

Knowledge, Attitude And Practice Of Community Pharmacists In Relation To Dispensing Antibiotics Without Prescription

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Abstract

Background: Dispensing antibiotics (DA) without prescription is a widespread practice, especially in developing countries, contributing to antibiotic resistance. Community pharmacists play a significant role in promoting rational use of antibiotics by refraining from DA without prescription, and providing drug information to patients. **This study aimed to evaluate community pharmacists' knowledge, attitude and practice, and to assess the factors behind DA without prescription. Methods:** A cross-sectional study was conducted from January to March 2023 among random sample of community pharmacists in KSA. Online semi-structured questionnaire was used for data collection. The association between dependent and independent variables was assessed using Chi-square test; a P-value less than 0.05 were considered significant. **Results:** Of the 1217 pharmacists who participated, the majority were female (n = 645, 53%). Most pharmacists have a bachelor degree (n = 1026, 84%) and less than 5 years' experience (n = 718, 59%). Notably, the majority of community pharmacists have good knowledge (n = 735, 61.7%), which is significantly associated with years of experience (P < 0.00). More than half (n = 623, 52.2%) of the pharmacists have above average score of practice. Nearly all the pharmacists who participated have a positive attitude in relation to DA without prescription (n = 1204, 98.9%). More than half of the pharmacists were DA without prescription for tonsillitis (n = 817, 67%), wound infection (n = 766, 62.9%), and urinary tract infection (n = 664, 54%¹). The leading factor behind DA without prescription was the low socioeconomic status of the patients (n = 624, 51%). Additionally, 47% of the pharmacists (n = 572) thought that they were knowledgeable enough to DA without prescription. **Conclusion:** Despite their positive attitude and average level of knowledge regarding DA without prescription, community pharmacists frequently are DA without prescription for tonsillitis. Low patients' socioeconomic status was the leading factor behind DA without prescription. Accordingly, extensive work from health authorities to improve the accessibility and affordability of the health system as well as the development of an antibiotic stewardship program are required to diminish DA without prescription.

Keywords: Dispensing antibiotics without prescription, pharmacist practice, antimicrobial resistance.

Introduction

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Antimicrobial resistance (AMR) has been stated by the World Health Organization (WHO) as one of the top ten global public health threats facing humanity ⁽¹⁾. Currently, AMR is causing 700,000 deaths worldwide each year and this number is expected to be approximately 10 million people by 2050. The majority of deaths are anticipated to be in low to middle-income countries (LMICs), where devastating infectious diseases are well-established ⁽²⁾. It has been estimated that in the USA more than 2 million people are infected with antibiotic-resistant bacteria, resulting in 23,000 deaths annually ⁽³⁾. While in Europe, 25,000 deaths occur each year due to AMR ⁽⁴⁾. Whereas in Asia, the mortality rate as a consequence of AMR reaches 96,000 per year ⁽⁵⁾. The current situation in African countries is catastrophic and very difficult to precisely describe since very few countries give a regular national surveillance report on AMR ⁽⁶⁾. The poor hygiene along with the growth in immune-compromised patients are further exaggerating the AMR in Sub-Saharan Africa (SSA) ⁽⁶⁾.

Unfortunately, many countries and healthcare organizations are not doing enough to stem the spread of antimicrobial resistance as the global consumption of antibiotics increased by over 60% between the years of 2000 and 2015 ⁽⁷⁾. The inappropriate use of antibiotics is believed to be the leading cause of antimicrobial resistance ⁽⁸⁾. Therefore, DA without prescription in community pharmacy settings has contributed to the spread of antimicrobial resistance ⁽⁹⁻¹¹⁾. In addition, the public misconceptions of antibiotics led to its misuse and contributed to the increase in the rate of DA without prescription ⁽¹²⁾. This was clear in several studies ⁽¹³⁻¹⁷⁾. In Saudi Arabia, study was conducted in two large hospitals and aimed to discover the patients' awareness of antimicrobial resistance, only 27% of the patients surveyed were aware of the antimicrobial resistance. Moreover, 40% did not think that the use of antibiotics without a prescription is harmful when obtained from a friend or family member, and 34% were unaware if this is a correct practice or not ⁽¹³⁾.

