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Evaluating the Information Usefulness of Online Health Information for Third-party Patients

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Abstract: Online health interactions (OHIs) can benefit patients, physicians, and society. However, little research has been conducted that studies the social value of OHIs for third-party patients who view previous OHIs concerning similar health issues to theirs. Drawing on the literature on social support and information uncertainty, this study established a theoretical model to explore the roles of treatment information, prevention information, and emotional support in determining information usefulness perceived by third-party patients, and whether such relationships are contingent on information uncertainty. The model was tested using "health questions and answers" textual data from 1,848 OHIs. The results indicate that prevention information and emotional support significantly improve information usefulness perceived by third-party patients. When the level of information uncertainty regarding physicians' replies is high, the effect of treatment information is strengthened and the effect of emotional support is weakened, indicating both positive and negative contingent roles of information uncertainty. This study has implications for practitioners and also contributes to the literature on online health information, social support, information science, and information uncertainty.

Keywords: Online health interaction, third-party patients, treatment information, prevention information, emotional support, information uncertainty

1. INTRODUCTION

Online health interaction (OHI) platforms have become an alternative channel for patients to consult online physicians. The Pew Internet and American Life Project estimated that 8 in 10 Internet users search for online health information in United States, making it the third most popular online activity [1]. Through online health platforms, patients can interact with other patients or physicians to access informational or emotional support [2, 3]. The existing literature has verified that online support not only enables patients to obtain treatment quickly and cheaply [4], but also improves physicians' income [5] and reputation [6], as well as enhancing physician–patient relationships . Therefore, OHIs have become an effective approach for exchanging health information and benefiting the physicians and patients encountered in the online health services.

Since OHIs are public and thus other patients can view previous interaction processes with or without payment, there may be a spillover value for society [7]. Viewing previous OHIs is useful for third-party patients to obtain more information about their health issues [8]. Moreover, it can be an effective approach for exchanging health information, although it has been largely neglected in the current literature.

To manifest precisely physician–patient interactions, and drawing on social support theory, we measured online support according to informational support and emotional support [2, 3]. The extant literature mainly treats informational support as a holistic concept and thus cannot provide a detailed view of how diverse types of health information can benefit online patients [9, 10]. Third-party patients may already understand a little about their diseases, so they can choose and view a specific OHI, which means they have already known the

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symptoms and diagnoses about their health issues. Their purpose for information seeking can be curing diseases, understanding side-effects, prevention, and emotional support[11]. Based on the characteristics of online health information exchange, this paper identifies two dimensions of online health informational support—treatment information and prevention information—as well as online health emotional support that constitute OHI.

Uncertainty exists when details of situations are ambiguous, complex, unpredictable, or probabilistic[12, 13]. One of the greatest obstacles of OHIs is that it is more difficult for physicians to evaluate patients' health issues or conditions compared with face-to-face communication [14]. Further, illness is often complex and changeable[15]. Thus, during OHIs, physicians are more cautious when helping online patients and tend to provide uncertainty information in the online context. However, patients wish to decrease uncertainty through online information seeking [16] or communicating with others [17]. In the health care literature, those studies involving uncertainty often focused on uncertainty management [17, 18] and the impacts on patient behaviors [19]. However, little research to date has examined the role of information uncertainty in OHIs, such as whether its shapes the linkage between the interaction process and information value. In our context, the uncertain information contained in previous OHIs may also shape the social value perception of the third-party patients.

To plug the research gaps previously mentioned, this study develops a theoretical model to investigate how OHIs influence spillover value for third-party patients and the moderating role of information uncertainty/ Specially, this study aims to address the following research questions.

1) *How do third-party patients value previous OHIs?*

2) *Are the effects of the interaction process on information value contingent on information uncertainty?*

2. RESEARCH MODEL

Fig. 1 presents the research model in this study.

