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How do Patients with Chronic Diseases Make Usage Decisions

Regarding Mobile Health Monitoring Services?

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Abstract: The increasing population of patients with chronic diseases generates great challenge of chronic disease management. The occurrence of mobile health monitoring service is beneficial to chronic disease prevention and health promotion. The objective of this study is to investigate how the patients with chronic diseases make usage decisions on mobile health monitoring service. A survey comprising 261 subjects were conducted to validate the research model and proposed hypotheses. The results revealed that health severity positively influences mobile health monitoring service use intention, while negative health emotions do not. Health uncertainty avoidance strengthens the effect of health severity but weakens the effect of negative health emotions on mobile health monitoring service use intention. Limitations and implications for research and practice are discussed.

Keywords: Mobile health monitoring service, chronic diseases, health severity, negative health emotions, health uncertainty avoidance.

1. INTRODUCTION

With the rapid approach of the aging society, patients with chronic diseases make up a considerable proportion of the global population ^[1]. According to a recent report by the World Health Organization, for instance, chronic diseases account for 60% of all deaths worldwide ^[2] and 85% of those in China ^[1]. Expenses incurred for chronic diseases comprise about 75% of the total healthcare expenses in the United States ^[3]. Despite the serious impacts resulting from chronic diseases, there are no effective measures to alleviate the patients' health problems. The mobile health monitoring service (MMS) is a widely-used approach for chronic disease management ^[4]. However, there is a lack of knowledge on how this special group makes usage decisions on this monitoring service, practically and theoretically. The current literature on this issue has thus far mainly adopted a technology acceptance perspective and has largely ignored the health-related factors ^[5,6]. Therefore, our research integrates health-related factors to investigate: How do patients with chronic diseases make usage decisions regarding the mHealth monitoring service? Exploring patients' decision-making from a health perspective will not only add to the current knowledge on health technology adoption, but also provide a basic understanding of how patients with chronic diseases make health-related decisions.

Due to the long-term influences of the chronic diseases, chronically ill patients may generate negative emotions, such as anxiety and depression, when facing their health issues ^[7]. These experiences will induce them to have a highly severe perception of their health conditions. Therefore, this study draws on negative health emotions and health severity to manifest the physical and emotional effects of the chronic diseases on patients, respectively. Prior evidence has indicated that services or transactions through virtual channels based on ICTs can provoke many uncertainties and potential risks ^[8]. Individuals possess different tolerances of uncertainty in their daily decision-making, which is determined by their characteristic of uncertainty-avoidance ^[9]. Accordingly, when they make health-related decisions, their health uncertainty avoidance can sharpen their decision processes. Therefore, to gain a better understanding of the role of negative health emotions and health severity in patients' usage of the MMS, this research further explores the contingency role of health uncertainty

avoidance.

To address the aforementioned questions, a theoretical research model is developed and empirically tested by a survey among patients with chronic diseases. In doing so, this research contributes to the extant literature in several aspects. First, our research is possibly one of the first to explore how users decide to use the mHealth monitoring service mainly from a health perspective. Second, by explicitly investigating the contingency role of health uncertainty avoidance, our findings shed light on the relative importance of the physical and emotional conditions for chronically ill patients' mHealth usage decisions. Third, our research focuses on a special group, i.e. patients with chronic diseases, and explores their special responses to mHealth services. We also contribute practical implications arising from this research to guide mHealth practitioners and providers.

The remaining sections of the paper are organized as follows. In the next section, we will review the literature on the mHealth monitoring service, the characteristics of patients with chronic diseases, and health uncertainty avoidance. Following the review, the research model is proposed. This is followed by an overall description of the research methodology and results, after which the key findings and implications are discussed. Finally, we end with a conclusion.

