillance and monitoring of antibiotics prescribing	1.1. Inadequate health information technology for ongoing collection, collation and analysis of antibiotic prescribing pattern	- Lack of built-in restrictions within the HIS to prevent antibiotic prescribing by unauthorized physicians - Limited HIS capacity to analysis and report pattern of antibiotic usage - Absence of interoperability with external analytical software - Lack of comprehensive HIS for accessing a full patient history (e.g. microbiology, Lab results, drugs, past infections, etc.) to make more appropriate prescribing decisions
	1.2. Poor audit, and feedback (A&F) mechanisms in HIS	- Poor HIS capabilities to provide comparative feedback to prescribers in terms of their antibiotic prescribing patterns versus guidelines or peer comparisons - Unable to monitor of antibiotic usage patterns due to incompatibility between paper-based antibiotic prescribing practices and HIS workflows - Lack of HIS-generated reports and distribution of antibiotic usage for developing corrective action by relevant stakeholders - Lack of data visualization tools to provide analytical graphical representation of information for supporting more precise prescribing decisions by clinicians
2. Deficiencies in health system governance, policies, and regulatory frameworks	2.1. Weak policy framework and clinical guidelines	- Absence of national and local antibiotic prescribing guidelines to support ASP implementation - Lack of comprehensive policies and formal regulations governing ASP activities
	2.2. Limited policy learning and contextual adaptation	- Failure to incorporate international experiences and best practices in ASP implementation - Insufficient learning from successful global ASP models
	2.3. Legal and regulatory gaps affecting clinical practice	- Lack of legal and judicial protection for physicians adhering strictly to ASP recommendations - Prevalence of defensive medicine and physician resistance to ASP implementation due to concerns about potential legal consequences of rational antibiotic prescribing
3. Deficiencies in hospital-wide management and support structure	3.1. Poor organizational governance and structural capacity	- Absence of clear organizational frameworks and operational processes for ASP implementation - Lack of standardized structures and clearly defined roles within ASP committees

	- Inadequate supporting infrastructure such as diagnostic and laboratory equipment necessary for ASP activities - Weak management practices in ensuring timely access to high-quality antibiotics - Insufficient availability of specialized personnel, particularly infectious disease physicians and clinical pharmacists
3.2. Ineffective interprofessional collaboration	- Limited interaction between ASP oversight committees and prescribing physicians - Insufficient collaboration between physicians and pharmacists - Lack of teamwork and professional disagreements between treating physicians and consultants during ASP implementation
3.3. Weak leadership commitment and low stakeholder engagement	- Senior hospital managers' reluctance to enforce restrictive or corrective measures related to ASP policies - Inadequate managerial support and failure to foster positive attitudes toward the importance of asps - Limited physician participation in ASP implementation
3.4. Inadequate professional competencies and limited technical skills	- Insufficient supervision of residents' antibiotic prescribing by senior physicians - Limited data management and analytical skills among health information and information technology personnel related to antibiotic utilization analysis

Abbreviations: **ASP**, Antibiotic Stewardship Program; **HIS**, Hospital Information System; **A&F**, Audit and Feedback.

Category 1: Deficiencies in intelligent surveillance and monitoring of antibiotics prescribing

Undoubtedly, one of the core pillars of implementing ASP in a hospital is the full utilization of information technology. In hospitals, hospital information system (HIS) supports all processes involved in the provision of care and support services; however, according to participants' viewpoint, this support is not fully realized in their settings. This category comprises three subcategories.

1.1. Inadequate health information technology for ongoing collection, collation and analysis of antibiotic prescribing pattern

A number of participants believed that the hospital environment lacked the appropriate information structure and processes necessary to implement a good ASP program. This subcategory included tree subsets.

Lack of built-in restrictions within the HIS to prevent antibiotic prescribing by unauthorized physicians

Based on participant responses, the implementation of ASP requires that antibiotic prescribing begin at a rational level, with consultation from infectious disease specialists (IDS) and pharmacologists for higher-level prescribing. However, observations in research-environment hospitals showed broad-spectrum

antibiotic prescrib by all physicians, especially general practitioners. Participants believed that the sole way to prevent such prescribing is to define prescribing constraints within the electronic prescribing process.

> *"The first dose should be initiated by the physician, with restrictions placed on the second dose to ensure the patient receives treatment. The second dose require consultation. Our HIS lacks a decision support that notifies how many days have passed since administration (X days ago) and how many days remain (Y days), and a final reminder on the last day indicating that the course is complete and infectious disease consultation is required to continue treatment. "(Code 13)*

> *"Prescribing restrictions must be implemented in HIS so that we can enforce prescribing limits and software alerts. For these changes, the HIS support vendor charges for the service, and the hospital cannot afford it. "(Code 49)*

> *"Within the HIS, the initial antibiotic request must obligatorily record the treating physician or prescriber, but this is not currently the case. Additionally, the HIS should require the duration of antibiotic therapy as prescribed by the physician, and the user should input this. We do not have these features in the HIS. "(Code 32)*

Limited HIS capacity to analysis and report pattern of antibiotic usage

Participants stated that HIS is not capable of analyzing extracted reports in a way that is understandable to ASP committee members and physicians, and that no aiding software is currently used for this purpose.