Additionally, another study in Sudan that surveyed the Sudanese population and community pharmacies were found the prevalence of self-medication using antibiotics without a prescription was as high as 74% ⁽¹⁴⁾. Similarly, another study that explored the rate of DA without prescription in community pharmacy settings in Egypt using a simulated patient method for two viral infections scenarios (eg, acute bronchitis and common cold) found that antibiotics were dispensed in 98% of visits that were made ⁽¹⁵⁾. Most of the dispensed antibiotics without a prescription were taken for non-bacterial infections, such as sore throat, based on the findings of several studies ^(16, 17). Thus, improving the public awareness regarding antibiotics is crucial to stem the spread of antimicrobial resistance. Several factors contribute to the development of AMR. However overuse and misuse of antibiotics are the most prevalent, accelerating the development of AMR; yet they are easily preventable ⁽¹⁸⁻²⁰⁾.

Despite the constraints which have been devolved to combat the misuse of antibiotics, it has been estimated that 50% of the antibiotics are prescribed without prescription worldwide ⁽²¹⁾. DA without prescription and antibiotic self-medication are multidimensional and require public awareness and good practice on the part of both clinicians and pharmacists ⁽²²⁾. Therefore, some countries have started taking actions against such practices that significantly contribute to the rising rate of antimicrobial resistance and put the lives of many at risk ^(23, 24). In Saudi Arabia, DA without prescription is illegal but the rate of antibiotics dispensing without a prescription has seen a dramatic increase over the last decade throughout Saudi Arabia ^(25, 26, and 27). Therefore, the Saudi Ministry of Health has introduced new amendments to the existing law and included fines up to \$26,666 against the pharmacy that dispensed any antibiotic without a prescription, license revocation, pharmacy closure, and a six-month jail term. The revised antibiotics dispensing law came into effect as of May 2018 ⁽²⁸⁾.

These amendments were introduced and enforced largely due to the failure of the previous measures that were taken by the Ministry of Health to stem the rise of antibiotics

dispensing without prescription, and the increasing rate of antimicrobial resistance in the Saudi society^(13, 25). Thus the current study was conducted to assess the knowledge, attitude, and practice of pharmacists in relation to antibiotics and AMR as well as to understand the main factors behind DA without prescription. It also explores the common medical conditions for DA without prescription by community pharmacists.

Methods

A cross-sectional study was conducted from January to March 2023 among random sample of community pharmacists in KSA. All registered pharmacists who were willing to participate in the study were included. Pharmacists not working in community pharmacies were excluded. The total number of registered pharmacists in KSA is 30,840⁽²⁹⁾ Sample size was calculated based on Solvin's equation as follows: $n = N / 1 + N (e)^2$, where n = sample size, N = targeted population attending a different pharmacy, e = margin of error (0.05) at 95% confidence level, resulting in a sample size of 588. However, we use all 1217 received responses to ensure generalizability.

An online semi-structured questionnaire with closed-ended questions was designed based on previous studies^(30, 31). The questionnaire link was shared with pharmacists through email. The questionnaire consisted of 28 questions divided into six parts. First part: gathered information regarding pharmacist gender, years of experience, and current qualifications. Second part: assessed pharmacists' knowledge (7 items) regarding antibiotic usage and antibiotic resistance in three scales (yes, no, or unsure). Third part: Pharmacists' attitude was measured by asking 5 questions on a 5-point Likert scale. In part four: practice of the community pharmacists was assessed (9 items) on three scales (always, sometimes, or never). Fifth and sixth part: were dedicated to investigate the factors behind DA without prescription and the common medical conditions for DA without prescription, respectively (more than one option was allowed in these parts). The complete form of the questionnaire used for data collection is provided as Supplementary Material.

Since there was no consistency in scaling knowledge, attitude, and practice in the current literature, we used the median to categorize the pharmacists into good and poor knowledge, good and poor practice, and positive and negative attitude. For each participant, the overall knowledge, attitude, and practice were calculated by dividing the summation of the correct answers over the total question numbers in each part. The questionnaire was validated at two levels; content validity was assessed by a Professor of Pharmacology and an Associated Professor of Pharmaceutical Microbiology who are experts in this field. Their comments were used to improve the questionnaire content, structure, and language. Face validity was carried out by a pilot questionnaire administered to 60 community pharmacists; their comments were adopted to clarify the questions. Those pharmacists who participated in the pilot study were excluded from the final result.

