

Knowledge, Attitude and Prescription Practice on Antimicrobials Use among Physicians: A Cross-sectional Study in Zhejiang, China

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Abstract

Introduction: 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 in relation to antimicrobials among physicians in the Zhejiang province in China, and identify the determining factors. **Methods:** A total of 600 physicians in public county hospitals and township health institutions were surveyed cross-sectionally using a structured electronic questionnaire. **Results:** The questionnaire was completed by 580 physicians and accordingly, the response rate was 96.67%. The mean score of 11 terms related to antimicrobial knowledge was 6.81, and that an average of 32.1% of patients with upper respiratory tract infections (URIs) would be prescribed antimicrobials. Multivariate analysis indicated that young general practitioners with less training are more likely to contribute to high antimicrobial prescriptions ($P < 0.05$). Older physicians with more trainings are more willing to provide patients with the correct knowledge regarding antimicrobials and less likely to prescribe antimicrobials to URIs. The results of the correlation analysis showed that a positive connection was found between the doctor's knowledge, attitude and prescription practice ($P < 0.05$). **Conclusion:** Proper prescription of antimicrobials depends on adequate knowledge and regular training programs for physicians.

1 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 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 that of 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 [5, 6], with 52% to 78% of the prescriptions for inpatients including at least one antibiotic [8, 9] compared to 30% in some developed countries [10]. In addition, there is empirical evidence showing higher frequency of antimicrobial prescription in the rural areas of China compared to the urban and economically more prosperous regions [9, 11]. Although township health institutions and county hospitals provide most of the essential healthcare services to the rural residents, the frequency of inappropriate and unnecessary antimicrobial prescriptions is very high in these centers [12, 13]. The decision to include antibiotics in a patient's treatment regimen is solely made by the resident physician in the absence of clinical pharmacists. Therefore, guidelines for regulating prescriptions can alleviate the issue of antimicrobial overuse and misuse, although they have not been successful in rural areas [12, 13]. Physicians prescribe excessive antimicrobials due to various reasons

including insufficient knowledge, incorrect attitude, patient insistence and monetary incentives. Therefore, the formulation of relevant policies should take into account these factors.

Zhejiang province is located in eastern China and has a population of 58.50 million. It ranked 4th 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]. The aim of this study was to assess the knowledge, attitude and prescription habits of physicians in the Zhejiang province regarding antimicrobials, and identify the underlying determinants.

2 METHODOLOGY

2.1 Study sample and questionnaire design

A total of 600 physicians from township health institutions and county hospitals of Zhejiang province were included in this cross-sectional study from July to August 2020. All participants were instructed to complete a structured electronic questionnaire consisting of the following four 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 practice; 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, health care 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); 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) was showed in S1. This study was approved by the research ethics committee of the Hangzhou Medical College. All participants provided written informed consent.

2.2 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 repeatedly filled were excluded.

2.3 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” was 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 0.05 was considered statistically significant.

3 RESULTS

3.1 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 $39.74 \text{ years} \pm 9.03$, 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 was 17.31 ± 10.06 years and 67.41% of the physicians had received more than 3 trainings regarding antimicrobials. All information is summarized in Table 1.

3.2 Univariate analysis

Male subjects scored lower for knowledge (MD: -0.43, $P = 0.005$) and showed less concern for the problem of AMR (MD: -0.61, $P < 0.001$) 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 URIs. 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 consultants or senior consultants gave more precise answers for ignorance, complacency, prescription practice, medication guidance, self-learning, and knowledge items (MD=1.12, 0.5, 0.67, 0.66, 0.58 and 1.7 respectively), and had a low APR for URIs (MD=-0.50, $P = 0.017$). Respondents that received more than three trainings and worked in township health institutions scored higher for ignorance, complacency, prescription practice, medication guidance, self-learning and knowledge. The data is summarized in Table 1.

