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Research Article

An Empirical Study to Explore the Adoption of Telehealth: Health Belief Model Perspective

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Abstract

The purpose of the study is to integrate self efficacy with the Health Belief Model in order to explore the usage intention model of Telehealth systems. The proposed framework is validated with respondents from Nantou County, which is located in Taiwan. The findings show that a good overall fit of the proposed model with the empirical data. This study also demonstrates that perceived susceptibility, perceived benefits, and perceived barriers have jointly significantly positive effect on cues to action. Furthermore, both cues to action and self efficacy have significantly positive effect on usage intention. This study emphasizes that hospital managers should pay more attention to understanding the five concepts of health belief of elderly (perceived susceptibility, perceived severity, perceived benefits, perceived barriers and cues to action), and improving self efficacy of elderly. The findings also imply that a successful telehealth system is not only an information system but also a health service provider to the residents. The findings may be used as a theoretical basis for future research and can also offer empirical foresight to the executives and managers of hospitals when they initially introduce and promote the telehealth systems into their surrounding community..

Keywords: Telecare, Telehealth, Health Belief Model, Self Efficacy

1. Introduction

The demographic structure changes as the society changes. The developed countries in the world are facing aging problem. A statistics by the Ministry of Interior, Executive Yuan of R.O.C. (Taiwan) shows that the population of the senior citizens is 7% of the total population in Taiwan by 1993. Taiwan has now become an aging society as defined by the World Health Organization. This percentage reached 10.9% by the end of 2011 while the aging index increased from 42.3% to 72.2%.It is estimated that the population of age 65 or more will exceed 20% by 2026. Taiwan will become a Super Aged Society then. It is also estimated that the senior citizen population will be 36.97% of the total population by 2051, i.e., one senior citizen of age 65 or more out of three citizens.

Aging pervades in Taiwan due to progress in medical industry and increase in life expectancy. By combining medical care and technology, many countries have attempted to apply Information Technology in Telemedicine care services to develop various functions, such as Emergency Reporting System, Medication Reminding, Physiological Recording and Monitoring, Remote Video, and Medical Advisory. The emphasis of such an effort is to allow users to benefit from various kinds of medical care services whether they are at home, outdoors, or at any care institution without any restraints of time and space. It is thus expected that citizens from rural area may benefit from good medical care services.

Under the promotion of the National Information Infrastructure (NII), Executive Yuan, R.O.C. (Taiwan), Taiwan's government has accumulated experience in implementing Telemedicine Policy for more than 10 years with focus in supporting people living in offshore islands and mountain areas. Since 1995 the Department of Health, Executive Yuan, R.O.C. (Taiwan) has been promoting Telemedicine Pilot Program to remedy the problem of inadequate medical resources in rural area. The applications of Telemedicine can be categorized into three areas – Teleconsultation, Telediagnosis and Teleeducation. Since 2007 the Department of Health has commissioned Information and Communications Laboratories, Industrial Technology Research Institute to develop Telecare Pilot Program. It is aimed at developing Community-based, Home-based, Institution-based Telecare service models and their application systems with user-friendly human/machine interface through introduction and application of the information and communication technology, thus further establishing Telecare Information Integration Platform. In 2008, Telecare Quality and Service Improvement Program was launched. An integrated and continual network of Telemedicine was developed based upon 2 original telemedicine models consisting of Home/Community-based and Institution-based models. In 2010, Telemedicine Service Development Program entered the stage of full scale launch. The remote services suitable for local conditions were

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developed through duplication and spread of service models via commissioned agencies.

The R.O.C. government is pushing forward relevant healthcare plans to cope with the weakening care-giving capability of the family from the increase of core family, and to cope with increasing demands for long-term healthcare services in an aging society. Information technology is gradually integrated in healthcare services. For residents in rural area the resources in the community may be effectively combined and medical care, localized through community-based Telemedicine services, thus helping individual self-monitor own physiological conditions and develop health behaviors. Telehealth is more broadly and includes administration and training in addition to clinical services. Telehealth has been considered a partial solution to the problems of delivering health care to remote areas as well as to areas underserved by health care professionals

The Health Belief Model proposed by Rosenstock [1] is one of the theories widely employed, which can provide excellent ability to explain people's health behaviors. The Self Efficacy Theory of Bandura [2] can also provide good ability in predicting people's behaviors in using new technology. This study is therefore aimed, on the bases of Health Belief Model and Self Efficacy Theory, to discuss the behaviors of the residents in a community in using telehealth and to understand the factors which affect their use of telehealth, thus popularizing the use of telehealth in a community.

