# Understanding Middle-Aged and Elderly Taiwanese People's Acceptance of the Personal Health Information System for Self-health Management

Pi-Jung Hsieh[1], Hui-Min Lai[2], Hsuan-Chi Ku[3], and Wen-Tsung Ku[4(✉)]

[1] Department of Hospital and Health Care Administration, Chia Nan University of Pharmacy and Science, Tainan, Taiwan, R.O.C.
beerun@seed.net.tw

[2] Department of Information Management, Chienkuo Technology University, Changhua, Taiwan, R.O.C.
hmin@cc.ctu.edu.tw

[3] National Chiayi Senior High School, Chia-Yi, Taiwan, R.O.C.
kwt2056@gmail.com

[4] Department of Physical Medicine and Rehabilitation, St. Martin De Porres Hospital, Chia-Yi, Taiwan, R.O.C.
kib56265@gmail.com

**Abstract.** With the increasingly aging population and advances in information technology, self-health management has become an important topic. Middle-aged and elderly people are considered to have higher risks of contracting multiple chronic diseases and complications, thus increasing their need for healthcare. Personal health information systems provide middle-aged and elderly people with their personal healthcare information, enable them to exercise their right to know their healthcare information, and ultimately enhance measures that increase users' convenience in managing their own health. Although several prior studies have focused on the factors that influence the adoption of personal health records and electronic medical records, the literature on middle-aged and elderly people's attitudes toward the use of personal health information systems in self-health management is scarce. Thus, this study proposes a theoretical model to explain middle-aged and elderly people's intention to use a personal health information system in self-health management. A field survey was conducted in Taiwan to collect data from middle-aged and elderly people. A total of 240 valid responses were obtained, constituting a response rate of 88.89%. The results indicate that perceived severity, perceived benefits, self-efficacy, and cues to action have positive effects on usage intention. However, perceived susceptibility and perceived barriers do not significantly affect behavioral intention. The study has implications on the development of strategies to improve personal health IT acceptance.

**Keywords:** Technology acceptance · Health belief · Self-health management · Personal health information


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# 1 Introduction

It has been two decades since Taiwan's National Health Insurance (NHI) system was launched in 1995 to provide universal and quality healthcare to citizens at an affordable cost. To date, over 99% of the population are covered by this public program [1]. The insured have access to more than 20,000 healthcare facilities around the country providing inpatient, ambulatory, and home care. With Taiwan now considered an aging society, the NHI Administration (NHIA) intends to build a health information platform where everyone's health records will be stored in the personal health information system (PHIS). The PHIS provides insured persons with their personal healthcare information, enables them to exercise their right to know their healthcare information, and ultimately enhances measures that increase users' convenience in managing their own health. Despite this potential, as of 2015, only about 0.57% of Taiwanese citizens were using the PHIS for queries regarding personal medical records. The PHIS can play a crucial role in healthcare by providing patient information that supports numerous healthcare applications such as the diagnosis, treatment, and prevention of disease. For these information technology (IT)-enabled benefits to manifest in Taiwan, citizens must first adopt the PHIS.

The adoption and use of health IT among middle-aged and elderly people is an important issue in the field of medical informatics. Despite an emerging interest in the field of medical informatics and studies that have identified barriers to personal health record adoption [2, 3] and acceptance factors among citizens [4, 5], the understanding of middle-aged and elderly people's self-health management behavior is limited. Since health technology services are used to promote, protect, or maintain health, health technology acceptance behavior should be considered health behavior [6]. Therefore, a better understanding of health technology acceptance behavior can be gained from a health behavior perspective. A variety of health behavior theories can be used to explain the health technology acceptance phenomenon. Among these theories, the health belief model (HBM) is the most widely used. The HBM suggests that individuals decide whether to take a health-related action based on their evaluations of the perceived health threat of not taking the action and the net benefits of taking the action [7]. Thus, this study aims to propose and empirically validate the HBM depicting the factors that influence middle-aged and elderly people's adoption of the PHIS in the context of self-health management.

