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Knowledge, practices, and influencers of antibiotic prescriptions of Nigerian doctors

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Abstract
Background: *There is a dire need to preserve antibiotics currently in use to avert resistance. Appropriate use of antibiotics would ensure antimicrobial stewardship. Doctors are in the forefront of prescriptions. Their knowledge of and proper prescription practice as well as what influences their antibiotic prescriptions go a long way in mitigating antimicrobial resistance.*
Aim: *To ascertain the knowledge, practices and influencers of antibiotic prescriptions of doctors in Nigeria.*
Methods: *An online self-administered questionnaire on aspects of knowledge of when to prescribe antibiotics, actual prescription practice, and factors that influence prescription, was employed. Questionnaires were sent out in doctors' social media groups as google forms soliciting for responses. Responses were automatically entered into google spreadsheets and data analysed using SPSS version 21.*
Results: *A total of 258 doctors responded. The overall mean (SD) knowledge score (%) was 66.0±9.3 with a range of 40.0-93.3. Family physicians and paediatricians had higher mean knowledge scores than those in other specialities (p<0.001). The overall mean appropriate practice score was 66.8±8.4 with a range of 40.0-85.7. The mean proper practice scores were highest among the family physicians, paediatricians and public health physicians (p=0.002). The greater the years of medical practice the more the mean*

knowledge score (p=0.007) and likewise doctors in tertiary care knew more than those in secondary and primary care (p=0.002). Possession of prior information on antibiotic stewardship resulted in higher knowledge (p<0.001) and practice (p=0.015) scores, while having facility antibiotic protocols/ antibiotic stewardship committees was akin to better knowledge (p=0.032) and prescription practice (p=0.012). There was a weak though statistically significant positive linear relationship between knowledge and practice scores (r_s=0.291, p<0.001. Knowledge accounted for only 9.2% (R^2=0.092) of variability in practice scores. A 1% increase in knowledge score increased practice score by 0.3%. Major influencers of prescribing practice were history of prior use of antibiotics by the patient (97.3%), cost of antibiotics intended to be prescribed (95.3%), age of patient (93.1%), request for antibiotics by the patient (89.6%), and patients presenting with high fevers (70.5%).

Conclusion: *Demographic characteristics of respondents influenced knowledge but not necessarily practice. Knowledge of appropriate antibiotic prescription had little effect on actual prescribing practice. The factors that affected prescribing practice were previous training on AMS and availability of institutional protocols and treatment guidelines. It is recommended that all medical practitioners receive training on AMS and adhere to institutional treatment protocols.*

Introduction

Antibiotics are among the most frequently prescribed medications. Since the discovery of penicillin, the first antibiotic, scores of antibiotics of varied classes have been added to the physician's armamentarium against microbial infections. An innate feature of every biological species is to self-propagate and prevent extinction. This invariably applies to microbes which ensure survival by mutation of genetic material in a bid to avert extermination by antimicrobial agents. Herein lies the principle of antimicrobial resistance.

Although antimicrobial resistance (AMR) is a natural phenomenon, the process has been much enhanced because of the overuse, underuse, and misuse of antimicrobials.[1] Infections caused by antibiotic-resistant microbes are difficult and sometimes impossible to treat. They pose a severe public health threat.[2] The world is currently running out of effective antibiotics and reports show that common bacterial infections, including urinary tract infections, sepsis, sexually transmitted infections, and some forms of diarrhoea, now manifest high rates of resistance against antibiotics previously used to treat these infections.[2] Antibiotic-resistant infections necessitate extended hospital stays, additional follow-up doctor visits and costly toxic alternatives.[3] Antibiotic resistance is a global phenomenon and multiple factors have been found to contribute to its increasing prevalence. These factors hinge on inadequate human behaviour such as patient self-medication, noncompliance with recommended treatments, and over-prescription of antimicrobials by physicians in the absence of appropriate indications.[4] Hospital practices, especially in large facilities, also provide a fertile ground for breeding and transmitting antibiotic resistant microbes.[4] Other determinants of antibiotic resistance are traits inherent in and factors associated with the microorganism.[5]

