

# Predictive Social Norms of Physicians' Intention to Use Liver Cancer Screening: Based on an Extended Theory of Planned Behavior

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## Research article

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# Abstract

**Background:** Globally, liver cancer is one of the most malignant tumors and has become a great concern to public health. The serious context of liver cancer prevention and control urges researchers to find more evidence about liver cancer screening and to expand its use. The purpose of this study was to determine the predictors associated with physicians' intention to use liver cancer screening.

**Methods:** We took contrast-enhanced ultrasound (CEUS) as an example, and developed the research framework by adding social norms to the Theory of Planned Behavior (TPB). Data was collected via a cross-sectional questionnaire survey on a sample of 292 physicians randomly selected from Fujian and Jiangxi provinces in China with a high and low incidence of liver cancer, respectively. Due to the multicollinearity problem of the data, ridge regression was applied to determine the influencing factors of physicians' intention to use CEUS.

**Results:** Most of the participants (87.30%) reported that they were willing to use liver cancer screening in their clinical practice. The scores of TPB variables were generally higher than those of social norms variables. Regression results indicated that the proposed model was explanatory, which has accounted for 72.6% of the total variance in physicians' intention. Analyses also illustrated the significant role of TPB variables (attitude and perceived behavioral control) and social norms variables (personal norms, organizational norms, and industrial norms) on the physicians' intention to use CEUS.

**Conclusions:** The study extended the Theory of Planned Behavior (TPB) by including the concepts of social norms, which is not only conducive to expanding the knowledge of factors associated with physicians' intention to use liver cancer screening, but also provide implications for developing strategies to promote the use of certain health services or products, such as playing the roles of core members, holding the panel meeting, and establishing an information push system.

## Background

With its incidence on the rise over the past few decades, liver cancer is one of the most serious malignant tumors globally, as well as the current second leading cause of cancer-related deaths [1]. Worse of all, once the clinical manifestations appear, most patients have entered the advanced stage, where has a low 5-year survival rate, poor quality of life, and unaffordable burden of disease [2,3]. The situation is particularly acute in China, which accounts for more than half of the world's new liver cancer cases and deaths each year [4]. Although a growing body of research aims at better understanding and increasing the use of cancer screening [5,6] and the fact that a fairly large number of cases can avoid advanced cancer through screening is well-established [7], it remains challenging for researchers and policymakers to persuade or motivate the public (including patients and physicians) to adopt cancer screening. Under the currently severe context of liver cancer prevention and control, there is a critical and urgent need to promote the use of liver cancer screening.

Researchers have been trying to use various theories and models to explain the rational mechanism of human behavior, such as the Theory of planned behavior (TPB) developed by Ajzen [8], which is one of the most influential and widespread theories to predict behavioral intention [9]. It presumes that people's particular behavior can be predicted and explained via their intention. In turn, the intention is functioned by three elements, namely attitude, subjective norms, and perceived behavior control [8]. Attitude reflects the perception or evaluation of performing a particular behavior. Perceived behavior control is defined as the perception of the controllable extent of performing a specific behavior. Subjective norms are perceived social pressures that whether people important to individuals think the behavior should be performed. To date, the TPB has been applied in research about health professionals' intentions [10], including the acceptance of innovative health technology [11,12] and the adherence to clinical guidelines [13]. And numerous studies basing on TPB have explained the over fifty percent of the total variance of intention [14–16].

According to Ajzen, the additional predictors are allowed in the TPB to improve the explanatory power in intentions [8], and given the calls for more consideration of the social environment aspect of health issues [17,18]. To some extent, subjective norms in the TPB are virtually a kind of social norm [19,20]. Social norms shape people's motivation and behavior based on the social environment [21]. It can be understood as the perceived prevalence of a behavior of others and the perceptions of how others think about or evaluate a behavior [22], which may come from multiple resources, such as the people, organizations, or industries around us. The perceptions from those around us are personal norms, namely subjective norms, which have been addressed in the TPB. While the influence of the perceptions from the organization and the industry on the individual can be called the organizational norms and the industrial norms, respectively represent the behavioral readiness of the whole members of the hospital and the competition pressure from the peers in the industry. In general, it's hard to make decisions that aren't influenced by the persons and various environmental elements around us, and people adjust their behavior and conform to the social expectation by information learned from observing others [23].

