A Cross-sectional Study Assessing Predictors of Essential Medicines Prescribing Behavior Based on Information-motivation-behavioral Skills Model among County Hospitals in Anhui, China

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Abstract

Background: The self-consciousness and practicality of preferentially prescribed essential medicines (EMs) are not high enough in county hospitals. The purposes of this study were to use the information-motivation-behavioral skills (IMB) model to identify the predictors of essential medicines prescribing behavior (EMPB) among doctors and to examine the association between demographic variables, IMB, and EMPB.
Methods: A cross-sectional study was carried out to assess predictive relationships among demographic variables and IMB model variables using an anonymous questionnaire administered in nine county hospitals of Anhui province. A structural equation model was constructed for the IMB model to test the instruments using analysis of moment structures 17.0.
Results: A total of 732 participants completed the survey. The average age of the participants was 37.7 ± 8.9 years old (range: 22–67 years old). The correct rate of information was 90.64%. The average scores of the motivation and behavioral skills were 45.46 ± 7.34 (hundred mark system: 75.77) and 19.92 ± 3.44 (hundred mark system: 79.68), respectively. Approximately half (50.8%) of respondents reported that the proportion of EM prescription was below 60%. The final revised model indicated a good fit to the data (χ^2/df = 4.146, goodness of fit index = 0.948, comparative fit index = 0.938, root mean square error of approximation = 0.066). More work experience ($\beta = 0.153$, $P < 0.001$) and behavioral skills ($\beta = 0.449$, $P < 0.001$) predicted more EMPB. Higher income predicted less information ($\beta = -0.197$, $P < 0.001$) and motivation ($\beta = -0.204$, $P < 0.001$). Behavioral skills were positively predicted by information ($\beta = 0.135$, $P < 0.001$) and motivation ($\beta = 0.742$, $P < 0.001$).
Conclusion: The present study predicted some factors of EMPB, and specified the relationships among the model variables. The utilization rate of EM was not high enough. Motivation and behavior skills were crucial factors affecting EMPB. The influence of demographic variables, such as income and work experience, on EMPB should be fully appreciated. Comprehensive intervention measures should be implemented from multiple perspectives.

Key words: China; County Hospitals; Essential Medicines; Information-motivation-behavioral Skills Model; Prescribing Behavior; Structural Equation Model

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Introduction

In September 2009, the national essential medicine system (NEMS) was initially implemented in government-funded primary health care institutions and

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was gradually expanded to secondary hospitals or higher rated hospitals in China.[1] To date, at least 11 provinces in China have successively defined the utilization of essential medicines (EMs) in county hospitals. In 2011, Anhui released "The notifications on preferentially equipping and using EM in secondary hospitals or higher rated hospitals," requiring that county hospitals be equipped with EM varieties for not <95% of the total number of EM varieties and for EM sales to account for no <30% of the proportion of total sales of all drugs.[2] In December 2012, the zero-profit policy in drug sales was implemented by all county hospitals in Anhui province. Since then, a series of supporting measures, including the development of a basic drug directory in county hospitals, the implementation of centralized drug procurement and unified distribution procedures, the supervision of health insurance fees by assessing basic drug usage in county hospitals, and the development of training on the national EMs clinical guidelines and prescription set are subsequently taken. As the leading part of the county medical service system, county hospitals are links between primary health care institutions and urban tertiary hospitals in health services structure, and medical cooperation is being established in Anhui province and throughout China, which requires that NEMS be gradually expanded into hospitals at the county level and above from primary health care institutions and should integrate with the experiences of primary health care institutions. However, due to the influence of personal factors (e.g., EM knowledge degree and EM policy, income, and others) and external environmental factors (e.g., patients, policies, peer effects, and economics),[3] the self-consciousness and practicality of preferentially prescribed that EM is not strong enough, and the utilization rate of EM is not high. One of the co-authors investigated the prescription quality from October 2011 and March 2012 in 10 county hospitals of Anhui, and the results suggested that the utilization rate of EM was 53.08%,[4] which is far from the 86% to 88% of target reference value standard required by the World Health Organization.[5] The findings come from research on the implementation outcomes of the EM systems in 21 county hospitals of Anhui conducted by other co-authors who showed that the EM equipment ratio and the EM sales ratio were 30.77–76.92% and 8.60–26.30%,[6] respectively, which did not meet the proportion stipulated by Anhui.

