Original Research Article

Knowledge, Attitude, and Prescription Practice on Antimicrobials Use Among Physicians: A Cross-Sectional Study in Eastern China

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Abstract

Over-prescription of antimicrobials for patients is a major driver of bacterial resistance. The aim of the present study was to assess the knowledge, attitude, and prescription practices regarding antimicrobials among physicians in the Zhejiang province in China, and identify the determining factors. A total of 600 physicians in public county hospitals and township health institutions were surveyed cross-sectionally using a structured electronic questionnaire. The questionnaire was completed by 580 physicians and the response rate was 96.67%. The mean score of 11 terms related to antimicrobial knowledge was 6.81, and an average of 32.1% of patients with upper respiratory tract infections (URTIs) were prescribed antimicrobials. Multivariate analysis indicated that young general practitioners with less training are more likely to contribute to more frequent antimicrobial prescriptions ($P < .05$). In contrast, older physicians with more training are more willing to provide patients with the correct knowledge regarding antimicrobials and less likely to prescribe antimicrobials for URTIs. Correlation analysis showed that the level of physician's knowledge, attitude, and prescription practice is related ($P < .05$). In conclusion, proper prescription of antimicrobials depends on adequate knowledge and regular training programs for physicians.

Keywords

antimicrobials, individual behavior, knowledge–attitude–practice, social determinants, antimicrobials stewardship

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What do we already know about this topic?

The misuse of antimicrobials is a global problem. Due to the insufficient effectiveness of the antimicrobial stewardship system, there is high antimicrobial prescription rate (APR) in some primary health hospitals and county hospitals in China.

How does your research contribute to the field?

There is a high proportion of unnecessary and inappropriate antimicrobial prescriptions among these physicians from sample hospitals. The physicians' performance in related indicators of knowledge, attitude, and prescription practice toward antimicrobials is not ideal.

What are your research's implications towards theory, practice, or policy?

The organizer needs to increase the participation rate of physicians (especially young ones) in each training on antimicrobials use, resistance, and policy. In addition, effective and reasonable incentive and punishment strategies need to be implemented to decrease physicians' APR.

Introduction

Antimicrobial resistance (AMR) is a major public health risk globally.[1] The emergence of multidrug-resistant (MDR) "super bacteria" due to frequent and unnecessary prescription of antimicrobials has increased the risk of morbidity and mortality from infections, leading to greater health expenditure and lower flexibility of therapy regimens. According to recent estimates, the number of deaths due to AMR is expected to rise to 10 million by 2050 and surpass the cancer-related deaths, leading to the loss of around 100 trillion USD worth of global economic output.[2]

As the second largest consumer of antibacterial drugs in the world, the problem of antimicrobial misuse and overuse is particularly severe in China.[3,4]. The prescription of antimicrobials has risen steadily in some provinces,[5,6] and is a major risk factor of AMR development. The antimicrobial prescription rate (APR) in China is twice as that recommended by the World Health Organization,[7] with 52% to 78% of the prescriptions for inpatients including at least 1 antibiotic[8,9] compared to 30% in some developed countries.[10] In addition, several studies conducted across China in recent years have reported higher frequency of antimicrobial prescription in the rural areas compared to the urban and economically more prosperous regions.[9,11]

In China, the objective of physicians depends on the level of the hospital. According to the requirements of the hierarchical diagnosis and treatment system, physicians from provincial and municipal hospitals mainly treat patients who cannot be treated by county hospitals. Similarly, physicians from county hospital treat patients who cannot be treated by township health institutions. In addition, it is stipulated that more than 90% of essential medical services for rural residents are provided by physicians from county hospitals and township health institutions. However, the decision to include antimicrobials in a patient's treatment regimen is solely made by the resident physician due to the absence of clinical pharmacists in most county and township care facilities. Due to insufficient knowledge, incorrect attitude, patient insistence, and monetary incentives, the frequency of inappropriate and unnecessary antimicrobial prescriptions is very high in these facilities.[12,13] Although Chinese health authorities have issued prescription guidelines to alleviate antimicrobial overuse and misuse, they have not been successful in rural areas.[13,14] Therefore, the aim of this study was to assess the knowledge, attitude, and prescription habits of physicians regarding antimicrobials in these facilities, and identify the underlying determinants. Findings from this study may help provide reference for future interventions to reduce the abuse of antimicrobials and tackle the growing problem of AMR in China.

