

Overuse of Antibiotics: Who is to Blame? A Qualitative Study

Abstract

Background: The irrational use of antibiotics seriously threatens global health. Clinicians undoubtedly play an essential role in consuming antibiotics in hospitals and communities, and their attitudes may help the health system's optimal treatment of antibiotics. In this study, we reported clinicians' experiences with antibiotics used in Isfahan, Iran. **Methods:** In a qualitative study conducted from October 2020 to March 2021, the experiences of 13 clinicians with different clinical specialties were collected through one-to-one interviews. Participants were selected through purposive sampling until data saturation; data collection was conducted through semi-structured interviews. Conventional content analysis was used to analyze the transcribed interviews. The main category was recognized and subcategorized and coded by three researchers. **Results:** Eight women and five men with a mean work experience of 12.54 ± 10.047 years participated in the study. All of them worried about the overuse of antibiotics and antibiotic resistance. Clinicians believe that the antimicrobial stewardship committee is not active in our country. Laboratory challenges, healthcare providers, the poor performance of the health system, and marketing and business were the main categories of the study. Subcategories of main categories included inefficiency in the function of laboratories, harmful profit, challenges in medical education, ups and downs of disease treatment, the unacceptable performance of hospitals, failure to upgrade the health system, threats and opportunities, and jobbery. **Conclusions:** The participants of this study believed that excessive use of antibiotics is a serious challenge in our country. Physicians were concerned about antibiotic resistance and believed that the pattern of antibiotic resistance was not routinely reported. Therefore, in our region, we should make more efforts to collect data in this field and provide this information to physicians. Also, this study confirmed many obstacles to implementing the antimicrobial stewardship program, and the infrastructure needs strengthening. There is also a need for cultural changes and the views of physicians.

Keywords: *Anti-infective agents, antimicrobial stewardship, drug prescriptions, Iran, qualitative research*

Introduction

After introducing antibiotics in the 1940s as drugs to prevent and control infectious diseases, a great medical sciences revolution took place.^[1] Today, antibiotics are widely used in both developing and developed countries. Antibiotic overuse increases the rate of antibiotic resistance.^[2,3] World Health Organization believes antimicrobial resistance threatens global security and harms health programs.^[4] Two million infections, 23000 death, and 20 billion dollars in the United States are annually attributed to antibiotic resistance.^[5] A study showed that from 2011 to 2018, antibiotic consumption in China's hospitals increased by almost 40%.^[6] According to one study in Iran, antibiotics consumption increased from

about 33.6 defined daily doses in 2000 to 60 defined daily doses in 2016.^[7]

Another problem is using the latest antibiotics on the market instead of previous antibiotics, which were the first-line antibiotics in recent years. Choosing the type of antibiotic, dosage, route, and treatment duration that provide the best clinical outcome, the lowest antibiotic resistance, and minimal toxicity for patients can be considered optimal treatment.^[8] Public health organizations such as the World Health Organization support strategies that control antibiotic overuse and minimize microbial threats. The lack of quantitative and qualitative information in monitoring and analyzing antibiotic consumption is a significant problem in developing and applying for international care system programs.

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: WKHLRPMedknow_reprints@wolterskluwer.com

How to cite this article: Nokhodian Z, Boroumandfar Z, Rostami S, Ataei B. Overuse of antibiotics: Who is to blame? A qualitative study. *Int J Prev Med* 2023;14:133.

Zary Nokhodian,
Zahra
Boroumandfar¹,
Soodabeh Rostami²,
Behrooz Ataei

Infectious Diseases and Tropical Medicine Research Center, Isfahan University of Medical Sciences, Isfahan, Iran, ¹Reproductive Science and Sexual Health Research Center, Isfahan University of Medical Sciences, Isfahan, Iran, ²Nosocomial Infection Research Center, Isfahan University of Medical Sciences, Isfahan, Iran

Address for correspondence:
Dr. Soodabeh Rostami,
Nosocomial Infection Research
Center, Isfahan University of
Medical Sciences, Isfahan, Iran.
E-mail: srostami1876@gmail.
com

Access this article online

Website:
www.ijpvmjournal.net/www.ijpvm.ir

DOI:
10.4103/ijpvm.ijpvm_287_22

Quick Response Code:



On the other hand, clinicians are involved in the treatment and care of patients and can undoubtedly influence therapy in hospitals and the community.^[9,10] Several studies reported clinicians' experience with overused antibiotics.^[10,11] However, since overuse and misuse of antibiotics depend on the community's culture about drugs and the relationship between a doctor and a patient,^[12] we decided to implement qualitative research to assess the experiences and perspectives of clinicians on antibiotics in Isfahan, Iran.