2. LITERATURE REVIEW

2.1 The mHealth monitoring service

mHealth service can be defined as the use of mobile information and communication technologies (ICTs) endowed with the capability of managing and delivering health information timely, between end-users and health professionals to improve patient safety and the quality of healthcare^[10]. mHealth service is a promising platform for chronic care due to the advantages provided by mobile ICTs. The long-term nature of chronic diseases promotes the need for health services while also leading to expense issues^[11]. A possible solution for these problems is to empower patients with the skills for self-health management^[12]. Thus, the MMS is important in their daily lives to keep them informed of their health conditions^[11]. Some researchers have verified the role of MMS in chronic care, such as by increasing clinical outcomes^[13, 14], decreasing patient costs^[15, 16], and improving patient-provider compliance^[14, 16].

As the MMS is an emerging service, behavioral studies on this topic are still scarce. Although the current research has mainly drawn on a technology perspective by applying the well-developed theories and models in the technology acceptance area, the health-related factors are largely ignored, leaving the mHealth diffusion research incomplete. To narrow this gap in the mHealth context, this study is designed to explore the effects of health-related factors, i.e. physical and emotional conditions on the diffusion of the MMS.

2.2 Characteristics of patients with chronic diseases

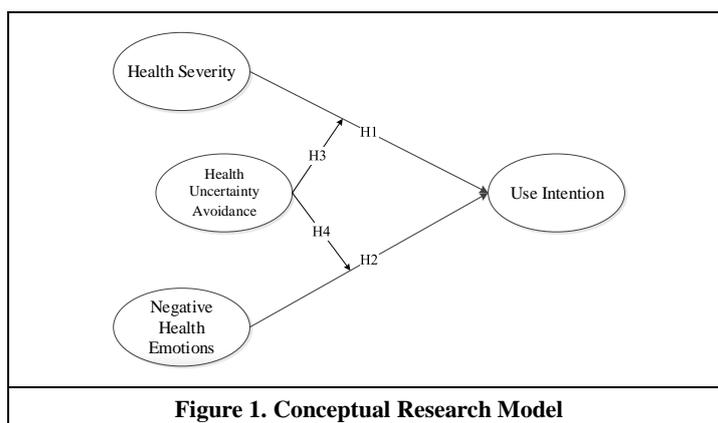
Chronic diseases are long-term conditions and cannot be cured easily and instantly, compared with the acute diseases^[17]. Patients with chronic diseases face many challenges for managing their health conditions in their daily lives. They would feel more threatened, which may, in turn, give rise to more negative emotions on their health, such as anxiety and depression^[7]. As chronic diseases are usually associated with substantial distress and functional limitations, patients have to deal with many changes in their daily lives, such as a feeling of discomfort, loss of potential opportunities, and the facing of financial constraints^[18]. Recognizing that these changes are caused by chronic diseases, which cannot be easily treated, they generally consider that their health condition is serious when making health-related decisions.

2.3 Uncertainty avoidance and health

Uncertainty avoidance refers to the extent to which individuals feel threatened by uncertain situations^[19]. With a strong sense of uncertainty avoidance, individuals will experience stress and anxiety in their daily routines, which may also influence their decision-making regarding new services and technologies^[20]. Since it is manifested as a general feeling of anxiety when individuals face uncertainty and challenges, uncertainty avoidance is widely seen as a personality of individuals that moderates their adoption decisions regarding various services and technologies^[20-22]. Accordingly, we define health uncertainty avoidance as the tendency to avoid any unexpected or unknown risks and uncertainty in health-related decisions. Due to the outcome randomness, information ambiguity, and treatment complexity, most health-related decisions are uncertain^[23]. Thus, when making health-related decisions, individuals are faced with many uncertainties, especially in the case of chronically ill patients. However, how patients make decisions under conditions of uncertainty and whether this special characteristic shapes their decision-making remain underexplored. To narrow this gap, our research proposes and tests the contingency role of health uncertainty avoidance in patients' MMS usage decisions.

3. RESEARCH MODEL

To address the previously mentioned research gaps, a conceptual research model with four hypotheses is proposed. Figure 1 is an illustration of the model. We explore the effects of health severity and health negative emotions on use intention and how such effects are shaped by health uncertainty avoidance among patients with chronic diseases.