> *"Implementing the ASP is not feasible without completing the HIS. We lack the infrastructure for defining services, creating alerts, and imposing restrictions. We have a large data warehouse, but extracting the information needed by the antimicrobial stewardship committee in a usable form is not possible. In general, we lack data-analysis capabilities. The HIS only provides a limited set of reports in PDF or Excel formats. There are no tools for analyzing reports and extracted results. Analyzing the data requires a set of indicators, yet no indicators related to antibiotic prescribing have ever been proposed. In the HIS, there is no capability to analyze reports related to antibiotic prescribing. The HIS is not linked to data-analytic software such as WHONET or similar. "(Code 47)*

Absence of interoperability with external analytical software

> *"Our information is either not valid or incomplete. If the HIS were upgraded to allow microbiological data from the laboratory to be immediately compared with antibiotic prescribing data, that would be advantageous. However, there are challenges in this area. The use of software like WHONET for data categorization is useful only if it can be linked to the HIS. "(Code 30)*

Lack of comprehensive HIS for accessing a full patient history (e.g. microbiology, Lab results, drugs, past infections, etc.) to make more appropriate prescribing decisions

In none of the research-environment hospitals was there a functioning Electronic Health Record (EHR) or even an Electronic Medical Record (EMR) system in place. Participants believed that this absence negatively affects the implementation of the hospital's ASP.

> *"The lack of a complete EMR is highly perceptible. When a physician issues a medication order, they do not know which antibiotics the patient has used in previous years. "(Code 47)*

> *"As a physician, when I am about to prescribe an antibiotic, I need full patient history antibiotic history. The patient's memory is unreliable, and the patient's history is not accessible to me. "(Code 51)*

1.2. Poor audit, and feedback mechanisms in HIS

Based on participants' statements, especially those of physicians, clinicians who prescribe antibiotics are unaware of the outcomes of their prescribing practices. They also lack information about antibiotic usage patterns and resistance levels within the hospital. They believed that providing performance feedback could significantly aid the implementation of ASP.

Unable to monitor of antibiotic usage patterns due to incompatibility between paper-based antibiotic prescribing practices and HIS workflows

Participants believed that the the clinical processes in the hospital for implementing an ASP program were not aligned with the existing information flow. This subcategory included one subsets.

Based on participants' remarks, the antibiotic prescription process in the paper-based file does not align with the corresponding workflow in HIS, and this misalignment poses a barrier to implementation of the ASP.

> *"The patient has an emergency department (ED) record, and the initial medication was prescribed by an ED specialist; afterwards, the patient was moved to the internal medicine service. The attending physician in internal medicine is a gastroenterologist who prescribed antibiotics. The HIS user requests antibiotics without checking the prescribing physician's name, and the request is attributed to the ED physician. In HIS discharge reports, this constitutes a fundamental problem." (Code 14)*

> *"There is also a disconnect between the electronic system and the manual workflow. Does the Hospital Information System Support Auto Stop Order? The patient has been hospitalized for three months and continues to receive a particular antibiotic despite no improvement; why is it not stopped? The duration of antibiotic therapy should be enforced in the HIS, with the system automatically stopping the antibiotic to prompt review and determine whether to discontinue or modify the therapy. Therefore, the prescribing physician should be specified in the HIS, the treatment duration for each antibiotic should be defined and applied (even if the record is manual, it is not reflected in the HIS)." (Code 32)*

Poor HIS capabilities to provide comparative feedback to prescribers in terms of their antibiotic prescribing patterns versus guidelines or peer comaprisons

> *"Despite the existence of information technology, we do not know which medical groups prescribe more frequently. The data on frequently used antibiotics, the effectiveness of prescribed antibiotics, the duration of therapy, and the dosages are not clearly defined. Which drugs are prescribed most, and what are the outcomes? Which antibiotics have higher resistance rates? There should be feedback for physicians; I would like to know how much of each antibiotic I have prescribed in the last month." (Code 22)*

> *"It is a pity that despite the presence of important IT tools, we still do not have feedback for physicians. Physicians view problems through an artificial lens and prescribe based on what they see, because they are unaware of the results of their performance. They do not know whether their actions were correct. We should tell a physician: in the previous shift, for every 100 patients, 5% received an antibiotic, but in your shift it was 25%. Are these differences due to one night or day? We should identify and compare the diagnoses of both shifts and indicate whether the diagnoses were correct." (Code 28)*

> *"Feedback should be accompanied by recommendations. Dashboarded feedback integrated with IT is an excellent approach. Some physicians are deeply attached to a particular antibiotic and are reluctant to change. However, if feedback is provided regularly and they continually see how prescribing aligns*

with treatment outcomes, it could be influential. In feedback, the physician should correctly learn from outcomes, for example, if a patient is readmitted, the physician should understand the possible reasons—perhaps the patient was readmitted due to a corticosteroid injection given last month, which the physician might consider." (Code 27)

Lack of HIS-generated reports and distribution of antibiotic usage for developing corrective action by relevant stakeholders

ASP committee requires a feed of information to implement the program and make effective decisions. Participants believed that a pattern of antibiotic consumption should be available to inform decisions, but such a pattern is not at hand, and the necessary tools to determine it do not exist.