To the best of our knowledge, the research object and content were relatively single and fixed in previous studies about cancer screening intention. On the one hand, previous studies mainly look at the patient level, as a number of studies have been conducted to investigate the intentions to use screening of different cancer groups, such as cervical cancer [24], breast cancer [25], prostate cancer [26] and colorectal cancer [27], etc., but rarely focus on the health services provider, i.e., physicians. On the other hand, in a few studies of cancer screening intention for physicians, they focused more on the internal factors at the personal level (for example, the physicians' attitudes, beliefs, knowledge [28,29], and nonprofessional experiences [30]) than the effect of the surrounding environment of organizational and industrial on the individual. It's noteworthy that although recently the social norms have received particular attention as the determinants of the adoption of certain behaviors, including cancer screening [6,31], most studies set forth only a single level of social norms, either personal normative beliefs [32] and mimetic pressures [33] at the personal norms level, institutional pressures [34] and organizational culture [35] at the organizational norms level, or industry competition [36] at the industrial norms level. The comprehensive consideration of these three aspects is necessary, especially for the physicians in public

hospitals [37], given physicians' strong dependence on their hospitals and the industrial environment may lead to the internalization of organization norms and industrial norms that contribute greatly to their decision-making [38].

Therefore, since few previous research on cancer screening intention targeting physicians, and lack of the discussion of perceived norms other than the individual, this study aims to determine the predictors of the intention to use liver cancer screening from the physicians' perspective, and the influence of the potential social norms from the personal, organizational and industrial level. To make the study more pertinent and focused, contrast-enhanced ultrasound (CEUS), one of the confirmed effective screening technology for liver cancer, will be taken as an example to conduct the survey. This study is promising for bridging the gap in the literature about the factors affecting physicians' intention to use liver cancer screening from the perspective of health services providers. The findings will not only provide direct guidance for giving full play to the role of social norms in promoting the use of CEUS and other liver cancer screening, but also have several implications for expanding the use of other health services/products.

## Methods

### Theoretical Framework

Based on the existing literature and the context of the use of CEUS, we developed a research framework that originated from the TPB and the concepts of social norms, which was shown in Fig. 1. The TPB included some important elements, such as attitude, perceived behavioral control, and subjective norms. And the social norms were explained by three aspects: personal norms (namely the variable of "subjective norms" mentioned above, it was the intersection of the TPB and the social norms), organizational norms ("hospital culture" and "technology sharing" were the measurement variables), and industrial norms (measured by "industry pressure").

### Design and Sample

From February to August 2019, we conducted a cross-sectional survey in China using a multistage sampling method. In the first stage, Fujian and Jiangxi province were randomly selected from the provinces with a high and low incidence of liver cancer, respectively. Secondly, due to the widespread implementation of the hierarchical medical system in China, which is a form of health resource cooperation among many health institutions at different levels, two medical treatment alliances were randomly selected in each province. Lastly, in each medical treatment alliance, physicians who meet all of the following criteria will be included in the survey: (1) work in liver disease-related departments, such as the department of hepatology, oncology, infection, gastroenterology, interventional medicine, radiotherapy, general surgery, and traditional Chinese medicine, (2) have knowledge of CEUS, (3) agree to participate in this study.

### Instrument

For the data collection, a structured questionnaire was developed on the basis of our research framework. It was divided into four parts: (1) demographic characteristics of participants, including sex, age, education, professional title, department, and years in practice. (2) Intention to use CEUS. To measure the behavioral intention, physicians were asked the degree to which they would be willing to use, learn, and recommend CEUS in their practice. (3) The scale of TPB. Items proposed by the TPB were used to capture attitude, subjective norms, and perceived behavioral control, and the items were restated to fit the practical context of CEUS. (4) The scale of social norms. For the subjective norms had been included in the TPB scale for measurement, this part focused on measuring organization norms and industrial norms. Organizational norms were measured by two dimensions of hospital culture and technology sharing, while industrial norms were measured by the dimension of industry pressure. Items in part 2 to part 4 were rated on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Table 1 provides the number of items of the dimension, sample questions, and Cronbach's  $\alpha$  for the dimensions and the questionnaire. The detailed questionnaire is available in Additional file 1. All dimensions and the whole questionnaire showed satisfactory reliability that was greater than the recommended threshold of 0.7.