Research has been performed worldwide in order to identify key factors that influence doctors' prescribing behaviors and to promote behavior change. However, scholars abroad have mainly explored the actuality of doctors' essential medicine prescribing behavior (EMPB), and there are few studies of the quantitative factors that influence such behavior.[7-10] While domestic researchers have conducted several studies on the influence factors of EMPB, their studies have been limited to certain aspects such as major, education, and age. Additionally, researchers in China have used the utilization rate, the constituent ratio or multivariate regression analyses and have failed to determine the direct relationship between the causes and the results. Various objective and subjective factors contribute to prescribing behavior changes. The measurement of latent variables directly and accurately is problematic when studying the relationship among factors that influence EMPB. Therefore, an intervention model using a theoretical framework to systematically and quantitatively determine which factors are driving prescribing behavior in order to promote EMPB is urgently needed. The information-motivation-behavioral skills (IMB) model is a relevant comprehensive behavior change framework.

The IMB model was first designed to predict human immunodeficiency virus (HIV) preventive behavior and necessary HIV prevention elements by Fisher and Fisher in 1992.[11] Combined with features of other theories, the IMB model incorporates the understanding of "motivation" in the theory of reasoned action (TRA) to generalize possible factors that influence behaviors and introduces the "self-efficacy" concept from social cognitive theory to categorize possible factors such as information, motivation and behavior, from which a theoretical framework is generated.[12,13] According to the IMB model, individuals must have information (e.g., knowledge), positive motivation (e.g., positive personal attitudes, beliefs, intentions, and social support) and the necessary behavioral skills (e.g., abilities and self-efficacy) to initiate objective behavior change.[14] Information and motivation may indirectly affect the target behavior via behavioral skills while information and motivation may also directly affect target behavior. However, behavioral skills always directly predict the target behavior. Currently, the IMB model has been extensively utilized in the field of social and health psychology, including applications in sexual risk reduction,[15] tuberculosis infection control,[16] the intention to smoke among junior high school students,[17] and HIV medication adherence.[18]

The reasons we chose the IMB model as the conceptual framework for our study are as follows: First, the concepts and connotations of the IMB model are applicable to all research on positive behavior change,[19,20] and it focuses on the multidimensional nature of behavior change and the complexity of the interactions among various latent variables;[11,21] second, engagement in EMPB seems to be collectively motivated by internal and external forces. On the one hand, the implementation of EMs system in county hospitals of Anhui province is a comprehensive measure, which is accompanied by medical insurance system reform and public hospitals reform. Strict and detailed regulations on the utilization of EM are developed to improve the reimbursement ratio for EM and to constrain the utilization of non-EMs under the medical insurance system reform, which forces doctors to meet policy requirements. This is the external driving force that encourages doctors to engage in positive EMPB. On the other hand, the public hospital reform requires that EMPB be linked with the physician assessment, payroll, performance, and year-end evaluation, which is the internal driving force encouraging doctors to engage in positive EMPB. In other words, positive EMBP

is directly beneficial to patients and to the self (e.g., in the avoidance of fines, monetary gain, and patient recognition). Finally, the use of the IMB model in our study explains why some direct benefits of health behaviors to the self are less beneficial than others, which is consistent with the application of the IMB model in other studies by Seacat and Northrup,[22] Mita *et al*.,[23] and Goodell *et al*.[24] that have been widely approved.

This research is a tentative exploratory study to explain the complex EMPB based on the comprehensive consideration of subjective and objective factors that influence doctors' behavior changes in prescribing EM. The IMB model was first used to identify the predictors of EMPB among doctors from county hospitals in Anhui, China, and to examine the associations among demographic variables, the IMB model variables and EMPB based on the IMB model. In addition, we expect that this study will be of great significance for future management measures and theory-based EMPB interventions.

Methods

Ethics

The present study protocol was reviewed by the Ethics Committee of the First Affiliated Hospital of Anhui Medical University prior to study enrollment. Before data collection, the potential public hospitals and participants were informed about the study objectives, procedures, and benefits via verbal informed consent. Participation was voluntary, and the data were handled anonymously and confidentially.