"The stewardship committee, to implement the ASP, requires an information feed. We do not have access to the antibiotic consumption pattern in this hospital, we do not know which physicians prescribe the largest quantities of antibiotics and why, and we do not know what clinicians think about the current consumption pattern, etc." (Code 23)

"The hospital committee should, by possessing information, set plans—for example, prohibit the use of ceftriaxone for up to three months. The committee should identify antimicrobial resistances and inform clinicians, for instance: if you prescribe ceftriaxone for patients, know that 80% of infections in this hospital are resistant to ceftriaxone, so avoid its use. To date, the committee has not performed this function." (Code 19)

Lack of data visualization tools to provide analytical graphical representation of information for supporting more precise prescribing decisions by clinicians

"The hospital committee needs information dashboard to decommission an antibiotic from the formulary. Data on microbial resistance, the types of cultures, results, the number of patients requiring antibiotics, which antibiotics were prescribed, and treatment outcomes are necessary. The committee currently lacks this information." (Code 21)

Category 2: Deficiencies in health system governance, policies, and regulatory frameworks

Based on participants' responses, successful implementation of the ASP requires active physician involvement, along with legal protections for physicians in cases of negligence claims or unintentional oversight.

2.1. Weak policy framework and clinical guidelines

Most participants agreed that antibiotic prescribing should adhere to the best practices available worldwide; however, in their hospitals these practices are absent. This subcategory includes two codes.

Absence of national and local antibiotic prescribing guidelines to support ASP implementation

Participants, and especially physicians, acknowledged that a valid guideline is essential for antibiotic prescribing and the implementation of the ASP, but none is being developed within the hospital.

"One of the barriers that has prevented proper implementation of the ASP in this hospital is the absence of a hospital-wide guideline under the supervision of the Stewardship Committee. " (Code 32)

"The lack of an appropriate hospital guideline has led each physician to rely on their own knowledge and prescribe medications accordingly, resulting in divergent prescribing even among peer physicians for the same diagnosis. When the Stewardship Committee prohibits an antibiotic, many physicians are displeased. " (Code 30)

"No explicit guideline has been provided to physicians to follow. Each physician seems to have their own rule. There are antibiotics in the pharmacy that are expired because a physician had a particular interest in them, and the hospital was forced to purchase them. After that physician left, no one prescribed those antibiotics. In patient records, we see two physicians with the same specialty prescribing different antibiotics for two patients with the same diagnosis, resulting in different lengths of stay. Prescribing appears discretionary rather than based on a validated protocol. The hospital drug formulary is not properly managed and appears to reflect individual clinicians' opinions rather than stewardship committee decisions or pharmacologists' input. " (Code 43)

Lack of comprehensive policies and formal regulations governing ASP activities

Participants stated that guidelines in the hospital have not been fully accepted or developed. The reasons cited include a lack of appropriate policies and physicians' resistance. According to the consultants, the ASP implementation program with a formal and defined policy is not part of the hospital's policies, and there are no clear guidelines addressing this issue.

"The hospital defines its own policies each year, but we have not observed any effect of ASP program implementation in defining these hospital policies. An operational guideline has not been written, and under these conditions, the ASP cannot be implemented. " (Code 27)

2.2. Limited policy learning and contextual adaptation

Participants believed that the ASP program has been successfully implemented in hospitals in many countries and that it would be better for us to use the experiences of these countries.

Failure to incorporate international experiences and best practices in ASP implementation

According to the participants, in implementing the ASP, lessons should be drawn from the experiences of countries that have successfully implemented it; however, political considerations have hindered this approach.

"The best way to implement ASP is to imitate the successful work of other countries, particularly in the Western world. Successful countries in this area, such as South Korea, Japan, Turkey, etc., have imitated the United States without involving political issues, but this has not happened in our country." (Code 30)

"The reality is that our managers lack awareness of this program and do not know that similar programs in other places have yielded results." (Code 14)

Insufficient learning from successful global ASP models

"Implementing ASP is not a complicated task, and we don't need to invent anything. There are successful models in countries around the world. We should go and see and learn, then implement them by making changes that suit our country's conditions." (Code 27)

2.3. Legal and regulatory gaps affecting clinical practice

Based on the participants' opinions, particularly those of physicians, doctors are left alone in legal matters, and any negligence or lapses in patient treatment and care by the care team ultimately fall on the treating physician. They believed there is a deep gap in legal protection that undermines the effective and safe implementation of the ASP program in hospitals.

Lack of legal and judicial protection for physicians adhering strictly to ASP recommendations

Fear of litigation, unclear legal protections, and defensive prescribing behaviors were repeatedly identified as barriers to rational antibiotic use and ASP participation.

