Original Paper

Antibiotic Prescribing Behavior of Physicians in Outpatient Departments in Hospitals in Northwest Ethiopia: Structural Equation Modeling Approach

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Abstract

Background: Antibiotic resistance, fueled by irrational prescribing, is a global threat associated with health, social, and economic consequences. Understanding antibiotic prescribing behavior and associated factors is important to promote good prescribing practice.

Objective: This study aimed to determine the factors affecting antibiotic prescribing behaviors of physicians based on the theory of planned behavior in hospitals in northwest Ethiopia in 2022.

Methods: A cross-sectional study was conducted from September 2022 to October 2022. A total of 185 health professionals were included, and a self-administered questionnaire was used to collect data. A structural equation model based on the modified theory of planned behavior was used to determine factors affecting antibiotic prescribing behavior. The percentages of physicians' estimated prescriptions for patients with upper respiratory tract infections (URTIs) and during weekly outpatient visits were used to predict antibiotic prescribing behavior and finally linked with behavioral constructs. A *P* value <.05 was considered significant.

Results: Physicians estimated that they prescribed antibiotics for 54.8% (9896/18,049) of weekly outpatient encounters, and 178 (96.2%) of the 185 physicians estimated they prescribed antibiotics for patients who presented with symptoms of a URTI. Physicians aged ≤30 years were less likely to prescribe antibiotics (48/100, 48%) for patients who presented with a URTI than physicians older than 30 years (51/100, 51%; *P*=.004), and general practitioners were less likely to prescribe antibiotics (47/100, 47%) for patients who presented with a URTI than residents (51/100, 51%; *P*=.03). Similarly, during outpatient visits, physicians ≤30 years old were less likely to prescribe antibiotics (54/100, 54%) than physicians older than 30 years (57/100, 57%; *P*<.001), male physicians were less likely to prescribe antibiotics (53/100, 53%) than female physicians (64/100, 64%; *P*=.03), and general practitioners were less likely to prescribe antibiotics (53/100, 53%) than residents (57/100, 57%; *P*=.02). Physicians with good knowledge were less affected by perceived social pressure (mean 4.4, SD 0.6) than those with poor knowledge (mean 4.0, SD 0.9; *P*<.001) and felt it was easy to make rational decisions (mean 4.1, SD 1.1) compared with those with poor knowledge (mean 3.8, SD 1; *P*<.001). However, intentions to reduce and prescribe antibiotics were not affected by attitudes, subjective norms, or perceived behavioral control, and perceived antibiotic prescribing behavior was not related to intentions to reduce or prescribe antibiotics.

Conclusions: Antibiotic prescribing behavior was not under the volitional control of physicians. This calls for a systematic approach to change antibiotic prescribing practices in hospital.

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KEYWORDS

antibiotic prescribing behavior; Ethiopia; outpatient departments; physicians; SEM; TPB

Introduction

Antimicrobial resistance (AMR) is a natural phenomenon [1], to which overuse and misuse of antibiotics contribute and augment [1-4]. Globally, antibiotic consumption has increased (eg, by 65% from 2000 to 2015), and 30% to 50% of antibiotic prescriptions were used either inappropriately or unnecessarily [2], further resulting in increased inappropriate use [3,4] and the development of selective pressure on antibiotics [5-7]. Inappropriate prescribing is a key contributing factor to the emergence of AMR [1,8,9] and varies from 62.8% for respiratory tract infections to 78.5% in patients with skin and soft tissue infections [4]. This would strengthen the belief that antibiotics ought to be prescribed and are effective in circumstances when they are not [10]. Physicians' prescribing behaviors impact not only patient health but also medical expenses and health resources [11]. It is recommended to monitor antibiotic prescribing in hospitals to improve the quality of antibiotic prescribing through education and practice changes [12**].** Identifying key behaviors and drivers for the behaviors that may be amenable to change and improve prescribing decisions is an important component of interventions in health care practice to mitigate the burden of AMR [1,10,11]. Antibiotic stewardship programs (ASPs), which are among the most common interventions in health facilities to optimize antibiotic use, are effective, low-cost methods to change behaviors that drive excessive prescribing of antibiotics in health facilities [1].

Human behavior is guided by beliefs about the likely consequence of the behavior (behavioral beliefs), beliefs about the normative expectations of others (normative beliefs), beliefs about the presence of factors that may facilitate or impede the performance of the behavior (control beliefs), shaping attitudes, subjective norms (SNs), and perceived behavioral control (PBC) [13]. It is reported that these behavioral beliefs (attitudes, PBC, and SN) of physicians are predictors of indiscriminate antibiotic prescribing behaviors in hospitals [9,14]; thus, campaigns that address both health service personnel and the general population should take this into account [8]. A high level of knowledge is known to be associated with a more positive attitude and behavioral intention for reducing antibiotic prescriptions and was linked with less complacency, less fear, and less ignorance, although it had indirect effects on intentions to prescribe antibiotics through the attitude of ignorance [14]. On the other hand, perceived higher patient pressure negatively affects attitudes toward the rational use of antibiotics and promotes higher use of antibiotics [15]. Thus, characterizing and designing behavior change interventions based on the behavior change wheel model and theory of planned behavior (TPB) serve as a framework for modeling the antibiotic prescribing behaviors of physicians [13,16,17]. Optimizing antibiotic consumption and reducing the rate of AMR are currently global issues [1,18]. In low- and middle-income countries, the prescribing of antibiotics is highly influenced by inadequate diagnostic facilities, lack of guidelines, difficulty monitoring patient progress, poor intensive care facilities, patient demand for quick relief, perceived patient expectations from past prescriptions, and fear of losing patients to competition [19,20]. This results in high mortality and morbidity due to inadequate regulation, limited access to diagnostic facilities, and antimicrobial over-prescription [21,22]. Based on the behavior change wheel, once a problem is identified and context is considered, functions and policies may be implemented as interventions to understand and change prescribing behavior and improve antibiotic consumption [13,17]. This requires the design and implementation of sustained awareness campaigns to change behaviors and improve health outcomes [9].