Health severity refers to the patients' perceptions of whether their health problems, i.e. chronic diseases, are serious issues. In situations of high health severity, patients with chronic diseases will devote more attention to their health and are more likely to adopt more preventive health behaviors and purchase more preventive healthcare products and services^[24]. For these patients, the MMS can help them to self-monitor and self-manage their daily healthcare, which can be an effective measure for preventive healthcare^[25]. Therefore, we expect that when chronically ill patients perceive high severity regarding their health conditions, they are more likely to choose to use the MMS for health prevention. Thus, we hypothesize that:

H1: Health severity is positively associated with MMS usage intentions.

Patients' emotions are closely related to their health conditions and the long-term chronic experiences generally lead patients to experience negative emotions such as anger, worry, and depression^[26, 27]. Such feelings can induce them into generating aversion of their chronic conditions, and they will be more positive towards the risk-seeking choices for their health conditions^[28]. Hence, patients with chronic conditions and facing negative emotions on their health conditions will be more likely to adopt new services, e.g. the MMS, as

a potential approach to keep the diseases at a distance. Therefore, we propose that the negative health emotions of patients will induce them to use the MMS. Thus, we hypothesize that:

H2: A negative health emotion is positively associated with MMS usage intention.

With a high sense of health uncertainty avoidance, individuals will feel upset concerning the unknown or uncertain health situations^[20]. Patients with highly serious health conditions will face many uncertainties regarding their physical conditions. In this situation, the high uncertainty avoidance will lead them to focus more on finding ways to reduce the uncertainties. Therefore, when making decisions on whether to use the MMS for their chronic diseases, there is a higher possibility for them to choose usage to reduce their feelings of health uncertainty. On the other hand, patients feeling a low sense of health uncertainty avoidance will pay less attention to their health conditions and feel less upset. They are less likely to use the MMS compared with those sensing high uncertainty avoidance. Thus, we hypothesize that:

H3: Health uncertainty avoidance positively moderates the relationship between health severity and use intention.

A negative health emotion induces patients into averting the current conditions and hence, they experience a higher tendency to make risk-seeking decisions to improve their health conditions^[28]. On the contrary, uncertainty avoidance causes individuals to choose more certain decisions and avoid uncertain decisions. Patients possessing feelings of high uncertainty avoidance on their health conditions are less likely to make risk-seeking decisions, and those feeling a sense of low uncertainty avoidance will rely more on their inner negative feelings to make health decisions. Therefore, health uncertainty avoidance will weaken the effect of negative health emotions on user decisions. Thus, we hypothesize that:

H4: Health uncertainty avoidance negatively moderates the relationship between negative health emotions and use intention.

4. METHODOLOGY

4.1 Measures and data collection

To test the research model, a survey is conducted among chronically ill patients by means of a questionnaire. As the theoretical constructs are widely measured and used in previous empirical studies, this research, therefore, adopts these measures and adapts them to our research context. Then the content validity was tested by several scholars. The measures and their original sources are presented in the Appendix.

Of 504 participants, 213 subjects experiencing one or more chronic diseases were considered as valid participants. An incentive of about US\$3 was provided as a form of motivation. Of these respondents, 159 of them have one chronic disease while 54 have more than one such disease. Of these, 40.4% are female. More than half of the respondents are in their forties, while 16.9% are in their fifties, and 3.8 % are in their sixties. To test our model, we conducted measurement model and structural model analyses subsequently.