> *"I have not seen regulations and laws that define the responsibilities, duties, and rights of physicians and the hospital in implementing the ASP program. If I, as a physician, face the risk of legal action during the program, the law does not provide adequate protection for my scientific and medical decisions, and the lack of this guarantee concerns me. Until these issues are resolved, I cannot collaborate with the ASP Committee. " (Code 20)*

> *"The type of legal approaches and judgments have put the medical staff on the defensive. When a legal issue arises and a doctor appears in court, the judge does not ask whether the Stewardship Committee encouraged you to prescribe this type of antibiotic or not, and accuses that if you had prescribed a certain antibiotic or if you had started two days earlier, the patient would not have been harmed, and this is why even in cases where antibiotics are not needed, the treating physician prescribes them and sometimes goes for the highest level of treatment and antibiotic from the very beginning. The doctor should not be afraid to treat the patient and that he has prescribed a low-level antibiotic. He should have the courage to prescribe rationally. " (Code 29)*

Prevalence of defensive medicine and physician resistance to ASP implementation due to concerns about potential legal consequences of rational antibiotic prescribing

> *"The first facilitator in a realistic situation is to resolve the problem of legal liability. If the Ministry of Health enters into negotiations with the judiciary, it should be said that every person in the hospital who provides a service to a patient is responsible for their service and that not everything goes back to the treating physician, and this should be taken into account in legal judgments. " (Code 30)*

> *"Another issue that concerns doctors is legal liability, as the entire responsibility for the patient's health lies with the treating physician. " (Code 44)*

Category 3: Deficiencies in hospital-wide management and support structure

Participants described poor organizational governance and structural capacity, ineffective interprofessional collaboration, human resource shortages, weak leadership commitment and low stakeholder engagement, and inadequate professional competencies and limited technical skills as barriers to implementation of ASP.

3-1. Poor organizational governance and structural capacity

Based on the participants' responses, hospitals lacked well-defined processes and sufficient resources, and suffered from ineffective management and inefficient organizational structures. Decision-makers in the care sector consistently face a variety of challenges.

Absence of clear organizational frameworks and operational processes for ASP implementation

Participants, led by the physicians who prescribe antibiotics, believed that the hospital lacks a clearly defined and documented process for rational antibiotic prescribing, and that each clinician prescribes based on personal knowledge and experience.

> *"One of the obstacles to implementing the ASP is the supply of various antibiotics, which forces the pharmacy to tell prescribing physicians that the requested drugs are unavailable. Unfortunately, the hospital is unable to procure them. In the hospital, a form aligned with the ministry's form has been issued to educate groups on the prescribing of nine antibiotics under the Antimicrobial Stewardship program, with explicit guidelines to follow when prescribing these nine antibiotics, but the overall process for this initiative has not been described. There is neither a properly established procurement process nor a properly defined consumption process.s." (Code 35)*

Lack of standardized structures and clearly defined roles within ASP committees

Interviewees stated that the ASP Committee in the hospital lacks a standard structure, and the roles of its members within the ASP implementation are not well defined.

"We need a solid infrastructure that we do not have. We do not realistically acknowledge the situation. We have endemic problems that we must admit. The current hospital committee is not a standard committee; by acting improperly, it restricts the prescribing authority of clinicians in a way that hinders rational prescribing—like an obstacle on a road that causes some cars to stop when they see it, while others bypass it. In the committee, members are making decisions, yet they are not the prescribers themselves." (Code 27)

Inadequate supporting infrastructure such as diagnostic and laboratory equipment necessary for ASP activities

Based on participants' opinions, particularly those of physicians and laboratory managers, the laboratory diagnostic equipment is outdated and does not provide the necessary accuracy for service delivery. This has led prescribing physicians to distrust laboratory results, calling into question the effectiveness of ASP.

> *"The hospital lacks the budget to purchase new instruments; we continue to use old and obsolete diagnostic devices that do not meet the accuracy of modern equipment, which erodes physicians' trust in results." (Code 38)*

> *"We face substantial laboratory constraints that hinder progress. Clinicians often begin antibiotic therapy without culture, antibiograms, or other tests. They are essentially shooting in the dark, citing the lack or scarcity of laboratory kits, distrust in laboratory results, time constraints, and other factors. The absence of advanced culture facilities (e.g., t-tests) and the general lack of confidence in antibiograms are evident." (Code 43)*

> *"We do not have the necessary equipment to accurately identify microorganisms. For blood culture, we rely on old, traditional methods. Either the relevant equipment is unavailable, or appropriate kits are lacking. The E-test method is not procured for the hospital due to cost. Consequently, antibiotic prescribing in this hospital is effectively blind and haphazard; physicians do not know what organism is present in the patient's body to tailor antibiotic therapy, leading them to prescribe the most powerful agent by chance." (Code 44)*

Weak management practices in ensuring timely access to high-quality antibiotics

Participants' views indicate that one of the major resource-related problems in the hospital is the supply of antibiotics that meet the hospital's needs. Procuring medications, both in terms of quantity and quality, has become a persistent challenge for the hospital.

> *"Logistics problems are always present. Most of the time, we do not have a supply of a given antibiotic in the hospital, and the physician is compelled to prescribe another antibiotic that is available. Logistics issues alter the hospital's consumption patterns. The adage 'prescribe whatever you have' affects prescribing patterns and hinders the implementation of the ASP." (Code 35)*

> *"In the hospital, if I diagnose a patient with, for example, a Klebsiella infection and choose a specific antibiotic for treatment, I am informed that it is not available. I then attempt a second antibiotic choice, only to be told that it is unavailable. I am constrained to choose among three other antibiotics that are available in the hospital, and these antibiotics are not approved by the stewardship committee." (Code 18)*

Insufficient availability of specialized personnel, particularly infectious disease physicians and clinical pharmacists

Among the obstacles to implementing ASP in the hospital, nearly all participants highlighted the shortage of specialized personnel as the main barrier. In none of the research environment hospitals were the numbers of clinical pharmacists and infectious disease specialists sufficient for the hospital's departments.