Methodology

Settings and Participants

Zhejiang province is located in eastern China and has a population of 58.50 million. It ranked fourth in terms of per capita GDP in 2019 among all provinces or municipalities in mainland China. According to "*resistance reported from China antimicrobial surveillance network (CHINET) in 2019*," nearly half of the drug-resistant bacteria analyzed so far in China have been detected in Zhejiang (6/13), which is above the national average. Furthermore, the *report on the status of antibacterial drug management and bacterial resistance in China (2018 version)* stated that the APR of inpatients in Zhejiang exceeded the national average.[15]

A total of 600 physicians from township health institutions and county hospitals of Zhejiang province were included in

this cross-sectional study. Only physicians who are authorized to prescribe drugs were included in our study. Clinical interns, nurses, and administrative staff in these facilities were excluded, but physicians who hold part-time administrative positions in some township health institutions met the inclusion criteria.

Questionnaire Design

All participants were instructed to complete a structured electronic questionnaire consisting of the following 4 parts: 1) personal information: type of hospital, city, age, clinical experience, gender, level of education, professional title, medical sub-specialization, and training times; 2) knowledge of antimicrobials: eleven structured questions including 5 from a previous study,[16] 2 associated with the national policy, 2 each related to basic pharmacology and the selection of appropriate antimicrobial for specific populations, and 3 related to simple and 2 to complex clinical practices; 3) physicians' attitude: a 13-item five-point Likert scale[17,18] evaluating complacency (prescribing antimicrobials to satisfy patients' demands and expectations), avoidance of responsibility (the belief that the patients, healthcare system, and other professionals are responsible for the problem of AMR), fear (prescribing antibiotics for fear of potential disputes with the patient), and ignorance (lack of concern for the problem of AMR caused by over-prescription of antimicrobials); and 4) prescription practice: 4 regarding prescription behavior, 3 medication guidance, and 2 self-learning. Cronbach's α was used to assess the reliability of the questionnaire, and the value of 7.18 indicated reliability. Survey instruments (translated version) are shown in Supplemental Table S1. This study was approved by the research ethics committee of the Hangzhou Medical College. All participants provided written informed consent.

Data Collection and Quality Control

The *Wen Juan Xing* electronic questionnaire platform was used for the survey. During July to August 2020, Zhejiang Provincial Health Commission successively carried out continuing education for physicians in county hospitals and township health institutions. This opportunity was used to carry out this survey. The sample size was calculated using Kendall's method wherein the total sample size is not less than 10 times the number of variables. Since our questionnaire contained 33 variables, the minimum number of respondents required was 330. Taking into account factors such as data invalidity, elimination, and loss, the sample size was expanded by 20% to 396. A total of 600 physicians were sent the internet link or QR code of the electronic questionnaire. In order to ensure data quality, professional investigators were employed to respond to the queries of subjects, a monetary incentive was provided to the personnel to complete the entire questionnaire, and questionnaires that were completed in less than 2 minutes, lacked key data, or were repeatedly filled were excluded.

Data Analysis

Each correct answer to the questions regarding knowledge was given a score of 1. The responses to other items ranged from "strongly disagree" to "strongly agree," corresponding to scores of −2 to 2. Finally, the responses ranging from "never" to "always" were scored from 1 to 5. The scores of each item were added and that of the subgroups were calculated. SPSS Statistics 17.0 (IBM, Chicago, USA) and Excel 2016 (Microsoft, New York, USA) were used for all data analysis. Independent sample t test, ANOVA, or Kruskal–Wallis rank tests were used to compare the difference between gender, level of education, professional title, medical sub-specialization, training times, types of institute and income toward knowledge, attitude, and prescription practice. Linear regression analysis was used to evaluate the correlation between age and knowledge, attitude and prescription practice. Stepwise algorithm was used in the multiple linear regression analysis to identify the independent factors. Pearson correlation test was used to determine the association between knowledge, attitude, and prescription practice. P value less than .05 was considered statistically significant.