Nigeria has a high burden of AMR and the reasons for this are multifactorial.[6] Prescription monitoring is virtually non-existent and prescription-only medicines, including antimicrobials, are routinely available over the counter in pharmacies and patent medicine outlets. Even though there is legislation on control of use of antimicrobials, this is not enforced, and drugs are sold in open markets by untrained persons many times under unfavourable storage conditions, without need for formal prescriptions.
To combat antibiotic resistance, the concept of antimicrobial stewardship (AMS) was enunciated. AMS is the effort to measure and improve how antibiotics are prescribed by clinicians and used by patients.[7] Clinicians ought to be primarily responsible for the decision to use antibiotics. Protocols and guidelines are put in place for healthcare personnel to avert antibiotic abuse. To ensure that options exist for treating infections, it is imperative to make the best use of currently available antimicrobials based on local antibiotic sensitivity patterns. This is the main thrust of AMS programmes which hitherto have been focussing on ensuring the proper use of antimicrobials to provide the best patient outcomes, lessen the risk of adverse effects, promote cost-effectiveness, and reduce or stabilize levels of resistance.[8]

In Nigeria, most hospitals do not implement AMS strategies; prescriptions are based on clinical acumen and affordability, with minimal laboratory support.[9, 10] It has also been reported that among health workers (physicians and others), antibiotics are prescribed for infections considered to be viral.[11] Continued research on the knowledge, attitudes, prescribing habits and factors that underlie the prescribing habits of clinicians is vital. This study was therefore carried out to ascertain the knowledge gaps, prescribing practices, and factors that influence antibiotic prescription among Nigerian doctors. This will contribute to raising awareness on the severity and magnitude of the problem of improper and over-prescription of antibiotics which is a prerequisite for improving prescription practices. Information generated would be helpful in initiating and designing simple interventions geared towards improving clinicians' antibiotic prescription, and in the long run, safeguarding the few available potent antimicrobials.

Methods

An online descriptive, cross-sectional, questionnaire-based survey was conducted on medical doctors in private and public health facilities in Nigeria from September to November, 2021. A link to the questionnaire was sent to medical doctors' social media groups on WhatsApp and Telegram, requesting them to fill Google forms (self-administered questionnaires) anonymously and voluntarily. The link was sent out once every week for the three-month survey. The questionnaire (attached as a supplementary file) consisted of 39 questions designed to collect sociodemographic data, evaluate the knowledge the medical doctors had of judicious use of antibiotics, their antibiotic prescribing practices, their attitudes towards, in addition to influencers of, antibiotic prescription. The questionnaire entered data automatically into Excel spreadsheets.

Demographic information included age, gender, duration of medical practice, level of practice, place of practice, type of practice and field of medicine practiced. Knowledge addressed appropriate indications and use of antibiotics for common ailments. The practice section looked out for the use of antibiotics in common clinical situations, adjudging whether they were judiciously employed or not. There were also queries on knowledge of antimicrobial stewardship, bacterial resistance and facility-based policies on antibiotic use. There were 15 queries testing knowledge of appropriate antibiotic prescription and 7 on aspects of prescription practice. For Knowledge and Practice, using a 5-point Likert scale (1-5) the best answer got 5, and this could either be 'Always' or 'Never'(for Practice) and 'Strongly agree' or Strongly disagree' (for Knowledge). If 'Always'(or 'Strongly agree') scored 5, then 'Often' (or Agree) scored 4, 'Sometimes'3 (or Neutral), 'Rarely' (or Disagree) 2 and 'Never' (or Strongly disagree) 1. If 'Never' was the best answer, it scored 5, and in the same vein scores decreased till 'Always' scored 1. The total available score for Knowledge was 75 (15 questions multiplied by 5). For Practice, it was 35 (7 questions multiplied by 5). For each respondent the Knowledge score was calculated as totalled scores out of 75, and percentages of the proportions generated by multiplying by 100. Likewise, the Practice score for each respondent was calculated as totalled scores out of 35, and percentages of the proportions generated by multiplying by 100.

