

# Effect of multifaceted social norms on physicians' use of clinical practice guidelines on antimicrobials: Evidence from secondary and tertiary general hospitals in central-western China

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## Research Article

**Keywords:** Antimicrobials, Clinical practice guidelines, Social norms, Structural equation modeling, China

**Posted Date:** September 15th, 2023

**DOI:** <https://doi.org/10.21203/rs.3.rs-3344140/v1>

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# Abstract

## Background

With the improper use of antimicrobials becoming a major public health concern globally, poor compliance of clinical practice guidelines (CPGs) on antimicrobials is still prominent, especially in less developed regions. Although social norms have received increasing attention as the determinants of physicians' CPGs use, most studies set forth only a single level of social norms. Therefore, this study aims to investigate the impact of multifaceted social norms on physician' use of CPGs on antimicrobials, and further reveal the temporal effects of social norms.

## Methods

Based on integration of Theory of Planned Behavior and Theory of Normative Social Behavior, a questionnaire survey was conducted covering social norms at individual level (subjective norms), organizational level (organization criterion) and social level (social identity), as well as other potential factors (attitudes, behavioral intention, etc) for the use of CPGs on antimicrobials. Data were collected by multi-stage random sampling from 502 physicians in secondary and tertiary general hospitals in central-western China. Structural equation model (SEM) was used to link the three-level factors with physician's behavior. And with reflected by the moderating effects of professional titles in this study, the temporal effects of social norms were examined by multi-group SEM.

## Results

Nearly 70% of the participants had a good practice of using CPGs on antimicrobials. Reliability and validity analysis shows that the questionnaire developed from the theoretical model is acceptable. Subjective norms, organization criterion and social identity were linked to higher behavioral intentions ( $\beta = 0.212, p < 0.01$ ;  $\beta = 0.254, P < 0.01$ ;  $\beta = 0.212, P < 0.01$ ). The direct effect of behavior intentions on physicians' practice was 0.822, and the indirect effects of subjective norms, organizational criterion and social identity on practice were 0.308, 0.236 and 0.235. The effects of organization criterion and social identity on behavior were moderated by the professional title, and regarding effects would be weakened with the rise of professional title.

## Conclusion

This study reveals the importance of multifaceted social norms in enhancing physicians' use of CPGs on antimicrobials and the moderating effects of professional titles on the role of social norms at organizational level (organizational criterion) and social level (social identity).

# Background

Antimicrobials play a vital role in the treatment, which can effectively reduce the incidence and mortality of bacterial infections (1, 2). However, with the widespread unnecessary and excessive use of antimicrobials, the challenge of antibiotic resistance (AMR) has become a major global public health problem and caused a series of problems, including increased mortality, prolonged hospital stay, and increased economic burden on patients, causing a variety of negative effects on individuals and society (3–6).

Although the effectiveness of the Clinical Practice Guidelines (CPGs) on antimicrobials has been fully demonstrated in standardizing clinical treatment and improving prescription behavior, and well expect in preventing the further deterioration of AMR and promoting patient health, the expansion of the regarding guidelines implementation was still stagnated with poor compliance. For example, China, one of the largest consumers of antimicrobial drugs, has issued the Guiding Principles for the Clinical Application of antimicrobials since 2015, and intends to reduce inappropriate antimicrobial prescription by auditing and testing the prescription behavior of physicians (7). However, the per capita use of antimicrobials is still much higher than the international level of 30% (8). Especially in the less developed regions of China, namely the central and western part, the phenomena of antibiotic overuse is more common (9–11). To reverse this serious situation, the underlying causes are worthy of further investigation.

Social norms are defined as informal and shared behavioral rules, such as pressure, beliefs or emotions of individuals, culture or features of social groups, mandatory guidelines or regulations and so on. As implicit or explicit behavioral standards widely perceived and recognized by members of a certain group in a specific situation, social norms play an important role in behavioral decision-making, and even affect behavior by affecting personal personality traits. These action paths had been widely confirmed by classical theories or frameworks in the field of social psychology, such as the theory of planned behavior expansion (TPB) and the theory of normative social behavior (TNSB) (12–14). Furthermore, according to the different sources, social norms could be divided into individual level (subjective norms), organizational level (organization criterion) and social level (social identity), and the roles of social norms at different levels are also different (15, 16).

Attributing to the high professionalism and normativity of physician group, the social norms' role on physicians' cognition and clinical practice have received increasing attention (17, 18). Some efforts also have been made to determine the impact mechanism of social norms on antimicrobials prescription or regarding CPGs compliance (19). Hallsworth's study found that providing social norm feedback from a high-profile messenger to high-prescription antimicrobials in general practice could effectively reduce the proportion of antimicrobials in prescriptions (16). And under the guidance of TPB, Fatemeh et al. found that social norm feedback interventions based on subjective norms improved antimicrobials prescribing behavior that lasted at least three months after the intervention (20). Furthermore, by integrating TPB and other related theoretical models, Deng et al. found that subjective norms had significant direct and indirect effects on intention to use CPGs on antimicrobials, and the impact of subjective norm on

individual attitude was also confirmed (21). It is worth noting that although recently social norms have received special attention as determinants of antimicrobials prescribing behaviors or regarding CPGs compliance, most studies have only proposed a single level of social norms: either individual normative beliefs, or acceptance pressure at the social normative level (22–26). It may lead to failure of fully identifying the different roles of social norms at different levels. Besides, some scholars have pointed out that unlike formal institutions and top-down regulations, social norms are usually strengthened or weakened over time(27) However, there are few studies have focused on the strengthening or weakening effects of other factors on social norms for prescribing behavior, such as the temporal effects.

Therefore, to bridge these knowledge gaps, this study aimed to construct a theoretical framework based on TPB and TNSB theories to comprehensively investigate the effect of social norms at multiple levels for physician' use of CPGs on antimicrobials, as well as determine whether social norms would be strengthened or weakened by the time of action. These findings not only add evidence to the impact mechanism of social norms on improving CPGs compliance with antimicrobials, but also provide a reference for tailoring social normative strategies to promote the implementation of CPGs on antimicrobials in future.