> *"Another barrier is the shortage of pharmacologists. For 320 beds, we have one pharmacologist who can only cover intensive care units. Additionally, there are only two infectious disease specialists for the entire hospital. The infectious disease specialists and the pharmacologists are not present around the clock because their numbers are limited; can we fully implement the ASP with these constraints?" (Code 43)*

> *"The number of patients is not commensurate with the number of specialists; we do not have enough infectious disease specialists for the patient load. A single pharmacologist for a 500-bed hospital is also insufficient. These shortages constitute a major barrier." (Code 42)*

"To impose restrictions on prescribers, in a given specialty we have only one person; if we do not allow prescribing, we have no alternative but to let clinicians prescribe as they wish. Under these conditions, implementing the ASP would be like going to war with an empty gun." (Code 39)

3-2. Ineffective interprofessional collaboration

Interviews revealed poor communication between committees and physicians, resistance to pharmacist or infectious disease consultation, professional conflicts, and low multidisciplinary engagement.

Limited interaction between ASP oversight committees and prescribing physicians

According to most participants, the ASP Committee in the hospital does not engage constructively with the most important stakeholders of the ASP program—physicians—and they believe that without physician participation the ASP will fail.

> *"The oversight committee does not keep physicians informed about its programs. We do not know what decisions have been made. At times, purchases are made based on decisions of the committee without informing the prescribing physicians. Physicians feel that the most critical information is being withheld*

from them. We do not even know what this committee is doing, what actions it has taken, what results it has achieved, or what recommendations it has proposed." (Code 19)

Insufficient collaboration between physicians and pharmacists

Participants stated that, despite the microbiologists' willingness to provide consultative input on the choice of antibiotic and duration of therapy, treating physicians were reluctant to obtain this consultation and often ignored the recommendations of pharmacologists.

"In Iran, the biggest barrier to implementing the ASP is the lack of cooperation from prescribers. Most treating physicians believe they already have sufficient knowledge about the drugs and know what is happening inside their patients' bodies, thus they consider themselves superior to pharmacologists and are unwilling to consult with them." (Code 30)

"One obstacle is the rejection of pharmacologists' input by treating physicians. The physician argues that, based on their knowledge, the patient should receive these three antibiotics. The pharmacologist says that, according to guidelines, these three antibiotics should not be prescribed together because this could cause adverse effects, promote resistance, prolong hospitalization, and incur costs. Moreover, infectious disease physicians also disagree with pharmacologists." (Code 43)

Lack of teamwork and professional disagreements between treating physicians and consultants during ASP implementation

Based on participants' views, the majority of antibiotic-prescribing physicians do not believe in using consultative advice for their prescribing and act according to their own knowledge, whereas the Ministry of Health guidelines for implementing antimicrobial stewardship require consultation with an infectious disease specialist for ongoing antibiotic therapy.

"The infectious disease physician has disagreements with the treating physician. The treating physician conflicts with the pharmacologist. The treating physician initiates and terminates antibiotic therapy themselves and does not seek consultation from the infectious disease specialist or pharmacologist, or resists their input." (Code 43)

"There is egotism among clinicians and center administrators. We do not have concurrent patient visits. The treating physician and the infectious disease clinician should see the patient simultaneously and issue orders. Ideally, the treating physician and pharmacologist should collaboratively decide on antibiotic prescriptions at the bedside, but each professional conducts their own visit separately. " (Code 39)

3-3. Weak leadership commitment and low stakeholder engagement

Participants reported managerial skepticism toward ASP effectiveness, reluctance to enforce restrictions, and limited physician engagement in committees.

Senior hospital managers' reluctance to enforce restrictive or corrective measures related to ASP policies

Senior hospital administrators are concerned about imposing punitive measures on physicians who resist the program. Participants contend that the hospital's administrator does not have the authority or power to sanction non-compliant physicians, nor the ability to criticize or enforce regulations in their face.

"To implement any program in a hospital, you must use carrots and sticks. In implementing the ASP, if a physician persistently prescribes a particular antibiotic for reasons unknown and does not comply with the monitoring program, I cannot use punitive measures because my administration's term will end in the near future, and that physician might become the hospital president and seek retaliation." (Code 50)

Inadequate managerial support and failure to foster positive attitudes toward the importance of ASPs

According to participants' views, shortages of resources have led to the ASP not being a priority for hospital administrators.

"The reality is that in a hospital, when you lack funds to provide meals for patients, to buy meat, to pay staff wages on time, to maintain equipment, or to replace outdated diagnostic devices, there is little motivation to implement the ASP, because there are other competing priorities." (Code 23)

According to interviewees, implementing ASP in the hospital requires managers with a positive mindset toward this initiative, a quality not evident among the current management.