In sub-Saharan Africa, physicians still prescribe antibiotics based only on a simple assessment of patients' symptoms, just as they used to when antibiotics first became commonly used in the 1950s [9], due to a lack of diagnostic and antibiotic susceptibility tests, resulting in up to 95% of antibiotic prescriptions as unnecessary [23]. Prescribing antibiotics requires balancing physician, patient, and facility-related factors [24]. In Ethiopia, antibiotic prescribing in hospitals may account for 52.39% of all prescriptions [25], and one-half of prescribed antibiotics might not be needed [26]. Although behavior change campaigns can be very cost-effective for changing antibiotic prescribing practices, based on identified gaps [9], in Ethiopia, to our knowledge, there have been no studies to model the antibiotic prescribing behavior of physicians other than determining the perceptions of health professionals on AMR and antibiotic use [27,28]. Modeling behavior is needed to help clinical leaders drive ASP and design educational programs to help standardize and improve antibiotic prescribing behaviors in health facilities [29]. Thus, this study assessed the determinants of antibiotic prescribing behavior among physicians serving in outpatient departments (OPDs) in hospitals in northwest Ethiopia using a structural equation modeling (SEM) approach.

Methods

Study Area and Period

A cross-sectional study was conducted from September 2022 to October 2022 in 4 hospitals: Felege Hiwot Comprehensive Specialized Hospital, Tibebe Ghion Specialized Hospital, Debre Markos Comprehensive Specialized Hospital, and Injibara General Hospital. Except for attempts to implement ASPs in inpatient wards in some of the hospitals, there is currently no system to monitor antibiotic prescribing or enabling factors for prescribing antibiotics in OPDs. This survey assessed the knowledge, attitudes, SN, and PBC of physicians and their intention to prescribe antibiotics as possible factors for antibiotic prescribing behaviors to provide insights into the driving forces of antibiotic prescribing as a complementary factor for antibiotic consumption, which together constitute baseline information to design effective ASPs to tackle AMR.

Study Participants, Sample Size Determination, and Sampling Procedures

Physicians (general practitioners and residents) working in OPDs of internal medicine, pediatrics, gynecology and obstetrics, and surgical departments were included in the study. The sample size for health professionals was determined based on the following formula for a finite population:

$$n = \chi^2 NP (1-P)/ (d^2 (N - 1) + \chi^2 P (1 - P))$$

where n is the sample size and χ^2 is the table value of the chi square for 1 degree of freedom at the desired confidence level (1.96 × 1.96=3.84), *N* is the total population, *P* is the population proportion (27%), and *d* is the degree of accuracy expressed as a proportion (0.05). According to Gebretekle et al [27], physicians estimate that they prescribe antibiotics to about 27% of their patients. Thus, a prevalence of 27% was used to calculate the sample size in this study. Accordingly, n was calculated as follows:

$$n=(1.96 \times 1.96) \times 487 \times 0.27(1-.27)/((0.05\times0.05) \times (487-1) + (1.96 \times 1.96) \times 0.27(1-0.27))$$

$$n=181.26 \text{ or } {\sim}182$$

To account for the nonresponse rate, 10% was added; thus, the total sample size was 200.

Data Collection Instruments and Processes

Data collection was based on the study by Liu et al [14,15] and customized to local scenarios in Ethiopian hospital settings. Questionnaires consisted of 4 behavioral aspects leading to antibiotic prescribing based on the TPB, namely attitudes (the degree to which a prescriber is in favor of the use of antibiotics), SN (perceived social pressure to which a prescriber is subject to prescribe antibiotics), PBC (the ease or difficulty of making a rational decision on antibiotic prescriptions), and intentions (the degree to which a prescriber is willing to prescribe or reduce antibiotics). The questionnaire for professionals was designed on a Likert scale with a 5-point response format, ranging from 1 (strongly disagree) to 5 (strongly agree) for attitudes about and intention to prescribe antibiotics, and a 5-point response format (from always to never) for SN and PBC. In addition, physicians were asked to estimate the number of patients who receive antibiotics from their weekly encounters that involve prescriptions and the number of patients for whom they prescribe antibiotics from 10 encounters with patients with symptoms of upper respiratory tract infections (URTIs) to assess their antibiotic prescribing behavior or practices. To assess physicians' knowledge, 11 questions were used, attitude was assessed using 7 questions, SN was assessed using 8 questions, PBC was assessed using 5 questions, and there were 3 questions each to measure intentions to reduce and prescribe antibiotics. Physicians (general practitioners and residents) working in internal medicine, pediatrics, gynecology and obstetrics, and surgical OPDs in the hospital were approached to participate in the study. The questionnaire was distributed while they were on duty. The completeness of the data was monitored on a daily basis. Finally, the data were compiled, and the behavioral constructs were linked with the percentages of physicians' perceived antibiotic prescribing behaviors and practices using SEM based on modified TPB (MTPB).

The Theoretical Framework for Structural Equation Modeling

Attitude, SN, and PBC were shown to be related to appropriate sets of salient behavioral, normative, and control beliefs about a behavior. PBC, together with behavioral intention, can be used directly to predict behavioral achievement. Attitude is defined as the degree to which a prescriber is in favor of the use of antibiotics in outpatient encounters, whereas SN and PBC measure the perceived social pressure to which a prescriber is subject to prescribe antibiotics and the perceived ease or difficulty of making a rational decision during antibiotic prescriptions, respectively. A behavioral intention that is intermediate measures the degree to which a prescriber is willing to prescribe antibiotics [13]. Thus, the theoretical framework was adopted from the TPB model [13], and links between knowledge and attitude, SN, and PBC were explored. However, since the comparative fit indexes (CFIs) were low, knowledge was linked to SN and PBC in relation to antibiotic use, and attitude, SN, and PBC were linked to intentions to prescribe antibiotics and finally to behaviors influencing antibiotic prescribing.