Study design and data collection

The multi-stage cluster random sampling method was conducted by researchers to sample participants. In the first stage, three prefecture-level cities in Anhui, namely Bengbu, Hefei and Tongling, were randomly selected as the sampling frame. In the second stage, three districts from each city were randomly selected. In the third stage, one county hospital from each district was randomly chosen for further investigation. Finally, all eligible doctors in each of the sampled hospital were asked to complete the survey. The eligible participants had to be practicing physicians with prescription rights who were present on the day the research was administered, and who cooperated. A total of 765 participants were selected from nine county hospitals and agreed to complete the survey. Questionnaires with any missing data were dropped. Thus, a total 732 questionnaires were included in the IMB model data analysis, and the response rate was 95.7%.

Before carrying out the field investigation, the principal researchers were trained on norms and cautions related to this study to increase the credibility and consistency of the data collection. Prior to administering the survey, the researchers explained the main purpose of the study and obtained consent, with a particular emphasis on the voluntary nature of participation and anonymity of the questionnaire responses. The self-report questionnaires were sent to participants in envelopes, and the participants were asked to independently complete the questionnaires within 15 min.

Measures

To explore doctors' perceptions of information, and their motivations and behaviors that are part of the IMB model in the present study, the researchers conducted the survey with self-administered questionnaires based on a large literature review and an adapted IMB model instrument used in previous studies of tuberculosis infection control[16] and HIV health behavior interventions.[11,15] The questionnaire was revised after two rounds of expert consultation and a pilot survey to increase its validity and reliability (Cronbach's alpha coefficient for all of the measurements in the IMB model was 0.890).

The structured questionnaire included basic demographic characteristic scales such as age, gender, education level, work experience, and average monthly income. Additional scales, including the frequency of EM training and the obstacles of EMPB, were added. Finally, the IMB model was constructed of elements of information, motivation (e.g., personal motivation and social motivation), and behavioral skills, in addition to the EMPB scales. The summed scales of each IMB construct measured by one or several observable items were analyzed through structural equation models (SEMs), in which information, motivation, and behavioral skills served as latent variables directly measured by several observable variables, and EMPB was the outcome and dependent variable. Higher summary scores indicated higher levels of IMB. A specific description of the measures included in the IMB model was presented below.

Information

Nineteen information items (Cronbach's alpha coefficient = 0.787) with "yes" or "no" responses assessed the participants' concepts of EM (seven items. Ia; e.g., "Essential Medicine refers to availability, safety, effectiveness, and rational use") and policy (12 items. Ib; e.g., "The national Model List (2009) includes 307 types of medicine?"). Positive responses were scored as one, and negative responses were assigned a score of zero. Higher total scores indicated access to more information.

Motivation

Motivation was assessed by measures of personal motivation (including attitudes and intentions) and social motivation (including social support from the hospital, colleagues, and patients) and contained three indexes. The recognition of and attitude toward EM were assessed with seven items (Ma; e.g., "Do you think that EM are safe drugs with less adverse reactions?"), and the Cronbach's alpha coefficient for these seven items was 0.844. The second index was the intention to perform EMPB, and it was assessed by one item, "Mb; would you support essential medicines as the prime choice?". The last index was of social motivation concerning the performance of EMPB and was measured with four items as the degrees that hospitals, colleagues and patients would support EMPB (Mc; e.g., "Would the

hospital support you implementing NEMS?"). Cronbach's alpha coefficient for these four items was 0.779. All of the items were anchored on a five-point Likert scale, ranging from 1 (strongly unsupported) to 5 (strongly supported) and were scored 1 (strongly unsupported) to 5 (strongly supported). The total scores of each index represent the participants' attitudes toward EMPB, the likelihood that the participants would perform EMPB and the degree of social support for EMPB.

Behavioral skills

Behavioral skills were measured by five items (Cronbach's alpha coefficient = 0.835). Four items assessed self-efficacy in identifying EM, obtaining EM and recommending EM to colleagues or patients (Sa; e.g., "Can you identify EM?"; Sb; e.g., "Can you have timely access to EM?"; Sc; e.g., "Will you take the initiative in recommending EM to colleagues?"; Sd; e.g., "Will you take the initiative in recommending EM to patients?"). One additional item assessed prior experience with EM education including EM knowledge and training courses (Se; e.g., "Have you participated in trainings or seminars carried out by the hospitals?"). All items were anchored on a five-point Likert scale, ranging from 1 (certainly not) to 5 (certainly). Higher scores indicated more self-efficacy and more prior experience applying the behavioral skills.

