Original Research

Development and validation of an instrument designed to measure factors influencing physician prescribing decisions

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Abstract

Background: Previous attempts to develop an instrument to measure factors that influence prescribing decisions among physicians were relatively insufficient and lacked validation scale.

Objective: We present a new tool that attempts to address this shortcoming. Hence, this study aims to develop and validate a self-administrated instrument to explain factors that influence the prescribing decisions of physicians.

Methods: The questionnaire was developed based on literature and then subjected to an exhaustive assessment by a board of professionals and a pilot examination before being administered to 705 physicians. Three pre-tests were carried out to evaluate the quality of the survey items. In pre-test 1, after items are generated and the validity of their content is assessed by academics and physicians. In pre-test 2, the scale is carried out with a small sample of 20 respondents of physicians. In pre-test 3, fifty drop-off questionnaires were piloted amongst physicians to test the reliability.

Results: On the basis of partial least squares structural equation modelling (PLS-SEM) analyses using SmartPLS 3, the content and convergent validity of the instrument were confirmed with 44 items grouped into four categories, namely, marketing efforts, patient characteristics, pharmacist variables, and contextual factors with 13 reflective constructs.

Conclusions: The study outcomes prove that the scale is more valid and reliable for measuring factors that influence the decision of the physician to prescribe the drug. The development and presentation of a scale of thirteen factors related to physicians prescribing decisions help to ensure valid findings and facilitates comparisons of studies and research settings.

Keywords

Physicians; Pharmacists; Professional Practice; Practice Patterns, Physicians'; Least-Squares Analysis; Reproducibility of Results; Validation Studies as Topic

INTRODUCTION

The factors associated with inappropriate prescribing as well as methods for improving prescribing behavior have been the subject of a considerable body of research. Furthermore, improving the prescribing behavior of physicians requires evidence-based factors that control their prescribing decisions and patterns.[1,2] Several methods have been proposed to increase the appropriateness of prescribing with focus on factors related patient-mediated interventions, pharmacist interventions, educational outreach visits, and feedback.[3-5] Other factors such as clinical skills, knowledge, experience, education, advice from colleagues, policy constitution of the institution, and perceptions of illness have been shown to play an important role in prescribing.[6,7] However, these factors are fixed, more difficult to adjust and may not offer improvements in prescribing patterns.[8] Some factors include marketing efforts, patients' drug requests and patients' expectations are likely responsible for inappropriate prescriptions.[9-16] Furthermore, contextual factors like drug attributes, habit persistence, and cost/benefits of the drug are found to exist during the time of the prescription.[17-20] Pharmacist expertise and collaboration factors may also offer many opportunities for modification prescribing decisions.[21-25]

Empirical studies, however, in this field are overwhelmed a well-validated and rationally complete set of scales to measure factors that influence prescribing decisions among physicians. Therefore, this article describes the process of developing and validating practical measures of factors related to physicians prescribing decisions. We describe our methods for identifying and selecting questionnaire items, initial pretesting and reduction of the item pool, and tests of predictive validity in both a pilot survey and a large survey study according to structural equation modelling (SEM) or partial least squares (PLS).

Assessment of prescribing decision

Research to date has tended to focus on measuring a proxy for physicians' decision making such as prescribing quality, prescription loyalty, the improving prescribing, and how prescriptions are made in general.[12,19,23,26-29] They used the number of prescriptions or patients who received it, panel data, clinical measures, and physician reports to measure prescribing decision.[12,27,30,31] For example, Joyce *et al*. determined the quantity and kind of drugs initially prescribed by each physician.[12] Wensing *et al*. used two indicators: prescription cost and the proportion of patients who received a prescription.[32] Venkataraman *et al*. used the overall quantity of prescriptions (newly and formerly diagnosed patients).[33] Kersnik and Peklar use the proportion of generic prescriptions to measure the choice of drugs.[34] Some authors have addressed prescribing

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behavior as measured by guideline adherence.[35] Shrank *et al*. based on 1200 random sampling found that 90% of the study physicians select drugs that minimize patients' out–of–pocket costs.[36] Khan *et al*. reported that 93.5% of USA physicians corroborate the prescribing drugs that would decrease the personal medical expenses of patients.[37] The critical fundamentals that a physician needs to take into consideration the drug type (brand vs. generic), guidelines of drug selection and cost/patient's ability to pay when selecting a drug.[38] However, it is unclear whether the use of these factors fully captures the prescribing decision. Moreover, these studies do not attempt to fully validate the process of prescribing decision items. Hence, the reliability and/or validity of these studies are doubtful.