Results

Participant Characteristics

A total of 580 physicians completed the questionnaire, resulting in effective response rate of 96.67%. The mean age of the respondents was 39.74 years ± 9.03, and 56.55% [328/580] were females. Over half of the respondents (60%) were from township health institutions, and the education level of most respondents (74.83%) was a bachelor degree or above. The average years of clinical experience were 17.31 ± 10.06 years and 67.41% of the physicians had received more than 3 trainings regarding antimicrobials. On average, the respondents answered 6.81 questions correctly (SD = 1.85) out of a total of 11 questions and reported that they would prescribe antimicrobials to about 32.1% (SD = 20.5%) of patients with URTIs. Other information of participants' characteristics and the scores of other categories are summarized in Supplemental Table S2.

Univariate Analysis

Male subjects scored lower for knowledge (MD: −.43, P = .005) and showed less concern for the problem of AMR (MD: −.61, P < .001) compared to the female subjects. Older respondents with longer clinical experience scored higher for knowledge, ignorance, fear, complacency, prescription behavior, medication guidance, and self-learning, and had a low APR for URTIs. The respondents with higher income or higher education scored satisfactorily for the items regarding ignorance, complacency, medication guidance, self-learning, and knowledge. Compared to junior doctors, associate senior

Table 1. Demographic Characteristics of Surveyed Physicians and Their Knowledge, Attitude, and Prescription Practice Toward Antimicrobials.

Variables	Total, N/mean ± SD	Ignorance, MD/B (95% CI)	Avoidance of responsibility, MD/B (95% CI)	Fear, MD/B (95% CI)	Complacency, MD/B (95% CI)	Prescription behavior, MD/B (95% CI)	Medication guidance, MD/B(95% CI)	Self-learning, MD/B (95% CI)	Knowledge, MD/B (95%CI)	Prescribe Antimicrobials for URTIs, MD/B (95%CI)
Gender										
Female	252	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Male	328	−.61 (−.87,−.34)**	−.11 (−.51,0.28)	−.30 (−.67,0.08)	−.12 (−.41,0.17)	−.01 (−.39,0.36)	−.28 (−.66,0.11)	.05 (−.21,0.31)	−.43 (−.73,−.12)**	.03 (−.31,0.37)
Age (year)	39.74±9.03	.04 (.03,0.06)**	−.01 (-.03,0.01)	.03 (.01,0.05)**	.03 (.02,0.05)**	.04 (.02,0.06)**	.05 (.03,0.07)**	.02 (.01,0.03)**	.07 (.05,0.08)**	−.04 (−.05,−.02)**
Level of education										
High vocational training and below	146	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Bachelor degree and above	434	.42 (.11,0.73)**	−.17 (−.63,0.28)	.21 (−.22,0.63)	.40 (.07,0.73)*	.328 (−.10,0.76)	.49 (.05,0.93)*	.41 (.11,0.70)**	.84 (.50,1.18)**	.17 (−.21,0.56)
Professional title										
Junior doctor	229	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Attending doctor	188	.57 (.26,0.88)**	−.31 (−.78,0.15)	−.12 (−.56,0.33)	.05 (−.29,0.39)	.14 (−.30,0.58)	.54 (.086,0.98)*	.22 (−.08,0.53)	1.09 (.76,1.42)	−.25 (−.65,−.14)
Associate senior or senior consultant	163	1.12 (.80,1.44)**	.07 (-.42,0.56)	.03 (-.43,0.49)	.50 (.14,0.85)**	.67 (.22,1.13)**	.66 (.19,1.12)**	.58 (.27,0.90)**	1.70 (1.35,2.04)	−.50 (−.91,−.09)*
Clinical experience (years)	17.31±10.06	.04 (.02,0.05)**	−.01 (−.03,0.01)	.03 (.0,0.04)**	.02 (.01,0.04)**	.031 (.01,0.05)**	.04 (.02,0.06)**	.02 (.01,0.03)*	.06 (.05,0.07)	−.03 (−.04,−.01)**
Medical sub-specialization										
General practitioner	356	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Chinese medical practitioner	63	.07 (−.37,0.52)	.30 (−.35,0.95)	1.01 (.40,1.62)**	.75 (.29,1.22)**	.75 (.14,1.35)*	.19 (−.44,0.82)	.33 (−.10,0.75)	−.37 (−.87,0.13)	−.225 (.77,0.33)
Others	161	.17 (−.14,0.48)	.49 (.04,0.94)	.35 (−.08,0.77)	.59 (.26,0.91)**	.74 (.32,1.16)**	−.16 (−.60,0.27)	.29 (−.01,0.58)	.01 (−.34,0.35)	−.197 (−.58,0.19)
Training times										
0	43	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
1	71	.85 (.24,1.46)**	−.86 (−1.78,0.06)	−.24 (−1.10,0.63)	−.01 (−.67,0.65)	.55 (−.31,1.41)	.74 (−.14,1.6)	.04 (−.55,0.64)	.98 (.33,1.62)**	.07 (-.69,0.84)
2	75	.94 (.33,1.55)**	−.33 (−1.24,0.58)	.373 (−.48,1.23)	.20 (−.45,0.85)	.46 (−.39,1.31)	.61 (−.26,1.47)	.28 (−.31,0.87)	1.68 (1.03,2.32)**	−.25 (−1.01,0.51)
≥3	391	1.41 (.90,1.92)**	−.42 (−1.18,0.34)	.55 (−.17,1.26)	.80 (.24,1.33)**	1.13 (.41,1.84)**	1.46 (.74,2.19)**	.70 (.20,1.19)**	2.35 (1.82,2.90)**	−.87 (−1.51,−.23)**
Types of institute										
Township health institutions	348	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Country hospital	232	.38 (.11,0.66)**	−.20 (−.60,0.20)	−.15 (−.53,0.23)	.425 (.13,0.72)	.41 (.03,0.79)*	.43 (.04,0.81)*	.40 (.13,0.66)**	1.18 (.88,1.47)**	−.02 (−.36.0,33)
Income										
≤4000	125	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
4001–6000	223	.54 (.18,0.89)**	−.162 (−.69,0.37)	.15 (−.35,0.65)	.32 (−.06,0.71)	.271 (−.23,0.77)	.06 (−.45,0.57)	.14 (−.20,0.49)	.78 (.40,1.17)**	.01 (−.44,0.46)
6001–8000	132	.76 (.37,1.16)**	−.64 (−1.23,−.05)*	−.27 (-.83,0.29)	.19 (-.62,0.24)	.211 (−.35,0.77)	.60 (−.03,1.17)	.59 (.21,0.98)**	1.18 (.74,1.61)**	.07 (−.43,−.58)
≥ 8001	100	1.28 (.85,1.70)**	.18 (−.46,0.81)	−.01 (−.62,0.59)	.55 (.08,1.01)*	.408 (−1.01,0.19)	.57 (−.050,1.18)	.53 (.12,0.95)*	1.61 (1.14,2.08)**	−.22 (−.77,0.32)