## Methods

### Study setting

This study was conduct in secondary and tertiary hospitals of central and western China. Since the provision of vast medical services is heavily dependent on tertiary and secondary hospitals, they were the major consumers of antimicrobials with widespread irrational use phenomenon. Especially in central and western China, this situation is more prominent. For example, the use rate of prophylactic antimicrobials for inpatients was 54.6% in tertiary hospitals and 60.7% in secondary hospitals, both higher than the national standard of 30% (28). Thus, for reducing AMR and promoting patients' health, it is necessary to regulate the physicians' use of antimicrobials preferentially in secondary and tertiary hospitals of regarding regions.

### Theoretical framework

Since individual behavior is usually constrained by relevant social norms at multiple levels, the theoretical framework of this study was adapted from the integration of TPB and TNSB to comprehensively investigate the effect of social norms at the individual level (subjective norms), organizational level (organization criterion), social level (social identity) on physician' use of CPGs on antimicrobials. And the temporal effects of social norms were also taken into account. Figure 1 illustrates the theoretical framework.

{insert Fig. 1 here}

### Social norms at individual level

Subjective norms are social norms at individual level, which refers to social pressures that individuals perceived as coming from parents, spouses, workmates, etc(29). As postulated by TPB, subjective norms indirectly influence behavior through behavioral intentions, which is a commonly known prerequisite of final behavior (30). Similar role are also played by attitude and perceived risk, while the former is an individual's positive or negative evaluation of particular behaviors, and the latter reflects the person's belief that an action is under his or her control, such as perceived risk (31, 32). Additionally, many studies also showed that except for direct effects, subjective norms could influence the behavioral intentions of the physicians through attitude (22–24).

## **Social norms at organizational level**

Organizational criterion is understood as prescribing or prohibiting behavioral norms or cultural understandings of group members (33). TNSB believes that organizational criterion is one of the most important factors influencing the behavior intention of organization members, which subsequently influence the final practice (14). Meanwhile, the indirect effect of organizational criterion on behavior intention with attitude as a key intermediate factor was also confirmed in previous studies (21, 24). Hospital managers could set organizational criterion to restrain and limit physicians' intention of nonadherence to CPGs on antimicrobials. Also, organizational criterion could be used to slowly change physicians' attitudes toward regarding CPGs compliance, which would bring effect on their intention and finally the real practice.

## **Social norms at social level**

At the social level, social identity refers to the recognition and approval of an individual from a wider group in society, including peers, celebrities, and other groups (34, 35). Since individuals often desire more approval from the outside world, social identity plays an important role in work and daily life. As it increases, individuals become more accepting of their own behavior and the social norms they adhere to. Research has demonstrated that the influence of social identity on intention or behavior is mostly moderated through attitudes, and it also has been confirmed that social identity is an independent predictor of intention (36).

## **Temporal effects of social norms**

Unlike formal instructions and top-down regulations, social norms cannot achieve the desired effect in a short period of time and are usually strengthened or weakened over time, which has been also reported in previous studies exploring social norms' effects on physicians' behavior (37). Accordingly, it is expected that in the beginning, the effect of social norms on the improvement of physicians' antimicrobials prescribing behavior were persisted and slowly strengthened over time. As time goes on, physicians become tired and numb to the same social norms, and the role of social norms could be weakened after reaching tipping points.

## **Measurements**

Based on previous research and reliable scales, this study developed a questionnaire containing four parts, including utilization, social norms, other potential determinants and personal information (Additional file 1). The measures used in the questionnaires follow the TPB and TNSB constructs, and represent an adaptation to this specific context of those used in previous research work on social norms or social influence. More specifically:

## **Physicians' utilization of CPGs on antimicrobials**

Part 1 covered 3 items to measure physicians' utilization of CPGs on antimicrobials in the past year. This part were measured using a 5-point Likert scale, where 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree.

### **Social norms**

Part 2 covered social norms at three different levels, namely subjective norm, organizational criterion and social identity. Among them, subjective norm refers to the perceived social pressure to which a physician is subject in relation to CPGs on antimicrobials. Organizational criterion reflects the mandatory guidelines of the physician's organization regarding CPGs on antimicrobials. Social identity represents the social group's approval of the physician's use of CPGs. Each social norm was measured by three corresponding items. Responses were asked to tick the number that best fits their real feelings on a five-point Likert scale labeled as follows: 1 (Strongly disagree), 2 (Disagree), 3 (Neutral), 4 (Agree), and 5 (Strongly agree).

### **Other potential determinants and personal information**

Part 3 covered three potential determinants of physician behavior regarding the use of CPGs on antimicrobials, including attitude, perceived risk and behavioral intention. Attitude reflects the degree to which a physician is in favor of the use of CPGs on antimicrobials. Perceived risk refers to how easy a prescriber feels in making a rational decision on CPGs on antimicrobials. Behavioral intention represents the degree to which a physician is willing to use CPGs on antimicrobials. In this part, respondents rated on a five-point Likert scale, ranging from "1 = strongly disagree" to "5 = strongly agree".

### **Personal information**

Part 4 was a personal information card with 6 items, including several basic characteristics of participants as gender, age, education, professional title, department and years of practice. Since the dual attributes of professional titles as different titles representing different social role and length of working time in the organization, and the temporal effects of social norms cannot be intuitively measure and analyze, this study choose the moderating effect of professional titles to reflect the temporal effects of social norms.