Methods

The present qualitative study was performed on 13 clinicians with different clinical specialties in Isfahan, Iran, from October 2020 to March 2021. Inclusion criteria included clinicians who could express their experiences prescribing antibiotics and working in Isfahan public hospital. Doctors suffering from any known mental illness or sensory, hearing, and speech disorders that affected the interview process and obtaining information were excluded from the study. Participants were selected through purposive sampling until data saturation. We tried to choose samples with different specialties, work experiences, ages, and sex [Table 1].

Data collection was conducted through semi-structured interviews. Interviews continued until researchers still needed to extract a new code. The interview duration was equal to or more than 45 minutes and was conducted in a quiet room without a third person in Infectious Diseases and Tropical Medicine research center by a medical microbiology Ph.D. The study goals were explained to the clinicians, who permitted us to record their voices. Also, a written informed consent was obtained. The interviews were initiated with the question, "Tell me about your experience with an antibiotic prescription." Depending on the answer, the following questions were asked to understand the participant's point of view. Conversations were recorded and were written word by word. A copy of the interview was sent to each participant and was verified

by them. The Graneheim and Lundman qualitative content analysis method was used to analyze data.^[13]

Briefly, all the participants' descriptions and experiences were studied to achieve a comprehensive preconception of their statements. The transcriptions were reviewed again for "open coding," and the semantic units were recognized in the text. This step was repeated several times until the semantic units extracted from the texts covered all participants' experiences in its challenges. Semantic units were reviewed and then the proper codes for each semantic unit were extracted. The codes were categorized based on conceptual and semantic similarity and compressed as far as possible. Finally, the data were categorized into more general and conceptual categories, and the themes were abstracted.^[14]

Routine rigor criteria in qualitative research, such as conformability, reliability, and transferability, were respected through techniques such as participants' review, systematic data collection, quick transcription, peers' review, and revision of all obtained data. Transferability was respected by conducting interviews with various participants, presenting direct speech and examples, and enriching the data.^[15]

Ethical considerations, including attaining informed written consent from the participants to attend the study, recording the interviews, respecting anonymity and confidentiality, and participants' right to leave the study whenever they liked, were all respected. The Ethics Committee of Isfahan University of Medical Sciences approved the research protocol (approval number: 293392).

Results

In the study, five men and eight women participated. Two participants were third-year and fourth-year residents at Isfahan University of medical sciences. One of the residents had worked as a general physician for five years. Five clinicians were subspecialties in different fields [Table 1].

Table 1: Characteristics of study participants

Clinicians	Specialty	Subspecialties	Sex	Years of work experience
1	Infectious diseases	-	Male	27
2	Infectious diseases	Cancer, Transplant, Immunodeficiency	Female	1
3	Anesthesiologist	ICU	Male	13
4	Infectious diseases	-	Female	8
5	Anesthesiologist	ICU	Female	2
6	Resident in Infectious diseases	-	Female	5
7	Infectious diseases	Clinical immunology and allergies	Female	24
8	Emergency Medicine	-	Male	11
9	Resident in Internal medicine	-	Female	-
10	Internal medicine	Nephrology	Male	5
11	Pediatric	Infectious diseases	Male	17
12	Infectious diseases	-	Female	24
13	Infectious diseases	-	Female	26

We stopped the project until the new codes were not extracted from interviews. We derived multiple categories from our analysis and identified multiple relationships between categories. Findings of the present study with regard to the barriers to the proper use of antibiotics were explored through four main category as follows: “Laboratory challenges”, “Healthcare providers”, “Poor performance of the health system” and Marketing and business [Table 2]. Details were presented as follows.

Laboratory challenges

Most participants stated that the laboratory has an essential role in the irrational use of antibiotics. These challenges were manifested in two subthemes: inefficiency in the function of laboratories and harmful profit.