Nine questions were posed on factors that may have an influence on antibiotic prescription. As regards 'influencers of prescriptions' responses were recorded on a 5-point scale, where 'always' was 5, 'often' 4, 'sometimes' 3, 'rarely' 2 and 'never' 1, for each subject. Percentages of proportions were calculated for each response. The internal consistency of the study instrument was quite reliable for the knowledge and influencer domains as indicated by Cronbach's alpha (α) scores[12] of 0.7 and 0.6 respectively, but not for the practice domain (α = 0.4).

Statistical Analysis

Data were analysed using SPSS Version 21 software. The normality of the knowledge and practice scores were tested using Kolmogorov–Smirnov test. The result showed that the data for both knowledge (p=0.014) and practice (p<0.001) scores were not normally distributed. Therefore, Mann-Whitney U Test was used to compare the mean knowledge and practice scores between two independent groups of a categorical variable, while Kruskal-Wallis H Test was used when the categorical variable had three or more independent groups. The relationship between knowledge and practice scores was examined using Spearman's rank-order correlation while Log-Log Linear regression analysis was used to predict the effect of a change in knowledge score on practice score. P-value ≤0.05 was considered statistically significant.

Results

258 doctors responded to the online questionnaire. Their characteristics are outlined in table 1.

Table 1. Characteristics of respondents

Characteristic	Frequency [N=258]	Percentage
Age in years		
20 – 30	32	12.4
31 – 40	97	37.6
41 – 50	89	34.5
51 – 60	27	10.5
61 – 70	11	4.3
>70	2	0.7
Sex		
Female	116	45.0
Male	142	55.0
Number of years in practice		
≤10	84	32.6
11 – 20	127	49.2
21 – 30	20	7.8
31 – 40	24	9.3
>40	3	1.1
Level of practice		
Primary care [general practice]	65	25.2
Secondary care [specialist practice]	25	9.7
Tertiary care [teaching hospital practice]	168	65.1
Place of practice		
Public [government-owned] facility	212	82.2
Faith-based [mission-owned] facility	13	5.0
Private facility	33	12.8
Specialty		
Internal medicine	19	7.4
Obstetrics & gynaecology	27	10.5
Paediatrics	78	30.2
Surgery	29	11.2
Family medicine	17	6.6
Public health	18	7.0
General duty medical officer	70	27.1

The overall mean knowledge score was 66.0±9.3 with a range of 40.0-93.3. Using Kruskal-Wallis H Test, the comparison between the means of knowledge scores between doctors of various specialties is shown in table 2. Family physicians and paediatricians had higher mean knowledge scores than those in other specialities (p<0.001).

Table 2. Comparison of knowledge of appropriate antibiotic prescriptions of doctors from various specialties

Specialty	N	Mean Score	95% CI	Standard deviation	Minimum score	Maximum score	p Value
Internal medicine	19	65.1	61.4-68.7	7.6	53.3	80.0	p<0.001
Obstetrics & gynaecology	27	63.0	59.9-66.0	7.8	44.0	74.7	
Paediatrics	78	70.9	68.9-72.8	8.6	42.7	93.3	
Surgery	29	63.5	60.4-66.7	8.3	42.7	77.3	
Family medicine	17	71.0	66.0-76.0	9.7	50.7	89.3	
Public health	18	63.1	59.6-66.7	7.2	48.0	74.7	
General duty medical officer	70	62.4	60.2-64.6	9.1	40.0	85.3	
Total	258	66.0	64.8-67.1	9.3	40.0	93.3	

The overall mean appropriate practice score was 66.8±8.4 with a range of 40-85.7.
Using Kruskal-Wallis H Test, the comparison between the means of practice scores between doctors of various specialties is shown in table 3. It is also noteworthy that the mean proper practice scores were highest among the family physicians, followed by paediatricians and public health physicians (p=0.002).