Data were entered and analyzed using SPSS software, version 28. Descriptive statistics using frequency and proportion were used to summarize the data; chi-square test and Fisher exact test were used, where applicable, to assess the association between demographic data and knowledge, attitude, and practice; and a P-value of less than 0.05 was considered statistically significant. The present study was approved by ethical committee of University. Informed consent was provided to all participants in the first statement of the questionnaire. Names and personal identifiers were not used to ensure confidentiality.

Results

Socio-Demographic Characteristics

Table (1) shows a total of 1217 pharmacists completed and returned the questionnaire; out of

1217 pharmacists, 53% were female (n = 645), and more than half (n = 718, 59%) have less than 5 years of experience in community pharmacies. The vast majority of the participating pharmacists have a bachelor degree as a higher qualification (n = 1026, 84%).

Pharmacists’ Knowledge

Out of 1217 pharmacists enrolled in the study, the total knowledge score of participants was 4.34 ± 1.36 out of the maximal attainable score of 7. In this study, more than half (n = 735, 61.7%) of the participants have a good knowledge of antibiotics and AMR. The good knowledge score was significantly associated (P = 0.008) with Pharmacists who have than more than 10 years’ experience, whereas, pharmacists’ gender and qualifications were not statistically significant.

Table (2) shows nearly half of the pharmacists (n = 629, 51.7%) thought that antibiotics are indicated to relieve inflammation. More than two-thirds of the pharmacists declared that resistant bacteria can be transmitted in health facilities, while more than half believed that the occurrence of resistance is a problem only in a hospital setting (n = 703, 57.8%). The vast majority (n = 1174, 96.5%) agreed with the fact that inappropriate antibiotic usage will increase the emergency of resistance; on the other hand, one-quarter of the pharmacists advised patients to stop taking antibiotics when their symptoms improved (n = 209, 23.8%).

Pharmacists’ Practice

Table (3) and (4) show the total practice score was 5.47 ± 1.75 . Nearly half (51.2%) of the pharmacists have good practice when DA without prescription; 70% always ask about medication history; and 79% explain to the patients the importance of medication adherence. Nearly two-thirds (62%) receive feedback when DA without prescription. There were no significant differences between pharmacists’ practice and gender, years of experience, and qualifications.

Pharmacists’ Attitude

Table (4) and (5) show the overall score of attitudes among the participating pharmacists was 4.49 ± 0.35 out of a maximum achievable score of 5. The vast majority of the participating pharmacists (98.9%) have a positive attitude concerning DA without prescription. The majority of the pharmacists (82%) strongly agreed with the fact that antibiotics are overprescribed. More than one-third (41.5%) of the pharmacists agreed that forbidding the dispensing of antibiotics without medical prescription will decrease pharmacy profits. Pharmacists’ attitude was not statistically significant in relation to gender; qualifications or years of experience.

Common Medical Conditions and Pharmacists’ Reasons behind DA without prescription

Table (6) shows two-thirds of the pharmacists (67%) were DA without prescription for tonsillitis and more than half for wound infection (62.9%) and UTIs (54.6%). Low socioeconomic status of patients was the main factor behind DA without prescription (51%).

Table (7) shows nearly half of the pharmacists (47%) thought that they were knowledgeable enough to DA without prescription.

Table (1): Socio-demographic Characteristic of theParticipating Pharmacists

Characteristic	Frequency (%)
Gender	
Male	572 (47%)
Female	645 (53%)

Work experience	
<5 years	718 (59%)
5–10 years	307 (25.2%)
>10 years	192 (15.08%)
Qualification	
Bachelor degree	1026 (84.3%)
Bachelor degree + Master or PhD	200 (15.6%)