Table 1  
Measurement of each dimension of the questionnaire.

Dimension	Items	Sample question/statement	Cronbach's $\alpha$
Intention	3	I would like to use CEUS for liver cancer screening.	0.946
Attitude	3	I think it's a wise choice to use CEUS for liver cancer screening.	0.917
Perceived behavior control	3	Using CEUS can increase my confidence in diagnosing liver cancer.	0.935
Subjective norms	3	People who are important to me have a positive attitude to use CEUS for liver cancer screening.	0.933
hospital culture	3	The hospital advocates technical innovation to improve the clinical outcomes for patients.	0.964
Technology sharing	3	The hospital is willing to share the experience of CEUS use with other institutions.	0.980
Industry pressure	4	CEUS has been widely used for liver cancer screening in the medical industry.	0.901
The whole questionnaire	22		0.959

## Analysis

A descriptive analysis was performed to depict the characteristics of the participants. The dimension score was calculated as the sum of the scores of each item divided by the number of items. Pearson

correlation was used to assess the relationship between physicians' intention to use CEUS and its potential determinants. Also, correlation analysis results were the basis of collinearity diagnostics. When the correlation coefficient is greater than 0.7, multicollinearity can be considered [39,40]. If multicollinearity exists, ridge regression rather than traditional multiple linear regression, a valid technique enabling regression coefficients more stable in the case of multicollinearity, will be chosen to produce the estimates [41] in the next analysis to determine the influencing factors of physicians' intention to use CEUS. Statistical significance was set at  $P < 0.05$ .

## Ethics

Ethics approval was obtained from the medical ethics committee, Fujian Medical University, China. Participation in the study was voluntary and anonymous. Informed consent was obtained from all participants.

## Results

### Characteristics of the Sample

Totally 292 physicians were included in this study. The characteristics of the participants are presented in Table 2. Among the participants, 65.07% were males, 86.64% were under 45 years old, 93.84% reported having a bachelor's degree or above, 76.37% with junior or intermediate title, and 82.88% had no administration role. The proportion of the participants who had less than 15 years of practice accounts for 87.33%.

Table 2  
 Characteristics of the sample physicians (n = 292).

Characteristic	Frequency	Percentage (%)
Sex		
Male	190	65.07
Female	102	34.93
Age		
< 35 years old	148	50.68
35 ~ 44 years old	105	35.96
≥ 45 years old	39	13.36
Education		
Junior college or below	18	6.16
Bachelor	156	53.42
Master	112	38.36
Doctor	6	2.05
Professional title		
Junior	107	36.64
Intermediate	116	39.73
Senior	69	23.63
Administration position		
Yes	50	17.12
No	242	82.88
Years in practice		
< 5 years	73	25.00
5 ~ 10 years	94	32.19
11 ~ 15 years	88	30.14
16 ~ 20 years	31	10.62
> 20 years	6	2.05

Of the participants, 87.30% reported that they intended to use liver cancer screening in their clinical practices, meaning 87.30% of potential adopters. The mean scores and standard deviations for the TPB variables and the social norms, and the percentage of participants having a positive score (a score above 3 was indicated as having a positive score) on that scale are presented in Table 3. The majority of the participants had a positive score for all dimensions. The scores of TPB variables were generally higher than those of social norms variables. Among them, attitude has the highest proportion of positive responses, while industry pressure has the lowest proportion of positive responses.

Table 3  
Mean scores for the dimensions of the TPB and the social norms.