### **Sampling**

Due to the differences in economic development levels among regions, a cross-sectional study was implemented by applying a multistage sampling strategy. First, Hubei, Yunnan & Sichuan provinces were randomly selected from central and western regions of China, respectively. Second, five secondary and

tertiary general hospitals were selected from each of these regions. Lastly, participants were chosen on the basis of the department size. There were 16–20 physicians randomly sampled from major departments of internal medicine and surgery, respectively. And 3–5 physicians were randomly selected respectively for other minor departments, such as obstetrics and gynecology, ophthalmology, and orthopedics. Thus, about 45–60 physicians were selected from each hospital, and at least 450 physicians would participate in the survey, which would fully meet the basic requirement that the sample size should be set at least five times survey question (38).

## Data collection

With the support of sampled hospitals, each round for filling out the questionnaire was accompanied by trained facilitators. The purpose of the study and the use of the data were explained in detail to the participants through professionally trained investigators. Additionally, all responses were anonymous to protect their privacy. Written informed consent was obtained from all participants for this study. Data collection lasted from April 2018 to January 2019, and a total of 502 physicians from the mid-west were included in this study.

## Data analysis

Data analysis was performed using SPSS 21.0 and AMOS 25.0. To better estimate model utility, structural equation modeling (SEM) was applied, allowing for the creation of latent variables and relaxing assumptions about data distribution and error (39). The data processing steps were as follows. First, descriptive statistics (mean, standard deviation, absolute and relative frequencies) were performed on the demographic characteristics of the participants and the scores of each variable measured. Second, Cronbach's  $\alpha$ , factor loadings, and CR were employed to discriminate the reliability and validity of all constructs. Finally, SEM was utilized to estimate the relationship and mechanism among potential influencing factors. The path coefficients calculated by path analysis are equivalent to the standardized regression coefficients and direct effects. The mediating effects were calculated by bootstrapping and were significant if the value of the mediation effect does not include 0 within its 95% confidence interval. Multi-group SEM was used to examine the moderating effect of professional title. The analysis samples were divided into two categories according to the level of professional titles. This study would compare the mediating effect in different groups. A two-tailed p-value for the comparison between groups less than 0.05 indicated the significant differences between groups.

## Results

### Descriptive characteristics

Table 1 demonstrates the characteristics of the 502 participants. Among them, 51.0% ( $n = 256$ ) were female and 58.0% ( $n = 291$ ) were younger than 35 years old. Regarding educational level, many participants reported having a master's degree (45.6%,  $n = 229$ ), followed by bachelor (44.2%,  $n = 222$ ). The proportion of the participants with the professional titles of non-senior and senior was 77.9% and

22.1%, respectively. As for years in practice, nearly 90% of the participants had less than 15 years of practice experience. And physicians in the central and west regions accounted for 52.8%(n = 265) and 47.2%(n = 237), respectively.

Table 1  
Demographic characteristics of participants

Variable	Category	Frequency	Percentage (%)
Gender	Male	246	49.0
	Female	256	51.0
Age	< 35 years old	291	58.0
	35–44 years old	155	30.9
	≥ 45 years old	56	11.1
Education	Junior college or below	10	2.0
	Bachelor	222	44.2
	Master	229	45.6
	Doctor	41	8.2
Professional title	Non-senior	391	77.9
	Senior	111	22.1
Years in practice	< 5 years	159	31.7
	5–10 years	150	29.9
	11–15 years	136	27.1
	16–20 years	49	9.8
	> 20 years	8	1.6
Region	Central	265	52.8
	West	237	47.2

{insert Table 1 here}

## Reliability and validity

As shown in Table 2, Cronbach's  $\alpha$  values for each dimension ranged from 0.799 to 0.893, all of which were greater than the recommended threshold of 0.7, which indicated that the scale had good internal consistency. Moreover, the convergent validity was assessed by factor loadings, average variance extracted (AVE), and composite reliability (CR). Most of the items had factor loadings greater than 0.7,



and the AVE and CR values for each item exceeded 0.5 and 0.7, implying a satisfactory convergent validity.

According to the formell-larcker criterion(40), it is known that values of the diagonal are greater than the element below the diagonal implying that the construct has good discriminant validity. The square root of AVE for each construct in Table 3 is greater than its correlation coefficient with the other constructs, which meant the discriminant validity of the measurement model was acceptable.

Table 2  
Results of reliability and convergent validity analyses

<b>Construct</b>	<b>Item</b>	<b>Factor loading</b>	<b>Cronbach's <math>\alpha</math></b>	<b>AVE</b>	<b>CR</b>
Attitude	ATT1	0.816	0.893	0.716	0.883
	ATT2	0.857			
	ATT3	0.864			
Behavioral intention	BI1	0.780	0.882	0.599	0.817
	BI2	0.817			
	BI3	0.722			
Organization criterion	OC1	0.685	0.799	0.590	0.811
	OC2	0.847			
	OC3	0.764			
Social Identity	SI1	0.665	0.823	0.6321	0.836
	SI2	0.871			
	SI3	0.834			
Perceived risk	PR1	0.699	0.807	0.592	0.812
	PR2	0.857			
	PR3	0.743			
Practice	Pra1	0.814	0.874	0.699	0.874
	Pra2	0.841			
	Pra3	0.852			
Subjective norms	SN1	0.855	0.893	0.735	0.893
	SN2	0.867			
	SN3	0.850			

Table 3  
Results of discriminant validity analysis

Construct	ATT	BI	OC	SI	PR	Pra	SN
ATT	0.846						
BI	0.656	0.774					
OC	0.497	0.585	0.768				
SI	0.495	0.609	0.559	0.795			
PR	-0.468	-0.493	-0.314	-0.373	0.769		
Pra	0.548	0.761	0.632	0.543	-0.442	0.836	
SN	0.675	0.610	0.489	0.509	-0.372	0.621	0.857

{insert Table 2 here}

{insert Table 3 here}

## Measurement scores of participants

As illustrated in Table 4, the skewness ranged from -0.747 to -0.088 implying that the data fit a normal distribution. The mean of 3.60 for physicians' practice to use CPGs on antimicrobials was slightly below the median, while the remaining variables were above the median. Physicians' social identity (M = 4.11, SD = 0.61) and organization criterion (M = 4.12, SD = 0.66) showed a strong tendency to support their use of CPGs on antimicrobials. In addition, they had higher mean scores on subjective norms (M = 4.17, SD = 0.64) and attitude (M = 4.33, SD = 0.57), but lower on perceived risk (M = 2.50, SD = 0.911).