"One of the barriers to program implementation is the managers' disbelief in the program's success. There is doubt about the proper execution of the ASP. Although we have a reasonably suitable infrastructure such as the HIS, and even the necessary personnel and knowledge are largely available, there is no conviction in the program's success." (Code 28)

Limited physician participation in ASP implementation

According to participants, physicians are the most effective members of the ASP committee, yet their participation is limited within the committee, which in turn makes program implementation difficult.

"Why are physicians not present in the committee? The only task is to leverage physician participation in forming and implementing the committee. Sending the committee's decisions to a physician, even with flexibility, yields the opposite result. If physicians are engaged in the decision-making process, individuals persuade one another. Real representatives of stakeholders should be present, and we must listen to their input; whatever these stakeholders say should be what is implemented, and this is what senior management desires. Of course, a fundamental problem in this regard is the inadequacy of facilities." (Code 27)

3-4. Inadequate professional competencies and limited technical skills

Educational gaps, outdated knowledge, insufficient supervision of trainees, and limited data-analysis skills among IT staff were identified as barriers to effective stewardship.

Insufficient supervision of residents' antibiotic prescribing by senior physicians

Participants stated that antibiotic prescriptions are predominantly carried out by residents, who lack sufficient experience and knowledge for this task, and attending physicians do not maintain full oversight of these prescriptions.

"Another issue concerns the training of interns and residents. It is very important that they initiate a medication in the ward, and then, for example, the attending physician may come the next day and instruct to discontinue it. This is especially critical on holidays and during evenings and nights." (code 34)

Limited data management and analytical skills among health information and information technology personnel related to antibiotic utilization analysis

Participants stated that, for the ASP committee to implement its program effectively, it requires analyzed data on the status and patterns of antibiotic use within the hospital. These data are extracted but not provided to the committee because the relevant experts lack the technical skills needed to prepare them in a technically sound and presentable form.

> *"Information technology specialists only possess technical knowledge in the field of information technology and do not have the necessary skills for data extraction, data analysis, and transforming them into understandable information that can be presented to physicians and managers." (Code 14).*

> *"We need an HIT expert, but one has not been provided. We have requested participation in training courses on dashboard construction or data analysis, but approval has not been granted due to course costs." (Code 47)*

Discussion

The study identified the barriers to implementation of ASP in Iranian hospitals as a LMIC, based on the perspectives of various stakeholders in the field. The study demonstrated that, as in many countries (7,26–29), the barriers identified in Iranian hospitals can have a profound impact on the efficiency and effectiveness of ASPs. The findings highlighted challenges across technological, governance, and organizational domains and demonstrated that ASP implementation is constrained not by a single factor but by the interaction of systemic weaknesses in health information systems, policy and regulatory frameworks, and healthcare management structures.

The findings reveal three major categories of barriers to ASP implementation in hospitals: (1) Deficiencies in intelligent surveillance and monitoring of antibiotics prescribing; (2) Deficiencies in health system governance, policies, and regulatory frameworks; and (3) Deficiencies in hospital-wide management and support structure. These barriers are described in greater detail in the text. Some of these barriers are hospital-specific and can be addressed within the hospital environment, while others lie beyond the hospital setting and require governance-level attention.

1. Deficiencies in intelligent surveillance and monitoring of antibiotics prescribing

One of the central findings of this study is the critical role of insufficient information technology infrastructure in intelligent surveillance of antibiotics prescribing and hindering effective ASP implementation. The lack of functional HISs, including the absence of built-in prescribing restrictions, limited analytical capacity, and lack of comprehensive HIS for accessing a full patient history to make more appropriate prescribing decisions, significantly constrains the ability of hospitals to monitor, evaluate, and optimize antibiotic use. These deficiencies undermine core ASP functions such as surveillance and A&F which are widely recognized as essential components of successful stewardship programs.

Furthermore, weak electronic surveillance systems and the absence of HIS-generated prescribing data limit the capacity of ASP committees to make data-driven decisions. Without reliable and timely feedback on antibiotic utilization patterns, inappropriate prescribing practices may persist unchecked. The misalignment between paper-based prescribing processes and electronic HIS workflows further exacerbates these challenges, leading to inefficiencies, data fragmentation, and reduced clinician engagement with stewardship interventions. Collectively, these findings underscore the importance of

integrating robust, interoperable IT systems with clinical workflows to support sustainable ASP implementation.

1.1. Inadequate health information technology for ongoing collection, collation and analysis of antibiotic prescribing pattern

The lack of IT support was one of the most important barriers from the participants' perspective. The inability to embed antibiotic restriction capabilities for authorized physicians within the HIS led to the initiation of broad-spectrum antibiotic prescribing and consumption as soon as the patient arrived at the hospital, which is contrary to standard ASP practice. The study demonstrated that the absence of IT support in implementing ASP contributed to the overall failure to execute the program. According to participants, the absence of an EHR and comprehensive HIS for accessing a full patient history, the lack of supervisory data in the ASP committee regarding antibiotic prescribing status in the HIS, and the absence of HIS data analytics capabilities within the hospital were conspicuous. Some studies reported that one of the greatest barriers to ASP implementation is weakness of technological and infrastructural capabilities (30,31). Another studies have addressed the added value of IT and regarded this technology as an effective contributor to the implementation of surveillance programs (32–36). An study identified lack of IT suportive alongside limited access to the ASP committee as important challenges in ASP implementation(37). Another study, highlighted IT support issues in weak data analysis capabilities, lack of EHR, and easier access to data and reports as significant challenges in ASP,(38) which align with the findings of this study.