Essential medicines prescribing behavior

The proportion of EM prescriptions served as an outcome variable and was usually regarded as the direct indicator of EMPB. The proportion of EM prescriptions was assessed as follows: "What was the proportion of EM prescriptions in the past 1-month?". The responses were given on a five-point Likert scale, ranging from 1 to 5 (1 = 0%, 2 = below 30%, 3 = over 30% and below 60%, 4 = over 60% and below 90%, and 5 = over 90%). The score was used as an indicator of EMPB, where a higher score indicated that the participants were strongly committed to EMPB.

Statistical analysis

EpiData 3.1 (EpiData Association, Denmark) was used for data entry to establish the database and SPSS 17.0 (SPSS Inc., Chicago, IL, USA) was used to perform the description statistical analyses and the correlation analyses. The hypothetical IMB model was examined by a SEM using analysis of moment structures 17.0 (SPSS Inc., Chicago, IL, USA). $P \leq 0.01$ was considered as statistically significant.

Correlation analyses were performed to assess the relationships between the demographic variables and the model variables and the relevant demographic variables were added to the subsequent SEM. We constructed the initial SEM based upon the correlation matrices and assumptions, in which demographic variables were included as "free floating" variables, information and motivation were exogenous latent variables, and behavioral skills and EMPB were endogenous variables.[18,25] A preliminary confirmatory factor analysis model was used to estimate the measurement model and the relationships among IMB and EMPB.[26] A path model was used to examine the predictors of EMPB. Variables with nonsignificant factor loading or pathways with nonsignificant path coefficients were dropped until a parsimonious model remained, and the fit of the model was good.

Prior to running the SEM, we evaluated the power in the present study: The sample size of 732 was sufficient to maintain adequate power for the model analysis, which satisfied the suggestion that at least 15 participants should be included per variable.[26,27] Four main indexes, including the ratio of the maximum likelihood Chi-square values divided by the degrees of freedom (χ^2/df), the goodness of fit index (GFI), the comparative fit index (CFI), and the root mean square error of approximation (RMSEA), were applied to evaluate the model fit.[24,28] The model was considered to fit the data well, which satisfied the following conditions simultaneously: The χ^2/df was lower than 5,[29] the GFI and CFI values were greater than or equal to 0.9,[28,30] and the RMSEA value was ≤0.08.[17,31]

Results

Participant characteristics

A total of 732 participants completed the questionnaire. The average age of the participants was 37.7 ± 8.9 years old (range: 22–67 years old). The majority of participants were male (63.7%). About 58.7% of participants were bachelor degree, and 26.9% of them were master degree, the rest being junior college (11.9%), doctoral degree or above (2.5%). Less than half (43.7%) of the participants had fewer than 10 years of work experience, and approximately one-quarter (26.1%) had more than 20 years of work experience, the rest being 10–20 years of work experience (20.2%). The average monthly income was varied with 52.2% reporting an income of RMB 2001–4000 Yuan, 24.5% reporting an income of RMB 4001–6000 Yuan, 10.4% reporting an income of RMB 6001–8000 Yuan and only 5.5% reporting an income of >RMB 8000 Yuan. With regard to the proportion of EM in the past 1-month, 4.6% reported that they had not prescribed any EM, 30.1% reported that the proportion of EM was 60–90%, and only 19.1% reported that the proportion of EM was ≥90%.

Correlation analysis

The correlations among the demographic variables and the model constructs were assessed, and the results are presented in Table 1. These analyses showed that gender and education levels had no effect on the model constructs, work experience ($r = 0.167$, $P < 0.010$) was found to be positively associated with EMPB, and income was negatively associated with EM information ($r = –0.169$, $P < 0.010$), motivation ($r = –0.158$, $P < 0.010$), and behavioral skills ($r = –0.166$, $P < 0.010$). Information ($r = 0.175$, $P < 0.010$), motivation ($r = 0.294$, $P < 0.010$) and behavioral skills ($r = 0.436$, $P < 0.010$) were all positively associated with EMPB, and they were significantly related among themselves. Specifically, motivation ($r = 0.616$, $P < 0.010$) was strongly related to behavioral skills.

Table 1: The correlation coefficient matrix among the demographic variables and the model constructs

	Gender	Education level	Work experience	Income	IMB information	IMB motivation	IMB skills	EMPB
Gender	–							
Education level	0.013	–						
Work experience	−0.104*	−0.109*	–					
Income	−0.056	0.227*	0.303*	–				
IMB information	−0.029	0.001	0.047	−0.169*	–			
IMB motivation	0.037	0.003	0.018	−0.158*	0.293*	–		
IMB skills	0.051	0.002	0.048	−0.166*	0.289*	0.616*	–	
EMPB	−0.027	0.037	0.167*	0.045	0.175*	0.294*	0.436*	–

*P<0.010. EMPB: Essential medicines prescribing behavior; IMB: Information-motivation-behavioral. "–" represents "not applicable".