Inefficiency in the function of laboratories

The participants believed laboratories need to work effectively on infectious diseases. The need for a strong connection between the laboratory and clinic and laboratory management challenges was significant. Participant 4 believed: “One of the most challenging recognized microorganisms is the contamination of laboratory and samples. Another problem is the misinterpretation of laboratory results. Laboratory staffs cause much duty and do not act according to protocols”. Participant 7 mentioned: “Sometimes we have to use broad-spectrum antibiotics and antifungal because test results are not sent to the doctor. It seems test results are not sent to the clinic unless one clinician goes to the laboratory to answer”. Participant No. 10 also stated, “Sometimes antibiotic susceptibility testing panels do not match with the type of infection and antibiotics treatment. The right panels for inpatients and outpatients are not separate. We reported the problem to the laboratory, but laboratory officials said the antibiotics disks were unavailable”.

Harmful profit

In this subcategory, the main problems were economic and policy aspects. More participants announced that an item essential in the laboratory is a benefit. Several things affect the laboratory’s correct performance to avoid wasting the budget. Participant 2 believed that the laboratory must quickly report the tests. However, the test result is not fast-ready due to financial problems. Instead of waiting and wasting time, I prefer to prescribe an antibiotic. She added, “different prices are charged in the various laboratories for the same test.”

“Collaboration between clinic and para-clinic is essential. For the correct diagnosis, we need clinical microbiologists, mycologists, and virologists in the laboratories”, participant 2 said.

Participant 7 replayed: “A microbiology laboratory must use all potentials such as specific culture medium and

molecular methods to isolate and identify microorganisms. Our laboratory also has defects in the detection of fungal and viral agents. She believed there are many laboratories in our country, and it is impossible to monitor them. This problem causes poor quality of test”.

Healthcare providers

Participants confirmed that health providers have a role in the overuse of antibiotics. They clarified that medical education and disease treatment are not without flaws in our country.

Challenges in medical education

Based on the present study, imperfect in the educational curriculum of medical students and weakness in informing clinicians were two main problems.

Participant 6 mentioned, “the first-year resident in infectious disease does not have enough knowledge about antibiotics because they are not trained in the infectious department and outpatient clinics in their medical internship. Patient bedside education is essential.”

Participant 8 said, “My thoughts are that there is a defect in our education system. The system is hospital-based, and medical students do not visit outpatients. They do not have enough experience with antibiotics at the time of graduation.”

Participant 11 told us, “There is enough education in our country, but there is no monitoring. We need a robust monitoring system for antibiotic consumption without indications. “

Ups and downs of diseases treatment

Physicians worry about patient satisfaction. This subject influences their decisions to prescribe antibiotics. They said that patients need to be followed up correctly.

Participant 13 replayed, “Doctors want their patients to recover as soon as possible without infection, so they may prescribe high-level antibiotics, but they must worry about antibiotic resistance in the future. Patients who refer to a hospital may infect with a resistant strain”.

Participant 6, a fourth-year resident in infectious diseases, explained, “Sometimes the residents prescribe antibiotics. When the professor visits the patient, she/he comments that antibiotics are unnecessary. We decided to stop the drugs, but she/he said it was better to continue treatment. She/he believes if the patient’s condition worsens due to discontinuation of the drug, she/he may have a legal problem. ”

Participant 10 told researchers, “use of some antibiotics damages patients’ kidneys. In these cases, physicians must consult with a nephrologist. In my opinion, we prescribe antibiotics traditionally and have chest-to-chest education.”