Assessment of marketing efforts

There is no consensus on suitable measures for marketing efforts constructs include information, drug brand, and the effectiveness of marketing agents and sales promotion of a drug in prescribing literature. The reviewed studies mostly used panel data of physicians either clinical measure, or focus group discussions or interviews, or measured overall promotions, or administered single factor with single item to address marketing efforts scales in the domain of prescription drugs.[1,28,39-45] For example, Zahrani reported that promotion tools did not influence prescribing among 275 Saudi GPs and family physicians.[43] However, the author did not accurately measure sales promotion, since she only considered sponsored lectures and gifts. Al–Areefi *et al*. measured the physicians' acuities of MRs visits, it does not measure the influence of the effectiveness of MRs on physicians' prescribing behaviour.[44] Parker and Pettijohn investigated the views of MRs and physicians as they relate to the effectiveness of marketing strategies in the USA.[45] The results showed that there is a consensus among both physicians and MRs that the MRs have a minimal influence on the prescribing. However, these results may be doubtful or invalid because they do not indicate causality (both MRs and prescribing were evaluated in the same item).

Other studies endeavored to evaluate the face or content validity of their measurement instruments using either pre-tests or opinions of experts.[31,46] Ladeira *et al*. used SEM to analyze factors that affect the prescription of medical drugs in Brazil among 232 physicians.[17] The questionnaire includes 18 items that measure available drug information, brand and advertising. Furthermore, Karayanni utilized cluster analysis to measure physicians' scores of MRs (4 items) and sales promotion (3 items).[46] The resulting seven-item scale proved to be reasonably reliable. However, the study utilized a very small sample size for the analysis.

Assessment of patient characteristics

This study takes into consideration the patient's request for a particular drug and expectations as well as their subsequent influence on prescribing behavior. Several researchers employed instruments to measure the patients' drug requests using single-items, which are poor in method "base questions" that were correlated with prescribing.[14,47-48] Parker and Pettijohn developed an instrument to measure patients' drug requests included only two items that reflect the direct patients' drug requests.[45] Other studies were based on different questions surveyed assessed patients' expectations with one item comprising two, three or more categories for answers, i.e., "Yes'' or ''No'' categories.[49-51] The items do not require the respondent to state when prescribing a drug, and how much importance was given to the patients' expectations. Using 250 GPs, Tusek–Bunc *et al*. focused on four items to assess the physicians' perceptions of patients' expectations.[13] However, content validity and reliability were not evaluated in this research.

Assessment of pharmacist factors

Some studies measured the perception of physicians about the influence of pharmacists' role which may be effective, but may not truly reflect relationship, the influence of expert power on the prescribing decision is not even weighted.[52,53] For example, Moore *et al*. assessed opinions on expanding the role played by community pharmacists, but they do not accurately measure the influence of pharmacist expert on prescribing.[52] Tahaineh *et al*. developed the scale for measuring physicians' expectations of pharmacists' role among 200 physicians in Kuwait.[54] However, they have weaknesses that compromise their validity and the measure can fully gauge the expert power. Basak *et al*. operationalized the relative expertise power between pharmacists and physicians, but they do not measure the influence of the actual expertise on the prescribing.[22]

Most studies that focus on the physician - pharmacist collaboration were in health care while recognizing that this variable may act independently or as a group. For example, Van *et al*. and Zillich *et al*. attempted to measure attitudes of GPs towards cooperation with pharmacists.[55,56] Kucukarslan *et al*. investigated the influence of physicians' perception toward pharmacist collaboration however they do not measure the influence of the actual pharmacist-physician cooperation on the prescribing.[23] Liu *et al*. used 750 self-administered surveys to develop a scale collaborative care at baseline.[57] However, this scale was performed with sampling that is concentrated on pharmacists rather than physicians. Overall these measures are more pertinent to interface GP/pharmacist attitudes toward collaboration than to collaboration -prescribing relationship measurement.

Assessment of contextual factors

Even though a considerable number of empirical studies have identified contextual factors, there is a need to develop an effective measure that integrates their influences. For example, Venkataraman and Stremersch empirically implemented the physician– level panel data and clinical trial reports approach to measure the influence of drug attributes on prescribing, however, this measure was not corrected for the test the variables independently.[33] Ladeira *et al*. used an instrument to measure drug characteristics and the cost/benefit ratio of the drug.[17] However, the development of the adapted measure was questionable.[17] Janakiraman *et al*. concluded that physicians who are more willing to respond to marketing efforts have a lower likelihood of being persistent.[27] However, this work may have more limitations, given that the insights were gathered through panel data. Abdul Waheed *et al*. examined brand loyalty

Table 1. Cronbach coefficient alpha for the pilot study sample (52 items)

No	Variable		Total items	Cronbach's Alpha
1	INF	Information Available on the Drug	4	0.791
2	BAR	Brand of the drug	4	0.714
3	SPR	Sales Promotion	5	0.950
4	MRE	Medical Representatives Effectiveness	5	0.825
5	PRD	Patient Request for the Drug	3	0.735
6	PEX	Patient Expectations	4	0.817
7	PEP	Pharmacist Expert Power	4	0.930
8	PCP	Pharmacist – Physician Collaboration	4	0.817
9	DCH	Drug Characteristics	5	0.751
10	CBD	Cost/Benefit Ratio of the Drug	4	0.885
11	PHP	Physician Habit Persistence	3	0.694
12	TRS	Trustworthiness	4	0.817
13	PPD	Physician Prescribing Decision	3	0.754

with two items among 71 respondents, which is too small for the outcomes of the results to be generalized.[26] Similarly, the scales reported by Mehralian *et al*. is limited because the study used six measures (compassion) to evaluate the prescription loyalty of physicians.[19]