Table (2): Community Pharmacists' Knowledge Regarding Antibiotic Resistance

(Knowledge) Statements	Yes	No	Unsure
Antibiotics are indicated to relieve inflammations.	629 (51.7%)	570 (46.8%)	18 (1.5%)
In most cases, antibiotics can be dispensed for prophylaxis of future infections.	301 (24.7%)	871 (70.7%)	18 (4.5%)
Cross-resistance is the condition in which bacteria are able to resist particular types of antibiotic that often result in resistance to another type of antibiotic, usually from a similar chemical class.	961 (79%)	115 (9.6%)	141 (11.6%)
Resistant bacteria cannot be spread in healthcare institutions and communities.	261 (21.4%)	882 (72.5%)	79 (6.1%)
The occurrence of antibiotic resistance is mainly a problem in hospital settings.	703 (57.8%)	436 (35.8%)	78 (6.4%)
Inappropriate use of antibiotics increases the emergence of bacterial resistance to antibiotics.	1174 (96.5%)	32 (2.6%)	11 (0.9%)
Pharmacists may advise patients to stop taking antibiotics when their symptoms improve.	209 (23.8%)	906 (74.4%)	21 (1.7%)

Table (3): Practice of Community Pharmacists Regarding DA without Prescription

(Practice) Statement	Always	Sometimes	Never
How often do you dispense antibiotics without prescription?	96 (7.9%)	1040 (85.5%)	81 (6.7%)
When dispensing antibiotics without prescription, I ask patients about medical and medication history.	852 (70%)	315 (25.9%)	50 (4.1%)
When a patient requests antibiotics when they do not need them, I explain to them why I think they do not need it.	922 (75.8%)	244 (20%)	51 (4.2%)
When dispensing antibiotics without prescription, I educate patients about the importance of adherence and completing the full course of antibiotics.	961 (79%)	230 (18.9%)	26 (2.1%)

(Practice) Statement	Always	Sometimes	Never
I refer a patient to the doctor if I am not sure about their symptoms.	1009 (82.9%)	184 (15.1%)	24 (2%)
How often do you receive feedback after dispensing antibiotics without prescription?	146 (12%)	755 (62%)	316 (26%)
I dispense antibiotics without a prescription if a patient requests an antibiotic by name.	135 (11.1%)	585 (48.1%)	497 (40.8%)
I dispense antibiotics without prescription if I know the symptoms.	352 (28.9%)	728 (59.8%)	137 (11.3%)
When the patient has insufficient money, I shift to a cheaper brand.	533 (43.8%)	556 (45.7%)	128 (10.5%)
When the patient has insufficient money, I halve the course of antibiotics.	155 (12.7%)	479 (39.4%)	583 (47.9%)
When the patient has insufficient money, I ask them to bring the price of the full course.	366 (30.1%)	587 (48.2%)	264 (21.7%)

Table (4): Association between Knowledge, Attitude, Practice and Characteristics of the Community Pharmacists

Variables	Level	Knowledge Score %	P-value	Attitude Score %	P-value	Practice Score %	P-value
Gender	Male = 572	Good = 61.1%	0.594	Positive = 99%	0.535	Good = 50.8%	0.802
		Poor = 39.9%		Negative = 1%		Poor = 49.2%	
	Female = 645	Good = 59.6%		Positive = 98.7%		Good = 51.6%	
		Poor = 40.4%		Negative = 1.3%		Poor = 48.4%	
Qualification	Bachelor degree = 1027	Good = 60%	0.492	Positive = 98.9%	0.982 ^b	Good = 50.04%	0.064
		Poor = 40%		Negative = 1.1%		Poor = 50.06%	
	Post graduate Bachelor degree (Master + PhD) = 190	Good = 62.6%		Positive = 98.9%		Good = 57.3%	
		Poor = 37.4%		Negative = 1.1%		Poor = 24.7%	
Years of experience	>5 = 718	Good = 60%	0.008 ^a	Positive = 98.6%	0.314	Good = 49.5%	0.335
		Poor = 40%		Negative = 1.2%		Poor = 50.5%	
	5-10 = 307	Good = 60%		Positive =		Good =	

Variables	Level	Knowledge Score %	P-value	Attitude Score %	P-value	Practice Score %	P-value
				99.7%		54%	
		Poor = 40%		Negative = 0.3%		Poor = 46%	
	<10 = 192	Good = 70%		Positive = 99%		Good = 53.1%	
		Poor = 30%		Negative = 1%		Poor = 46.9%	

Notes: ^aSignificant P-value; ^bP-value from Fisher test.