Table 2: Barriers to the proper use of antibiotics

Category	Subcategory	Sub-subcategory	Code	
Challenges in laboratory	Dysfunctional in laboratory	Lack of strong connection between lab and clinic	delay in test report	
			Lack of follow-up by clinicians	
			Lack of feedback from doctors about laboratory problems	
			lack of improvement by Laboratory personnel	
			Incomplete information of nurses about when and how to take samples	
		Laboratory management challenges	Misinterpretation of microbiology laboratory results	
			laboratory contamination	
			Huge workload	
			Inadequate monitoring of the laboratory system	
Harmful profit	Economic	Inconsistency of clinical symptoms and test results due to the absence of a microbiologist		
		Recommendation not to use new methods of identifying infectious agents		
Policy		Not using laboratories of research centers to diagnose infections		
		A large number of microbiology labs in our country		
Healthcare providers	Challenges in Medical Education	Defects in the educational courses of medical students	Lack of training of medical students in infectious departments	
			Absence of medical students in outpatient clinics	
			Inadequate training in antibiotics prescription in the general course	
		Weakness in informing clinicians	Failure to inform doctors about the use of antibiotics in the community	
			Failure to inform doctors about antibiotic resistance in the community	
	Ups and downs of treatment	keeping the patient satisfied	Lack of information about the best treatment in epidemics and pandemics	
			Clinicians worry about re-infection due to the discontinuation of antibiotics	
			The tendency of physicians to prescribe last-line antibiotics without indication	
			Imitation of physician in prescribing antibiotics	
			Rejection of criticism of overuse of antibiotics by some physicians	
Lack of follow-up of patients		Legal problems for physicians due to delays in prescribing antibiotics		
		Failure of physicians to consult with specialists about the side effects of antibiotics		
		Failure of medical assistants to pay attention to the recommendations of infectious disease experts		
poor performance of health system	Irresponsible hospital management	Defect in hospital's strategic plan	Lack of local guidelines	
			Lack of knowledge about the pattern of antibiotic resistance in hospitals	
		Challenges in implementation of stewardship programs	Inability of antibiotic Stewardship Committee's to punish violators	
			Antibiotic Stewardship Committee's failure to provide feedback to offending physicians	
			The inattention of some clinicians about the implementation of Antibiotic stewardship programs	
	Failure to upgrade the health system	The inactive community-based healthcare system	Culture	weakness in informing physicians of committee decisions
				Unacceptable monitoring of antibiotics prescriptions in outpatients
			Lack of data analysis on antibiotic prescription in outpatients and feedback to physicians	
Marketing and business	Threats and opportunities	Reduce infectious diseases	The tendency of people to the arbitrarily use antibiotics	
			Lack of awareness people of the difference between viral and bacterial diseases	
		Increase antibiotic resistance	Pressures from patients on clinicians to prescribe antibiotics for them	
			Improving health system	
			Vaccine control of infectious diseases	
	Jobbery	Boycott	Low profits of pharmaceutical companies in the production of antibiotics	Corona pandemic and overuse of antibiotics
				Transportation resistant bacterial by food-chain
			The damaging effect of the boycott on produce drugs	
			Rise in the prices of medicines during the boycott conditions	
			lack of presentation of new antibiotics	
Advertising pharmaceutical companies in the use of potent antibiotics				

Poor performance of the health system

Some clinicians believe that the health system is also to blame, in addition to the doctor and the patient. Our results showed that the unacceptable performance of hospitals and failure to upgrade the health system were not minor issues.

Unacceptable performance of hospitals

Defects in hospitals' strategic plans and challenges with stewardship programs were critical points in our research.

Participant 3 said, "Infectious disease specialists usually write the topic of infection in the different textbooks. So prescribing antibiotics overlaps with different fields of medical sciences. However, I do not believe that texts can be the basis for hospital decision-making. We need a native guideline which parts of it have been adapted from the reference books."

Participant 2 explained, "The antibiotics used in each hospital should vary according to the hospital's antibiotic resistance pattern. In Iran, we research at a hospital and then generalize the result to other hospitals. We need to know the antibiotic resistance pattern in each hospital and revise it every three to six months."

Participant 11 mentioned, "In the first step, a guideline should be provided and taught to clinicians. In the second step, doctors should act according to the guidelines, but legal action must be taken if they do not act."

Participant 8 said, "I am unaware of the committee's decisions. It expects to y physicians when the ASC committee makes a decision. I do not see a committee's enactment informing us how to act."

Problems in the health system

Community and culture have essential roles in overused antibiotics, too.

Participant 1 mentioned, "Controlling the prescription of antibiotics on outpatients is necessary for the community. Many antibiotic resistances start in the community. The doctor's knowledge and clinical judgment in outpatients are vital in prescribing antibiotics." Participant 9 told us, "Public knowledge is very imperative. In my opinion, there is a direct relationship between people's level of information and the correct prescription of antibiotics. In small villages, people push doctors to prescribe antibiotics for them or their children."

Participant 7 believed that "self-medication and over-the-counter sale of antibiotics are two essential issues in medical sciences." "Doctors who prescribe antibiotics without clinical indication should be legally punished," She said.

Participant 8 mentioned, "A government agency must inform physicians monthly about the use of antibiotics. The

methods help clinicians know about highly used antibiotics and antibiotic-resistant in the community."