Statistical Analysis

Data were coded, entered, cleaned, and transferred to STATA version 14.0 (Stata Corp) for SEM analyses, but descriptive statistics were analyzed using SPSS version 23 (IBM Corp). ANOVA and chi-squared tests were performed to determine the difference in the mean measuring knowledge, attitudes, SN, PBC, and behavioral intentions of the participants according to age, gender, city, professional status, workplace, and duration of clinical practice. For knowledge, the percentage of respondents who answered correctly and the total number of correct answers per respondent were calculated. In addition, correct answers were coded as 1, and incorrect answers were coded as 0 for the SEM. Each attitude item was coded using a 5-point Likert scale (1=strongly agree, 5=strongly disagree), then recoded (–2=strongly disagree, 2=strongly agree), with a negative score indicating disagreements and a positive score indicating agreement with the average scores (ranging from –2 to 2). Intentions to reduce and prescribe antibiotics were coded similarly as the attitude measurements, with a negative score indicating refusal and a positive score indicating support for reducing antibiotic prescriptions (from –2 to 2). SN and PBC were measured from 1 to 5, with 1 indicating always and 5 indicating never, then recoded from 0 to 4, where 0 denotes never and 4 represents always. Behaviors around antibiotic prescriptions were measured using the percentage of antibiotic prescriptions for URTIs, per every 10 patients, and the percentage of antibiotic prescriptions among the estimated weekly visits.

Each variable was modeled separately to exclude factor loadings <0.3. Finally, SEM was applied to establish the associations between knowledge, attitudes, and practices. Standardized path coefficients with statistical significance (*P*<.05) were used. The maximum likelihood method was used to estimate the parameters. The fitness of the data in the SEM model was assessed using model fitness indexes based on recommended level acceptances such as $P>\chi^2$ ($P>.05$), standardized root mean squared residual <0.09, and root mean squared error of approximation <0.08; Tucker-Lewis index >0.90; CFI>0.90; and coefficient of determination ≥0.7. In addition, descriptive analysis was used.

Operational Definitions

We considered attitude to be the degree to which a participant had a positive or negative evaluation of indiscriminate antibiotic use. SNs were participants' beliefs about whether significant others would approve or disapprove of indiscriminate antibiotic use (ie, the perceived social pressure to which a prescriber is subject to prescribe antibiotics). PBC was the participant's beliefs regarding the ease or difficulty of making a rational decision about antibiotic prescriptions. Knowledge was considered participants' understanding and awareness regarding indiscriminate antibiotic use and AMR. The level of knowledge was determined based on the average score for all the questions (ie, physicians who answered at least or above the average score were considered to have good knowledge). Behavioral intentions around antibiotic prescriptions were the degree to which a prescriber was willing to prescribe antibiotics. Behaviors were documented as physicians' self-reported antibiotic prescribing behaviors.

Ethical Considerations

Ethical approval was obtained from the College of Health Sciences (protocol code: 106/22/SoP) and the School of Pharmacy (protocol code: ERB/SOP/472/14/2022) of Addis Ababa University. A support letter to the hospitals was obtained from the Amhara Public Health Institute. During data collection, physicians' names were deidentified. All participants provided informed consent prior to participating in this study. The information obtained was kept confidential and used only for research purposes. Ethical issues like privacy and confidentiality were considered during data collection in order not to disclose information about people outside the research.

Results

Among 200 planned respondents, 185 completed the questionnaires. Thus, the overall response rate was 92.5%.

General Characteristics of Study Participants

The majority of physicians (153/185, 82.7%) were men, and their average age was 30.3 (3.9) years. Overall, physicians had been in their current roles an average of 3.0 (2.2) years and had worked at their current hospital for an average of 2.0 (1.8) years. The majority of physicians (149/185, 80.5%) had worked in their current roles for <5 years; 87 (87/185, 47%) and 55 (55/185, 29.9%) were from Tibebe Ghion Specialized Hospital and the gynecology and obstetrics department, respectively. Of the patients who visited the OPDs, the physicians estimated that 9896 (9896/18,049 54.8%) had received at least one antibiotic (Table 1).

Table 1. Characteristics of the 185 physician respondents in hospital outpatient departments in 2022.

Variables	Results
Sex, n (%)	
Male	153 (82.7)
Female	32 (17.3)
Age (years), n (%)	
≤30	116 (62.7)
>30	69 (37.3)
Professional title, n (%)	
GP[a]	93 (50.2)
Residents	92 (49.8)
Facility, n (%)	
FHCSH[b]	43 (23.2)
TGSH[c]	87 (47)
DMCSH[d]	31(16.8)
IGH[e]	24 (13)
Department, n (%)	
Medical	36 (19.5)
Surgery	40 (21.6)
Pediatrics	48 (25.9)
Gyne/obs[f]	55 (29.9)
Others	6 (3.2)
Length of employment in the current hospital (years), n (%)	
<5	172 (93)
≥5	13 (7)
Overall length of employment in the current role (years), n (%)	
<5	149 (80.5)
≥5	36 (19.5)
Training on antibiotic use	
No	159 (85.9)
Yes	26 (14.1)
Patients seen per week, n	18,049
Patients seen per week, mean (SD)	97.5 (79.7)
Patients estimated to receive antibiotics per week, n	9896
Patients estimated to receive antibiotics per week, mean (SD)	60.1 (53.5)

[a]GP: general practitioner.

[b]FHCSH: Felege Hiwot Comprehensive Specialized Hospital.

[c]TGSH: Tibebe Ghion Specialized Hospital.

[d] DMCSH: Debre Markos Comprehensive Specialized Hospital.

[e]IGH: Injibara General Hospital.

[f]Gyne/obs: gynecology and obstetrics.

Knowledge of Physicians About Antibiotic Prescription

The majority of physicians agreed that amoxicillin is safe for pregnant patients (169/185, 91.4%), metronidazole has the best activity against anaerobes (166/185, 89.7%), and antibiotics should not be prescribed for nonfebrile diarrhea (151/185, 81.6%). However, none of the physicians answered, "Aminoglycosides are very active if they are administered parenterally once daily." Physicians answered 5 of 11 (46%) questions correctly. Based on this, 121 (65.4%) of the 185 physicians had good knowledge, based on the cutoff of a mean ≥5; however, for 64 (34%) of the 185 physicians, knowledge was poor (Table 2).

Table 2. Knowledge about antibiotic prescriptions of 185 physicians in hospital outpatient departments in 2022.