Table 3. Comparison of practice of appropriate antibiotic prescriptions of doctors from various specialties

Specialty	N	Mean Score	Standard deviation	95% CI	Minimum score	Maximum score	p Value
Internal medicine	19	67.2	11.0	61.9-72.5	40.0	85.7	p=0.002
Obstetrics & gynaecology	27	61.8	7.7	58.7-64.8	45.7	77.1	
Paediatrics	78	68.5	8.4	66.6-70.4	40.0	82.9	
Surgery	29	66.1	7.5	63.3-69.0	54.3	80.0	
Family medicine	17	70.1	8.2	65.9-74.3	48.6	80.0	
Public health	18	68.3	8.8	63.9-72.6	45.7	80.0	
General duty medical officer	70	65.8	7.5	64.0-67.6	48.6	80.0	
Total	258	66.8	8.4	65.8-67.8	40.0	85.7	

The greater the years of medical practice, the more the mean knowledge score (p=0.007) and likewise doctors in tertiary care scored higher than those in secondary and primary care (p=0.002). Possession of prior information on antibiotic stewardship resulted in higher knowledge (p<0.001) and practice (p=0.015) scores, while having facility antibiotic protocols/ antibiotic stewardship committees was akin to better knowledge (p=0.032) and prescription practice (p=0.012). These are shown in table 4.

Table 4. Sociodemographic characteristics and associated knowledge and practice scores

Characteristics	Knowledge score		Practice Score		Total (%)
	Mean ± SD	p-value	Mean ± SD	p- value	
Gender					
Female	66.1± 9.4	0.791	67.4±8.8	0.185	116 (45.0)
Male	65.8±9.2		66.3±8.2		142 (55.0)
Years of practice					
≤ 10 years	62.8±9.7		65.8±7.7		84(32.6)
11-20 years	67.1±8.7		67.2±8.7		127 (49.2)
21-30years	69.6±8.1	0.007	67.9±9.5	0.380	20 (7.8)
>30 years	67.8±9.0		67.2±8.7		27 (10.4)
Level of practice					
Primary care	62.6±9.0		65.8±8.3		65 (25.2)
Secondary care	64.4±10.2	0.002	67.9±10.7	0.374	25 (9.7)
Tertiary care	67.5±8.9		67.0±8.1		168 (65.1)
Type of facility					
Public	66.6±9.4	0.052	66.9±8.3	0.369	212 (82.2)
Faith-based	62.8±6.7		64.4±7.2		13 (5.0)
Private	63.4±8.9		67.4±9.5		33 (12.8)
Possession of previous information on antibiotics stewardship					
Yes	68.6±8.3		67.9±8.3		151 (58.5)
No	62.2±9.2	<0.001	65.23±8.4	0.015	107 (41.5)
Availability of hospital protocols guiding antibiotic prescription and/or antibiotic stewardship committee					
Yes	68.2±9.7		69.3±9.3		63 (24.4)
No	64.6±8.6		65.7±8.5		94 (36.4)
Not sure	65.8±9.4	0.032	66.2±7.5	0.012	101(39.2)

About half of the doctors (151, 58.5%) had received some information (formally or informally) on antibiotic stewardship.

About a third (101,39.1%) had no idea if their hospitals had antibiotic protocols, a quarter (63, 24.4%) replied that their facilities did have guidance, while the rest (94, 36.4%) said their hospitals had no protocols guiding antibiotic prescriptions and/or antibiotic stewardship committee.

Spearman's rank correlation was run to determine the relationship between knowledge about antibiotic prescription and proper prescription practice. There was a weak, though statistically significant, positive linear relationship between knowledge and practice scores (r_s=0.291, p<0.001) as shown in Figure 1.