Marketing and business

Threats/opportunities and jobbery were two challenges in our study.

Threats and opportunities

The reduced infectious diseases are a severe threat to producing antibiotics, and increasing antibiotic resistance creates new opportunities for making novel drugs.

Participant 1 told us, "People have become more aware of controlling and transmitting infectious diseases. As a result, childhood vaccination programs are performed almost worldwide." Participant 11 believed antibiotics are prescribed to children less than before.

Jobbery

In this subgroup, the main challenges were boycotts and low profits of pharmaceutical companies in the production of antibiotics.

Participant 1 said, "As you know, Iran is under sanctions. The raw materials of domestically produced drugs are not supplied. We have faced a shortage of medicine: imported drugs are not imported and domestically produced drugs are not made. Boycott harms drugs in the country."

Participant 3 told us, "Pharmaceutical companies prefer to produce a drug that patients use for all of their life, for example, anticancer or cardiovascular drugs instead of antibiotics. Resistant antibiotics force pharmaceutical companies to formulate new antibiotics. These drugs are prescribed sparingly and cheaper than other drugs that do not have much profit for the companies."

Participant 10 mentioned, "Most pharmaceutical companies promote physicians to prescribe new and powerful antibiotics that this subject negatively impacts on antibiotics therapy."

Discussion

This study is the first qualitative study to explore the clinicians' experiences and perspectives on the overuse of antibiotics in Isfahan hospitals and communities.

ASPs provide optimal antimicrobial treatment in healthcare settings and aid clinicians in prescribing the proper antimicrobial regimen to the right patient for the correct period.^[16] One of the most important sources of data for ASP is microbiology laboratories. Besides infectious disease specialists and clinical pharmacists, microbiology laboratories and microbiologists have a crucial role in these programs. A clinical microbiologist is responsible for providing sufficient data for physicians to manage the health of their patients. These responsibilities include identifying relevant pathogens and performing susceptibility

testing at the right time, optimizing ways to deliver this information to the patient's physician and deciding on the most cost-effective assessment of clinical situations based on local resources.^[17] One of the reasons for the overuse of antibiotics is misdiagnosis or failure to diagnose the cause of the infection. Therefore, microbiologists must use new technologies to enhance diagnosis.^[17]

Based on the participants' opinions in this study, one of the biggest challenges in the laboratory is the lack of a connection between the laboratory and the clinic. Unfortunately, in our country, despite a large number of laboratories, graduates of clinical microbiology are not recruited in clinical laboratories, and most of them, especially PhDs, enter academic jobs. Therefore, microbiology laboratories do not have sufficient expertise.

From the participants' point of view, another problem with the overuse of antibiotics is the attitude and issues of healthcare workers. In this study, participants pointed out some of these problems: Imperfective in the educational curriculum of medical students and keeping the patient satisfied. In a systematic review by Nogueira-Uzal *et al.*, there are severe gaps in medical students' knowledge in diagnosing and treating high-incidence infectious diseases, particularly upper respiratory tract infections, and this lack of knowledge did not seem to differ among students of different years. Also, in this review, like our study, modeling the experienced physicians in prescribing antibiotics by medical students has been discussed.^[18]

Another problem in antibiotic prescribing issue is keeping the patient satisfied. Antibiotic prescription depends on infrastructural processes that could be affected by limitations such as lack of diagnostics and shortages of medical staff; social constraints, such as economic access to antibiotics; and overall hygiene and sanitation in communities.^[19] Physicians adapt their prescription practices to the social infrastructural behaviors. Some studies state that antibiotic prescriptions can be influenced by complex relationships between physicians and patients or pharmacists and patients.^[20-22] Sometimes doctors may feel obliged to prescribe antibiotics to preserve a trusting doctor-patient relationship, and they do their job in the form of antibiotics prescriptions.^[19] This issue is more severe in countries like ours and needs more analysis.

According to participants, the main barriers to ASP implementation in hospitals are the lack of local guidelines in antibiotic prescription according to the local pattern of antibiotic resistance, education/feedback deficits to offending physicians, and inattention of some clinicians about the ASP rules and continuing usual prescriptions.

As participants noted, the lack of data on antibiotic resistance patterns in each hospital and the lack of appropriate local treatment guidelines caused ASP to fail from the beginning. Therefore, in our system,

creating infrastructure to provide continuous and accurate information and providing native guidelines based on this information seems very necessary.