Table (5): Community Pharmacists' Attitude Regarding D A without Prescription

(Attitude) Statement	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
I think antibiotics are overprescribed in Sudanese community	1100 (82.5%)	183 (15%)	19 (10.6%)	7 (0.6%)	4 (0.3%)
Prevention of dispensing antibiotics without medical prescription will decrease sales and profits of the pharmacy	216 (17.7%)	505 (41.5)	262 (21.5%)	166 (13.6%)	68 (5.6%)
Pharmacists have a responsibility to take an effective role in reducing antibiotic resistance	980 (80.5)	212 (17.4%)	16 (1.3%)	7 (0.6%)	2 (0.2%)
Once culture and sensitivity results are available, we should change empiric therapy to narrow- spectrum therapy	685 (56.3%)	389 (32%)	128 (10.5%)	12 (1%)	3 (0.2%)
If you refuse to give antibiotics to a patient, as they do not require antibiotics, they can easily get them from another pharmacy	701 (57.6%)	422 (34.7%)	72 (5.9%)	15 (1.2%)	7 (0.6%)

Table (6): Common Medical Conditions for Pharmacists DA without Prescription

Medical Condition	Frequency	Percentage
Acute sore throat	538	44.24%
Common cold	247	20.31%
Tonsillitis	817	67.19%
Diarrhea	378	31.09%

Medical Condition	Frequency	Percentage
Urinary tract infections	664	54.61%
Ear infections	296	24.34%
Wound infections	766	62.99%
Skin infections	397	32.65%

Note: More than one option is allowed.

Table (7): Factors behind D A without Prescription

Factor	Frequency	Percentage
Fear of losing customers	97	8.0%
To increase pharmacy income	99	8.1%
Pharmacy owner pressure	106	8.7%
Patient pressure	456	37.5%
Low socioeconomic status of patients	624	51.3%
Patients' trust and relationship	347	28.5%
Pharmacists knowledgeable enough to give a patient antibiotics without a prescription	572	47%
Weak regulatory enforcement mechanism	202	16.6%

Note: More than one option is allowed.

Discussion

DA without prescription is a key factor contributing to irrational use of antibiotics, which in turn speeds the rate of emerging resistant pathogens. This study aimed to evaluate community pharmacists' knowledge, attitude and practice, and to assess the factors behind DA without prescription. Out of 1217 pharmacists enrolled, more than half have good knowledge (61%) and practice (51%), and roughly all of the pharmacists have a positive attitude (98.9%). In the present study, 61% of the pharmacists have good knowledge regarding DA without prescription and AMR.

This finding is higher than that obtained in Egypt (51%)⁽³¹⁾, and lower than in Tanzania (77%)⁽³²⁾. Variations in the studies are attributed to the structure of the questionnaire and questions used. They might also be due to the scoring system used in each study, since there is inconsistency in the scaling system; in the current study the median of the data was used as a cut-off. Similar to the results obtained in Tanzania⁽³²⁾, overall knowledge scores were significantly associated with years of experience (P = 0.008). The proportion of pharmacists with more than 10 years' experience having a good knowledge score (70%) was greater than those having less than 10 years' experience (60%).

Disturbingly, more than half of the pharmacists (51%) thought that antibiotics can be used to treat inflammations. This finding is much higher than that in an Egyptian study (15.1%)⁽³¹⁾, which might be due to the fact that pharmacists were confused between the terms

“infection” and “inflammation”. Also, one-quarter (23.1%) of the pharmacists thought that patients should stop taking antibiotics when their symptoms improved, clearly pointing to their poor knowledge. To overcome this, the department of continuing professional development in the Ministry of Health should develop further courses on antibiotic usage and prescriptions for graduated community pharmacists. Furthermore, the Ministry of Health should focus on AMR and how antibiotics are prescribed in the professional examination for pharmacists to obtain their license.

While more than half (52.2%) of the pharmacists have above-average scores in relation to practice, worryingly the vast majority of the pharmacists were “always” or “sometimes” DA without prescription (93.4%), which is higher than is reported in Egypt (77.6%) and Tanzania (77.2%)^(31,32). Additionally, nearly half (48%) of the pharmacists were DA without prescription if the patients request a particular antibiotic by name; this figure is lower than in a previous study in Nigeria (65%)⁽³³⁾. However, another study in Sudan reflected that the malpractice of the community pharmacists, given the fact that antibiotics are stated to be “Prescription only Medicine”⁽³⁴⁾. Health authorities should thus implement an antibiotics stewardship program, particularly as adoption of such strategies in some countries has dramatically reduced DA without prescription^(35,36).