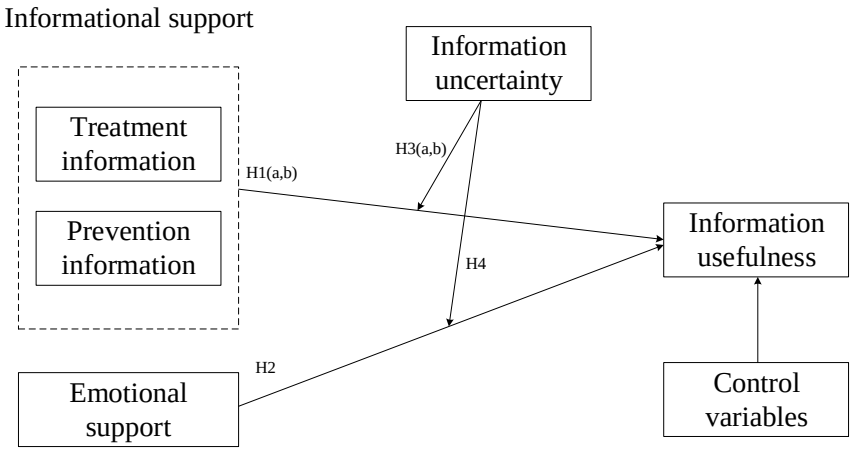

Fig. 1. Research model

Informational support, in this context, is the transmission of information, suggestions, or guidance to third-party patients via OHIs [20]. Treatment information relates to curing diseases, and prevention information relates to preventing diseases or injuries from occurring or worsening. On online health platforms, third-party patients act as support seekers by viewing previous OHIs. Informational support can benefit them either through the direct effect of improving their health condition via the treatment information [21, 22] or through the indirect effect of providing prevention information to enable them to manage their health condition better [21, 23]. Thus, for third-party patients seeking health information from previous OHIs, more treatment and prevention information provided in OHIs can be more useful to them because it presents more choices in curing or managing their health issues. Based on the above arguments, we hypothesize that:

H1a. *Treatment information provided in previous OHIs positively influences the information usefulness perceived by third-party patients.*

H1b. *Prevention information provided in previous OHIs positively influences the information usefulness perceived by third-party patients.*

Emotional support is providing care or concern, understanding, empathy, and encouragement to third-party patients [24]. Such support can help patients reduce their levels of stress or anxiety when dealing with their health issues [20, 25]. Third-party patients have generally developed anxiety about their health issues, which has induced them to read previous OHIs. In addition to professional treatment information to deal with the issues, they may also need emotional comfort from physicians to increase their confidence in recovery or reduce their anxiety. Therefore, besides informational support, emotional support acquired from previous OHIs can also benefit third-party patients. The more information gained from previous OHIs for emotional support, the more likely it is to help third-party patients increase their confidence and reduce their anxiety. We therefore hypothesize that:

H2. *Emotional support provided in previous OHIs positively influences the information usefulness perceived by third-party patients.*

Cutrona and Russell [26]characterized illnesses as uncertain events because illnesses are often perceived to be uncontrollable in health-related circumstances, in which patients tend to seek certain health information. Third-party patients who view previous OHIs are seeking further information about their health issues, either for treatment or prevention purposes. If the treatment and prevention information obtained is uncertain, third-party patients may question whether the information provided to the original patients encountered in the OHIs fits their own health condition. If not, they would need to view more OHIs to seek more health information [27], which diminishes the value of the information obtained from the previous OHIs. Based on this, we propose that:

H3a. *Information uncertainty weakens the effect of treatment information on information usefulness perceived by third-party patients.*

H3b. *Information uncertainty weakens the effect of prevention information on information usefulness perceived by third-party patients.*

According to Cutrona and Russell [26], for uncontrollable events (uncertainty) such as those experienced in health-related circumstances, emotional support is more beneficial for patients than in controllable events. When seeking health information from previous OHIS, third-party patients are also experiencing similar diseases to the patients initially engaged in the OHIs, and have concerns about their present conditions. Thus, third-party patients are also eager to obtain emotional support, such as comfort or commitment, from the physicians or previous OHIs to increase their confidence to manage their health issues. With regard to OHIs demonstrating a high level of uncertainty, third-party patients may require more emotional support because the uncertain information provided may cause concern about whether the support is suitable for their condition [26]. Consequently, they will perceive that the emotional support offered in the OHIs is not adequate, thereby weakening the effect of emotional support on their usefulness perception. Based this, we propose that:

H4. *Information uncertainty weakens the effect of emotional support on information usefulness perceived by third-party patients.*

3. RESEARCH METHODOLOGY

We developed a JAVA-based web crawler to collect data from the OHIs on the AliHealth platform. We collected 1,848 OHIs from 15 departments. In this research, we were concerned about the word-level information in the OHIs not the reply-level information. Meanwhile, most of the physicians' replies in OHIs contain emotional expressions and two types of information: treatment information and prevention information. Our model considered whether the treatment words, prevention words, and emotional words appear in the

physicians' replies and the frequency of such words to measure physicians' replies. Thus, we conducted word segmentation to identify the medical-specific vocabularies and emotional vocabularies to analyze physicians' replies in the OHIs.