Consistent with the findings of Skodvin *et al.*, it is essential to pay attention to training and feedback, check the correct implementation of the ASP, and increase nurse involvement.^[23] One of the biggest challenges in ASP implementation in our hospitals is the lack of audit/feedback, particularly offending physicians. This issue has a cultural aspect and the need for behavioral and cultural changes is crucial in this area. The feedback logistics require external support, and hospital managers and policymakers should provide the necessary infrastructure. It should be noted that the correct implementation of the ASP is multifactorial. Uncertainty of diagnosis and time pressures forces the doctor to prescribe broad-spectrum antibiotics and noncompliance with the ASP rules.

In our survey, we found that marketing and business can also affect the use of antibiotics. New antibiotics need to be protected against antibiotic resistance, and the only way to protect them is to use these drugs less. Less use of the new antibiotics is not pleasant and cost-effective for antibiotic-developer companies.^[24]

Participants mentioned that one of the policies of antibiotic developers is to encourage doctors to use these drugs. On the other hand, recent sanctions against Iran have led to a lack of access to antibiotics or increased prices. Because doctors want patients to recover as quickly as possible, they prescribe more broad-spectrum antibiotics.

One of the limitations of our study was that the interviews were conducted only with specialists in some fields, and the place of family doctors, pharmacists, and other specialists was empty and their opinions could be effective in the results. More studies are needed in this field.

In conclusion, the participants of this study believed that excessive use of antibiotics is a serious challenge in our country. Physicians were concerned about antibiotic resistance and thought that the pattern of antibiotic resistance was not routinely reported. Therefore, in our region, we should make more efforts to collect data in this field and provide this information to physicians. Also, this study confirmed many obstacles to implementing the ASP, and the infrastructure needs strengthening. There is also a need for cultural changes and the views of physicians.

Acknowledgments

We appreciate the participants and all the colleagues that help us to do this study.

Financial support and sponsorship

This work was supported by Infectious Diseases and Tropical Medicine Research Center, Isfahan University of Medical Sciences, Isfahan, Iran (grant number: 298134).

Conflicts of interest

There are no conflicts of interest.

Data Accessibility

None.

Ethical Consideration

The Ethics Committee of Isfahan University of Medical Sciences approved the research protocol.

Code of Ethics

IR.MUI.MED.REC.1398.453.

Authors' Contribution

ZN was project manager and collected the data. ZB analyzed the data, interview, and wrote the first draft of the manuscript. SR was the main investigator and proposed the main idea, designed the study, interview, and revised the manuscript. ZN, and BA checked the interviews text and recognized the open coding and the semantic units in the text.