In contrast, more than two-thirds of the pharmacists always explain to patients why they do not need antibiotics, ask patients about their medical and medication history, and educate patients about the importance of adherence and completing the full course of antibiotics. Fortunately, nearly all participating pharmacists have a positive attitude regarding DA without prescription (98.9%). This figure is higher than that obtained in Egypt (42.7%)⁽³¹⁾. Additionally, most of the pharmacists (80.5%) strongly agreed that they have a responsibility to take an effective role in reducing antibiotic resistance. Given their positive attitude, the role of the pharmacists should be extended further to educate the public about the negative consequences of DA without prescription.

An attempt to explore the common medical conditions for which community pharmacists DA without prescription was included in the current study and more than half of the pharmacists DA without prescription to treat tonsillitis (67.1%), UTIs (54.6%), and wound infections (62.9%), which is similar to the findings in a previous study in Nigeria where 62.9% and 83% of the pharmacists were DA without prescription to treat wound infection and UTIs, respectively⁽³³⁾. On the other hand, the finding is inconsistent with that reported in the Kingdom of Saudi Arabia, in which 68.4% of the pharmacists were DA without prescription to treat colds and flu (20% in this study)⁽³⁷⁾. The possible reason for such discrepancies might be due to variations in the epidemiology of these conditions in the three countries. However, regardless of the symptoms, DA without prescription should be prohibited by the community pharmacist.

The common factors behind DA without prescription were investigated in this study, strictly following a previous qualitative exploratory interview study in Sudan, in which patients’ inability to afford consultation fees was reported to be the main factor behind DA without prescription. More than half (51.3%) of the participating pharmacists indicated that low socioeconomic status of the patients was the main factor; additionally, more than one-third (37.1%) declared that patient pressure was the common factor⁽³⁰⁾. The association between self-medication, low socioeconomic status and lack of medical insurance was reported previously among the Sudanese community^(38,39). These findings require urgent action to further improve the accessibility and quality of the governmental health services provided, particularly the national health insurance. Moreover, the role of the community pharmacists should be further extended to educate patients about the negative consequences of antibiotics as a self-medication.

One of the findings that must be pointed out in this study is that nearly half of pharmacists (47%) thought that they were knowledgeable enough to DA without prescription, a finding that is consistent with that reported in Nigeria (78%)⁽³³⁾. This finding is paradoxical, since nearly half of community pharmacists lack basic knowledge of antibiotics (51% have good knowledge). Health authorities in KSA should undertake comprehensive measures to further guide community pharmacists about the rational use of antibiotics. DA without prescription is a malpractice accelerating the development of AMR and must be urgently prohibited.

Conclusion

The present study concluded that positive attitude and average level of knowledge regarding antibiotics and antimicrobial resistance, community pharmacists frequently DA without prescription to treat tonsillitis. Patient pressure and primarily low socioeconomic status are the main factors leading to this malpractice.