Confirmatory factor analysis

Table 2 presents the range, means, standard deviations, and factor loading for each IMB variable. The mean percentages of correct responses to the knowledge of EM concepts and policy were 92.76% and 89.40%, respectively, and the mean correct rate of information was 90.64%. All factor loadings were significant ($P < 0.001$). The findings from the initial IMB model test recommended that the fit indexes were acceptable: χ^2/df = 4.213, GFI = 0.954, CFI = 0.944, and RMSEA = 0.066. However, nonsignificant paths might still exist. On the whole, these findings indicated that the initial model should be modified.

Information-motivation-behavioral skills path model

We modified the IMB model by dropping nonsignificant paths until only significant paths remained. An examination of the individual pathways indicated that the direct pathways from information, motivation and income to EMPB, from income to behavioral skills, and from work experience to IMB were nonsignificant and should be dropped. The revised model is depicted in Figure 1. The fit indexes for the model were still acceptable after modification: χ^2/df = 4.146, GFI = 0.948, CFI = 0.938, and RMSEA = 0.066. The IMB model explained 22% of the variability in EMPB and 58% of the variability in behavioral skills.

The parameters and tests of significance of the individual paths of the hypothesized IMB model are presented in Table 3 and Figure 1. Consistent with the IMB model, our study indicated that EMPB was directly predicted by behavioral skills ($\beta = 0.449$, $P < 0.001$). Behavioral skills were directly predicted by information ($\beta = 0.135$, $P < 0.001$) and motivation ($\beta = 0.742$, $P < 0.001$). However, in contrast to the IMB model, information and motivation were not significantly associated with EMPB while information and motivation indirectly predicted EMPB mediated by behavioral skills. Meanwhile, income had a negative effect on information ($\beta = -0.197$, $P < 0.001$) and motivation ($\beta = -0.204$, $P < 0.001$). Work experience had a positively effect on EMPB ($\beta = 0.153$, $P < 0.001$).

Table 2: Summary statistics and factor loading of the IMB model in confirmatory factor analysis

Scales	Code	Range	Mean ± SD	FL*
Information				
Concept	(Ia)	0–7	6.49 ± 0.92	0.71
Policy	(Ib)	0–12	10.73 ± 1.86	0.79
Motivation				
Attitude and recognition	(Ma)	7–35	26.23 ± 4.86	0.67
Intention to prescribe	(Mb)	1–5	4.04 ± 0.91	0.67
Social support	(Mc)	4–20	15.18 ± 2.72	0.85
Behavioral skills				
Identification ability	(Sa)	1–5	3.70 ± 0.81	0.57
Availability	(Sb)	1–5	3.86 ± 0.96	0.76
Communication with colleagues	(Sc)	1–5	4.08 ± 0.91	0.81
Communication with patients	(Sd)	1–5	4.11 ± 0.93	0.74
Training	(Se)	1–5	4.17 ± 0.81	0.65
Behavior				
The proportion of EM prescription in the past 1-month	(EMPB)	1–5	3.37 ± 1.16	–

*P<0.001. SD: Standard deviation; FL: Factor loading; EMPB: Essential medicines prescribing behavior; IMB: Information-motivation-behavioral skills.

Discussion

Information-motivation-behavioral skills model analysis

The IMB model designed in our study indicated a good fit among the county hospitals and the indicator tests were all significant, which suggested that the IMB model applies to EMPB interventions. The results obtained from the final IMB model showed that EMPB was mainly predicted by behavior skills, and there was no significant direct pathway from information and motivation to behavior, in contrast to our initial hypothesis. This finding also went against the classic IMB model proposed by Fisher and Fisher.[11] However, this finding is similar to the IMB model with curbside recycling behavior proposed by Seacat and Northrup.[22] As supported by previous research, Fisher *et al*.[32] believed that information and motivation have no direct effect on the target behavior when the behavior itself is very complex or requires multiple behavioral skills to achieve. EMPB is a dynamic, nonstandardized, and complex behavior, which not only is influenced by a variety of internal and external factors, such as the doctors themselves, patients, hospitals, national policy, and economic conditions, but also requires multiple behavioral skills to perform prescribing behaviors, such as the abilities to identify EM, to recommend EM to patients, and to attend relevant education programs.