# 2 Literature Review

## 2.1 Personal Health Information System

Population aging, intensified by the low birth rate, is affecting the rate of economic growth and national health expenditure. To improve the general public's understanding of personal health and treatment conditions, the NHIA established the PHIS to enable people to check their medical records anytime and anywhere. Individuals can use their password-registered NHI card or citizen digital certificate to get information on hospitalization, vaccination, preventive care, dental health, drug allergies, discharge

summaries, pathological test reports, medical image reports, personal outpatient visits, and organ donation and palliative care wishes. Thus, the PHIS bridges the medical information gap between medical personnel and patients to make treatment safer and more effective. The PHIS can also be used to check and download one's personal NHI card status and records as well as insurance fees and premium records. By allowing people to quickly and conveniently obtain personal healthcare data, the PHIS makes self-health management easier. For example, an elderly patient with diabetes will be directed to a list of competent medical institutions that treat diabetes, with attached quality indicators for people to choose from. An elderly patient with chronic hepatitis B or C will be directed to the website of the liver disease prevention, treatment, and research foundation, which offers rich health information, prompting timely and appropriate actions. For these health IT–enabled benefits to materialize, middle-aged and elderly people must first adopt the PHIS. A number of previous studies regarding users' health IT adoption behaviors developed technology characteristic constructs to better understand patients' unique features [3, 8, 9]. However, studies that examine middle-aged and elderly people's willingness to use a PHIS are rare.

### 2.2 The Health Belief Model

The HBM was developed in the 1950s. It tries to explain people's preventive health behaviors and considers health behavior a function of two basic mechanisms: threat perception and behavioral evaluation [10]. Perceived threat is assessed according to perceived susceptibility and perceived severity. Perceived susceptibility is an individual's assessment of his or her risk of contracting a condition, whereas perceived severity is an individual's assessment of the seriousness of the disease and its consequences. Behavioral evaluation is based on the perceived benefits and perceived barriers. Perceived benefits refer to an individual's assessment of the positive consequences of adopting a health behavior, including the extent to which it reduces the risk of the disease or the severity of its consequences. Perceived barriers refer to an individual's assessment of the influences that discourage the adoption of the health action.

Other important cognitive components of the HBM are self-efficacy and cues to action. Self-efficacy is an individual's confidence in his or her ability to perform the health action [11, 12]. This concept originates from the social cognitive theory [13]. Cues to action are triggers that stimulate an individual to take health action, such as health education and advice from others. Cues to action may be internal (e.g., perception of bodily states) or external (e.g., physician's advice, interpersonal interactions, and the impact of the communication medium). High susceptibility, high severity, high benefits, low barriers, high self-efficacy, and high cues to action are assumed to lead to a high probability of adopting the recommended action [11, 14–16]. Prior studies have also shown that the HBM has good explanatory power in predicting users' health IT acceptance [14, 16]. Therefore, this study applies the HBM to explain middle-aged and elderly people's intention to use the PHIS for self-health management.

## 3 Research Model

Prior studies have argued that behavior intentions are more appropriate than actual behavior because the former are measured contemporaneously with beliefs [17–19]. Certain studies have also chosen behavior intentions instead of actual behavior as the dependent variable to investigate users' health IT acceptance [20]. Therefore, we considered it appropriate to use middle-aged and elderly people's behavior intentions as the dependent variable of this study. Previous studies have empirically proven that the effect of the original HBM variables on behavior can be mediated by behavior intentions [14, 21]. Thus, we linked the six HBM constructs (i.e., perceived susceptibility, perceived severity, perceived benefits, perceived barriers, self-efficacy, and cues to action) to behavior intentions. Figure 1 shows the proposed research model, which details the various dimensions and the development of the theoretical arguments.