Code	Items to assess knowledge levels	Response		Factor loading	*P* value
	Correct, n (%)	Incorrect, n (%)			
q35	Antibiotic treatment is not needed for non-febrile diarrhea.	151 (81.6)	34 (19.4)	0.43	<.001
q36	Antibiotics are not prescribed for upper respiratory tract infections.	19 (10.3)	166 (89.7)	–0.14	.11
q37	Dosage reduction for ceftriaxone and clindamycin is needed for renal failure.	37 (20)	148 (80)	–0.11	.22
q38	Amoxicillin is a safe antibiotic product for pregnant patients.	169 (91.4)	16 (9.9)	0.55	<.001
q39	Metronidazole has the best activity against anaerobes.	166 (89.7)	19 (10.3)	0.82	<.001
q40	Methicillin-resistant *staphylococcus aureus* is resistant to beta-lactam antibiotics.	108 (58.4)	77 (39.4)	0.42	<.001
q41	Ceftriaxone most effectively crosses the blood-brain barrier.	85 (45.9)	100 (54.1)	0.37	<.001
q42	Aminoglycosides are very active if they are administered parenterally once daily.	0	185 (100)	0	.99
q43	Bacterial pneumonia (with symptoms of fast breathing, chest in-drawing, or stridor) requires antibiotic treatment.	90 (48.6)	95 (48.6)	0.14	.15
q44	Antibiotics do not reduce the duration and the occurrence of complications of upper respiratory tract infections.	37 (20)	148 (80)	0.17	.07
q45	The average number of patients taking antibiotics should be below 30% in a primary care facility.	36 (19.5)	149 (80.5)	0.063	.47

Attitudes and Intentions of Physicians Toward Antibiotic Prescriptions

The mean response for attitude questions was 2.5 (0.4). Of the 185 physicians, 88 (47.6%) perceived that microbiology results are important for treating infectious diseases, 95 (51.4%) believed that over-prescribing of antibiotics contributes to the generation of antibiotic resistance, and 89 (48.1%) believed that over-prescription of antibiotics leads to the development of resistance. Regarding intention to prescribe antibiotics, the mean score for intention to reduce antibiotics was 2.4 (0.9), whereas the mean score for intention to prescribe antibiotics 2.5 (0.8). Of the 185 physicians, 133 (71.9%) wanted to reduce antibiotic consumption, 132 (71.4%) expected to reduce antibiotic consumption, and 117 (63.2%) planned to reduce antibiotic consumption for outpatients; however, 107 (57.8%) wanted to prescribe antibiotics, 103 (55.6%) expected to prescribe antibiotics, and 102 (55.1%) planned to prescribe antibiotics to their patients (Table 3).

Table 3. Physicians' (n=185) responses to individual items about attitudes and behavioral intentions about antibiotic prescribing in hospital outpatient departments in 2022.

Measurement and items	Code	Response score, mean (SD)	Responses, n (%)					Factor loading	*P* value
			Strongly agree 1)	Agree (2)	Neutral (3)	Disagree (4)	Strongly disagree (5)		
Attitude[a]									
In primary care, microbiology results are useful when treating infectious diseases.	Q1	1.8 (1)	88 (47.6)	73 (39.5)	8 (4.3)	11 (5.9)	5 (2.7)	0.34	<.001
The prescription of an antibiotic to a patient does not influence the development of resistance.	Q2	4.2 (0.9)	0	16 (8.6)	12 (6.5)	68 (36.8)	89 (48.1)	–0.09	.30
Overuse of antibiotics contributes to the generation of antibiotic resistance.	Q3	1.7 (1)	107 (57.8)	57 (30.8)	7 (3.8)	7 (3.8)	7 (3.8)	0.56	<.001
Prescribing antibiotics to patients does not cause damage even if they are not indicated.	Q4	4.2 (0.9)	1 (0.01)	13 (7.0)	10 (5.4)	77 (41.6)	84 (45.4)	–0.03	.73
Over-prescribing antibiotics contributes to the generation of antibiotic resistance	Q5	1.7 (0.9)	95 (51.4)	64 (34.6)	13 (7)	10 (5.4)	3 (1.6)	0.80	<.001
Irrational use of broad-spectrum antibiotics contributes to generation of AMR[b]	Q6	1.7 (0.9)	88 (47.6)	81 (43.8)	7 (3.8)	5 (2.7)	4 (2.2)	0.62	<.001
Not selecting antibiotics to be prescribed based on the infected bacteria contributes to the generation of antibiotic resistance.	Q7	2.2 (1.1)	56 (30.3)	82 (44.3)	16 (8.6)	22 (11.9)	9 (4.9)	0.27	.009
Intention to reduce antibiotics[c]									
I want to reduce antibiotic consumption for outpatients.	Q29	2.5 (1.7)	20 (10.8)	113 (61.1)	27 (14.6)	18 (9.7)	7 (3.8)	0.40	<.001
I expect to reduce antibiotic consumption for outpatients.	Q30	2.3 (0.8)	21 (11.4)	111 (60)	33 (17.8)	18 (9.7)	2 (1.1)	0.82	.001
I plan to reduce antibiotic consumption for outpatients.	Q31	2.4 (0.8)	15 (8.1)	102 (55.1)	48 (25.9)	18 (9.7)	2 (1.1)	0.57	<.001
Intention to prescribe antibiotics[d]									
I want to prescribe antibiotics to outpatients	Q32	2.5 (0.9)	23 (12.4)	84 (45.4)	55 (29.7)	17 (9.2)	6 (3.2)	0.74	<.001
I expect to prescribe antibiotics to outpatients.	Q33	2.5 (0.9)	16 (8.6)	87 (47)	61 (33)	17 (9.2)	4 (2.2)	0.87	<.001
I plan to prescribe antibiotics to outpatients.	Q34	2.5 (0.9)	15 (8.1)	87 (47)	57 (30.1)	21 (11.4)	5 (2.7)	0.80	<.001

[a]Overall score: mean 2.5 (SD 0.4).
[b]AMR: antimicrobial resistance.
[c]Overall score: mean 2.4 (SD 0.9).
[d]Overall score: mean 2.5 (SD 0.8).