Table 4  
Measurement scores of the participants

Measurements	Mean	SD	Skewness	Median	N(%) of scores > 3
Attitude	4.33	0.57	-0.337	4	97.8
Behavioral intention	4.21	0.55	-0.188	4	96.6
Organization criterion	4.12	0.66	-0.088	4	94.8
Social Identity	4.11	0.61	-0.491	4	93.6
Perceived risk	2.50	0.91	-0.417	2	23.7
Practice	3.50	0.66	-0.088	4	69.5
Subjective norms	4.17	0.64	-0.747	4	93.8

{insert Table 4 here}

# Structural equation modelling

The overall structural model for physicians to use CPGs on antimicrobials exhibited the following goodness-of-fit indices:  $\chi^2/df = 2.347 (< 5)$ , GFI = 0.895 (> 0.8), AGFI = 0.863 (> 0.8), RMSEA = 0.045 (< 0.06), and CFI = 0.943 (> 0.9), which denoted that the research model has fit the data well.

Model with standardized path coefficients are summarized in Fig. 2. At the individual level, physicians' subjective norms regarding the use of CPGs on antimicrobials were linked to lower perceived risk ( $\beta = -0.265, P < 0.01$ ), better attitude ( $\beta = 0.534, P < 0.01$ ) and higher behavioral intentions ( $\beta = 0.212, P < 0.01$ ). In addition, attitude had significant positive impact on behavioral intentions ( $\beta = 0.217, P < 0.01$ ), while greater perceived risk was linked to lower intentions to use CPGs on antimicrobials ( $\beta = -0.175, P < 0.01$ ). At the organizational level, organization criterion significantly influenced attitude ( $\beta = 0.153, P < 0.05$ ) and behavioral intention ( $\beta = 0.254, P < 0.01$ ). At the social level, social identity were linked to lower perceived risk ( $\beta = -0.248, P < 0.01$ ) and higher behavioral intention ( $\beta = 0.212, P < 0.01$ ), while the impact of social identity on attitude toward CPGs on antimicrobials was not significant ( $\beta = 0.143, P > 0.05$ ). Finally, behavioral intention were linked to better practice about the use of CPGs on antimicrobials ( $\beta = 0.822, P < 0.01$ ), indicating that intention significantly influenced behavior.

{insert Fig. 2 here}

Table 5 shows the standardized path coefficients observed between the theoretical variables derived from the previous structural analysis. Physicians' behavioral intention of the physician group had the highest total effect (0.822) on the practice to use CPGs on antimicrobials, followed closely by the effect of subjective norms on attitude (0.534). And three dimensions of social norms also had some indirect effects on practice, namely subjective norms (0.308), organization criterion (0.236), and social identity (0.235).

Table 5  
Results of standardized direct, indirect, and total effects

Paths	Direct effects (path Coefficients)	Indirect effects	Total effects
Subjective norms→ Attitude	0.534**	0	0.534**
Organization criterion→ Attitude	0.153*	0	0.153*
Social Identity→ Attitude	0.143	0	0.143
Subjective norms→ Perceived risk	-0.265**	0	-0.265**
Social Identity→ Perceived risk	-0.248**	0	-0.248**
Attitude→ Behavioral intention	0.217**	0	0.217**
Perceived risk→ Behavioral intention	-0.175**	0	-0.175**
Subjective norms→ Behavioral intention	0.212**	0.162**	0.374**
Organization criterion→ Behavioral intention	0.254**	0.033*	0.287**
Social Identity→ Behavioral intention	0.212**	0.075**	0.287**
Behavioral intention→ Practice	0.822**	0	0.822**
Subjective norms→ Practice	0	0.308**	0.308**
Organization criterion→ Practice	0	0.236**	0.236**
Social Identity→ Practice	0	0.235**	0.235**
*p < 0.05; **p < 0.01			

{insert Table 5 here}

As Table 6 and Fig. 3 show, in senior group, organization criterion ( $\beta = 0.327$ ,  $P < 0.05$ ) were linked to better attitude and attitude ( $\beta = 0.664$ ,  $P < 0.01$ ) was associated with higher behavioral intentions, while the direct impact of organization criterion ( $\beta = -0.059$ ,  $p > 0.05$ ) and social identity ( $\beta = 0.114$ ,  $p > 0.05$ ) toward behavioral intentions were not significant. In non-senior group, organization criterion ( $\beta = 0.312$ ,  $P < 0.01$ ) and social identity ( $\beta = 0.282$ ,  $P < 0.01$ ) were linked to higher behavioral intentions. However, the influence of organization criterion on attitude ( $\beta = 0.033$ ,  $p > 0.05$ ) and attitude on behavioral intentions ( $\beta = 0.054$ ,  $p > 0.05$ ) were not significant. Additionally, in senior group, the effect of organization criterion toward attitude ( $\chi^2=2.201$ ,  $P < 0.05$ ) and attitude toward behavioral intention ( $\chi^2=4.463$ ,  $P < 0.05$ ) were significantly higher than that in non-senior group, while in non-senior group, the effect of organization criterion and social identity toward behavioral intention ( $\chi^2 = -3.627$ ,  $P < 0.05$ ;  $\chi^2 = -2.249$ ,  $P < 0.05$ ) were significantly higher than that in senior group.