2. Literature Review

2.1 Telecare and Telehealth

Telecare is defined as "the continuous, automatic and remote monitoring of real time emergencies and lifestyle changes over time in order to manage the risks associated with independent living " [3]. Telecare encompasses a wide range of equipment (e.g., detectors, monitors, alarms, and pendants) and services (e.g., monitoring, call centers and response). Equipment of telecare is offered to support individuals in their home and tailored to meet their specific needs. Telecare services range from a basic community alarm service that is able to react to an emergency to an integrated system that includes detectors or monitors (e.g., falls, fire, and gas) triggering a warning to a response centre [3]. Telecare employs information and communication technologies to transfer medical information for the diagnosis and therapy of patients in their place of dwelling [3].

The Department of Health of Executive Yuan in Taiwan commissioned telecare projects in 2007 that established three telecare models: community-, home-, and institution-based telecare [4,5]. This project integrated medical care, medical equipment, information communication technology, and security protection for providing a model of holistic, continued, accessible, and digital healthcare services. Home-based telecare services include three-fold: (1) physiological information retrieval, such as body temperature, heart beat, respiratory rate, blood pressure, blood sugar, and blood oxygen; (2) communication and collaboration of healthcare services, such as urgent call, transmission of abnormal alarm signals, and notice to revisit; and (3) assistance of health self-management, such as grasping changes of physiological information daily, self-management and follow-up, and early prevention.

Proponents of telecare suggest that it could enable older people to live in a safer and more independent manner. Three generations of telecare systems can be identified. The first generation of telecare systems was technically simple, with no embedded intelligence and entirely reliant on the user activating calls. The second generation systems have all the features of the first generation, but also provide some level of intelligence and automatic detection in limited alert conditions. The third generation systems provide additional support capabilities, such as lifestyle monitoring or reassurance and the introduction of virtual neighborhoods [6].

Telehealth is defined more broadly and includes administration and training in addition to clinical services [7]. Telehealth refers to the remote exchange of data between a patient (usually at home) and healthcare professionals (at a monitoring center) to assist in the management of an existing long-term condition [8]. Telehealth has been considered a partial solution to the problems of delivering health care to remote areas as well as to areas underserved by health care professionals [9]. The devices monitor vital signs of patients (or rural residents) include blood pressure, blood glucose, blood oxygen, and weight. Telehealth system is currently being trailed to improve older people's ability to remain within their homes as long as possible, with access to acre and support services that enable them to do this safely [10].

2.2 Health Belief Model

Preventive health behaviors refer to behaviors which can prolong one's healthy life or practices that reduce the influences from infectious diseases, chronic diseases, or diseases that weaken or cause pains to patients [11]. Factors that affect people to take preventive health behaviors include social influences; family supports; commercial message; physician's advise; habits; self-confidence/belief and value; situation factors; financial considerations; emotional factors; and physical disabilities, etc. Health Belief Factor is one of the most comprehensive models that have ever been proposed to interpret preventive health behaviors.

Health Belief Model was developed in 1950s. It tried to explain people's preventive health behaviors (such as screening) and the factors causing failure of immunization program. The Health Belief Model originated from social psychology theories, especially Kurt Lewin's Field Theory and Expectancy-Value Orientation for motives and behaviors [12]. Expectancy-value orientation refers to an expectation for the result and its value when individuals do or do not act, and based on such an expectation individuals determine their behaviors. Lewin's Field Theory explains that individuals live in a life space in which both positive and negative values exist and their forces attract and oppose each other. Since disease lies in the area of negative value, men are therefore motivated to avoid it.

According to Health Belief Model, behavior generally depends on the degree of importance one thinks about a specific goal and on the likelihood one thinks a specific action may reach such a goal. If such a goal is to avoid a health problem, one must then feel that he/she is vulnerable while subject to this problem with potential severity. Moreover, one must expect to benefit from reducing this threat to health and not to meet any obstacle in overcoming the problem [13].