METHODS

Instrument development process

For physician decision to prescribe the drug, items were measured using the three-item including drug type's choices (brand and generic), drug guidelines, and the buying power of patients, with context-specific modifications.[36,38] Information on a drug (4 items) and the brand (4 items) was adapted from Karayanni.[46] Sales promotion was measured using the six items, three items were adapted from Karayanni, and three items were adapted from Ladeira *et al*. The effectiveness of MRs was measured using six items considered in related studies.[17,31,46]

For patient request the drug, two items were modified from Parker *et al*., and a single item was developed from the literature. Patient expectations were assumed by four items.[13,45] The adapted items from Tahaineh *et al*. were used to measure pharmacist expert power with some modifications to suit the context of the current research.[54] Collaboration and trustworthiness were measured by four items each.[24,57] Drug characteristics (6 items) and the cost/benefit ratio of a drug (5 items) was drawn from a scale of Ladeira *et al*. with context-specific modifications.[17] Three items used to measure the construct of habit persistence in the current study (Online appendix 1).[19,26] This study employed a five-point rating scale ('strongly disagree' to 'strongly agree').

Content Validity

Three pre-tests were carried out to evaluate the quality of the 56 items. In pre-test 1, a brief questionnaire was subsequently sent to 8 academics and physicians using e-mail. Academics experts in pharmaceutical sciences, prescription marketing, and health assessment were examined the quality of face validity of the survey in terms of clarity, simplicity as well as the ambiguity of the scale items. While physicians in a different area were asked to comment on the suitability of the questions for doctors whether the instrument relates to their practice or difficult to answer. The experts also delivered several recommendations resulting in the elimination of three items (one item of drug characteristics) and the addition of three (drug requests, habit persistence, and MRs' effectiveness). Lastly, seven items, one item in the information available on a drug, two in pharmacist collaboration, two items in pharmacist expert power, and two items of habit persistence were recast to reflect the dimensions. This process expanded the items to 52. The 5-point Likert scaling techniques were suitable for performing tests.

In pre-test 2, a pre-test of the novel instrument was carried out with a small sample of 20 respondents comprising diverse physicians in both public and private hospitals. The respondents were asked to identify and eliminate potential problems. The pre-test participants recommended that the entire items for one construct should be measured in the same direction. Another issue wording in the items of habit persistence, the items should reflect the phrase "prescribing the same drug".

In pre-test 3, based on pre-test results, fifty drop-off questionnaires were piloted in Yemen amongst physicians in private and public hospitals in Sana'a City. Out of the 50, 30 questionnaires were returned and valid for the pilot study analysis used. The observations gathered from the pre-test were used to revise the questions of the brand, expert power, trustworthiness, patient expectations, and habit persistence. Cronbach's alpha was adopted for the reliability test of this pilot study using the SPSS software v22.0 (Table 1).

Data collection

In Yemen, most doctors hold two positions simultaneously; the central in public hospitals and the other in the private sector (hospitals/clinics). In this situation, the sample was calculated regardless of their place of employment or their affiliation with the public or private sector.[4,44] Furthermore, there is no statistically significant differences were found between physicians at public and private hospitals regarding attitude toward marketing efforts such as MRs. Therefore, they may have not a different prescribing pattern between categories.

The physicians who participated in the study were purposively sampled and were from both specialists and GPs working in private and public hospitals and were all practicing the prescribing drugs. However, since the

Table 2. Summary of Principal Component Analysis test for common method bias test: Total variance explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	11.539	26.225	26.225	11.539	26.225	26.225
2	3.231	7.344	33.568	3.231	7.344	33.568
3	2.810	6.386	39.954	2.810	6.386	39.954
4	2.088	4.746	44.701	2.088	4.746	44.701
5	1.767	4.017	48.718	1.767	4.017	48.718
6	1.697	3.856	52.573	1.697	3.856	52.573
7	1.362	3.094	55.668	1.362	3.094	55.668
8	1.308	2.973	58.641	1.308	2.973	58.641
9	1.153	2.621	61.262	1.153	2.621	61.262
10	1.082	2.459	63.721	1.082	2.459	63.721

Source: SPSS v22.0

referral chain was carried out to expand the sample, the snowball sampling technique was utilized as a type of non-probability sampling approach, thus increasing the response rate in the data. In June 2017, 420 of 705 questionnaires were completed, however, 393 (59%) of the questionnaires were usable. While 71% and 28.4% of the respondents are males and females. The age of the majority of the respondents varies between 35 or less and 35-45 years. Over half of the respondents have a postgraduate degree (63.6%), and 53.4% of the participants worked at general and private hospitals. Many of them are consultants (38.4%) and GPs (27%). More specifically, the study participants comprise GPs (27.5%), and gynecologists (17.3%). Approximately 51.1% of the respondents had 5 to 10 years of experience in practice, 42.8% of the respondents see 1-15 patients per day and 52.7% of the respondents see <5 MRs per week.