4.2 Measurement model

Smart PLS was used to test our measurement model. For the reflective constructs, the reliability, convergent validity, and discriminant validity of the measurement model were examined as indicators of the goodness of the measurement model. The reliability of the measurement model was assessed by examining Cronbach's alpha, composite reliability (CR) and average variance extracted (AVE)^[29]. The results are presented in Table 1. In our study, the threshold values of CRs and AVEs were .70 and .50 respectively, consistent with those of Chin^[30]. According to Nunnally^[31], a value of at least .70 of Cronbach's alpha indicates adequate reliability. Composite reliabilities for these constructs ranged from .822 to .938, and the average

variances extracted varied from .571 to .835. These results suggest that all indicators are above the cut-off values, indicating good construct reliability^[29]. All item loadings on expected constructs were greater than their cross-loadings on other constructs, and the correlations of the constructs were significantly smaller than the square roots of the AVE of each construct, indicating that the constructs have good discriminant validity.

Table 1. Correlations and Discriminant Validity

	Cronbach's Alpha	CR	AVE	UI	NHE	HSEV	HUAE
UI	.901	.938	.835	.913			
NHE	.742	.822	.608	.188	.779		
HSEV	.828	.839	.571	.149	.414	.755	
HUAE	.863	.906	.709	.416	.026	.102	.842

Note: The diagonally arranged bold numbers are the square roots of AVEs.

4.3 Structural model

The structural model was assessed by checking the significance of path coefficients (β) between various factors. The results show that negative health emotion does not significantly influence use intention ($\beta=.092$, $t=1.291$) and health severity significantly influences use intention ($\beta=.150$, $t=2.603$). Therefore, H1 was supported, while H2 was not. Regarding the moderating effects, health uncertainty avoidance positively moderates the relationship between health severity and use intention ($\beta=.133$, $t=1.890$), thus supporting H3. Health uncertainty avoidance negatively moderates the relationship between negative health emotion and use intention ($\beta=.133$, $t=1.890$), and therefore H4 is supported. These factors fully explain 24.3% of the variance of use intention.

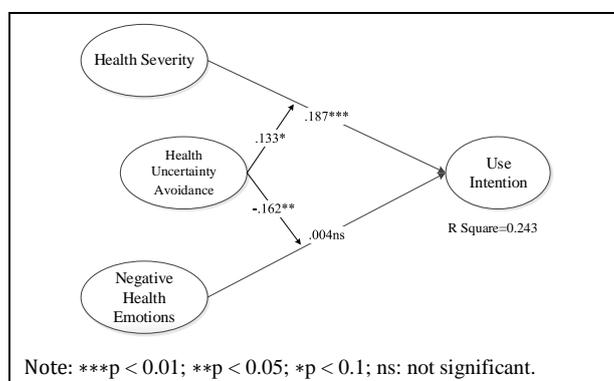


Figure 2. Results of the Research Model

5. DISCUSSION

5.1 Key findings

By testing the proposed research model and hypotheses, our research highlights four aspects of the key findings. First, the health severity perceptions of patients with chronic diseases enhance their use of the MMS for health monitoring. The relationship between health severity and use intention makes sense for these patients in that, if they perceive their health problems as serious, they will feel a strong need to take health preventive measures.

Second, while we propose that negative health emotions can motivate the patients into using the MMS, the empirical results do not support. This result seems controversial, but it is acceptable given the special participants of our study. Different from the general population, the patients with chronic diseases could be

influenced by the long-term effects of their diseases. Negative health emotions should be normalcy to those with chronic disease and do not have significant effects on their behavioral intentions toward MMS.

Third, we find that health uncertainty avoidance strengthens the effects of health severity on use intention. This indicates that if patients feel a sense of high uncertainty avoidance regarding their health conditions, the effects of their serious perceptions on their health status will have a stronger effect on their use intentions. This is because once the patients experience a high tendency to avoid health uncertainty they will feel a strong demand to take measures to deal with their chronic diseases.

Finally, health uncertainty avoidance weakens the effects of negative health emotions on use intentions. This negative moderating effect indicates that when patients feel a high sense of health uncertainty avoidance, their negative health emotions will deter them from using new services to monitor their health conditions. The direct effects of the negative health emotion are not significant but its interaction with health uncertainty avoidance is negatively significant. This indicates that patients with chronic diseases are more likely to make a more risk-avoidance decision when they are presented with MMS.