The results indicated that doctors had access to more information on EM. This may be due to the initial

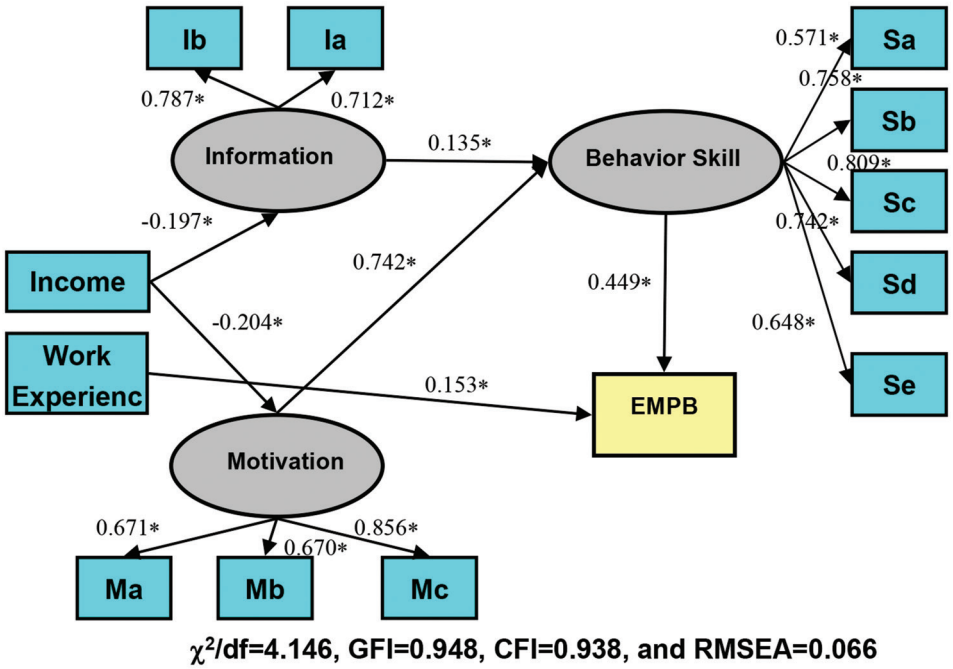

Figure 1: The final information-motivation-behavioral skills model predicting essential medicines prescribing behavior among the 732 doctors. Ovals represents multiple-indicator latent variables, and rectangles represent single-indicator observable variables. Single-headed arrows represent the regression path. Regression coefficients are standardized (*$P < 0.001$). Ia: Concept; Ib: Policy; Ma: Attitude and recognition; Mb: Intention to prescribe; Mc: Social support; Sa: Identification ability; Sb: Availability; Sc: Communication with colleagues; Sd: Communication with patients; Se: Training; EMPB: Essential medicines prescribing behavior. χ^2/df: Maximum likelihood Chi-square values/degrees of freedom; GFI: Goodness of fit index; CFI: Comparative fit index; RMSEA: Root mean square error of approximation.

Table 3: Structural equation model depicting significant regression paths in the final IMB model

Pathway	Regression coefficient	Standardized regression coefficient	SE	*P*
Information←income	−0.019	−0.197	0.005	<0.001
Motivation←income	−0.123	−0.204	0.024	<0.001
Behavioral skills←information	0.984	0.135	0.277	<0.001
Behavioral skills←motivation	0.869	0.742	0.056	<0.001
Ia←information	1.000	0.712		
Ib←information	1.304	0.787	0.243	<0.001
Ma←motivation	0.799	0.671	0.046	<0.001
Mb←motivation	1.053	0.670	0.060	<0.001
Mc←motivation	1.000	0.856		
Sa←behavioral skills	0.677	0.571	0.046	<0.001
Sb←behavioral skills	1.060	0.758	0.054	<0.001
Sc←behavioral skills	1.065	0.809	0.051	<0.001
Sd←behavioral skills	1.000	0.742		
Se←behavioral skills	0.762	0.648	0.046	<0.001
EMPB←behavioral skills	0.755	0.449	0.066	<0.001
EMPB←work experience	0.109	0.153	0.024	<0.001