3.3 Multivariate analysis

Attitude

Female respondents with lower job title and less training did not show any concern regarding the problem of AMR. General practitioners (GPs) were more likely to shirk responsibility ($P = 0.03$), 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 ($B = 0.37$, $P < 0.001$), younger age ($B = 0.07$, $P = 0.004$) and less training ($B = 0.24$, $P = 0.023$) were risk factors of inappropriate antimicrobial prescription, and the physicians with younger age ($B = 0.04$, $P < 0.001$), less training ($B = 0.33$, $P = 0.002$) were unwilling to provide patients with the correct knowledge regarding antimicrobials during consultation ($P < 0.01$). The physicians with more trainings ($B = 0.233$, $P = 0.001$) and higher income ($B = 0.153$, $P = 0.024$) were highly likely to improve their knowledge through self-learning. In addition, physicians with less training ($B = -0.372$, $P < 0.001$) and younger age ($B = -0.024$, $P = 0.015$) more inclined to prescribe antimicrobials for URIs. (Table 2)

Knowledge

Older age ($B = 0.03$, $P = 0.001$), higher professional title ($B = 0.356$, $P = 0.001$), GP ($B = -0.209$, $P = 0.008$), more trainings ($B = 0.414$, $P < 0.001$) and working in county hospitals ($B = 0.831$, $P < 0.001$) were associated with higher knowledge scores. (Table 2)

3.4 Correlation analysis

The Pearson correlation test showed that physicians with higher knowledge scores had a positive attitude for ignorance ($r=0.228, P<0.001$) and complacency ($r=0.141, P=0.001$), and positive performance in prescribing antimicrobials ($r=0.157, P<0.001$), medication guidance ($r=0.183, P<0.001$) and self-learning ($r=0.129, P<0.001$). Physicians who were concerned about the AMR problem prescribed antimicrobials more reasonably ($r=0.206, P<0.001$), and scored high for medication guidance ($r=0.142, P=0.001$) and self-learning ($r=0.206, P=0.015$). In addition, knowledge and attitude parameters except avoidance of responsibility were correlated positively with the practice of prescribing antimicrobials for URIs. More details was shown in Table 3.

4 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 measure is that a county hospital and several township health centers in the same area was merge into one institution, naming as “County Medical Community”, aiming to improve the quality of medical services in rural areas. Which means that a patient may receive treatment from different level hospitals according to the deterioration or alleviation of their condition. Therefore, physicians from township health institutions and county hospitals need to be considered in this study equally.

To our knowledge, this is the first study based on the KAP model to explore the knowledge, attitude and prescription practice regarding antimicrobials among physicians working in county hospitals and township health institutions, and evaluate the association between the three parameters. Our survey indicated that government-organized trainings can improve physicians’ knowledge, and establish a positive attitude towards prescribing antimicrobials. Secondly, 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 the respondents reported that an average of 3.21 out of ten patients with URIs would be prescribed antimicrobials by them.

4.1 Knowledge

The surveyed participants exhibited an overall moderate knowledge regarding antimicrobials, and correctly answered 61.9% of the questions (6.3 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. 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. Empirical evidence shows 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 and highly qualified physicians 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.

4.2 Attitude

The surveyed physicians were generally receptive to the demands of patients and colleagues, and held the belief that the health system, patients and retail pharmacies are 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 antibacterial drugs have been prescribed so far [15]. Nevertheless, this number may be seriously underestimated in township health institutions since the physicians may not have objectively evaluated their habit of prescribing antimicrobials. 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 [22]. In addition, given

the strong correlation between knowledge and ignorance/complacency, training programs may indirectly establish correct attitudes by improving the physicians' knowledge.

4.3 Prescription practice

The average APR of the surveyed physicians for URIs was 32.1%, which is lower compared to 44.7% reported in Croatia[24] and 53% in USA [24], but not recommended in the clinical practice guidelines of USA and UK [26, 27]. In addition, physicians who have participated in more than three government-organized trainings are more cautious in prescribing antimicrobials to patients with URIs. 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 in our research that the effect of training less than three times on change of physicians' prescription behavior is not significant, which is suggested 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 [29] has led to severe antimicrobials overuse [29] due to self-medication, insistence for drugs and the notion that antimicrobials are equivalent to anti-inflammatory drugs [30]. Therefore, it is extremely important for physicians to inform patients about rational drug and improve their awareness regarding AMR. The surveyed physicians performed moderately in this aspect, and those that refused to accede to patient demands 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.

4.4 Limitations

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 search for answers online. Since the data was 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 risk of recall bias. 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.

5 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.

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Interest Conflicts:

There are no other potential conflicts of interest for the authors

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