Dimension	Mean	SD	% of Participants Having a Positive Score
Attitude	4.21	0.83	87.70
Perceived behavior control	4.21	0.80	86.30
Subjective norms	4.02	0.95	79.50
hospital culture	4.07	1.07	80.10
Technology sharing	4.04	1.09	76.00
Industry pressure	3.78	0.93	71.20
Intention	4.25	0.82	87.30
SD: standard deviation			

## Relationships Between Intention and Its Potential Determinants

As shown in Table 4, all potential determinants showed a positive correlation with physicians' intention to use CEUS ( $r= 0.462$  to  $0.860$ ,  $P < 0.01$ ). Some predictor variables were highly correlated (including attitude and perceived behavior control, attitude and subjective norms, perceived behavior control and subjective norms, hospital culture, and technology sharing), reaching the common threshold of multicollinearity of 0.7 [39,40]. To avoid multicollinearity, ridge regression will be used [41] in the next analysis to determine the influencing factors of physicians' intention to use CEUS.



Table 4  
Pearson correlation matrix of intention and its potential determinants (*r*).

Dimension	Attitude	Perceived behavior control	Subjective norms	hospital culture	Technology sharing	Industry pressure	Intention
Attitude	1						
Perceived behavior control	0.806**	1					
Subjective norms	0.766**	0.706**	1				
hospital culture	0.399**	0.457**	0.404**	1			
Technology sharing	0.408**	0.444**	0.427**	0.847**	1		
Industry pressure	0.484**	0.542**	0.554**	0.432**	0.503**	1	
Intention	0.825**	0.860**	0.719**	0.467**	0.462**	0.465**	1
** $P < 0.01$ .							

## Ridge Regression

The ridge regression model supported the assumptions in the proposed framework (Table 5). The overall model accounts for a large proportion of variance in physicians' intention to use CEUS,  $R^2=0.732$ , Adjusted  $R^2=0.726$ ,  $F=129.712$ ,  $P < 0.001$ . Physicians' attitude ( $\beta=0.226$ ,  $P < 0.001$ ) and perceived behavior control ( $\beta=0.259$ ,  $P < 0.001$ ) were positively associated with their intention to use CEUS. All of the social norms variables (including subjective norms, hospital culture, technology sharing, and industry competition) were found to be significantly affect physicians' intention to use CEUS.

Table 5  
Ridge regression model for influencing factors of physicians' intention to use CEUS.

Dimension	$R^2$	Adjusted $R^2$	$F$	$B$	S.E.	$\beta$	T
	0.732	0.726	129.712***				
Attitude				0.225	0.013	0.226	17.230***
Perceived behavior control				0.266	0.014	0.259	19.378***
Subjective norms				0.132	0.012	0.152	10.994***
hospital culture				0.053	0.010	0.069	5.111***
Technology sharing				0.045	0.010	0.060	4.491***
Industry pressure				0.033	0.013	0.037	2.462*
Constant				1.130	0.116	0.000	9.717***
S.E. Standard error; *** $P < 0.001$ , * $P < 0.05$ .							

## Discussion

This study aimed to provide insights into the predictors associated with the intention to use liver cancer screening in physicians. The research framework developed on the basis of the TPB plus the social norms constructs was supported in this study, which explained 72.6% of the total variance in the intention. Additionally, the predictability of the TPB variables and social norms variables for physicians' intention to use CEUS was verified, including attitude, perceived behavioral control, subjective norms, hospital culture, technology sharing, and industry pressure. These findings will provide a reference for developing strategies of improving the use of liver cancer screening.

Consistent with previous research [42–44], attitude and perceived behavioral control are the important influencing factors of health professionals' intention to use a certain service or product. TPB suggests that an individual's intention and usage behavior are the results of internal factors, the consistency of behavior with attitude and motivation is the requirement of performing a specific behavior [45]. A favorable attitude toward liver cancer screening is indispensable feedback to a behavior. In addition, the results indicated that physicians' intention to use liver cancer screening was influenced by perceived behavioral control that could control or enhance their intention. More specifically, the perception of the obstacles, risks, or rewards associated with the use of liver cancer screening decreases or increases physicians' willingness to try to achieve it or to avoid it.