SE: Standard error; IMB: Information-motivation-behavioral skills; EMPB: Essential medicines prescribing behavior.

achievements of publicity and training activities, including propaganda and education, which have been carried out in county hospitals. However, information did not predict EMPB directly, which is consistent with the results of a previous study of the IMB model of intention to smoke conducted by Zhu *et al*.[17] and an IMB model of consistent condom use conducted by Liu *et al*.[33] Previous literature has suggested that when the level of information in the target population reaches a certain threshold, it weakens the effect of information on other variables in the model.[34] Therefore, high levels of information play an important role in promoting behavior change, but are not the necessary precursor to behavior change. Blindly, requiring high levels of knowledge does not directly affect behavior: The participants in our study possessed a high level of information, but the information exerted a small effect on the other model variables. As a result, while promoting publicity and education in terms of EMPB-related information in future interventions is important, more attention should be paid to how information affects other variables, especially behavioral skills.

The motivation variable results indicated that the average scores of attitudes toward and the recognition of EM were low, and the hundred mark system score was 79.44. It is likely that some doctors had incorrect understandings of EM and questioned their curative effects, partly due to a lack of clinical experience prescribing EM. This further led to the low intention to prescribe EM. Thus, it is necessary to rectify the misunderstandings in the doctors' subjective consciousness through education, training and sharing clinical experiences that enhance their perceptions of EM.

The average social support scores and related items were also not high, and the hundred mark system score was 75.90. Social, hospital, colleague, and patient support for prescribing EM were not adequate. This could be a result of the inadequate government propaganda and indoctrination for EM and uncommitted support measures that do not facilitate policy implementation. Hospitals are assigned income-generating tasks without strict implementation of relevant reward and punishment. We found that colleagues do not share their experiences with each other or that this information was missing from the model. Patients with low EM awareness did not tend to use these medicines and were more likely to use drugs that cost more, drugs with higher curative effects and imported medicines. Therefore, patients would initially ask doctors to prescribe non-EM, and doctors occasionally fulfilled these requests. In addition, motivation did not predict the targeted behavior, which is supported by a previous IMB-related study on children's consumption of sweetened beverages.[24] Compared with the application of the IMB model in HIV/AIDS, tuberculosis, and diabetes research, the harmful consequences caused by weak EMPB to doctors themselves or patients are not fatal. Therefore, doctors might not have strong motivations to prescribe EM and do not pay much attention to this behavior.

Doctors' abilities to identify and use EM were clearly impaired. This could be because the national EMs list (2012) contained 520 types of medicines, and combined with the provincial supplemental directory, there are too many types of EM to remember clearly. However, doctors were more likely to confuse the EM general name and commodity name. Availability was an important factor influencing the utilization of EM. There is clear evidence in the literature showing that delayed delivery and incomplete availability of EM occurs in most county hospitals, which limits the acquisition and use of EM.[6,35] In addition, although the items about communication between colleagues and patients and participation in training scored higher, further efforts to emphasize and strengthen communication and training should still be taken into account, as they are important components of behavioral skills and play important roles in promoting targeted behavior change.

In short, both information and motivation were important variables in the IMB model and mainly affected prescribing behavior through behavioral skills. This finding demonstrates the importance of intervening in doctors' behavioral skills by focusing on EM skill training, strengthening their abilities to identify EM, their abilities to convince their colleagues to prescribing EM, and their abilities in recommending EM to patients.

Demographic variable analysis

In the final IMB model, work experience had a positive effect on prescription behaviors. Doctors with longer work lives have rich clinical medicine experiences and have developed a stronger sense of social responsibility. Thus, they were more likely to push the limits of the EMs list and to find alternative medicines on the EM list with flexible selection capabilities. Income directly acted on the information and motivation variables, but the path coefficients were negative. That is, higher income levels predicted lower information and motivation levels. This phenomenon may be because after implementing a zero mark-up policy on drug sales, the drug revenue in county hospitals declined significantly and doctors were confronted with revenue pressure. In addition, as part of nonessential drugs marketing, doctors might earn "kickbacks" from prescribing non-EMs, and this type of gray income significantly contributes to their income levels. Additionally, some doctors seemed to have an inaccurate understanding of EM and believed EM to be cheap and poor-quality medicines. Thus, they were more inclined to prescribe non-EMs because they believed that non-EMs were expensive and therefore of good quality. In conclusion, demographic variables exerted a powerful influence on IMB, as well as the targeted behavior change, and their roles should not be ignored. Further research is needed to confirm the above results.