Table 6  
Parameters comparisons between multi-group structural models across professional title

Paths	Non-senior (path Coefficients)	Senior (path Coefficients)	Non-senior vs Senior ( $\chi^2$ )
Subjective norms→Attitude	0.581**	0.376*	-1.784
Organization criterion→Attitude	0.033	0.327*	2.201*
Social Identity→Attitude	0.218*	0.121	-1.219
Subjective norms→Perceived risk	-0.274**	-0.168	0.699
Social Identity→Perceived risk	-0.243*	-0.307	-0.059
Attitude→Behavioral intention	0.054	0.664**	4.463*
Perceived risk→Behavioral intention	-0.143**	-0.173	-0.003
Organization criterion→Behavioral intention	0.312**	-0.059	-3.627*
Social Identity→Behavioral intention	0.282**	0.114	-2.249*
Subjective norms→Behavioral intention	0.275**	0.098	-1.794
Behavioral intention→Practice	0.827**	0.870**	0.070
*p < 0.05; **p < 0.01			

{insert Table 6 here}

{insert Fig. 3 here}

## Discussion

In order to bridge the knowledge gap of the influence of multifaceted social norms on physicians' use of CPGs on antimicrobials, this study investigated potential social norms and mediating factors at the individual level, organizational level and social level by integrating TPB and TNSB. In addition, it applied multi-group SEM to determine whether the effects of social norms on final regarding CPGs use would be strengthened or weakened by the time of action.

## Main findings

This study showed that social norms at the individual level (subjective norms), organizational level (organization criterion) and social level (social identity) had important impacts on the intention and behavior of physicians' use of CPGs on antimicrobials. Additionally, in the results of multi-group SEM, the professional title significantly regulated the effect of organization criterion to attitude, attitude to

behavioral intention, organization criterion to behavioral intention and social identity to behavioral intention.

## **Comparison with other studies**

### **Effects of individual-level social norm**

In this study, subjective norms, attitude and perceived risk were identified as important factors that directly influenced physicians' intention to use CPGs on antimicrobials, and indirectly influenced the final use behavior, which was in line with some previous studies that established the TPB models of antimicrobials prescribing behavior (41–43). In the field of medical services, subjective norms and attitude are often emphasized because they are related to the sense of security of a particular behavior (44). To a certain extent, the sense of security is determined by the external pressure and risk felt by physicians (45), so it is not hard to understand the important role of subjective norms in CPGs use behavior. Moreover, except for direct effects, subjective norms could have indirect effects on behavioral intention through attitudes and perceived risk, which in turn influence actual practice about the use of CPGs on antimicrobials. This is mainly due to the exemplary role of key people, whose opinions or behaviors regarding CPGs on antimicrobials or other health technologies can form a perceived norm and exert pressure on other physicians around them (46).

### **Effects of organizational-level social norm**

In this study, organizational criterion refers to the mandatory guidelines of the physician's organization regarding CPGs on antimicrobials, which are inscribed provisions for specific CPGs usage practices (47). Consistent with previous studies (16, 21, 26), this study also confirmed the important role of organizational criterion on influencing the application attitudes, intentions and behaviors towards using CPGs on antimicrobials. The reasons for this result may originate from the following two aspects. On the one hand, organizational criterion, as the most universal and mandatory norms, have a self-evident effect on the members of a certain organization (3, 48). They can continuously exert direct or indirect influence on physicians' behavioral intention of adhering CPGs on antimicrobials until they gradually adjust their behavior to align with the organization. On the other hand, organizational criterion will slowly shape the organizational culture of the hospital regarding CPGs on antimicrobials over time (12). During this long process, organizational criterion could influence physicians' attitudes, views and intentions on the use of CPGs on antimicrobials, which would also promote physicians to adjust their antimicrobials prescription behavior for ensuring consistency with the organizationally recognized norms (49, 50).

### **Effects of social-level social norm**

The important direct effect of social identity on the intention to use of CPGs on antimicrobials was proved in this study, and so as its indirect effects on regarding CPGs use practice through intention and indirect effects on intention through perceived risk. Similar results were demonstrated in Hallsworth's study that the recognition and evaluation of physicians from a high-profile figure could reduce their unnecessary prescriptions of antimicrobials (17). Additionally, it is also reported that the recognition and

praise from patients and their families often reinforce the physician's acceptance of his own behavior and the norms he adheres to (16, 47). Since social identity mainly refers to the recognition and support of physician from social groups such as peers, industry expert, patients and their family members(51, 52), it is not hard to understand that in order to get more recognition from these social groups, physicians would complete their work and comply with CPGs with higher behavior intentions, thus forming a virtuous circle.

In contrast to expectations, social identity was not shown to have a significant influence on attitude which is different from the findings of Liu (3). The plausible reason may be that attitudes generally change more slowly than behavioral intentions and behaviors. Especially at the beginning of implementation regarding CPGs, the impact of social identity may be too limited to change the physicians' attitude, although it has reversed their intentions or behaviors. Future studies are recommended to further investigate whether there are other factors or reasons that affect the role of social identity.

## **The moderating role of professional title**

The temporal effect, namely the moderating role of professional title played in the social norm impact mechanism, had been also confirmed in this study. With the rise of professional title, the effects of organizational criterion on attitude and attitude on behavioral intention were strengthened, while the effects of organizational criterion and social identity on behavioral intention were weakened. These results are inconsistent with the findings of a randomized clinical trial that the effect of the social norm-related intervention for physicians' antimicrobials prescription was strengthened over time (37). The underlying reason may be that the social norm-related intervention in the trial was a strong external stimulus for the physicians, so the effect of "Hawthorne effect" led to the enhancement of the effect of social norms in a short time. In contrast for this study, rather than strong external stimulus, some effects of professional title promotion may play more important role in contributing to the seemingly contradictory findings. On the one hand, for the physicians with lower professional titles, they are often eager to get more recognition and praise from their peers, leaders, and other social groups. Thus, under the context with CPGs compliance as organizational criterion and social identity, these physicians may deem CPGs as decrees that must be obeyed, although they don't have a positive attitude towards certain CPGs. So, it is demonstrated that the impact pathway directly from social norm to behavioral intention dominated in the group with lower professional titles. On the other hand, for the physicians with higher professional titles, they tend to be affected by organizational criterion for a longer time with their attitudes and behavior intention on the use of CPGs on antimicrobials successively changed (53). It is noteworthy that the change of intention for senior group tends to follow a path of "norm-attitude-intention", rather than directly norm to intention. The plausible reasons may be that, with higher positions in hospitals and higher social status, the physicians with higher professional titles swift their roles from passive obedient to active implementers of norms, which made them capable of implementing or adjusting the organizational code according to their understanding, or even of asserting their own judgment or behavior in the face of corresponding rules. Under this situation, the organizational criterion to which they have

been subject may be changed or adjusted accordingly, which may also weaken the influence of organizational criterion (54, 55).