5.2 Theoretical implications

Our research contributes several implications to the extant literature. First, ours is possibly one of the first to explore the diffusion of the mHealth service from a health perspective. Although the diffusion of the mHealth or other services has been widely explored in recent decades, most prior studies have adopted a technology perspective and investigated the well-developed technology acceptance theories and models mainly from a theoretical lens. However, the health-related factors have been largely neglected. When exploring patients' responses to health services, their physical and emotional conditions, as well as the tendencies of health decision-making can play a critical role in determining their behavior.

Second, this research explores the important contingency role of health uncertainty avoidance. Our results indicate that health uncertainty avoidance positively moderates the effects of health severity and negatively moderates the effects of negative health emotions. The special contingency role of health uncertainty avoidance indicates that it plays a significant role in shaping patients' decision-making regarding health services. By explicitly investigating the contingency role of health uncertainty avoidance, our findings shed light on the relative importance of physical and emotional conditions for patients' mHealth usage decisions among different patient groups.

Third, little research attention has been devoted to the MMS usage behavior of this special group. By investigating the effects of their unique responses from their physical and emotional conditions, our research provides a basic understanding of how chronically ill patients respond to mHealth monitoring service.

5.3 Practical implications

This study also has several practical implications. First, service providers should be aware of the factors that cause patients to use their services. As patients' serious perceptions of their health conditions positively influence their use intentions, the providers are advised to exert efforts on informing the patients about the hazards of their chronic diseases. Hence, they can target their potential customers, patients with serious chronic conditions, who have also realized the hazards of their diseases. Second, in their role of facilitating health uncertainty avoidance, they can segment such customers in their marketing campaigns. To assist patients with serious health concerns, providers can assist them by facilitating health uncertainty avoidance, with measures such as paying more attention to those with a higher sense of health uncertainty avoidance. Providers can alleviate the problems faced by patients with negative emotions on their health by devoting more attention to those with a lower sense of health uncertainty avoidance. In this way, the service providers will experience a

higher possibility of transforming these patients with chronic diseases from potential customers to actual ones.

6. CONCLUSIONS

The increasing population of patients with chronic diseases has promoted the use of mobile ICTs in mHealth monitoring services. While the MMS is suitable for these patients, we know very little about how they make usage decisions regarding the MMS, and whether their health-related features cause them to make different decisions. To address our research questions, this study creates a theoretical model to test the effects of health severity and negative health emotions on the usage intentions of the MMSs and the contingency role of health uncertainty avoidance. The model was tested employing a survey among patients with chronic diseases. We find that health severity positively influences usage intentions while health uncertainty avoidance plays different moderating roles on the effects of health severity and negative health emotions. This research contributes to the understanding of the diffusion of the mHealth service, the role of health-related factors in decision-making, and the unique decision-making processes of patients with chronic diseases.

Appendix

Measurement Items		
Construct	Measure	Source
Use Intention	I plan to use the mHealth services in the next 3 months	20
	I predict I will use the mHealth service software in the next 3 months	
	I plan to use the mHealth services in the next 3 months	
Negative Health Emotion	I feel furious about my present health status	22
	My current health status is a real inconvenience	
	My present health problems fill me with dread	
	I feel disgusted with my current state of health	
Health Severity	My health issues are severe	20
	My health issues are serious	
	My health issues are significant	
Health Uncertainty Avoidance	If I use the mHealth services, I will increase my effectiveness on avoidance of any uncertainty or unknown situations related to my health status.	21
	If I use mHealth services, I will spend less time feeling concerned about any uncertainty or unknown situations related to my health status.	
	If I use Health services, I will improve the quality of avoidance of any uncertainty or unknown situations related to my health status.	
	If I use mHealth services, I will increase the quantity of output for the same amount of effort in avoiding any uncertainty or unknown situations related to my health status.	

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