Countermeasures and suggestions

The complexity of EMPB and the multiplicity of various factors that commonly determine targeted behavior interventions should take comprehensive countermeasures to improve IMB from the perspectives of the government, hospitals, industry, the media, patients and residents instead of focusing solely on individual factors. Only by comprehensively addressing the factors related to EMPB can we eventually target behavior change and improve the utilization of EM in county hospitals. Therefore, in view of the above research results, we put forward the following suggestions.

The government should further strengthen the publicity of the EM policy, making the administrators of hospitals, doctors and patients aware of the NEMS implementation to encourage medical institutions and doctors to transform their EM knowledge and related policies in order to target behavior change. The government must supervise the implementation of these policies in county hospitals by evaluating the utilization rate of EM, the satisfaction of patients, and rational drug usage to ensure that the institutions are earnestly implementing the national policy. Establishing and perfecting the compensation mechanism is a basic guarantee for improving hospitals' and doctors' enthusiasm for such implementation policies. Appropriate incentive mechanisms include: (1) Combining the implementation of NEMS with an assessment of annual targets, resulting in hospital accreditation and personal promotion, and (2) offering high-performing hospitals medical insurance and financial support. Meanwhile, the list and prescribing policies for EM are being updated to ensure widespread accessibility to safe, appropriate, and cost-effective drugs. Provincial-level platforms for the centralized procurement of EM should also be established to seek procurement tenders from producers. Domestic scholars have found that the specification of prescription rates can ultimately affect target behavior through behavior intentions. Therefore,

reasonable prescription rates for medical institutions at all levels should be stipulated to guide doctors' prescription behaviors. Additionally, as supported by the literature, pharmaceutical marketing stimulates doctors to prescribe expensive medicines, thereby influencing their rational drug use.[36] Thus, the supervision of the interests of hospitals and drug companies should be strengthened in order to block the influence of unreasonable marketing behaviors on rational drug use.

In the county hospitals, various rules and regulations including regular prescription quality inspections, reasonable rewards and punishment mechanisms, and advanced performance system evaluations should be set up to enhance personal accountability and to encourage EM prescription behaviors. A variety of education and training activities should be carried out via exchange platforms and experience sharing to help doctors update their prescription knowledge and experiences to improve their personal prescription capabilities. Goodell *et al*.[24] found that modeling was helpful in promoting targeted behavior change. In this study area, clinical department heads serve as model, and their prescription behaviors could provide examples of EM prescribing guidance. If so, a prescription management mechanism for the clinical department heads could be developed to guide doctors' preferential and reasonable EMPB. Additionally, in order to deepen patients' understandings of EM, communication about EM knowledge between doctors and patients should be encouraged.

In addition, industry associations should undertake supervisory roles of rational prescribing behaviors by regularly carrying out information exchanges and training activities. Patients, residents and the media should serve the social supervision function. Unreasonable prescribing behavior should be reported to relevant authorities in order to prevent noncompliant doctors from prescribing few or no EM.

Limitations

There are several potential limitations in our study that should be noted. First, previous studies have demonstrated that self-report questionnaire data collection may lead to systematic bias because participants may misrepresent their attitudes, behaviors or other information.[37] Second, the participants were sampled from county hospitals in three cities of Anhui, which may limit the overall generalizability and applicability of the IMB model due to the restricted sample size. In addition, the observed indexes may be not comprehensive, as this was the first application of the IMB model in this field of research. Finally, this is a cross-sectional study and can thus only clarify relationships among model constructs observed at a single time point. However, prescribing behavior is a dynamic process and is affected by highly individualized factors and complicated external environmental factors. Thus, longitudinal studies should be conducted to assess the effects of IMB on changes in EMPB.

In conclusion, this is the first application of the IMB model for the prediction of key factors related to EMPB to provide a comprehensive understanding of the associations among model constructs. As such, this study represents the first step for research about interventions targeting doctors' EMPB, and additional studies are required to validate the effectiveness and practicability of the IMB model in this context. Currently, important aspects such as the impact of behavioral skills interventions on behavior transitions attract little attention. Further research should develop a theory-based comprehensive intervention framework to promote EMPB from the perspective of the government, hospitals, industry, the media, patients and residents. In addition, an objective assessment of the intervention performance is needed.

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Conflicts of interest

There are no conflicts of interest.

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