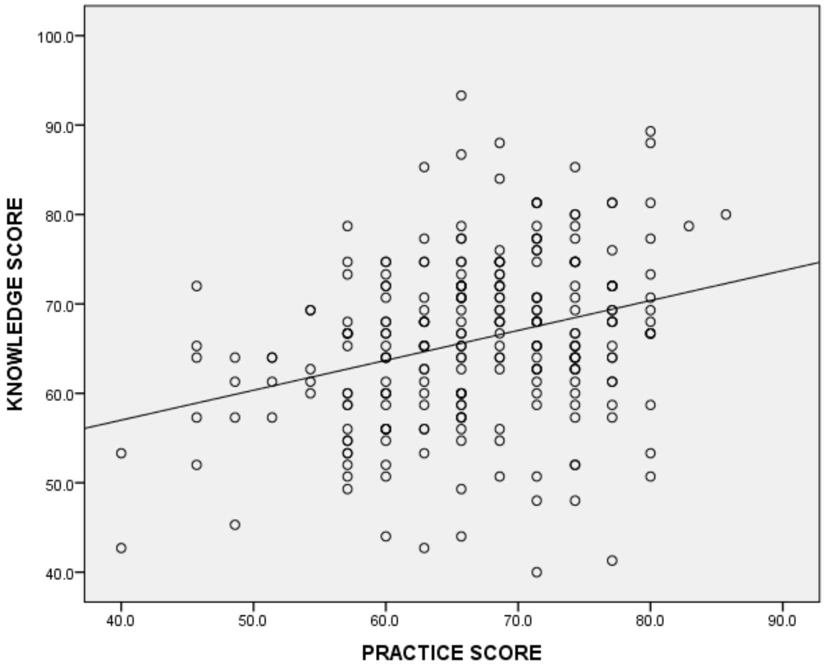


Figure 1. Relationship between knowledge about antibiotic prescription and appropriate prescription practice

Log-Log linear regression analysis was used to predict the effect of an increase in knowledge score on practice score. The result showed that the knowledge accounts for only 9.2% (R2=0.092) of variability in practice scores. A 1% increase in knowledge score increases practice score by 0.3%.

Influencers of antibiotic prescription were rated on a 5-point Likert scale ranging from 'Always' through 'Often', 'Sometimes', 'Rarely' to 'Never'. The influencers included the following: patients' request for antibiotics, doctor being unsure of diagnosis, very high fever in the patient, wanting to finish off available near-expiry drugs, advertisement by pharmaceutical representatives, prescribing to keep patient clientele, prior antibiotic use by the patient, cost of particular antibiotics, and age of the patient. Details are shown in figure 2.

Summing up the proportions of 'always', 'often' and 'sometimes' for each factor, the total affirmative responses were generated as follows: history of prior use of antibiotics by the patient (97.3%), cost of antibiotics intended to be prescribed (95.3%), age of patient (93.1%), request for antibiotics by the patient (89.6%), and patients presenting with high fevers (70.5).

Discussion

Key to the preservation of available antibiotics is their rational use by informed and dedicated healthcare workers. Doctors are the major prescribers of these drugs in the milieu of healthcare delivery. As such, it behoves the doctor to acquire relevant knowledge and have his practice tailored accordingly towards achieving desired results without endangering the efficacy of antibiotics. The overall mean score of doctors' knowledge about antibiotic prescriptions was 66%. This is similar to scores from studies done in China, India, the USA, and the Carribean where responses to questionnaires were also anonymous and online.[13-16] However, the knowledge of when to prescribe antibiotics varied appreciably among the cadres of physicians. Those in family medicine and paediatrics, as well as more experienced doctors, and those employed in tertiary care facilities, exhibited better knowledge than their peers. The finding among family physicians and paediatricians may be explained by the fact that these doctors were mostly from tertiary care facilities. Multidisciplinary clinicians in Jeddah, Saudi Arabia[17] from university, public and private hospitals, did not exhibit such disparity in knowledge.