Subjective Norms and Perceived Behavioral Control of Physicians

The mean scores for SNs and PBC were 4.3 (0.8) and 4.0 (1.1), respectively. Of the 185 physicians, 133 (71.9%), 128 (69.2%), 126 (68.1%), and 125 (67.6%) never prescribed antibiotics based on patients' expectations, based on patient pressure, based on patients' requests for antibiotics, and to make patients trust them, respectively. Similarly, 119 (64.3%) of the 185 physicians never prescribed antibiotics to avoid being perceived as doing nothing for patients. Only a limited number of physicians agreed that they prescribed antibiotics based on patients' expectations or pressure (Table 4).

Table 4. Physicians' (n=185) responses to individual items about subjective norms and perceived behavioral control for intention to prescribe antibiotics in hospital outpatient departments in 2022.

Measurement and items	Codes	Response score, mean (SD)	Responses, n (%)					Factor loading	*P* value
			Always (1)	Often (2)	Sometimes (3)	Rarely (4)	Never (5)		
Subjective norm[a]									
I prescribe antibiotics since patients expect it.	Q15	3.9 (1.2)	6 (3.2)	21 (11.4)	38 (20.5)	48 (25.9)	72 (38.9)	0.54	<.001
I prescribe antibiotics since patients require and insist on it.	Q16	3.9 (1.1)	7 (3.8)	16 (8.6)	33 (17.8)	55 (29.7)	74 (40)	0.64	<.001
I prescribe antibiotics to satisfy patients.	Q17	4.1 (1.2)	10 (5.7)	12 (6.5)	24 (13.0)	46 (24.9)	93 (50.3)	0.55	<.001
I prescribe antibiotics so patients continue to trust me.	Q18	4.4 (1.0)	5 (2.7)	11 (5.9)	12 (6.5)	32 (17.3)	125 (67.6)	0.68	<.001
Even when I know that they are not indicated, I prescribe antibiotics since patients expect it.	Q19	4.5 (0.9)	3 (1.6)	4 (2.2)	19 (10.3)	26 (14.1)	133 (71.9)	0.84	<.001
Even when I know that they are not indicated, I prescribe antibiotics since patients ask for it.	Q20	4.5 (0.8)	1 (0.1)	7 (3.8)	13 (7)	38 (20.5)	126 (68.1)	0.86	<.001
Even when I know that they are not indicated, I prescribe antibiotics since patients press me to prescribe it.	Q21	4.5 (0.9)	3 (1.6)	3 (1.6)	19 (10.3)	32 (17.3)	128 (69.2)	0.87	<.001
Even when I know that they are not indicated, I prescribe antibiotics since I do not have time to explain to the patient the reason why they are not called for.	Q22	4.3 (1.1)	4 (2.2)	16 (8.6)	10 (5.4)	40 (21.6)	115 (62.2)	0.70	<.001
Perceived behavioral control[b]									
I prescribe antibiotics because I fear patient deterioration.	Q23	3.9 (3.2)	5 (2.7)	25 (13.5)	50 (27)	43 (23.2)	62 (33.5)	0.28	<.001
I prescribe antibiotics since it is impossible to track the patient accurately.	Q24	3.7 (1.1)	4 (2.2)	24 (13)	47 (25.4)	55 (29.7)	55 (29.7)	0.63	<.001
I prescribe antibiotics to avoid possible patient complaints or medico-legal problems.	Q25	4.1 (1.1)	8 (4.3)	10 (5.4)	31 (16.8)	44 (23.8)	92 (49.7)	0.85	<.001
I prescribe antibiotics to avoid being perceived as doing nothing for patients.	Q26	4.3 (1.1)	6 (3.2)	10 (5.4)	18 (9.7)	32 (17.3)	119 (64.3)	0.73	<.001
I prescribe antibiotics to avoid losing patients.	Q27	3.9 (1.3)	9 (4.9)	25 (13.5)	23 (12.4)	32 (17.3)	96 (51.9)	0.61	<.001

[a]Overall score: mean 4.3 (SD 0.8).

[b]Overall score: mean 4.0 (SD 1.1).

Antibiotic Prescribing Practices of Physicians

Of the 18,049 patients seen in the OPDs, 9896 (54.8%), or an average of 60.1 (53.5%) patients per week, were estimated to receive at least one antibiotic. Using an estimate of 10 patients for each of the 185 physicians, for a total of 1850 patients with URTIs, about 916 (49.5%) were estimated to be prescribed at least one antibiotic. Accordingly, 178 (96.2%) of the 185 physicians estimated that they prescribed antibiotics for at least one patient out of every 10 patients who presented with symptoms of a URTI, with a mean score of 5.9 (SD 2.2); 142 (142/185, 76.8%) physicians believed they would prescribe antibiotics for >3 patients; and 43 (43/185, 23.3%) physicians estimated they would prescribe antibiotics for 0 to 3 patients. The majority of physicians (56/185, 30.3%) said they would prescribe antibiotics to 5 patients out of 10 encounters with patients with URTIs in the OPDs (Table 5).

Table 5. Estimated prescriptions of antibiotics for upper respiratory tract infections (URTIs) out of every 10 patients by 185 physicians in hospital outpatient departments.

Number of patients prescribed antibiotics per every 10 patients	Physicians who estimated they would prescribe antibiotics, n (%)
0	7 (3.8)
1	4 (2.2)
2	9 (4.9)
3	23 (12.4)
Total for ≤3 encounters (30% of patients) with a URTI	43 (23.3)
4	31 (16.8)
5	56 (30.3)
6	20 (10.8)
7	10 (5.4)
8	12 (6.5)
9	2 (1.1)
10	11 (5.9)
Total for >3 encounters with a URTI	142 (76.8)

Structural Equation Modeling

The SEM using MTPB confirmed the theoretical framework for the antibiotic prescribing behaviors of physicians with some modifications. Based on the coefficient of determination (R^2), 94.6% of the variation in antibiotic prescribing behavior could be explained by all the exogenous variables. Data in the MTPB model had good fit, with $P>\chi^2$ ($P>0.0001$), a root mean squared error of approximation of 0.049, a standardized root mean squared residual of 0.071, a CFI of 0.91, and a Tucker-Lewis index of 0.901 (Table 6).