## **Policy implications**

Based on understanding the impact of multifaced social norms on physicians' use of CPGs on antimicrobials, several intervention strategies can be emphasized to further improve the actual use of regarding CPGs. Firstly, give full play to the demonstration effect of core members. Since the lead, senior physicians usually have an exemplary role for other physicians, it is strongly recommended to mobilize them to hold experience sharing sessions on their use of CPGs on antimicrobials. Through the active advocacy of these influential people to strengthen the role of subjective norms, physicians could be motivated to actively comply with regarding CPGs. Secondly, create a good hospital organizational culture to bring into full play of the role of organizational criterion. For hospital managers, they could promote the use of CPGs on antimicrobials through explicit means such as formulating and issuing formal regulations. Additionally, hospital managers were advised to pay attention to the practice of organizational criterion among the medical staff within their institution, such as holding regular education and training to improve relevant knowledge of regarding CPGs use for young physicians, establishing monitoring and supervision mechanism to timely address emerging problems during the process of organizational criterion and norms implementation. Thirdly, some concrete measures are also recommended to let the physicians get more social identity, such as establishing a feedback mechanism to regularly feedback good external evaluations to physicians, promoting the establishment of a good public image and encourage physicians to comply with CPGs in order to maintain a good image.

## **Strengths and limitations**

In addition to the policy implications, this study is also strengthened by some distinguished features. Firstly, to the best of our knowledge, few studies have investigated the impact of social norms at the multiple levels on physicians' use of CPGs on antimicrobials, especially in developing countries. Based on the integration of TPB and TNSB, this study enables us to systematically consider the influence of social norms on physicians' use of CPGs on antimicrobials from three levels, namely individual, organizational and social levels. Secondly, this study also investigated the moderating effects of professional titles on the role of social norms, which greatly expanded the understanding of the temporal effects of social norms on physicians' prescription behavior. Thirdly, the sample areas were from the central and western provinces of China, which are relatively backward in social and economic development. It will benefit providing reference to reveal the effect of social norms on physicians' use of CPGs on antimicrobials in other less developed regions of the world.

This study also has some limitations. First of all, all data are obtained through self-reporting, and we cannot rule out the social expectation bias that some physicians may be reluctant to voice negative evaluations of themselves and hospitals. Secondly, cross-sectional studies have limitations in the interpretation of causality. Future studies may involve samples at different time points to form panel



data, which will be more conducive to determine the impact and changes brought about by social norms. Thirdly, due to time and funding constraints, this study included a limited number of variables to investigate the impact mechanism of multifaced social norms on physicians' use of CPGs on antimicrobials, and the influence of other potential variables will be explored in future research.

## Conclusion

By integrating TPB and TNSB, this study investigated the impact of multifaced social norms on physician' use of CPGs on antimicrobials, and determined the temporal effects of social norms. The SEM method is used to verify the proposed conceptual research framework. The results of this study reveal the significant effect of multifaceted social norms, namely subjective norms at individual level, organizational criterion at organizational level, and social identity at social level, on the use of CPGs on antimicrobials. And the organizational criterion and social identity had a more significant impact on physicians' behavior at their early stage of practice, which demonstrated its different effect on physicians with different professional titles. These findings will not only help tailor pertinent social intervention strategies to expand the use of CPGs on antimicrobials, especially for the less developed regions, but also provide clues for future research about impact mechanism of multifaced social norms on physicians' adoption behavior of certain health services or products.

## Abbreviations

AMR

Antimicrobials resistance

CPGs

Clinical practice guidelines

TPB

The theory of planned behavior expansion

TNSB

The theory of normative social behavior

SEM

Structural equation modeling

## Declarations

### Ethics approval and consent to participate

Ethics approval was obtained from the medical ethics committee, Fujian Medical University, China. Written informed consent was obtained from all study participants.

### Consent for publication

Not applicable.

## Availability of data and materials

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

## Competing interests

The authors declare no competing interests.

## Funding

This research was supported by National Natural Science Foundation of China (Grant Number: 72274035) and the Soft Science Project of Fujian Provincial Department of Science and Technology (Grant Number: 2017R0044). No funders had a role in study design, data collection, data analysis, or in writing the manuscript.

## Authors' contributions

WL and LW contributed to the conception and design of the study. LW conducted the data reduction, analyses and wrote the manuscript. WL guided the whole process and reviewed the manuscript. All authors read and approved the manuscript before submission.

## Acknowledgments

We are thankful to all coordinators and physicians for their participation in this study.