Test for non-response bias

An independent sample t-test was employed mainly to check whether any form of a discrepancy between these two groups by comparing their means.[58] The present study divided the respondents into two main categories: those who responded within 30 days (291 early respondents) and those who returned after 30 days (102 late respondents) following Armstrong and Overton's approaches.[59] The findings reported that the equivalent variance significance values for all the variables were >0.05 significance level of Levene's test for equality of variances. Therefore, it can be deduced that the theory of equal differences between early and late respondents has not been infringed.

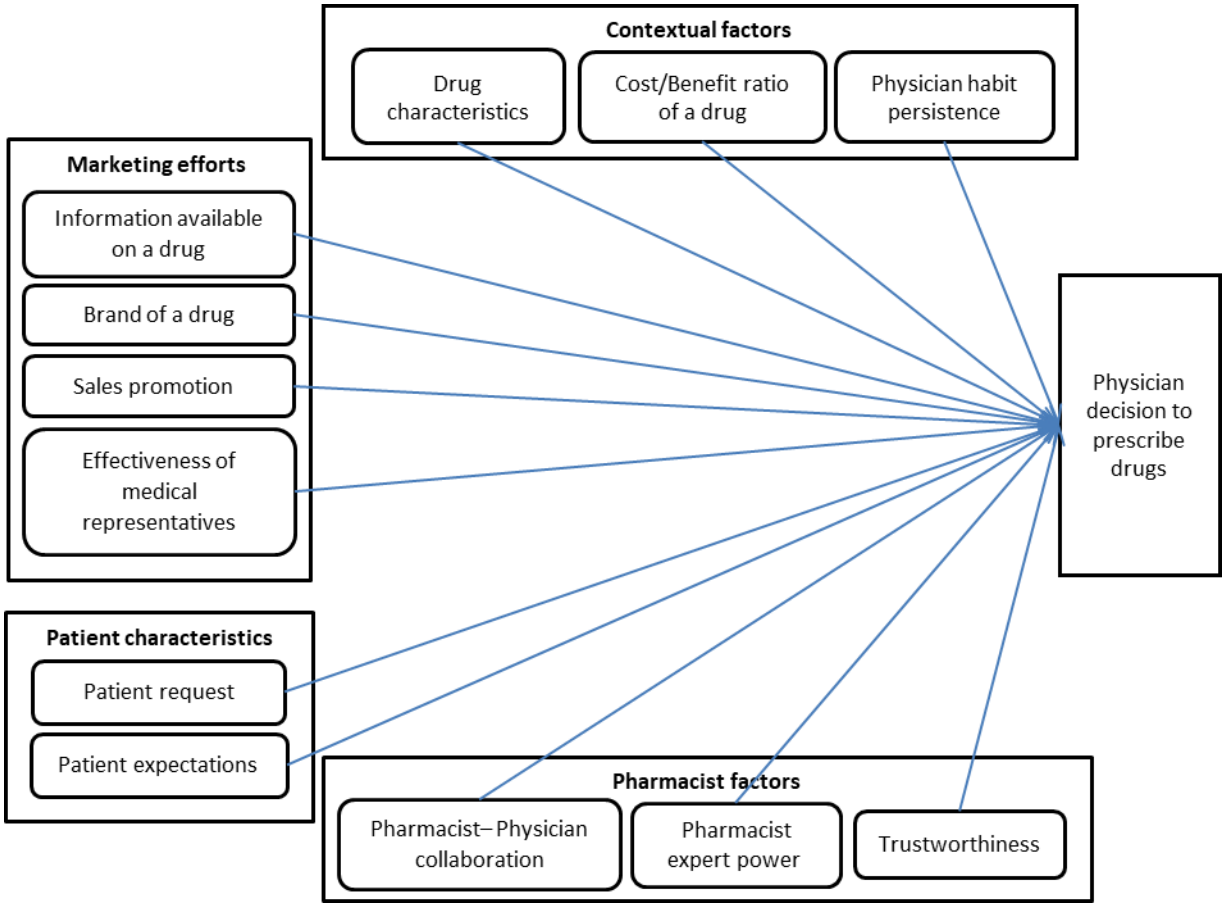

Figure 1. Research model

Table 3. Final instrument (44 items)