The influence of social norms on physicians' intention to use liver cancer screening was also confirmed in three aspects: personal norms, organizational norms, and industrial norms. Personal norms, namely

subjective norms, refer to the perceived expectations or evaluations for particular behaviors by which people who are important to us [8]. In a work situation, these people are usually colleagues, superiors, and authorities. An important reminder from the results was that even though those influential figures did not exert direct pressure on us to act, they play the exemplary and leading role that implicitly affects the intentions and behaviors of others, especially for new members and marginal groups. In addition to personal norms, the effects of organizational norms and industrial norms were also significant in this study. Hospital culture and technology sharing represented the organizational norms. The former is the ensemble of values and beliefs that accumulated by the members within a hospital over a long period of time [46,47], while the latter is the extent to which knowledge and information are shared with other health care institutions [48,49]. Both of them reflected the overall attitude and readiness of the hospitals for liver cancer screening at the spirit level in this study. As the invisible “public opinion environment”, it’s recognized that the organizational norms unavoidably affected physicians’ intention to use liver cancer screening. In order to give full play to its role, it is necessary to attach the importance to the cultivation of hospital spirit [50,51], reach consensus beliefs within the hospital that encourage early diagnosis and treatment for liver cancer patients or high-risk populations via screening, and develop an atmosphere of advocating technology diffusion in a wider range to promote health. Industrial norms referred to industry pressure in this study. Such pressure may be from surrounding hospitals, business partners, and standards in this industry [52]. In most cases, hospitals and physicians face competition from peers for more patients, and the pressure from the technology developers and suppliers will impact on their expecting for investment returns [53]. The industry pressure would enhance physicians’ intention to use liver cancer screening if they want to stay competitive.

Social norms interventions have received increased interest in “changing or promoting certain behaviors” in health professionals. To strengthen physicians’ intention and behavior of using liver cancer screening, several strategies basing on the compliance mechanism of social norms [54] can be recommended. The first strategy is *core members take the lead*. The wide acceptance and use of liver cancer screening by senior physicians and supervisors, who generally have a demonstration role for other physicians, are the best guides. For better expanding the use of liver cancer screening, it is recommended to mobilize the senior individuals at the first. The second is *panel meeting*. Through the process of collective thinking, the meeting will be capable to reshape norms and practices from a critical perspective [55]. Another strategy is *information push system*. By regularly and timely sending information and hot spots in the field of liver cancer diagnosis and treatment, physicians will be capable to make decisions on the basis of the knowledge of industry trends.

In additional to the implications, this study was also strengthened by some features. One of the strengths was the research framework developed by integrating the TPB with the concepts of social norms, which was conducive to identify the influence of organizational norms and industrial norms in addition to the individuals. The second strength was the findings expanded the corresponding knowledge of physicians’ intention to use cancer screening, this will be useful in providing approaches for future interventions. Another strength was that the application of ridge regression analysis avoided the problems caused by multicollinearity and made the model more matching to the actual situation. Inevitably, this study also

has some limitations. First, since all of the variables were measured by self-reports, the social desirability bias can't be ruled out that some physicians may tend to make more positive responses. Second, some potential factors may be not taken into consideration, and more comprehensive content should be studied. Third, due to the limited time and fund, the representativeness may be a concern of research data, the sample size needs to be expanded in the future work.

## **Conclusions**

This study enriches the knowledge of the research field of technology diffusion and utilization, especially increases the understanding of the associated factors of physicians' intention to use liver cancer screening. In addition to the internal factors that include attitude and perceived behavioral control in the TPB, this study has identified that physicians' intention to use liver cancer screening was predicted by the perceived social norms of physicians at three levels: personal, organizational, and industrial norms. It is concluded that appropriate social norms interventions should be integrated to improve physicians' intention and usage behavior. And some concrete measures, such as playing the roles of core members, holding the panel meeting, and establishing an information push system, have been put forward for future practice.

## **Abbreviations**

CEUS: Contrast-enhanced ultrasound

TPB: The Theory of Planned Behavior

## **Declarations**

### **Ethics approval and consent to participate**

The study was approved by the Ethics Committee of the Fujian Medical University. The data were collected through a questionnaire survey after getting participants' consent.

### **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.

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## Authors' contributions

LW designed and conducted the project, contributed to grasp the subject and revised the manuscript. DQ carried out the data analysis and drafted the manuscript. LW and DQ developed the questionnaire. All authors read and approved the manuscript before submission.

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## Figures





**Figure 1**

The research framework of physicians' intention to use liver cancer screening (CEUS).

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