Therefore, Rosenstock believes health behavior depends on three sets of factors which are at work simultaneously: (1) sufficient motivation (or health concern) that make

health salient or relevant; (2) the belief that one is susceptible (vulnerable) to a serious health problem or to the sequelae of that illness or condition.; (3) the belief that following a particular health recommendation would be beneficial in reducing the perceived threat, and at a subjectively-acceptable cost [13]. The important concepts of the Health Belief Model are: perceived susceptibility, perceived severity, perceived benefits, perceived barriers and cues to action. Perceived susceptibility refers to the subjective risk perception that one is infected with or develops a specific disease. Perceived severity refers to one's evaluation for the impact and the consequence from certain disease which one may feel that he/she is suffering from. Perceived benefits refer to the evaluation of effectiveness from taking actions to reduce a threat to a disease. Perceived barriers refer to potential cost or negative impact that may occur according to one's subjective evaluation during the course of actions, such as, cost per action, pain, inconvenience, time consumption, etc. The last variable is cues to action, which is the direct factor that moves people to undertake health behaviors, including external stimuli and internal stimuli. Internal stimuli includes symptoms of disease and external stimuli, media activity for health promotion, physicians' advise, family members or relatives who suffer from health problem. Generally speaking, cues to action may be events, people, or things that stimulate one to change his/her behaviors.

Health Belief Model is now being widely employed in each field in the area of public health. This model has gained supports from many studies in explaining and predicting various health behaviors. It has also been verified in preventive health behaviors among various areas and extensive ethnic groups, such as cancer, health examination, giving up smoking, contraception, healthy diet, etc. Moreover, this model has also been adopted in designing many successful health intervention activities. The goal of telehealth is to extend medical services provided by remote hospitals and to provide early diagnosis and early treatment through patients' self-management of health. Many countries have now applied this innovative technology in the area of preventive medicine. Therefore, routine use of telehealth may be considered as a preventive health behavior. This study thus aims to explain and predict community residents' behaviors of using telehealth.

2.3 Self Efficacy

Self-efficacy refers to the belief that target behaviors that mitigate health threats can be successfully implemented [14]. Rosenstock et al. [13] included Health Belief Model in self-efficacy. Self efficacy is used to describe the belief one think he/she can undertake certain action. Generally speaking, one may not want to undertake certain action unless he/she feels capable of doing it. For instance, if one thinks that certain new behavior is beneficial, but he/she is not capable of doing it, he/she may not try to undertake such a behavior.

Self efficacy is very important to preventive health behaviors for chronic diseases, especially in the situations where change of behaviors is required for a long time. These situations include changing habits of eating, drinking, exercise, and smoking. Compared with the one-time activity such as immunization or screening, changing habits is much more difficult. Before a successful intervention is possible, one needs to have confidence enough to change his/her life style. Therefore, for change of behaviors to be successful one needs motives for action, feels that his/her current behavior pattern is under threat, and believes changing specific actions for valuable results within acceptable cost is beneficial. Of course, he/she must also feel capable of making such a change.

Self efficacy has been proven to be an important and determining factor in explaining and predicting preventive health behavior. In this study, self efficacy refers to a belief of continual use of telemedicine and reduction of threats to health. Community residents must believe they are capable of using telehealth to monitor vital signs continually and achieving the goal of health management.

The previous arguments support the proposed research model depicted in Fig. 1.

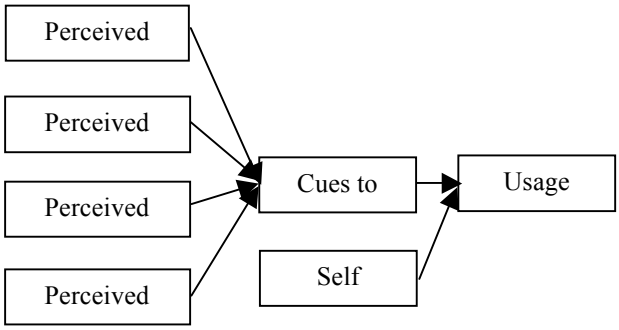

Fig. 1 The Proposed Research Model

3. Research Method

We adopted the questionnaire survey for data collection, and examined our hypotheses by applying the structural equation modeling (SEM) method to validate the model. The measurement instruments for variables in the questionnaire were developed from previous studies to enhance the variability and reliability. Responses to the various variables related to the perceptions of the individual subjects were measured using the Likert-type scale.