Note: N: number; SD: standard deviation; MD: mean difference; B: regression coefficients; CI: confidence interval; *:$P < .05$; **:$P < .01$.
Note: r: Correlation coefficient; *:$P < .05$; **:$P < .01$.

Table 2. Multiple Linear Regression Analysis for the Characteristics Associated With Physicians' Knowledge, Attitude, and Practice.

Variables	Ignorance, B (95% CI)	Avoidance of responsibility, B (95% CI)	Fear, B (95% CI)	Complacency, B (95% CI)	Prescription behavior, B (95% CI)	Medication guidance, B (95% CI)	Self-learning, B (95% CI)	Knowledge, B (95% CI)	Prescribe antimicrobials for URTIs, B (95% CI)
Gender	−.41 (−.68,−.15)**		−.45 (−.83,−.07)*						
Age (years)			.04 (.02,0.06)**	.07 (.02,0.12)**	.03 (.01,0.05)**	.04 (.02,0.06)**		.03 (.01,0.05)**	−.02 (−.04,−.004)*
Professional title	.39 (.22,0.57)**							.36 (.15,0.56)**	
Clinical experience (years)				−.046 (−.09,−.003)*					
Medical sub-specialization		.25 (.03,0.47)*		.28 (.12,0.44)**	.37 (.16,0.58)**			−.21 (−.36,−.06)**	
Training times	.24 (.09,0.38)**			.24 (.08,0.39)**	.24 (.03,0.44)*	.33 (.12,0.53)**	.23 (.10,0.37)**	.41 (.26,0.57)**	−.37 (−.54,−.20)**
Types of institute								.83 (.57,1.12)**	
Income							.15 (.02,0.29)*		

Note: B: regression coefficients; CI: confidence interval; *:$P < .05$; **:$P < .01$.