References

1. Dadgostar P. Antimicrobial resistance: implications and costs. *Infect Drug Resist.* 2019; 12:3903. doi:10.2147/IDR.S234610
2. O'Neill J. Review on antimicrobial resistance: tackling drug-resistant infections globally: final report and recommendations; 2016.
3. Control CfD, Prevention. Antibiotic resistance threats in the United States, 2013. Available from: <https://www.cdc.gov/drugresistance/threat-report-2013/index.html>.
4. Pourmand A, Mazer-Amirshahi M, Jasani G, May L. Emerging trends in antibiotic resistance: implications for emergency medicine. *Am J Emerg Med.* 2017; 35(8):1172–1176. doi:10.1016/j.ajem.2017.03.010
5. Khan MU, Hassali MAA, Ahmad A, Elkalmi RM, Zaidi STR, Dhingra S. Perceptions and practices of community pharmacists towards antimicrobial stewardship in the state of Selangor, Malaysia. *PLoS One.* 2016; 11(2):e0149623. doi:10.1371/journal.pone.0149623
6. Berhe DF, Beyene GT, Seyoum B, et al. Prevalence of antimicrobial resistance and its clinical implications in Ethiopia: a systematic review. *Antimicrob Resist Infect Control.* 2021; 10(1):1–14. doi:10.1186/s13756-021-00965-0
7. Lipsitch M, Samore MH. Antimicrobial use and antimicrobial resistance: a population perspective. *Emerg Infect Dis.* 2002; 8(4):347–354. doi: 10.3201/eid0804.010312
8. Nga DTT, Chuc NTK, Hoa NP, et al. Antibiotic sales in rural and urban pharmacies in northern Vietnam: an observational study. *BMC Pharmacology and Toxicology.* 2014; 15(1):6. doi: 10.1186/2050-6511-15-6
9. Kwena Z, Sharma A, Wamae N, Muga C, Bukusi E. Provider characteristics among staff providing care to sexually transmitted infection self-medicating patients in retail pharmacies in Kibera slum, Nairobi, Kenya. *Sex Transm Dis.* 2008; 35(5):480–483. doi: 10.1097/OLQ.0b013e3181644b84
10. Ventola CL. [Review] The antibiotic resistance crisis: part 1: causes and threats. *Pharm Ther.* 2015; 40:4.
11. Yagoub U, Al Qahtani B, Al HI, Al Zahrani A, Siddique K. <p>Antibiotic resistance: a hospital-based multicenter study in Tabuk city, Kingdom of Saudi Arabia [Infection and Drug Resistance]. 2019; 12:1815–1825. doi: 10.2147/IDR.S200996
12. Awad A, Eltayeb I, Matowe L, Thalib L. Self-medication with antibiotics and antimalarial in the community of Khartoum State, Sudan. *J Pharm Pharm Sci.* 2005; 8(2):326–331.
13. Abdelaziz AI, Tawfik AG, Rabie KA, et al. Quality of Community Pharmacy Practice in Antibiotic Self-Medication Encounters: A Simulated Patient Study in Upper Egypt. *Antibiotics.* 2002; 20(4):253–257.
14. Borg MA, Scicluna EA. Over-the-counter acquisition of antibiotics in the Maltese general population. *Int J Antimicrob Agents.* 2002; 20(4):253–7.
15. Togoobaatar G, Ikeda N, Ali M, et al. A survey of non-prescribed use of antibiotics for children in an urban community in Mongolia. *Bull World Health Organ.* 2010; 88(12):930–936. doi: 10.2471/BLT.10.079004