1.2. Poor audit and feedback mechanisms in HIS

Among the other barriers to effective ASP implementation identified in this category, participants highlighted the lack of electronic audit and feedback (A&F) mechanisms to inform physicians about their antibiotic prescribing practices, the lack of HIS-generated reports, and the absence of data visualization tools to provide graphical representations of prescribing data. Several studies have reported that prospective A&F on performance constitutes an intervention to enhance the implementation of ASP, supporting (13,39–42) findings that align with our results. According to participants, the misalignment between paper-based prescribing processes and electronic HIS workflows further exacerbates other challenges, leading to inefficiencies, data fragmentation, and reduced clinician engagement with stewardship interventions. Collectively, these findings underscore the importance of integrating robust, interoperable IT systems with clinical workflows to support sustainable ASP implementation.

2. Deficiencies in health system governance, policies, and regulatory frameworks

Findings from participants' viewpoints indicate that weaknesses in laws and clinical guidelines, inability to implement official policies, and lack of strong oversight for clinical practice hinder the implementation of the ASP.

2.1. Weak policy framework and clinical guidelines

The absence of national and local antibiotic prescribing guidelines signals a lack of institutional prioritization of stewardship and contributes to heterogeneity in clinical decision-making. Inconsistent or unclear policy direction weakens accountability mechanisms and limits the authority of ASP committees.

Guidelines are effective in improving antibiotic (13) . Locally developed, evidence-based ASP guidelines have been adopted in 96% of hospitals in North America, 77% in Latin America, 72% in Europe, and 76% in Asia (43). An study conducted across three tertiary care centers in LMICs, concluded that lack of local guidelines is one of the most important barriers to ASP implementation(44). Several hospital-based studies focusing on hospitalized patients have shown that failure to align guidelines with ASP implementation fails to improve antibiotic (7,42,45).

2.2. Limited policy learning and contextual adaptation

The limited use of international experience and successful ASP models further suggests missed opportunities for accelerating stewardship development through contextualized policy learning. In LMIC settings, adaptive adoption of global best practices may be particularly valuable in overcoming resource and capacity constraints.

2.3. Legal and regulatory gaps affecting clinical practice

This study found that the lack of legal and judicial protection for physicians and their concerns about the potential legal consequences of rational antibiotic prescribing have led to the prevalence of defensive medicine and physician's resistance to implementing ASP. Other studies have reported the impact of the legal vacuum of support for physicians on the implementation of ASP. One study reported that law and policy are among the main themes hindering ASP implementation(46). Another study identified weaknesses in legal and regulatory frameworks as one of the major challenges to the successful implementation of core ASP elements (2). Harun et al. reported that 22% of studies cited limited government support for physicians as one of the most important barriers to ASP implementation (7).

3. Deficiencies in hospital-wide Management and Support Structure

3.1. Poor organizational governance and structural capacity

At the organizational level, the study identifies substantial gaps in institutional readiness for ASP implementation. The lack of clearly defined governance structures, standardized roles within ASP committees, inadequate diagnostic capacity and access to high-quality antibiotics constrains hospitals' ability to support implementation ASP. Several studies have reported that key barriers to ASP implementation in LMICs are technological weakness, infrastructural limitations, and inadequate microbiology laboratory support (1,47) and limited access to diagnostics and health facility infrastructure (48). Several other studies have identified the lack of reliable laboratory infrastructure and weak microbiology laboratory support for diagnosis as significant challenges to effective ASP implementation (7,30,49–51).

Human resource shortages, particularly the limited availability of infectious disease specialists and clinical pharmacists, further weaken ASP implementation capacity. These shortages not only increase workload pressures but also limit access to specialized expertise essential for stewardship activities. A systematic review, reported that among 22 studies documenting barriers to ASP adoption, 50% cited human resource shortages as an important barrier (7). Other studies have reported that shortage of skilled personnel, especially infectious disease physicians and trained pharmacists with knowledge of ASP, as a common barrier to establishing ASP in LMICs (31,39,52)

3.2. Ineffective interprofessional collaboration

Ineffective interprofessional collaboration was also identified as a key challenge. Poor communication and coordination between ASP committee members, physicians, pharmacists, and consultants undermine teamwork and reduce the effectiveness of stewardship interventions. Given that ASPs inherently rely on multidisciplinary collaboration, these findings highlight the importance of fostering trust, shared responsibility, and effective communication across professional groups. According to the participants, lack of teamwork among care providers, such as disagreements between treating physicians and consultants and lack of collaboration between prescribing physicians and pharmacists, on the other hand, has led to hospital-wide failure in ASP implementation.

Seshadri et al. found that explicit leadership support, inclusion of antimicrobial stewardship specialists, interprofessional collaboration, and ongoing education for physicians are the most crucial factors affecting the sustainability of an ASP (53). Several studies also emphasized the importance and effectiveness of teamwork and collaboration among care providers, particularly physicians and pharmacists, or noted the absence of these elements as barriers to ASP implementation (46,54–56).