Latent variable	Indicator	Text
BRA	BRA2	The physician takes into consideration prescribing drugs that have a good reputation and reliable brand.
	BRA3	The physician takes into consideration prescribing drugs that have a brand already been tested by colleagues.
	BRA4	The physician takes into consideration prescribing drugs that have efficacy brand.
CBD	CBD1	The physician takes into consideration the price of a drug very seriously before prescribing any for their patients.
	CBD2	The physician takes into consideration the income of the patient before prescribing.
	CBD3	The physician takes into consideration the cost/benefit relation of a drug before prescribing any for their patients.
DCH	DCH1	The physician takes into consideration the efficacy of a drug before prescribing any for their patients.
	DCH3	The physician takes into consideration the form of a drug (i.e. syrup, tablet, & injection...etc.) before prescribing any for their patients.
	DCH4	The physician takes into consideration the age of the drug in the market before prescribing any for their patients.
	DCH5	The physician takes into consideration the image of the drug in the market before prescribing any for their patients.
INF	INF2	The physician takes into consideration prescribing drugs that have their information published in medical textbooks.
	INF3	The physician takes into consideration prescribing drugs that have their information published on the internet (Web sites of drug firm).
	INF4	The physician takes into consideration prescribing drugs that have their information published in medical journals and scientific publications.
MRE	MRE1	The physician takes into consideration prescribing drugs where the MRs possess sufficient knowledge of the medicine.
	MRE2	The physician takes into consideration prescribing drugs where the MRs explain the side effect of the drugs.
	MRE3	The physician takes into consideration prescribing drugs where the MRs keep in contact with the physicians (i.e. repeated visits).
	MRE4	The physician takes into consideration prescribing drugs where the MRs adhere ethical and professional standards at all times.
PEP	PEP1	The physician takes into consideration the suggestion of pharmacists about cost-effective alternative drugs before prescribing any for their patients.
	PEP2	The physician takes into consideration the information provided by pharmacists about new drugs before prescribing any for their patients.
	PEP3	The physician takes into consideration the recommendation of pharmacists regarding prescribing certain medications from some companies before prescribing any for their patients.
	PEP4	The physician takes into consideration the advice of pharmacist about available medicines that are readily available before prescribing any for their patients.
PEX	PEX1	The physician takes into consideration the priority of generic drugs over brand drugs before prescribing.
	PEX2	The physician takes into consideration the generic drugs suggested by health policymakers.
	PEX3	The physician takes into consideration the general public opinion about the benefit of brand-name drugs before prescribing any for their patients.
PHP	PHP1	The physician takes into consideration prescribing the same drug that they have had a positive experience with the patient.
	PHP2	The physician takes into consideration prescribing the same drug that they have had a positive experience with.
	PHP3	The physician takes into consideration prescribing the same drug from particular companies/MRs that they are loyal to or committed with.
PCP	PPC2	The physician takes into consideration the coordination with the pharmacist about drugs (i.e., to ensure the patient receives the desired medication) before prescribing any for their patients.
	PPC3	The physician takes into consideration the coordination with the pharmacist about the drugs (i.e. to ensure the patient receives the optimal medication at the optimal dose etc.) before prescribing any for their patients.
	PPC4	The physician takes into consideration the sharing of responsibility with pharmacists about drugs before prescribing any for their patients.
PPD	PPD1	The type of a drug (generic, branded) determines what medicine I prescribe to my patient.
	PPD2	I prescribe a drug to a patient based mainly on his/her purchasing power (the patient's ability to pay for the drug).
	PPD3	I follow treatment guidelines every time I prescribe drugs to my patient.
PRD	PRD1	The physician takes into consideration the request of a patient for a specific type of drug before prescribing.
	PRD2	The physician takes into consideration the request of a patient for a specific brand of the drug before prescribing.
	PRD3	The physician takes into consideration the request of a patient for a less expensive drug regardless of the drug's efficacy before prescribing.
SPR	SPR2	The physician takes into consideration prescribing drugs from companies that initially offer free samples to physicians.
	SPR3	The physician takes into consideration prescribing drugs from companies that offer supplementary valuable incentives, i.e. office-practice items, prescription pads, and patient record forms.
	SPR4	The physician takes into consideration prescribing drugs from companies that provide educational materials to patients (i.e, posters).
	SPR5	The physician takes into consideration prescribing drugs from companies that give financial incentives (i.e., cash payment, bonuses, and commissions).
TRS	TRS1	The physician takes into consideration the credibility of the pharmacist about the drugs before prescribing any for their patients.
	TRS2	The physician takes into consideration the bidirectional communication with a pharmacist about drugs (exchange of information on available medicines) before prescribing any for their patients.
	TRS3	The physician takes into consideration the expertise of the pharmacist about the drug (i.e., quality of medicines, brand names for medications) before prescribing any for their patients.
	TRS4	The physician takes into consideration the working relationship with the pharmacist about the use of drugs in specific situations before prescribing any for their patients.