Table 3. Correlation Analysis Between Knowledge, Attitude, and Practice.

Variables	Ignorance, r	Avoidance of responsibility, r	Fear, r	Complacency, r	Prescription behavior, r	Medication education, r	Self-learning, r	Prescribe antibiotics for URTIs, r
Knowledge	.228**	−.005	.051	.141**	.157**	.183**	.129**	−.124**
Ignorance	/	/	/	/	.206**	.142**	.101*	−.129**
Avoidance	/	/	/	/	.103*	−.109**	−.068	−.07
Fear	/	/	/	/	.513**	.039	.015	−.407**
Complacency	/	/	/	/	.543**	.149**	.105*	−.430**

Note: r: Correlation coefficient; *:$P < .05$; **:$P < .01$.

consultants or senior consultants gave more precise answers for ignorance, complacency, prescription practice, medication guidance, self-learning, and knowledge items (MD = 1.12, .5, .67, .66, .58, and 1.7, respectively), and had a low APR for URTIs (MD = −.50, $P = .017$). Respondents that received more than 3 trainings and worked in township health institutions scored higher for ignorance, complacency, prescription practice, medication guidance, self-learning, and knowledge. The data are summarized in Table 1.

Multivariate Analysis

Attitude. Female respondents with lower professional title and less training did not show any concern regarding the problem of AMR. General practitioners (GPs) were more likely to shirk responsibility ($P = .03$), whereas male and younger physicians were more likely to prescribe antimicrobials to patients due to fear of potential disputes. GPs and younger respondents with longer clinical experience and less training are more likely to prescribe antimicrobials to satisfy patients' demands and expectations (Table 2).

Practice. The position of GP (B = .37, $P < .001$), younger age (B = .07, $P = .004$), and less training (B = .24, $P = .023$) were risk factors of inappropriate antimicrobial prescription, and the physicians with younger age (B= .04, $P < .001$) and less training (B = .33, $P = .002$) were unwilling to provide patients with the correct knowledge regarding antimicrobials during consultation ($P < .01$). The physicians with more training (B = .233, $P = .001$) and higher income (B = .153, $P = .024$) were highly likely to improve their knowledge through self-learning. In addition, physicians with less training (B = −.372, $P < .001$) and younger age (B = − .024, $P = .015$) more inclined to prescribe antimicrobials for URTIs (Table 2).

Knowledge. Older age (B = .03, $P = .001$), higher professional title (B =.356, $P = .001$), GP position (B = −.209, $P = .008$), more training (B = .414, P < .001), and working in county hospitals (B = .831, $P < .001$) were associated with higher knowledge scores (Table 2).

Correlation Analysis

The Pearson correlation test showed that physicians with higher knowledge scores had a positive attitude for ignorance (r = .228, $P < .001$) and complacency (r = .141, $P = .001$), and positive performance in prescribing antimicrobials (r = .157, $P < .001$), medication guidance (r = .183, $P < .001$), and self-learning (r = .129, $P < .001$). Physicians who were concerned about the AMR problem prescribed antimicrobials more reasonably (r = .206, $P < .001$), and scored high for medication guidance (r = .142, $P = .001$) and self-learning (r = .206, $P = .015$). In addition, knowledge and attitude parameters except avoidance of responsibility correlated positively with the practice of prescribing antimicrobials for URTIs. More details are shown in Table 3.

Discussion

In 2015, the Chinese government began to develop a hierarchical medical system in public hospitals with the aim of achieving fair access to basic medical and health services.[19] One major change was to merge a county hospital and several township health centers in the same area into a "County Medical Community" in order to improve the quality of medical services in rural areas. This ensured treatment of patients at different level hospitals depending on their condition. Therefore, physicians from township health institutions and county hospitals were equally considered in this study.

To the best of our knowledge, this is the first study based on the KAP model to explore the knowledge, attitude, and prescription practices regarding antimicrobials among physicians working in county hospitals and township health institutions, and evaluate the association between these parameters. Our survey indicated that government-organized trainings can improve physicians' knowledge, and establish a relatively positive attitude toward prescribing antimicrobials. Second, although GPs have better knowledge, they are more likely to avoid responsibility for AMR and prescribe antimicrobials indiscriminately to satisfy patients' expectations. Finally, the respondents reported that an average of 3.21 out of ten patients with URTIs would be prescribed antimicrobials by them.