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## Figures

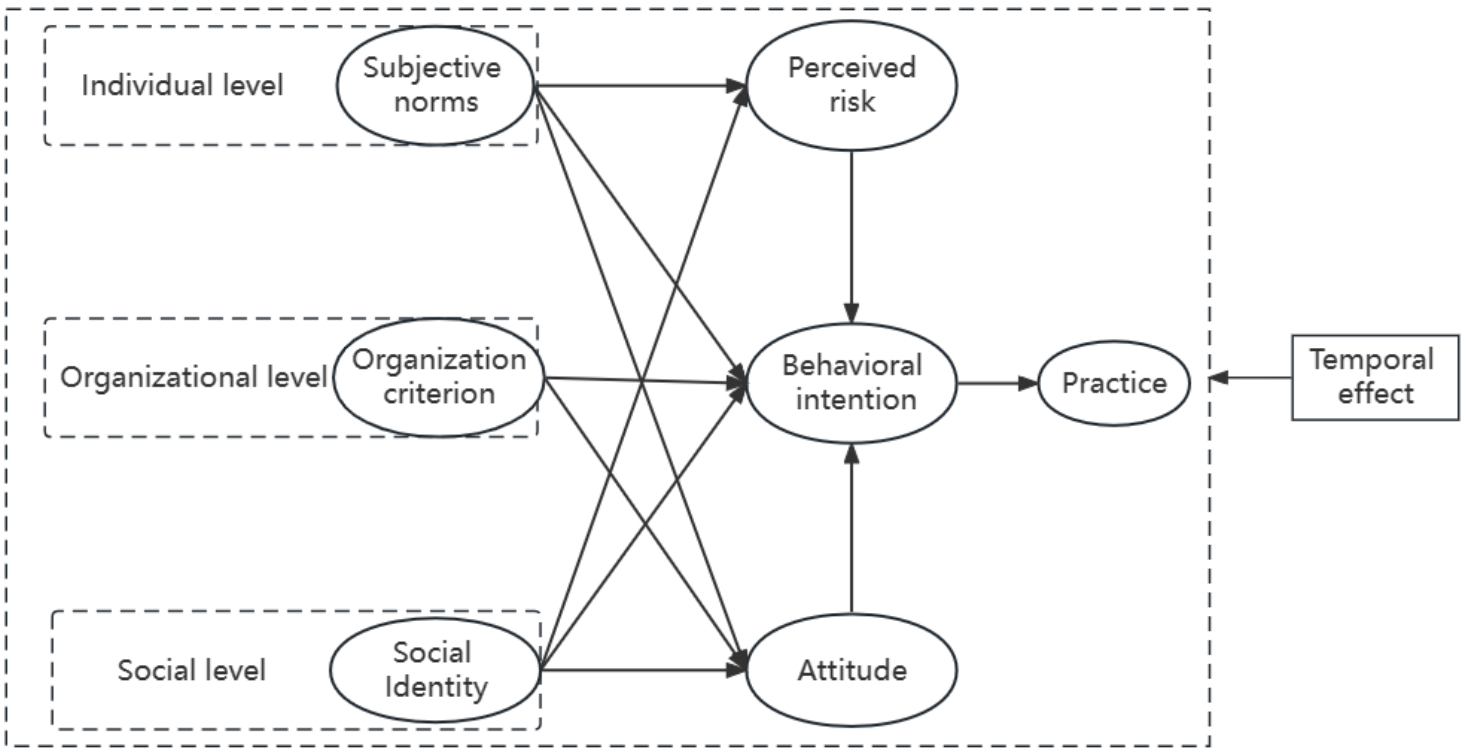


Figure 1

The theoretical framework

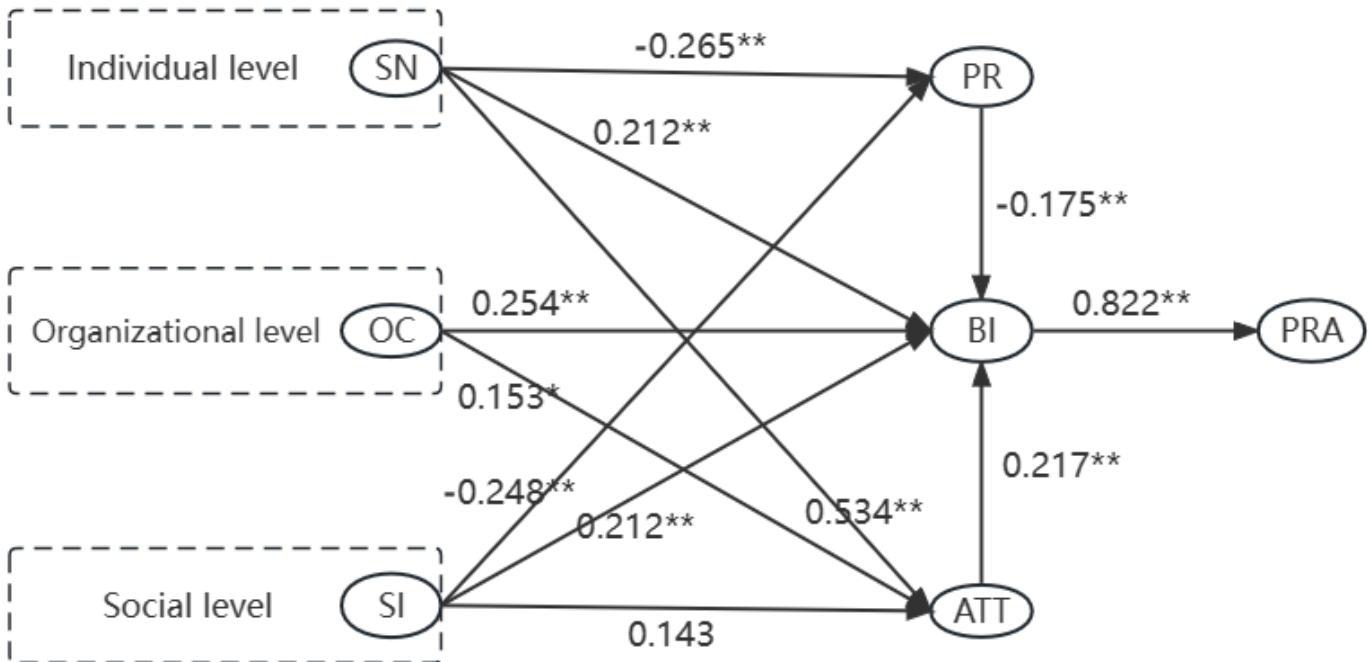


Figure 2

## Determinants of physicians' intentions to use CPGs on