16. Bin Abdulhak AA, Altannir MA, Almansor MA, et al. Non prescribed sale of antibiotics in Riyadh, Saudi Arabia: a cross sectional study. *BMC Public Health*. 2011; 11(1):538. doi: 10.1186/1471-2458-11-538
17. AMR. 7% of antibiotics in the EU are taken without a prescription | antimicrobial Resistance; 2020. Available from: https://ec.europa.eu/health/amr/news/amr-7-antibiotics-eu-are-taken-without-prescription_en.
18. World Health Organization Geneva. Antibiotic resistance: World Health Organization Geneva; 2018.
19. Rather IA, Kim B-C, Bajpai VK, Park Y-H. Self-medication and antibiotic resistance: crisis, current challenges, and prevention. *Saudi J Biol Sci*. 2017; 24(4):808–812. doi:10.1016/j.sjbs.2017.01.004
20. Levy SB. The antibiotic paradox. How miracle drugs are destroying the miracle; 1992.
21. Cars O, Nordberg P. Antibiotic resistance–The faceless threat. *Int J Risk Saf Med*. 2005; 17(3, 4):103–110.
22. Lescure D, Paget J, Schellevis F, Van Dijk L. Determinants of self-medication with antibiotics in European and Anglo-Saxon countries: a systematic review of the literature. *Front Public Health*. 2018; 6:370. doi:10.3389/fpubh.2018.00370
23. Al-Mohamadi A, Badr A, Bin Mahfouz L, Samargandi D, Al Ahdal A. Dispensing medications without prescription at Saudi community pharmacy: extent and perception. *Saudi Pharm J SPJ off Publ Saudi Pharm Soc*. 2013; 21(1):13–18.
24. Al Rasheed A, Yagoub U, Alkhashan H, et al. Prevalence and Predictors of Self-Medication with Antibiotics in Al Wazarat Health Center, Riyadh City, KSA. *Biomed Res Int*. 2016.
25. Morgan DJ, Okeke IN, Laxminarayan R, Perencevich EN, Weisenberg S. Non-prescription antimicrobial use worldwide: a systematic review. *Lancet Infect Dis*. 2011; 11(9):692–701. doi: 10.1016/S1473-3099(11)70054-8
26. Ministry of Health. MOH Warns Against Selling Antibiotics without Prescription. MOH News. 2018. Available from: <https://www.moh.gov.sa/en/Ministry/MediaCenter/News/Pages/news-2018-04-17-004.aspx>
27. Servia-Dopazo M, Figueiras A. Determinants of antibiotic dispensing without prescription: A systematic review. *J Antimicrobial Chemother*. 2018; 73(12):3244–3253. doi: 10.1093/jac/dky319
28. Zawahir S, Lekamwasam S, Aslani P. Antibiotic dispensing practice in community pharmacies: A simulated client study. *Res Soc Adm Pharm*. 2019; 15(5):584–590. doi: 10.1016/j.sapharm.2018.07.019
29. Almaghaslah D (2023). An analysis of pharmacy workforce capacity in Saudi Arabia. *Front. Pharmacol*. 14:1219528. doi: 10.3389/fphar.2023.1219528
30. Salim AM, Elgizoli B. Exploring the reasons why pharmacists dispense antibiotics without prescriptions in Khartoum state, Sudan. *Int J Pharm Pract*. 2017; 25(1):59–65. doi:10.1111/ijpp.12317
31. El-din M Z, Samy F, Mohamed A, Hamdy F, Yasser S, Ehab M. Egyptian community pharmacists' attitudes and practices towards antibiotic dispensing and antibiotic resistance; a cross-sectional survey in Greater Cairo. *Curr Med Res Opin*. 2019; 35(6):939–946. doi:10.1080/03007995.2018.1544119
32. Poyongo BP, Sangeda RZ. Pharmacists' knowledge, attitude and practice regarding the dispensing of antibiotics without prescription in Tanzania: an explorative cross-sectional study. *Pharmacy*. 2020; 8(4):238. doi:10.3390/pharmacy8040238
33. Abubakar U, Tangiisuran B. Knowledge and practices of community pharmacists towards non-prescription dispensing of antibiotics in Northern Nigeria. *Int J Clin Pharm*. 2020; 42(2):756–764. doi:10.1007/s11096-020-01019-y
34. Mahmoud MA, Aldhaefi M, Sheikh A, Aljadhey H. Community pharmacists perspectives about reasons behind antibiotics dispensing without prescription: a qualitative study. *Biomed Res*. 2018; 29(21). doi:10.4066/biomedicalresearch.29-18-1112
35. Santa-Ana-Tellez Y, Mantel-Teeuwisse AK, Dreser A, Leufkens HG, Wirtz VJ. Impact of over-the-counter restrictions on antibiotic consumption in Brazil and Mexico. *PLoS One*. 2013; 8(10):e75550. doi:10.1371/journal.pone.0075550
36. Bavestrello L. trends of community consumption of antibiotics in Chile. *Rev Med Chile*. 2002; 130(11):1265–1272.

37. Hadi MA, Karami NA, Al-Muwalid AS, et al. Community pharmacists' knowledge, attitude, and practices towards dispensing antibiotics without prescription (DAWP): a cross-sectional survey in Makkah Province, Saudi Arabia. *Int J Infect Dis.* 2016; 47:95–100. [doi:10.1016/j.ijid.2016.06.003](https://doi.org/10.1016/j.ijid.2016.06.003)
38. Elhada A, Eltayeb IB, Mudawi MM. Pattern of self-medication with antibiotics in Khartoum State, Sudan. *World J Pharm Res.* 2014; 3(5):678–692.
39. Yousif M. In-home drug storage and utilization habits: a Sudanese study. *East Mediterr Health J.* 2002; 8(2–3):422–431. [doi:10.26719/2002.8.2-3.422](https://doi.org/10.26719/2002.8.2-3.422)