Received: 23 Aug 22 **Accepted:** 17 May 23

Published: 30 Jan 24

References

- Prah J, Kizzie-Hayford J, Walker E, Ampofo-Asiama A. Antibiotic prescription pattern in a Ghanaian primary health care facility. *Pan Afr Med J* 2017;28:214.
- Holmes AH, Moore LS, Sundsfjord A, Steinbakk M, Regmi S, Karkey A, et al. Understanding the mechanisms and drivers of antimicrobial resistance. *Lancet* 2016;387:176-87.
- Smieszek T, Pouwels KB, Dolk FCK, Smith DRM, Hopkins S, Sharland M, et al. Potential for reducing inappropriate antibiotic prescribing in English primary care. *J Antimicrob Chemother* 2018;73(suppl_2):ii36-ii43.
- Arnolda G, Hibbert P, Ting HP, Molloy C, Wiles L, Warwick M, et al. Assessing the appropriateness of paediatric antibiotic overuse in Australian children: A population-based sample survey. *BMC Pediatr* 2020;20:185.
- Solomon SL, Oliver KB. Antibiotic resistance threats in the United States: Stepping back from the brink. *Am Fam Physician* 2014;89:938-41.
- Wushouer H, Zhou Y, Zhang X, Fu M, Fan D, Shi L, et al. Secular trend analysis of antibiotic utilisation in China's hospitals 2011-2018, a retrospective analysis of procurement data. *Antimicrob Resist Infect Control* 2020;9:53.
- Abbasian H, Hajimolaali M, Yektadoost A, Zartab S. Antibiotic utilization in Iran 2000-2016: Pattern analysis and benchmarking with organization for economic co-operation and development countries. *J Res Pharm Pract* 2019;8:162-167.
- Ho PL, Cheng JC, Ching PT, Kwan JK, Lim WW, Tong WC, et al. Optimising antimicrobial prescription in hospitals by introducing an antimicrobial stewardship programme in Hong Kong: Consensus statement. *Hong Kong Med J* 2006;12:141-8.
- May L, Cosgrove S, L'Archeveque M, Talan DA, Payne P, Jordan J, et al. A call to action for antimicrobial stewardship in the emergency department: Approaches and strategies. *Ann Emerg Med* 2013;62:69-77.
- Chatterjee D, Sen S, Begum SA, Adhikari A, Hazra A, Das AK. A questionnaire-based survey to ascertain the views of clinicians regarding rational use of antibiotics in teaching hospitals of Kolkata. *Indian J Pharmacol* 2015;47:105-8.
- Remesh A, Gayathri AM, Singh R, Retnavally KG. The knowledge, attitude and the perception of prescribers on the rational use of antibiotics and the need for an antibiotic policy-a cross sectional survey in a tertiary care hospital. *J Clin Diagn Res* 2013;7:675-9.
- Radyowijati A, Haak H. Improving antibiotic use in low-income countries: An overview of evidence on determinants. *Soc Sci Med* 2003;57:733-44.
- Graneheim UH, Lundman B. Qualitative content analysis in nursing research: Concepts, procedures and measures to achieve trustworthiness. *Nurse Educ Today* 2004;24:105-12.
- Essentials of nursing research: Methods, appraisal, and utilization Denise F Polit Essentials of nursing research: Methods, appraisal, and utilization, Cheryl Tatano Beck Lipincott Williams and Wilkins 554≤24.95 0781749727 0781749727 [Formula: see text]. *Nurse Res* 2006;13:91-92.
- Hsieh HF, Shannon SE. Three approaches to qualitative content analysis. *Qual Health Res* 2005;15:1277-88.
- Morency-Potvin P, Schwartz DN, Weinstein RA. Antimicrobial stewardship: How the microbiology laboratory can right the ship. *Clin Microbiol Rev* 2017;30:381-407.
- Kim J, Craft DW, Katzman M. Building an antimicrobial stewardship program: Cooperative roles for pharmacists, infectious diseases specialists, and clinical microbiologists. *Lab Med* 2015;46:e65-71.
- Nogueira-Uzal N, Zapata-Cachafeiro M, Vázquez-Cancela O, López-Durán A, Herdeiro MT, Figueiras A. Does the problem begin at the beginning? medical students' knowledge and beliefs regarding antibiotics and resistance: A systematic review. *Antimicrob Resist Infect Control* 2020;9:172.
- Kamenshchikova A, Fedotova MM, Fedorova OS, Fedosenko SV, Wolffs PFG, Hoebe CJPA, et al. Obligatory medical prescription of antibiotics in Russia: Navigating formal and informal health-care infrastructures. *Sociol Health Illn* 2021;43:353-368.
- Broom A, Kenny K, Kirby E, George N, Chittam M. Improvisation, therapeutic brokerage and antibiotic (mis) use in India: A qualitative interview study of Hyderabad physicians and pharmacists. *Critical Public Health* 2020;30:16-27.
- Cabral C, Lucas PJ, Ingram J, Hay AD, Horwood J. "it's safer to ..." parent consulting and clinician antibiotic prescribing decisions for children with respiratory tract infections: An analysis across four qualitative studies. *Soc Sci Med* 2015;136-137:156-64.
- Lambert H, Chen M, Cabral C. Antimicrobial resistance, inflammatory responses: A comparative analysis of pathogenicities, knowledge hybrids and the semantics of antibiotic use. 2019;5:1-13.
- Skodvin B, Høgli JU, Gravningen K, Neteland MI, Harthug S, Akselsen PE. Nationwide audit and feedback on implementation of antibiotic stewardship programmes in Norwegian hospitals. *JAC Antimicrob Resist* 2021;3:dlab063.
- Årdal C, Balasegaram M, Laxminarayan R, McAdams D, Outtersen K, Rex JH, et al. Antibiotic development - economic, regulatory and societal challenges. *Nat Rev Microbiol* 2020;18:267-274.