The questionnaire items included demographic characteristics, perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, self efficacy and usage intention of using telehealth systems. The survey subjects of the questionnaire were those residents who are the end users of a telehealth system from Nantou County, Taiwan. These end users all used the telehealth system for one month. The telehealth system was developed and installed by a community hospital in Jhushang township, namely Chu Shang Show Chwan Hospital. The overall telehealth system is shown in Fig. 2.

Fig. 2 The telehealth system

4. Results

The data analysis proceeds according to the two-step approach recommended by Anderson and Gerbing [15]. First, we assess the measurement model, which consists of the seven latent factors, and includes the assessment of reliability, discriminant validity, and convergent validity of the scales. Second, we validate the structural model, which represents the series of path relationships linking the seven constructs.

4.1 Sample Characteristics

Of the recruited 370 subjects, there were 365 subjects who agreed to participate in the study. Of these respondents, 217 respondents are women (59.5%) and 148 respondents are men (40.5%). Most of the respondents were 71-80 years of age (41.9%). Most respondents hold elementary school degrees (46.8%). A majority of the caregivers are spouses (48.8%). The respondents mostly suffered from at least one chronic disease (71.2%). Table 1 presents descriptive statistics for the seven constructs in the study. The mean scores of three constructs (perceived susceptibility, perceived severity, and self efficacy) are almost on the middle point of 5-point Likert-type scales, and show a reasonable dispersion in their distributions across the ranges. Besides, the mean scores of three constructs (perceived benefits, cues to action, and usage intention) are higher and one construct (perceived barriers) is lower than the middle point of 5-point Likert-type scales. Generally, the evidences show the telehealth system has been recognized as really useful and efficient for health promotion of the residents and the residents are willing to overcome some barriers to use it.

Table 1 Sample demographics

Construct	Mean	Standard Deviation	Minimum	Maximum
Perceived Susceptibility	3.13	1.23	1	5
Perceived Severity	3.90	1.04	1	5
Perceived Benefits	4.67	0.60	2	5
Perceived Barriers	1.43	0.62	1	5
Cues to Action	4.60	0.63	2	5
Self Efficacy	3.44	1.47	1	5
Usage Intention	4.59	0.70	2	5

4.2 Measurement Model Results

To validate the measurement model, three types of validity were assessed: content validity, convergent validity, and discriminant validity. Content validity was done by interviewing senior system users and pilot-testing the instrument. And the convergent validity was validated by examining Cronbach's α, composite reliability and average variance extracted from the measures [16]. As shown in Table 2, the Cronbach's α of every subscale range from 0.72 to 0.99 was above the acceptability value 0.7 [17]. Moreover, the composite reliability values, which ranged from 0.67 to 0.99, and the average variances extracted by our measures, which ranged from 0.50 to 0.99, are all within the commonly accepted range greater than 0.5 [16]. In addition, all measures are significant on their path loadings at the level of 0.001. Therefore, the convergent validities of all seven constructs are confirmed.

Table 2 Construct Reliability and Convergent Validity

Construct	Cronbach's α	Composite Reliability	Average Variance Extracted
Perceived Susceptibility	0.85	0.92	0.79
Perceived Severity	0.72	0.67	0.50
Perceived Benefits	0.99	0.99	0.96
Perceived Barriers	0.80	0.82	0.50
Cues to Action	0.88	0.89	0.68
Self Efficacy	0.99	0.99	0.97
Usage Intention	0.99	0.99	0.99

In addition, according to Fornell and Larcker [18], discriminant validity can be tested among all constructs by comparing the average variance extracted (AVE) of each construct with the squared correlation of that construct and all the other constructs. All squared correlations between two constructs are less than the average variance extracted of both constructs. Therefore, the results confirm that the discriminant validity of the constructs in the study is satisfactory.