The MTPB model indicated that only physician knowledge was associated with PBC and SN. There was covariance between SNs and PBC (*P*<.001). Attitudes, SNs, and PBC were not associated with intentions to prescribe or reduce use of antibiotics. Similarly, intentions to prescribe or reduce use of antibiotics was not associated with the estimated number of antibiotic prescriptions for URTIs or during weekly visits (Figure 1). Physician age (*P*=.004) and professional level (*P*<.02) were predictors of the number of estimated prescriptions for URTIs, and physician age (*P*=.001), sex (*P*=.03), and professional level (*P*=.02) were predictors of the estimated number of prescriptions during weekly OPD visits. Knowledge was a direct predictor of SNs (*P*<.001) and PBC (*P*<.001). There was no indirect relationship between prescriber behaviors and knowledge, attitude, SN, and PBC (Table 7).

Based on the information in Table 7, for the 49.5% of the 1850 patients with URTIs who were estimated to be prescribed at least one antibiotic, physicians older than 30 years were more likely to prescribe antibiotics (51/100, 51%) than those ≤30 years old (48/100, 48%). Based on professional level, residents (51/100, 51%) were more likely to prescribe antibiotics than general practitioners (47/100, 47%). Similarly, for the estimated 54.8% (9896/18,049) of weekly OPD visits that had an antibiotic prescription, physicians older than 30 years were more likely to prescribe antibiotics (57/100, 57%) than those ≤30 years old (54/100, 54%). Women (63/100, 63%) and residents (57/100, 57%) were also more likely to prescribe antibiotics than men (53/100, 53%) and general practitioners (53/100, 53%), respectively. Good knowledge was a direct predictor of SNs (mean 4.4, SD 0.6) and PBC (mean 4.1, SD 1.1), both of which are in contrast for those with poor knowledge (mean 4.0, SD 0.9) and (mean 3.8, SD 1), respectively. However, intentions to reduce and prescribe antibiotics were not affected by attitudes, SNs, nor PBC, and perceived antibiotic prescribing behavior was not related to intentions to reduce or prescribe antibiotics.

Table 6. The model goodness of fit indexes for antibiotic prescribing behaviors of 185 physicians in hospital outpatient departments.

Fit statistics	Value	Description	Standard
Likelihood ratio			
χ^2_ms (314)	451.292	Model versus saturated	—[a]
P>χ^2	0.0001	—	—
χ^2_bs (348)	1878.872	Baseline versus saturated	—
P>χ^2	0.0001	—	—
Information criteria			
Akaike information criterion (AIC)	14073.713	—	
Bayesian information criterion (BIC)	14337.782	—	
Population error			
Root mean squared error of approximation (RMSEA)	0.049	—	0.08
90% CI	0.038-0.058	—	—
Pclose	0.581	Probability of RMSEA ≤0.05	—
Size of residuals			
Standardized root mean squared residual (SRMR)	0.071	—	<0.09
Coefficient of determination (CD)	0.946	—	—
Baseline comparison			
Comparative fit index (CFI)	0.910	—	≥0.90
Tucker-Lewis index (TLI)	0.901	—	≥0.90

[a]Not applicable.

Figure 1. SEM of Antibiotic Prescribing Behavior in hospital outpatient departments using standardized coefficients in 2022. This SEM is also available as Multimedia Appendix 1. SEM: Structural Equation Modeling.

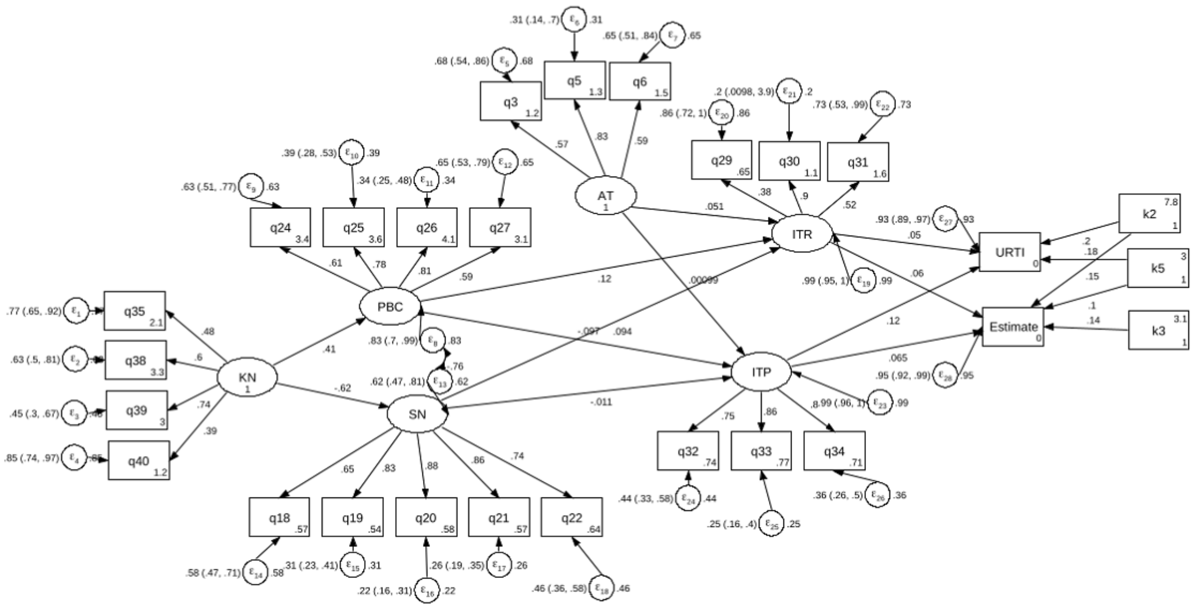

Table 7. Effects of direct and indirect variables on the intention to prescribe antibiotics by 185 physicians in hospital outpatient departments in 2022.