3.3. Weak leadership commitment and low stakeholder engagement

Weak leadership commitment and low stakeholder engagement emerged as cross-cutting barriers. Senior managers' reluctance to enforce restrictive ASP measures, combined with limited motivation and physician participation, suggests that stewardship is often perceived as a low organizational priority. Without visible leadership support and a culture that values rational antibiotic use, ASPs are unlikely to be effectively institutionalized.

The study showed that a lack of positive attitude and sufficient motivation among managers toward the necessity of implementing ASP have led to hospital-level failures in ASP execution. In LMICs, ASPs are often given lower priority than other needs, and surveillance and other evidence of the impact of AMR on population health are limited. Without such data, policymakers and health managers are less likely to arrange resources toward policies and programs addressing AMR (57,58). Several studies have reported that, globally, hospital managers are motivated by healthcare providers to allocate resources to implement ASP (58, 59), but due to a lack of awareness among these providers, managers are not motivated, which has become an obstacle to the success of ASP (56). A number of studies have also reported that provider knowledge and education are important and effective in ASP execution (30,34,39,40,47,48) aligning with our findings.

3.4. Inadequate professional competencies and limited technical skills

Insufficient supervision of residents by attending physicians, as well as a lack of technical skills among health information management and IT professionals in data processing and analysis, are additional barriers to ASP implementation identified in this study. One study reported that although awareness of ASPs is essential for residents, 73.2% of them do not know what antimicrobial stewardship means and have not been taught it during their 4 years of education (59) therefore, it is not possible to run ASP in such an environment.

Conclusion

This study highlights the diversity of barriers to ASP implementation from the perspective of stakeholders involved in antibiotic prescribing within a LMIC. Inadequate information technology support and suboptimal clinical processes, deficiencies in health system governance, policies, and regulatory frameworks, and structural and managerial weaknesses in healthcare delivery, emerged as the most important barriers to ASP implementation. To overcome these barriers, increasing IT capabilities, developing strong and coordinated policies at national and local levels, structural reforms, raising awareness levels among providers are essential. Ongoing applied research and cross-sectoral collaboration can provide practical and effective solutions to improve the implementation of ASP programs in Iranian hospitals.

Strengths

This study is among the few qualitative studies that examine into the barriers to implementation of ASP in a LMIC. A significant strength is the involvement of all stakeholders in antibiotic prescribing across three different cities, which resulted in a comprehensive identification of ASP implementation barriers from the perspectives of all involved parties. In this study, participants encompassed not only clinicians directly involved in antibiotic therapy, such as physicians, pharmacologists, microbiologists, ward matrons, and ICU nurses, but also non-physician professionals engaged in the antibiotic treatment process, including senior hospital and university administrators, hospital infection control specialists, quality improvement specialists, and IT professionals.

Limitations

This study was limited to five hospitals from three medium and small cities in Iran. It is possible that hospitals in large cities such as the capital have more facilities to implement ASP, which may have influenced the results. Additionally, some physicians in executive roles declined to participate in interviews, potentially leading to the omission of important realities, may be due to possible conflicts of interest and reluctance to disclose facts. We also note that, in this study, patients were not included as antibiotic recipients since they were not directly involved in prescribing or managing antibiotic therapy processes in the hospital, which may be open to questioning.

Abbreviations

A&F: audit & feedback; AMR: Antimicrobial resistance; ASP: Antibiotic stewardship program; EHR: Electronic health records; E-Test: Epsilometer test; HCP: Healthcare providers; HIS: Hospital information system; IDS: Infectious disease specialist; LMIC: Low and middle income countries; MDR: Multidrug resistance.

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Author contributions

Study design: AN, ZM and EN; data collection: AN, ZM, AK and EN; data analysis: AN, ZM, MM, MHP and EN; manuscript preparation: AN, ZM, MM, HB, YG and EN. All authors read, reviewed, and approved the final manuscript.

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Availability of the data and materials

The datasets generated and analysed during the current study are not publicly available due to ethical and confidentiality considerations (qualitative interview transcripts may contain potentially identifying information), but are available from the corresponding author on reasonable request and with approval from the relevant ethics committee.

Declarations

Ethical approval and consent to participate

The Ethics Committee of Kashan University of Medical Sciences, Kashan, Iran, approved this study (code: IR.KAUMS.NUHEPM.REC.1402.052). All procedures involving human participants were performed in accordance with relevant guidelines and regulations, including the Declaration of Helsinki. Verbal informed consent to participate was obtained from all participants prior to the interviews.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Implications for policy and practice

The findings of this study underscore several priority areas for strengthening ASP at both the national health system level and within hospital settings.

Practice implications

The findings of this study highlight the need for a systems-based approach to ASP implementation. Addressing technological barriers without concurrent reforms in governance, organizational structures, and human resource capacity is unlikely to yield sustainable improvements. Strengthening health information systems, establishing clear policy and legal frameworks, enhancing leadership commitment, and investing in infrastructures and workforce development are all critical to creating an enabling environment for ASPs.

By demonstrating how barriers operate across multiple levels of the health system, this study contributes to a deeper understanding of the complexity of ASP implementation in resource-limited settings. These insights may inform policymakers, hospital managers, and clinicians seeking to design contextually appropriate and sustainable stewardship strategies.

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