4.3 Structural Model Results

To validate the measurement model, we used AMOS 18.0 to assess the analysis. As shown in the Table 3, the goodness-of-fit indices are within the accepted thresholds. Generally, these fit indexes are all greater than or equal to 0.9 for GFI, NFI, RFI, IFI, TLI, and CFI. Furthermore, χ^2/d.f. value is less than 5 and RMSEA value is less than 0.08. Accordingly, the summary of the overall goodness-of-fit indices indicate an excellent fit of the model and data.

Table 3 Fit Indices for the Structural Model

Structural Model Statistic	Fit Indexes	Recommended Threshold
χ^2	453.337	-
χ^2/ d.f.	2.361	< 5
GFI	0.900	> 0.9
RMSEA	0.061	< 0.08
NFI	0.954	> 0.9
RFI	0.945	> 0.9
IFI	0.973	> 0.9
TLI	0.968	> 0.9
CFI	0.973	> 0.9

Fig. 3 illustrates the results of the structural model with the estimated standardized path coefficients and path significance among constructs. The estimated standardized path coefficients indicate the strengths of the relationships between the dependent and independent variable. As predicted, almost all proposed hypotheses are supported. As expected, perceived susceptibility (β=0.180), perceived benefits (β=0.452) and perceived barriers (β=-0.287) have significant effects on cues to action. In addition, both cues to

action (β=0.644), and self efficacy (β=0.088) have significant effects on usage intention.

The results of the structural model show that health belief factors are key aspects affecting usage intention of telehealth system. The results also demonstrate that health belief factors (perceived susceptibility, perceived benefits, and perceived barriers) have significant impacts on usage intention mediated by cues to action. However, perceived severity has insignificant effect on cues to action. The unexpected finding can be explained that the residents have enough health promotion knowledge and resources from the community hospital (Chu Shang Show Chwan Hospital). If one's evaluation for the impact and the consequence from certain disease is highly risky, one may go to the community hospital directly and meet the physician face to face to treat diseases. Therefore, perceived severity of the residents may not impact significantly on cues to action of telehealth system.

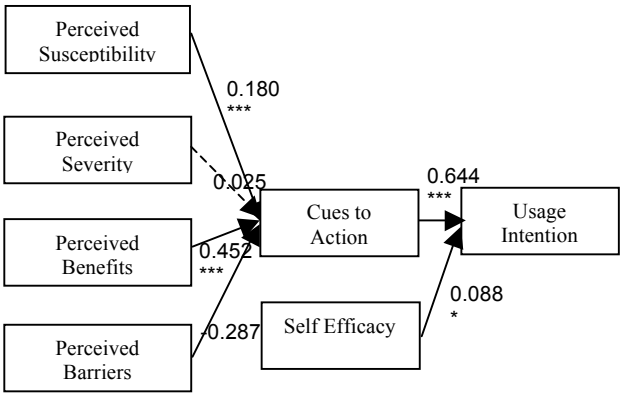

Fig. 3 Final Proposed Model

5. Conclusion

Based on the Health Belief Model, this study proposed a research model to better understand the older residents' usage intention of telehealth system. The model considered the relationships among perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, self efficacy and intention to use. Using Structural Equation Modeling (SEM), the hypotheses are proposed to validate the fit of empirical data and model.

This empirical study has highlighted how rural residents are reported to have benefited from the telehealth system. The findings have also reported that the Health Belief Model is a suitable model to explain and predict the usage compliance behavior of telehealth. That is, the routine usage behavior of telehealth could be treated as a preventive health behavior. Based on information system adoption perspective, many telehealth researches have utilized TAM (Technology Acceptance Model) to demonstrate that the constructs of perceived ease of use and usefulness of telehealth equipment are primary factors in technology user acceptance and usage. However, the major purpose of telehealth is to provide increased access to medical care for rural residents. Successful deployment of this innovation requires much more than the installation of the equipment. The role of specialists and community nurses is important, since it is already used to underpin services for residents [8]. Therefore, a successful telehealth system is not only an information system but also a health service provider to the residents. We believe that more integrated model (e.g., integrative perspective of HBM and TAM) applied in future studies should provide more valuable and informative contributions toward development of successful telehealth.

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