Factor	Effects of covariates on each other		
	B	SE	*P* value
Subjective norms			
Knowledge	0.41	0.49	<.001
Perceived behavioral control			
Knowledge	–0.62	0.43	<.001
Intention to reduce antibiotic prescriptions			
Attitude	0.16	0.20	.42
Subjective norms	0.15	0.20	.45
Perceived behavioral control	0.13	0.21	.53
Intention to prescribe antibiotics			
Attitude	0.10	0.89	.91
Subjective norms	0.20	0.93	.83
Perceived behavioral control	–0.26	0.89	.79
Proportion of patients from 10 who were estimated to be prescribed antibiotics for a URTI[a]			
Facility	3.09	1.84	.09
Age	1.05	0.37	.004
Sex	5.19	4.09	.20
Work area	0.17	1.56	.91
Professional level	6.96	3.24	.03
Length of employment in the current hospital	0.36	1.64	.83
Overall length of employment in the current position	–0.31	1.31	.81
Training	3.68	4.28	.39
ITRABx[b]	1.66	2.69	.54
ITPABx[c]	Constrained	Constrained	Constrained
Proportion of weekly visits during which physicians estimated they would prescribe antibiotics			
Facility	1.19	2.31	.61
Age	1.53	0.46	.001
Sex	11.15	5.16	.03
Work area	–2.83	1.97	.15
Professional level	9.69	4.08	.02
Length of employment in the current hospital	1.97	2.07	.34
Overall length of employment in the current position	–1.03	1.65	.53
Training	–8.13	5.39	.13
ITRABx	2.88	3.38	.39
ITPABx	0.65	0.78	.41

[a]URTI: upper respiratory tract infection.

[b]ITRABx: intention to reduce antibioitcs.

[c]ITPABx: intention to prescribe antibiotics.

Discussion

AMR is a global crisis [27,29-32], calling for urgent action to resolve it. One of the important strategies for combating AMR is improving antibiotic prescribing practices by determining factors that affect physicians' prescribing behaviors [10,11,14]. Physicians' antibiotic prescribing practices are influenced by physician-related factors (knowledge, expertise, specific prescription patterns, time constraints, and communication with patients), patient-related factors (preferences, expectations, knowledge, culture, economic status, and previous experience), and health system–related factors (guidelines, policies, regulations, and financial incentives) [24]. Thus, the TPB in its original or modified (MTPB) form provides a theoretical framework to identify the determinants of physicians' antibiotic prescribing behaviors [14,15,33]. This study, using SEM, confirmed the theoretical framework for physicians' antibiotic prescribing behaviors with some modifications. The MTPB model revealed that physician knowledge was associated with PBC and SN (*P*<.001). However, attitudes, SNs, and PBC did not influence intentions around prescriptions and perceived prescribing behaviors of physicians. Overall, the study revealed that physicians' perceived antibiotic prescribing behaviors were not affected by intentions to reduce and prescribe antibiotics.

A qualitative study in Ethiopia uncovered that "junior physicians (interns and residents) are more likely to prescribe broad-spectrum antibiotics, and they further speculate these practices are driven by poor knowledge" [27]. In this, 121 (65.4%) of the 185 physicians had good knowledge (answered 5 questions out of 11), although the respondents answered only 44.13% of the total questions about antibiotic prescriptions correctly. This was relatively low compared with the 55% to 86% for physicians in hospitals in China [14,15], Lao People's Democratic Republic, Democratic Republic of Congo, and Peru [34-36]. In this study, MTPB knowledge was directly linked with the PBC and SNs of physicians (*P*<.05). This was different than the findings of a study in China that reported a link between high knowledge and positive attitudes toward the rational use of antibiotics [14,15] but similar to a study that reported a link between high knowledge and decreased SNs to prescribe antibiotics [14]. This study revealed a lack of indirect links between knowledge and antibiotic prescribing behavior, which was similar to a study in China that reported a lack of a link between knowledge and antibiotic prescribing practices [14,15]. Knowledge helps physicians weigh the treatment options and increases the accuracy of risk perception; thus, physicians with different professional titles (such as resident physicians and general practitioners) and length of practice may have different attitudes toward antibiotics, based on findings in previous studies [37,38]. Although training can contribute to knowledge acquisition, this study revealed a lack of difference in knowledge between those who completed training on antibiotic prescribing and AMR and those who did not.

This study also revealed a lack of a link between attitudes, SNs, and PBC to prescribe antibiotics. This was different from a report in China that confirmed that "intentions to prescribe antibiotics are predicted by the attitudes, subjective norms, and sense of behavioral control of the prescribers" [33], although another study reported a lack of relationship with intentions to prescribe antibiotics [14,15]. It was reported that attitudes, SNs, and PBC were predictors of antibiotic prescribing behaviors [11,39]. However, this study did not show indirect relationships between attitudes, SNs, and PBC and prescribers' perceived antibiotic prescribing behaviors.

Of the patients seen in the OPDs weekly, 54.8% were estimated to receive at least one antibiotic, and of the 1850 estimated patients who presented with a URTI, 916 (49.5%) were estimated to be prescribed at least one antibiotic. In Ethiopia, antibiotic prescribing ranges from 56.0% in primary health care facilities [40] to 73.7% in inpatient wards in the national referral hospital [41]. The majority of the prescriptions (32.9%-39.3%) were for respiratory tract infections, although about 54.2% of all antibiotic prescriptions might not be needed [27]. This could explain the high rates of perceived antibiotic prescriptions for outpatient visits and patients with URTIs in this study. In ambulatory care facilities in Tanzania, 95% to 96.3% of presenting cases were receiving at least one antibiotic [42], which is higher than the estimated prescriptions among weekly visits and patients with URTIs in this study. Another study in the same hospital reported 66.9% of patients were treated with or prescribed at least one antibiotic among weekly visits [28], which was higher than the perceived weekly prescriptions and prescriptions for URTIs in this study. A study in China reported that physicians prescribed antibiotics to an estimated 40% of patients with URTIs [14], and actual antibiotic prescribing behavior was 44.3% [33], both of which are lower than the rates in this study.