Common method bias test (CMB)

A single-factor test was employed to identify the existence of this bias by using principal component analysis (PCA) in SPSS (v22.0). All items of understudy constructs were entered into factor analysis and run the PCA. The unrotated primary components analysis yielded 10 factors with eigenvalues>1, accounting for 63.7% of the variance (Table 2). Given that a single factor solution did not emerge, (the highest one accounted for 26% of the difference) and an overall factor not did account for the majority of the variance, CMB was not considered a major problem in this research (see Table 2).

Descriptive analysis

Online appendix 2 presents the mean values, SD, and correlations between the study constructs. The correlation between the variables was in the predicted direction and significant at p<0.01. The correlation values were well below the threshold of 0.80.[60] It shows no problem of high correlation among the variables and provides evidence that multicollinearity is not an issue in the present study.

Conceptual model

The conceptual model specifies the marketing efforts (available drug information, drug brand, sales promotion, and MRs' effectiveness); patient characteristics (patients, requests and patients' expectations); pharmacist factors (trustworthiness, expert power, and collaboration); and contextual factors (drug characteristics, cost/benefit ratio of a drug, and physicians' habit of persistence). Therefore, to assess the prescribing decision of physicians' model and to measure the factors affecting their choices, we posit that all factors are significant influence physician decision to prescribe the drug (see Figure 1).

RESULTS

PLS-SEM approach

To estimate the prescribing decision model, the study utilized component-based PLS-SEM because it is a more accurate method for studies that focus on prediction and is ideal for handling complex frameworks.[61,62] Thus, PLS-SEM was applied to establish the measurement models of the latent variables, leading to several modifications to improve the model and its fit. Having confirmed to the individual item reliability and validity, a bootstrap procedure with 1000 (one–tallied, 0.5) bootstrap re-sampling with 399 cases was used to estimate the significance of the interactions.

Assessment of the outer measurement model

The analyses comprise two stages. The first stage involves an assessment of the outer measurement model, which includes reliability and validity tests of measurement properties. As shown in Online appendix 3, the results of the 44 items that were retained in the model had loadings between 0.709 and 0.912 (see also Table 3). A total of 8 items fall below 0.708 could still be fairly weak (shown in italics in Online appendix 1).[60,61] Online appendix 4 provides that AVE values exhibited higher loadings (> 0.50) on their respective constructs, showing adequate discriminant validity.[61] The composite reliability (CR) coefficient of the entire potential constructs which range from 0.838 to 0.904, with each exceeded the minimum level of 0.70 and not above 0.95, indicates adequate internal consistency reliability of the measures. Further, all the values passed the heterotrait-monotrait ratio of correlations (HTMT) 0.90 and the HTMT 0.85 indicating that discriminant validity has been ascertained (Online appendix 5).[63]

Assessment of the overall parameters

The model of research revealed a coefficient of determination (R^2) = 40 percent of the total variance in the prescribing decision of the physician can be regarded as moderate.[64] The standardized root means square residual (SRMR) of 0.061 which less than 0.08 indicates that the degree of misfit is not substantial and suggests that the data support a standard factor model.[65] A GoF value of 0.488 was obtained for the overall factors influencing the prescribing scale, which overtaken the value of cutoff 0.36 for large effect sizes of R^2.[66] Q^2 value was 0.248 which considerably higher than zero and is slightly sizeable predictive relevance for the endogenous construct (that is PPD).[67] Consequently, it is concluded that the scale of the PPD has substantial predictive validity.

The assessment of the structure model

Table 4 and Online appendix 6 show that the beta, t, f^2 values meet the criterion for evaluating the model. The results confirm that brand (beta= 0.182, t= 3.588, f^2=0.043), sales promotion (beta= -0.108, t= 1.672, f^2=0.008), MRs effectiveness (beta= -0.087, t= 1.341, f^2= 0.006), patient

Table 4. Summary of the hypothesis testing direct relationships (Structural Model 1)

	Relationship	Std. Beta	Std. Error	t-value	Supported	5%	95%	VIF	R^2	SRMR	Q^2	f^2	Effect size
H1	INF -> PPD	-0.011	0.05	0.220	No	-0.086	0.083	1.413				0.000	-
H2	BAR -> PPD	0.182	0.051	3.588***	Yes	0.101	0.265	1.297				0.043	Small
H3	SPR -> PPD	-0.108	0.064	1.672**	Yes	-0.209	0.001	2.288				0.008	Small
H4	MRE -> PPD	-0.087	0.065	1.341*	Yes	-0.182	0.025	2.054				0.006	Small
H5	PRD -> PPD	0.223	0.066	3.363***	Yes	0.105	0.322	1.915	0.401	0.061	0.248	0.043	Small
H6	PEX -> PPD	0.218	0.065	3.370***	Yes	0.102	0.319	1.780				0.045	Small
H7	PEP -> PPD	-0.269	0.065	4.141***	Yes	-0.367	-0.155	1.899				0.063	Small
H8	PCP -> PPD	0.311	0.065	4.801***	Yes	0.196	0.413	1.816				0.089	Small
H9	DCH -> PPD	0.041	0.046	0.056	-	0.049	0.134	1.655				0.002	-
H10	PHP -> PPD	0.054	0.060	0.912	-	0.036-	0.159	1.474				0.003	-
H11	CBD -> PPD	0.065	0.066	0.980	-	0.048-	0.174	1.766				0.004	-
H12	TRS -> PPD	0.165	0.054	3.038	Yes	0.073	0.258	1.342				0.034	-