The surveyed participants exhibited an overall moderate knowledge regarding antimicrobials, and correctly answered 61.9% of the questions (6.8 of 11) on an average. This is similar to 55% and 62.2% correct responses reported by recent surveys conducted in Hubei and across China, respectively.[12,15] Most physicians could answer basic questions such as the main ADR of penicillin or antibacterial mechanism of β-lactams, but exhibited poor knowledge regarding clinical practice or policy regulations. This indicates greater reliance on theoretical rather than practical knowledge, as well as lack of coordination with existing policies. Previous studies show that medical students or prospective physicians in China are poorly informed about antimicrobials before they begin clinical practice.[20,21] Clinical experience and training may help improve their level of knowledge, which is consistent with the higher knowledge scores of older physicians and those with higher professional titles in our survey. However, a recent study conducted in South Africa showed completely opposite results.[22] To the best of our knowledge, this is the first study that fully considers the association between training and knowledge, attitude, and prescription practice. Our findings indicate that government-organized training can significantly improve physicians' knowledge of antimicrobials. Nevertheless, 7.4% of the surveyed physicians had not received any training.

Although physicians can resist the pressure from patients and colleagues, they held the belief that the health system, patients, and retail pharmacies should be responsible for AMR. According to China Health Commission data, antimicrobials are prescribed over 50 times daily for every 100 patients in Zhejiang, and more than 50 antimicrobials have been prescribed in 2017.[15] Moreover, this number may be seriously underestimated in township health institutions after interviewing experts. Therefore, the surveyed physicians' attitude that others are responsible for AMR is regarded as a performance of avoidance responsibility. Interestingly, female physicians were more likely to be concerned about AMR and resist pressure from patients compared to their male counterparts. A previous study also reported that female physicians were less likely to prescribe antibiotics.[23] In addition, given the strong correlation between knowledge and ignorance/complacency, training programs may indirectly establish correct attitudes by improving the physicians' knowledge.

The average APR of the surveyed physicians for URTIs was 32.1%, which is lower compared to 44.7% reported in Croatia[24] and 53% in South Korea,[25] but not recommended in the clinical practice guidelines of USA and UK.[26,27] In addition, physicians who have participated in more than 3 government-organized trainings were more cautious in prescribing antimicrobials to patients with URTIs. Training is a simple and low-cost intervention method, and its effectiveness has also been proven in some studies in China.[28] However, we found that the effect of fewer than 3 training sessions did not significantly change the prescription behavior of the physicians. This suggests that periodic training strategies need to be established in the daily work of physicians.

The generally poor knowledge of antimicrobials among the inhabitants of rural areas has led to severe antimicrobials overuse[29] such as self-medication, asking physicians for drugs, and replacing other drugs during the course of treatment without consulting the physician.[30] Therefore, it is extremely important for physicians to inform patients about rational use of antimicrobials and improve their awareness regarding AMR. The surveyed physicians performed moderately in this aspect, and those that refused to accede to patients' demands for antimicrobials were more likely to provide medication guidance. In addition, keeping abreast of the latest developments in AMR is also vital for rational drug prescription.[31] However, since the income of a physician may limit the extent of self-learning, hospitals should provide physicians with free learning resources.

There are several limitations in this study that ought to be considered. Since the health policies differ across the provinces in China and our study was conducted in the Zhejiang province, the results should be cautiously summarized. In addition, the knowledge scores may have been slightly overestimated since respondents may have searched for answers online.

Conclusion

The surveyed physicians had a moderate level of knowledge regarding antimicrobials prescription, which was positively associated with their training history. Centralized training can not only improve physicians' knowledge but also establish proper attitudes in prescribing antimicrobials, providing guidance to patients and self-learning. Training-based comprehensive strategies are needed to improve prescription habits of physicians. Future studies should focus on analyzing real-world data, such as actual prescriptions and assessment of patient attitudes, to objectively determine the current situation and determinants. Since the data were collected on the basis of self-reporting by the physicians, the respondents may have been more inclined to choose answers that benefited them and thus increase the risk of recall bias.

Declaration of conflicting interests

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Ethical approval

This study was approved by the research ethics committee of the Hangzhou Medical College.

Informed consent

All participants provided written informed consent before data collection.

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Supplemental Material

Supplemental material for this article is available online.

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