In this study, intention to reduce antibiotic use and intention to prescribe antibiotics were not linked with perceived antibiotic prescribing behaviors. Similar findings from China supported the limited role of intentions on antibiotic prescribing behavior [33]. Intraphysician prescription variability is affected by the availability of clinical guidelines, experience, peer prescribing practices, pharmaceutical pressure, time pressure, financial considerations, individual practice patterns, practice volume, and relationships with patients [24]. Differences in these factors might explain the discrepancy in the findings from this study and those from a study in China [33], which reported that a positive attitude toward antibiotics resulted in a higher intention to prescribe antibiotics. The difference might be due to differences in the type of patients, clinical practice, and availability of structural and process controls in antibiotic prescribing. Two studies, one in Eritrea and one in Ethiopia, confirmed this by reporting that patient age (<18 years), gender (male), and the number of drugs in a prescription (≥2) were associated with the prescription of antibiotics [43,44]. Thus, physicians in different health systems may be subjected to different working environments and social pressures, which could affect their overall intention to prescribe and prescribing behavior.

In general, this study uncovered a lack of volitional control among physicians when prescribing antibiotics. This indicates the complex nature of antibiotic prescribing practices, which are influenced by various factors [24]. Thus, a campaign is needed to reduce over-prescriptions of antibiotics using a systems approach to addressing gaps in the knowledge and attitudes of prescribers [33]. Introducing educational programs and training on antibiotic prescribing practices and antibiotic resistance, preparing targeted guidelines to address gaps in antibiotic prescriptions for URTIs, and involving specialists will help address the gaps in antibiotic prescribing [24,33,45]. Providing antibiotics as a universal therapy due to gaps in knowledge and skills and financial or reputational incentives on the one hand and a lack of antibiotic and poor facility regulations, the absence of a regulatory framework, and poor implementation of existing policies on the other hand might be drivers of inappropriate antibiotic prescriptions [46]. Thus, disease-specific prescribing guidelines like those for URTIs can facilitate the translation of intentions into practices, since the inability to make a clear diagnosis and over-prescription of antibiotics may be linked with physicians' clinical capacity rather than behavioral control intentions [24]. Despite this, self-regulation, outcome expectation, and anticipation of possible barriers may still have a considerable effect on prescribing behaviors and will help reduce inappropriate antibiotic use, since inappropriate prescribing of antibiotics in ambulatory care is known to be linked to current knowledge on antibiotics, ASPs, and AMR among prescribers [42].

Therefore, ASPs must have fiduciary responsibility for all health care institutions across the continuum of care [47]. A comprehensive approach through a hospital policy on the rational use of antibiotics is essential to developing and implementing an evidence-based antibiotic use policy and standard treatment guidelines for common infectious diseases, improving antimicrobial prescribing through educational and administrative means, and monitoring and providing feedback regarding antibiotic resistance, all of which are strategic approaches [48]. Knowledge of determinants that influence antibiotic prescription behavior is essential for the successful implementation of antimicrobial stewardship interventions [49]. In Ethiopia, at present, there are limited or no national or coordinated legislative or regulatory mandates designed to optimize the use of antimicrobial therapy through ASPs [6,26]. This research on behavioral determinants may have a substantial impact on designing policies on antibiotic prescribing behaviors and implementing effective, efficient, and evidence-based interventions. It urges strengthening efforts to improve prevention and control efforts for infectious diseases, including the adoption of ASPs in all health care facilities. Research is also needed to define the optimal elements and goals of ASPs in different health care settings; expand educational efforts on ASP; devise novel mechanisms to prevent the over-prescription of antibiotics; and implement rapid, point-of-care diagnostic tests that would enable appropriate prescription and care.

Overall, this study will help understand prescribing behaviors by applying the TPB model and will be helpful for regulating prescribing behaviors, improving clinical management, promoting physician-patient communication, and establishing a harmonious physician-patient relationship to improve rational prescribing behaviors in delivering high-quality medical services. Policymakers should also consider multiple scenarios rather than merely concentrating on creating awareness. The model can hopefully be incorporated as part of multilevel interventions designed to decrease irrational prescriptions for actual patients. Furthermore, it might help initiate a nationwide survey on factors affecting antibiotic prescribing behaviors, and more research is needed to explore the views of other stakeholders on antibiotic use. Although this study presents opportunities for future studies in the country, it does have its limitations. The sample size was relatively small, and self-administered questionnaires may not provide the possibility for respondents to verify their answers, resulting in socially desirable answers. Due to a lack of records for antibiotic prescriptions, it was not possible to determine the actual antibiotic prescribing behaviors of physicians. Another limitation might be that it did not include all comprehensive physician-related factors (expertise, knowledge, specific prescription patterns, time constraints, and communication with patients), patient-related factors (knowledge, preferences, expectations, culture, economic status, and previous experience), and health system–related factors (financial incentives, guidelines, policies, and regulations) that influence antibiotic prescribing practices. Thus, further studies using TPB with a large number of physicians are warranted.

In conclusion, there was a high level of estimated antibiotic prescriptions for URTIs and weekly outpatient visits. However, the perceived behaviors around antibiotic prescription were not affected by the intention to prescribe antibiotics or the intention to reduce antibiotic use. Although the physicians had a good level of knowledge about antibiotics, antibiotic resistance, and prescriptions, which were linked with the attitudes and SNs of physicians, intentions to reduce use and prescribe antibiotics were not significantly associated with attitudes, SNs, or PBC. This may show the complex nature of antibiotic prescriptions, which cannot be justified simply by intentions and behaviors of physicians, as determined based on TPB.

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Authors' Contributions

AAA was involved in study conception, study design, study execution, acquisition of data, data analysis and interpretation, manuscript writing, and manuscript review. TGF was involved in study conception, study design, supervision, manuscript writing, and manuscript review. GYW was involved in supervision, manuscript writing, and manuscript review.

Conflicts of Interest

None declared.

Multimedia Appendix 1

Structural equation modelling file.
[ZIP File (Zip Archive), 74 KB-Multimedia Appendix 1]

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Abbreviations

AMR: antimicrobial resistance
ASP: antibiotic stewardship program
CFI: comparative fit index
MTPB: modified theory of planned behavior
OPD: outpatient department
PBC: perceived behavioral control
SEM: structural equation modeling
SN: subjective norm
TPB: theory of planned behavior
URTI: upper respiratory tract infection

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