Note: ***Significant at 0.01 (1-tailed), **significant at 0.05 (1-tailed), *significant at 0.1 (1-tailed).

request drug (beta=0.223, t=3.363, f^2=0.043), patient expectations (beta=0.218, t=3.370, f2=0.045), pharmacist expert power (beta= -0.269, t=4.141, f^2=0.063), pharmacist-physician collaboration (beta = 0.311, t=4.801, f^2=0.089), and trustworthiness (beta=0.165, t=3.038, f^2=0.034), which explained 40% of overall prescribing decisions.

DISCUSSION

The aim of this study is to construct an instrument that measures the direct factors that influence physicians' prescribing behavior. Specifically, by developing 52 items (44 retained and 8 removed) and classifying them into four categories with 13 factors (variables or constructs), this study helps researchers conduct more systematic empirical analyses. The reliability or Cronbach's α values of the 13 constructs varied between 0.79 and 0.85, which were above the cut-off point level, indicating all the variables are reliable. This also confirms that the scale developed in this study shows an appropriate level of internal consistency.

The findings suggest that most respondents highly tend to prescribe branded generic drugs or patent instead of generic drugs and to consider applicable guidelines and the buying power of patients base their final decision when a physician prescribes the drug for your patient. Also, the proposed three items serve as a basis for comparatively analyzing the results against other studies and research settings, thereby improving the possibility of advancing the appropriate measurement of physician prescribing decisions as a construct. For example, the results show that a physician with enhanced sensitivity for security may prefer a branded medicine, over a generic alternative, in order to mitigate the accompanying risk of a generic product. At the same time, they appear responsibility to prescribe the drug recommended by the treatment guideline, in order to overcome uncertainties in initiating and monitoring systemic treatment, with the line of several researchers.[12,42,44]

In normal conditions, selecting between similarly effective and safe medications; physicians may employ patients' out–of–pocket cost-saving tactics when prescribing in the case there are not many choices. The replacement of generic medicines is not always appropriate in some instances where the drug with the brand is suitable only for the patient and thus determines whether the patient needs a generic drug or a branded drug.[68] However, a physician prescribes expensive brand medications that guarantee efficiency and gives even the patient economic status is poor because of the treatment guideline has not covered it. Thus, all categories of drugs have the same possibilities to be prescribed to patients, suggesting that treatment guidelines and the purchasing power of patients play equal roles in influencing the decision-making of physicians.

The obtained results proved that sales promotion and MR's effectiveness is negatively associated with decisions to prescribe drugs confirm prior studies in the western context, which found that MR's effectiveness could enhance adverse effects prescribing behavior.[69] Marketing efforts measures developed in this research are also important for investigating irrational prescriptions as one of the critical issues. This may help to examine if there is a need to educate physicians about the influence of drug promotion, the ethics of promotional relationships, and provide guidance on the appropriate ways to manage and deal with promotional pressure.

A mean of 3.741 and 3.788 for patient requests and patient expectations assessed on a 5-point Likert scale suggested that both variables are considered in the prescribing drugs (Online appendix 2). The associations between the variables were found to be lower than the results of Cronbach's alpha, indicating evidence of the discriminant validity of the measure. This finding maybe not surprising, considering previous research findings confirmed that drug requests by brand name and patient expectations are found to have a positive effect on the physician prescriptions.[13,70]

This study fills the gap by incorporating the pharmacist determinants of prescribing behavior and well-validated measures to evaluate their influence. The interaction of the expert power bases did not approach significance positive relationship. The finding consists of the view of previous studies that argue that pharmacists' lack of knowledge is related to prescribing drugs.[54] Furthermore, the significant positive relationship between pharmacist cooperation and prescribing was similar to previous studies but from different perspectives.[23]

The results found that drug characteristics have no significant relationship with prescribing decisions. Perhaps that the characteristics of the drug make it entail diverse viewpoints of the products in the prescription of drugs.[13,71] This argument corresponds to Pinto *et al*., who opine that elements such as side effects and cost were considered less relevant by the physicians.[72] Contrary to what was expected, the cost/benefit ratio of medicine was not significantly related to prescribing decisions in this study. This is, however, not surprising, because a number of the prior studies have also found that no consensus in prescribing world literature that price/cost of the drug has a major effect on prescribing decisions.[18,72] With respect to habit persistent, our results correspond to Janakiraman *et al*. who argue that the higher persistent seems to be sensitive only to promotion meetings or lunch invention was not affected by physician choice.[27]

Implications for theory

First, this study extends the literature on prescribing behaviour by developing and validating the influence of marketing efforts, in addition to providing procedures for new constructs such as "pharmacist expert power" "pharmacist-physician collaboration" and also the patient characteristics into two categories, namely, "patient request for the drug" and "patient expectations" influence prescribing decision. By encompassing the explanatory power of each factor, this research expands knowledge on what influences physicians' decisions to prescribe the drug in the context of a physician-patient/pharmacist relationship.