Four dictionary sources were used for the word segmentation. The treatment information dictionary come from a highly recognized and authoritative professional Chinses health term dictionary. The emotional vocabularies come from a text analysis tool based on word measurement, LIWC, which is widely used to identify emotional support [28, 29]. Since there is no mature dictionary of uncertainty information and preventive health information available at present, two specific dictionaries for use in this study were constructed. Both the assistants and researchers highlighted the uncertainty words and preventive words from physicians' replies in a sample of 90 OHIs in parallel. Then, the words with higher coincidence degree were included in the dictionaries. Finally, we achieved a customized dictionary with 34 uncertainty words or phrases, such as possible, temporary, usually and seems to be.

On the basis of word segmentation, the ratio of the number of usefulness indications (i.e., likes) to the number of views was used to measure information usefulness perceived by third-party patients. The independent variables were measured by the proportion of various types of words apparent in the whole OHI, including treatment information, prevention information, and emotional support. The moderator, information uncertainty, was measured by the presence of uncertain words in the physicians' replies in each OHI. The uncertainty rate, physician title, top hospital, applause rate, the number of likes and the number of views were used as control variables.

To test the hypotheses regarding what factors in OHIs can determine information usefulness perceived by third-party patients, we developed an empirical model with the moderating role of information uncertainty:

$$Usefulness_i = \beta_0 + \beta_1 TreatInfor_i + \beta_2 PrevenInfor_i + \beta_3 EmotInfor_i + \beta_4 Uncertainty_i * TreatInfor_i + \beta_5 Uncertainty_i * PrevenInfor_i + \beta_6 Uncertainty_i * EmotInfor_i + \beta' Z \quad (1)$$

where β parameters are the coefficients to be estimated and Z is the vector controlling information uncertainty, physician title, top hospital, applause rating, the number of likes, the number of views, and hospital level. The models were then tested hierarchically: the model including only the control variables was first tested in Stage 1, then the baseline model including the independent variables was tested in Stage 2. In Stage 3, the model with interaction terms was then tested to verify the moderating effects. Table 1 presents the results.

Table 1. Hierarchical Regression Results

DV: *Usefulness*$_i$	Stage 1	Stage 2	Stage 3
TreatInfor$_i$		0.001	−0.001**
PrevenInfor$_i$		0.001*	0.001
EmotInfor$_i$		0.002**	0.004***
*Uncertainty*TreatInfor*$_i$			6.98e-04***
*Uncertainty*PrevenInfor*$_i$			−2.04e-04
*Uncertainty*EmotInfor*$_i$			−0.002***
Uncertainty_rate$_i$	0.037	0.042	−0.008
Pysician_title$_i$	0.111	0.116	0.105
Top_hospital$_i$	−0.030	−0.034	−0.027
Applause_rate$_i$	0.132	0.136	0.121
Like$_i$	0.000***	0.000***	0.000***
View$_i$	−4.18e-06***	−4.30e-06***	−4.25e-06***
Hospital level dummy	YES	YES	YES
Department dummy	YES	YES	YES
Constant	−1.378	−1.418	−1.256
Observations	1,891	1,891	1,891
R-squared	0.606	0.609	0.615

Note:* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Stage 1 results revealed that only *Like* and *View* both significantly influenced *Usefulness*, and the other controls were not significant. From Stage 2 results, it can be concluded that the ratio of prevention information (*PrevenInfor*, $\beta = 0.001$, $t = 1.79$, $p < 0.10$) and the ratio of emotional support words (*EmotInfor*, $\beta = 0.002$, $t = 2.16$, $p < 0.05$) positively and significantly influenced information usefulness. Meanwhile, the effect of *TreatInfor* on *Usefulness* was not significant ($\beta = 0.000$, $t = 0.38$, $p > 0.10$), which indicates that H1a is not supported while our H1b and H2 are supported.