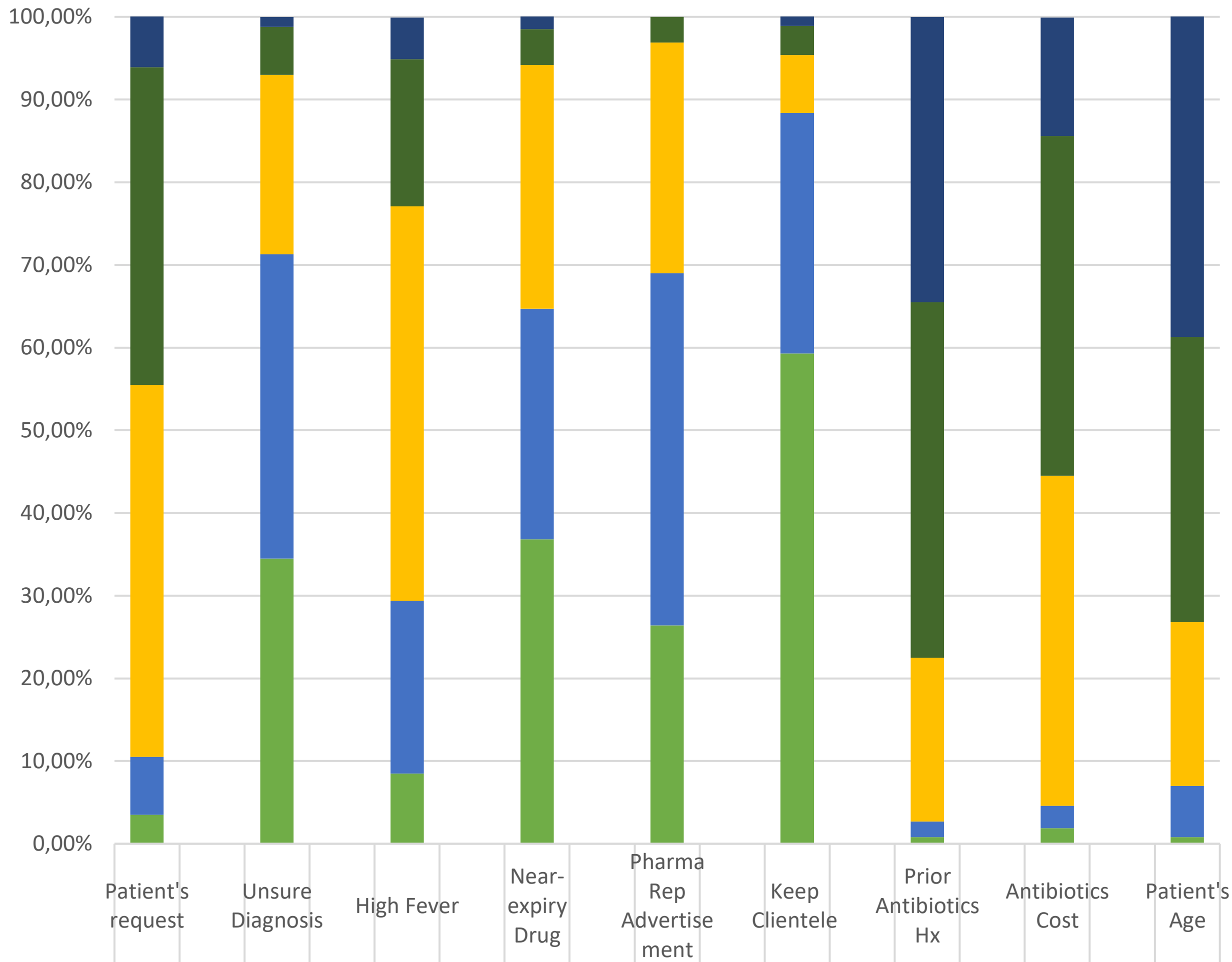
From this study the major factors influencing antibiotic prescription practice were history of prior use of antibiotics by the patient, cost of the antibiotic intended to be prescribed, age of the patient, request for antibiotics by the patient, and patients presenting with high fevers. The presentation with high fever is usually a common reason for empirical antibiotic prescription by clinicians.[18, 19] Having knowledge of a patient's prior exposure to antibiotics either following self-treatment or from prescriptions of other health care providers, goes a long way to ensure success of antimicrobial therapy. [20] The antimicrobials the patient has been exposed to, their dosages, dosing frequency and duration of therapy would give a clue to possible antimicrobial resistance, and hence guide further prescriptions. Drug cost is essential vis-à-vis affordability by the patient, averting incomplete or erratic dosing of drugs in an environment where out of pocket payment is the norm. [20] Pertaining to age, certain drugs are restricted for very young infants and the elderly, hence consideration of age is appropriate.