antimicrobials

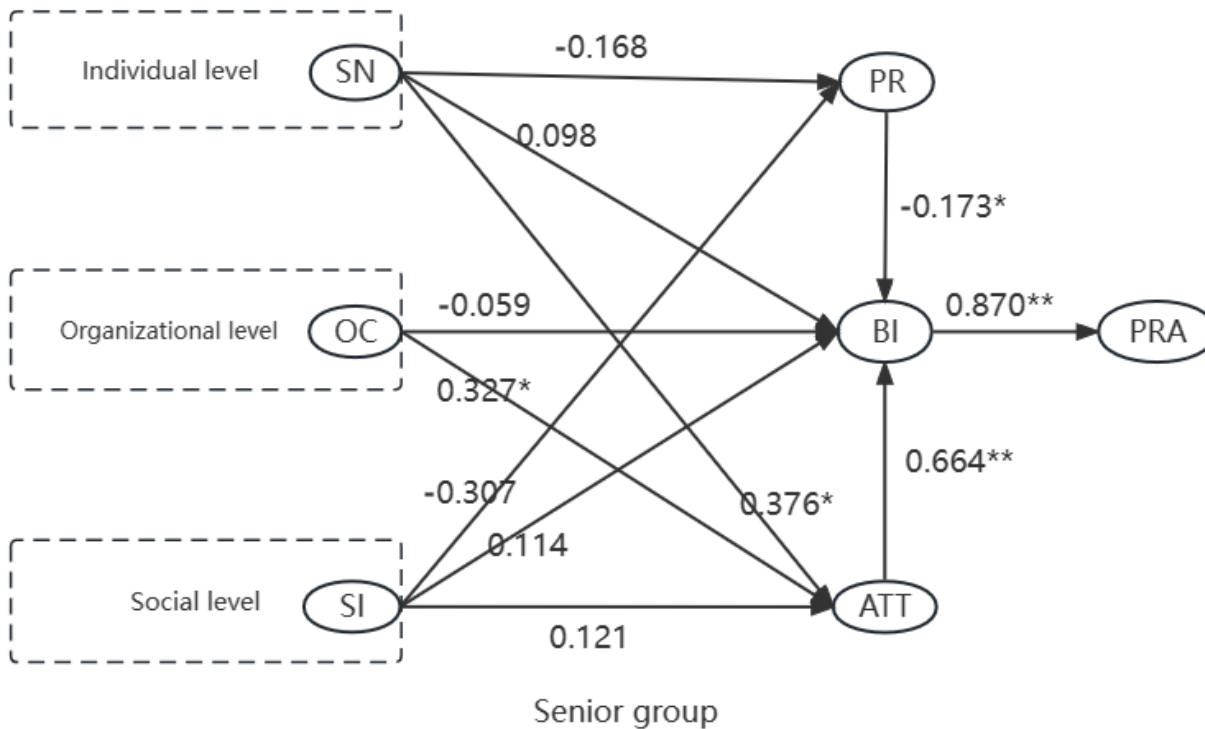
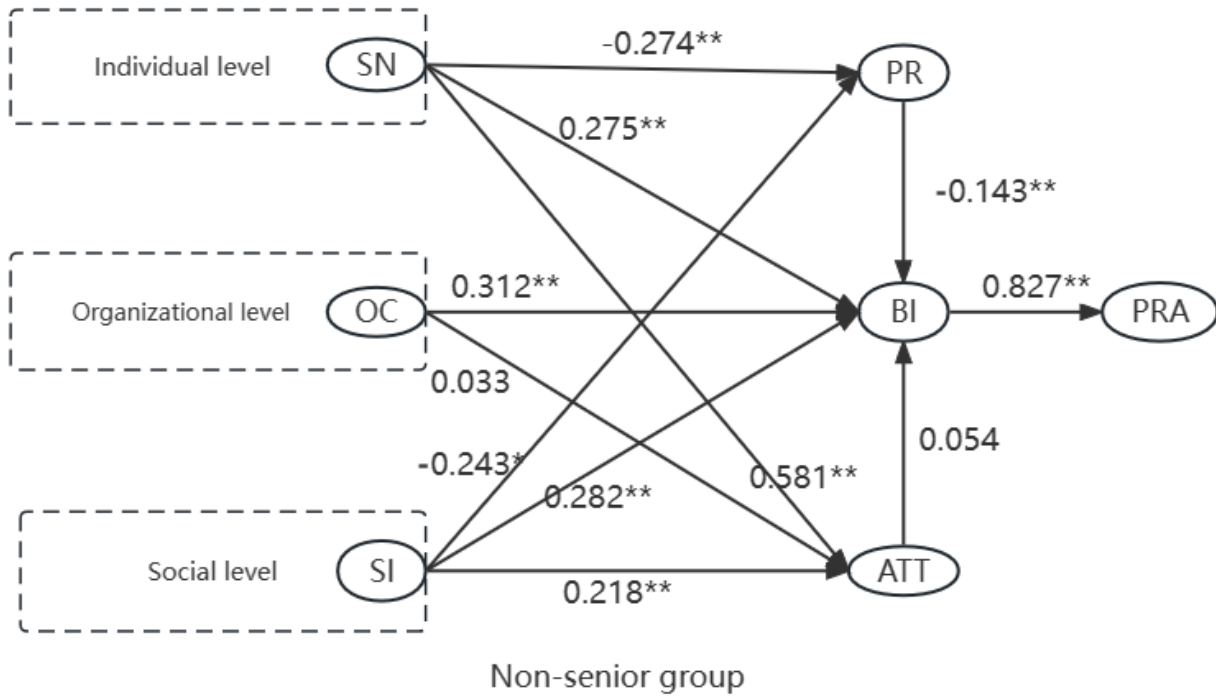


Figure 3

Comparisons between multi-group structural models across professional title

## Supplementary Files



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