Second, it categorizes a wide-ranging set of items that aid the prediction of physician-pharmacist relationship (i.e.,

expertise power, collaboration, and trustworthiness), and their associated impact on prescribing decisions. These factors cannot be easily identified and separated and have received scant attention in the prescribing behaviours literature. Since these measurements were not reported in any study on prescribing behavior, this current study will contribute to the development of the subject of prescribing behavior in the context of a theory extension. These constructs can be exploited by policymakers to measure physicians' perceptions of their relationships with pharmacist's in general health care settings. Hence, this study provides a basis for researchers who are interested in this field to further test the relationships among these constructs, especially in the pharmacy setting. Third, the study frames the final decision of the physician when prescribing the drug as a crucial finding of studies on prescribing behavior, which has not been examined prior to research on prescribing behavior. Based on an analytical perspective, this study ultimately models factors influencing the prescribing decision for the first time as a reflective model using SmartPLS using SEM.

Implications for practice

The findings enhance the understanding of marketing managers regarding how physicians assess the effectiveness of MRs and sales promotion when making prescribing decisions. In particular, such findings suggest that managers should focus on encouraging their MRs to comply with ethical marketing and self–regulation with one outcome being better prescribing, which can be achieved by educational evidence to physicians. Likewise, the cost of a drug is crucial in determining what drug they choose. For policymakers, there is a need to look into the drug cost policy to facilitate patient's access to medicine, hence the need to address the cost/benefit of the drug issue. A powerful pharmacist should be motivated to influence physicians in ways that are believed to be effective and further produce a positive outcome. It is vital to pay more attention to pharmacist collaboration in ensuring improving prescribing behaviours. Trustworthiness is also an excellent choice for health policymakers while targeting the improvement of particular dimensions such as trust, bi-directional communication, and commitment at different levels. Also, the professional association of physicians should build awareness of the physicians that their decisions on best evidence will consider patients' requests and expectations could positively influence the prescribing decisions. Overall, the prescribing decision model proposed in this study may help policymakers to achieve and ensure appropriate drug for the patient which consequently help them in performing rational prescribing.

Limitations and future studies

First, the items that make up the instruments are reflective of marketing efforts on prescribing could be considered as a sensitive issue and thus could raise the issue of social desirability bias. Physicians may feel not comfortable indicating their involvement in marketing efforts, rather than stating their effects, in a circumstance in which the promotion was a human being. However, the risk of bias from the self-administrative survey cannot be ruled out. Thus, a longitudinal study could be employed to assess the influence of marketing efforts on the perceptions of physicians towards prescription drugs over time. Second, three items captured only the prescribing decision of the physician, which may not be an adequate proxy for actual prescribing decision behaviour in all circumstances. Third, to gain a deeper understanding, the distinction between GPs and specialist physicians should be considered, which would enable an improved comparative analysis against other studies in this subject. Future research might look at combine patient request and expectation measures in regards to their influence on prescribing drugs. The measuring of pharmacist-physician relationships may vary in salience for different classes of a pharmacist that is clinical, community, etc., and across healthcare facilities. Fourth, replication of this study by assessing the pharmacist-physician relationship from two perspectives may be a worthy effort. Further studies are required to promote an advanced perception of the nature of the relationships projected in the multifaceted model.

CONCLUSIONS

It is evident from the review of previous studies that there are insufficient validated instrument that measures the factors influencing the decision prescribing of physicians. Therefore, this research highlights the necessity for a valid and reliable scale that measures the fundamental constructs of physicians' prescribing decisions include marketing efforts, patient characteristics, pharmacist factors, and contextual factors. A 44-item measuring instrument that comprises thirteen scales was developed, which was confirmed to be highly valid and reliable based on PLS-SEM results. This instrument is applicable for assessing the factors influencing the physicians' decisions regarding prescribing. The instrument can assist policymakers to prepare valuable guidelines and develop interventions about drug prescribing to improve prescribing practices and rational use of drugs. The study offers crucial insights for academics and physicians by creating a more inclusive global picture of scale development and validation procedures with regards to factors that influence prescribing decisions. More specifically, the research suggested that physician-pharmacist cooperation is essential to enhance the quality of prescribing and health outcomes. This provides valuable insight for policymakers to develop systems that enhance the pharmacist's cooperation to improve drug prescribing.

CONFLICT OF INTEREST

The authors state that they do not present any conflict of interest in the present investigation.

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