Many of the Nigerian medical practitioners agreed to patients' demands for antibiotics. This naturally leads to antibiotic prescriptions that may not be strictly indicated. This factor was highlighted by other studies as contributing to antibiotic overuse among physicians. [21, 22, 23] In one study it resulted in an increased likelihood of subsequent future requests for unnecessary antibiotics.[24] More frequent antibiotic prescriptions for young children have been noted to be a common practice being given as accompaniment to virtually all prescriptions. [18, 19] Presence of a high fever prompts the use of antibiotics empirically. This is common practice and was even thought to speed up recovery from malaria when given along with antimalarial drugs.[19]

Clinicians' use of antibiotics in situations where diagnosis was uncertain has been reported.[25, 26, 27] It was however, not observed in this study probably due to the subset of doctors that completed the survey. Pharmaceutical representatives who advertised their drugs and offered gifts and sponsorships do regularly influence prescribers.[28, 29, 30] This was however played down among this group of doctors.

It has been observed that doctors tend to have individual propensities for antibiotic prescriptions and may not easily be influenced to make changes.[31] Findings observed among some groups of Nigerian doctors had not altered appreciably even after a period of twenty-four years. [32] The locus of decision-making in antibiotic prescribing is thought to reside in the individual physician.[20, 33] This physician's mindset must necessarily be attuned towards antimicrobial stewardship so as to preserve the few available antimicrobials. To aid this an eight-step modification of the World Health Organization's six-step approach, to help minimize poor quality and erroneous prescribing, has been proposed by Pollock et al.[34] These include (1) evaluating and clearly defining the patient's problem; (2) specifying the therapeutic objective; (3) selecting the appropriate drug therapy; (4) initiating therapy with appropriate details and considering non-pharmacologic therapies; (5) providing patient information, instructions and warnings; (6) evaluating therapy regularly; (7) considering drug cost when prescribing; and (8) using computers and other tools to reduce prescribing errors.

Using guidelines for common outpatient infections and ensuring strict adherence to them by audit and feedback, tracking individual prescribing behaviour, and giving feedback on their performance relative to peers or established benchmarks, have been advocated.[27] This however will not be applicable to the numerous prescriptions made in privately-owned clinics not in the purview of large, structured institutions.



	Patient's request	Unsure Diagnosis	High Fever	Near-expiry Drug	Pharma Rep Advertise ment	Keep Clientele	Prior Antibiotics Hx	Antibiotics Cost	Patient's Age
ALWAYS	6,20%	1,20%	5,00%	1,60%	0,00%	1,20%	34,50	14,30	38,80
OFTEN	38,40	5,80%	17,80	4,30%	3,10%	3,50%	43,00	41,10	34,50
SOMETIMES	45,00	21,70	47,70	29,50	27,90	7,00%	19,80	39,90	19,80
RARELY	7,00%	36,80	20,90	27,90	42,60	29,10	1,90%	2,70%	6,20%
NEVER	3,50%	34,50	8,50%	36,80	26,40	59,30	0,80%	1,90%	0,80%

Figure 2. Influencers of antibiotic prescription

Conclusion

We conclude that just having the knowledge of proper use of antibiotics does not necessarily translate to appropriate prescription practice. Deciding whether or not to prescribe an antibiotic can be a complex process, during which physicians are influenced not only by medical information, but also by their interactions with patients and other stakeholders in the healthcare industry. It is noteworthy that previous training on AMS and availability of institutional antibiotic stewardship committees and treatment protocols/guidelines for antibiotic therapy of common illnesses were the factors associated with appropriate antibiotic prescription practice. By understanding the factors that affect physicians' antibiotic prescribing decisions and applying concepts from the social and behavioural sciences, inappropriate prescribing can be reduced, which in turn can reduce the threat of resistance.

It is recommended that all practising doctors receive trainings on AMS, and that all healthcare institutions, public and private, have well constituted antibiotic stewardship committees, while physicians should be encouraged to adhere to well-articulated guidelines/protocols for antibiotic use, which are revised periodically.

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Competing Interests: The authors declare no competing interests.

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