In Stage 3, the moderating role of information uncertainty was tested. We found that the interaction term *Uncertainty*TreatInform*$_i$ ($\beta = 6.98\text{e-}04$, $t = 4.18$, $p < 0.01$) was positive and significant, which is contrary to our H3a. The coefficient of *Uncertainty*PrevenInfor* was not significant ($\beta = -2.04\text{e-}04$, $t = -0.45$, $p > 0.10$), indicating H3b is not supported. We also found that the interaction terms *Uncertainty*EmotionInfor*$_i$ ($\beta = -0.002$, $t = 4.30$, $p < 0.01$) was negative and significant, thus supporting H4. Thus, information uncertainty strengthens the effect of treatment information and weakens the effect of emotional support.

To test the moderating role of information uncertainty further, and following the suggestions of Meyer[30], we calculated the effect of treatment information on information usefulness at different levels of information uncertainty. The results indicate that as the number of uncertain words in one OHI increased from 0 to 8 (accounting for 99.95% of the total sample size), the effect of treatment information on information usefulness became significantly stronger. These results were consistent with our main finding that information uncertainty positively moderates the effect of treatment information on information usefulness among third-party patients. We also calculated the effect of emotional information on information usefulness at different levels of information uncertainty. The results indicate that as the number of uncertain words in one OHI increased from 0 to 8, the effect of emotional support on information usefulness became significantly weaker. These results are consistent with our H4. Therefore, our moderating effects are further supported.

4. CONCLUSIONS

This paper presents four significant key findings. First, informational support from previous OHIs can partially contribute to their social value. We find prevention information from previous OHIs can increase information usefulness perceived by third-party patients, while the effect of treatment information is not significant. Thus, prevention information contained in previous OHIs can augment their social value among third-party patients, while treatment information cannot. This may be because prevention information is related to health suggestions that prevent patients from acquiring diseases or injuries, which are more general for a kind of diseases and the potential value of such information for the other patients is great [31]. However, compared with prevention information, treatment information is more situation-specific or targeted at specific patients engaged in the OHIs, and different patients in different situations may need significantly different treatments [32]. Second, we find emotional support from previous OHIs can also positively influence social value perceived by third-party patients. Third, our research findings suggest that information uncertainty strengthens the effect of treatment information on information usefulness. This is consistent with the finding that the direct effect of treatment information is not significant because treatment information that is too specific is not valued by third-party patients [32]. However, the result suggests the uncertainty positively moderates the effect of treatment information on information usefulness. This positive role of information uncertainty is due to the special situation of evaluating the information usefulness of online health information from the third-party patient perspective who view information uncertainty differently from those patients engaged in one-to one encounters. if the treatment information is uncertain, more third-party patients will believe that the treatment procedures are not specific to the original patients engaged in the OHIs, but can also be suitable for themselves. In contrast, the moderating effect of information uncertainty on the relationship between prevention information and

information usefulness is not significant. One possible explanation for this is that prevention information is less specific and more universal under different disease conditions [31]. Thus, with the presence of a high or low level of information uncertainty in previous OHIs, third-party patients do not greatly perceive social value changes [31]. Finally, the effect of emotional support on the social value of OHIs is weakened with the presence of information uncertainty. This is because third-party patients are surrounded by a high level of uncertainty and anxiety in managing their health issues, so they need emotional support from the experiences of patients with similar symptoms [33]. As a result, if they still encounter uncertain information when seeking emotional support from previous OHIs to reduce their health anxiety, their value perceptions of the OHIs will be lowered.

This study provides several theoretical contributions. First, it contributes to the health information literature by proposing and explaining a new type of online health information value, namely, social value. Second, our study is one of the first effort to investigate the underlying mechanism of the social value of online health information in the information science field. Third, this study extends social support theory by measuring informational support from specific categories to reconcile the theory better with the health care context. Finally, this research indicates that while uncertainty has been widely believed to be a negative factor and to have a dark side, it may play a positive role in certain situations. this study enriches the uncertainty literature by disentangling the positive role of information uncertainty from the dark sides.

This study has some practical implications for related practitioners. First, physicians should take measures to adjust informational and emotional support in their information sharing to increase the information usefulness perceived by third-party patients. Second, physicians also need to pay attention to the use of uncertain words, since we found that information uncertainty positively moderates the effect of treatment information but negatively moderates the effect of emotional support on information usefulness perceived by third-party patients. Third, online platform managers can take measures to improve the social value of previous OHIs perceived by third-party patients, such as organizing OHIs concerning the same topic by their potential social value to increase exposure of OHIs with a higher social value. Finally, when evaluating the social value of OHIs, it is critical for third-party patients on the platforms to realize that information uncertainty can reflect the professionalism of the physicians to a certain extent because of the OHI mechanism.

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