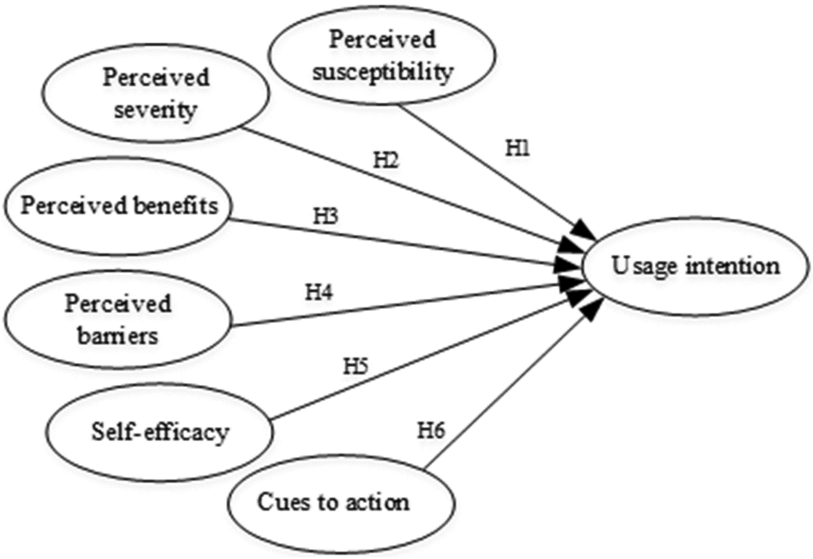


**Fig. 1.** Research framework

In the HBM, when users consider themselves more likely to suffer a health-related threat (i.e., high perceived susceptibility) and/or perceive the threat as likely to cause serious harm (i.e., high perceived severity), they tend to adopt the health IT that can prevent or reduce the risk of contracting a condition or disease [16]. Prior studies have provided support for the positive effect of perceived susceptibility and perceived severity on behavior intentions [14, 22]. Thus, we posit the following hypotheses:

**H1.** Perceived susceptibility is positively related to the intention to use the PHIS.
**H2.** Perceived severity is positively related to the intention to use the PHIS.

As indicated in the HBM, perceived benefits refer to the evaluation of the effectiveness of taking health actions to reduce the threat of a disease. Thus, if users believe that

using health IT enables them to reduce the threats to their health, then they will be more likely to adopt this health technology. Prior studies have provided support for the positive effect of perceived benefits on behavior intentions [14, 16]. On the other hand, costs and negative perceptions pertaining to system usage, such as inconvenience, time consumption, and the considerable expense of system usage, also affect the possibility of action by functioning as perceived barriers. The stronger the perceived barriers, the more difficult it would be for one to take health action [16, 23]. Thus, we posit the following hypotheses:

**H3.** Perceived benefits are positively related to the intention to use the PHIS.
**H4.** Perceived barriers are negatively related to the intention to use the PHIS.

According to social cognitive theory, individuals with greater confidence in their abilities are more likely to initiate challenging behaviors such as healthy eating behavior [12]. In the health technology acceptance context, when users are confident in their ability to use the health IT, they are more likely to use that technology. Conversely, the lack of competence to use the health IT may become a major barrier to middle-aged and elderly users' new technology acceptance [6]. Prior studies have provided support for the positive effect of self-efficacy on behavior intentions [6, 12, 14, 23]. Therefore, we propose the following hypothesis:

**H5**. Self-efficacy is positively related to the intention to use the PHIS.

Based on the HBM perspective, cues to action—including internal cues (e.g., physical discomfort and appearance of symptoms) and external cues (e.g., physician's advice, impact of media education, encouragement from friends and relatives, and family members or relatives who suffer from health problems)—directly move people to undertake health behaviors. These cues positively affect the chances of health action [16]. Prior studies have provided support for the positive effect of cues to action on behavior intentions [14, 23]. Thus, we posit the following hypothesis:

**H6.** Cues to action are positively related to the intention to use the PHIS.

## 4 Research Method

### 4.1 Questionnaire Development

The questionnaire is divided into two parts. The first part includes nominal scales and five-point Likert scales ranging from *strongly agree* to *strongly disagree*. The first part of the questionnaire was used to collect basic information about the respondents' characteristics, including age, gender, education, occupation, experience in computer use, and mobile device usage experience. The second part of the questionnaire was developed based on the constructs of perceived susceptibility, perceived severity, perceived benefits, perceived barriers, self-efficacy, and cues to action. Although previous studies have validated the questionnaire items, we conducted pretests by requesting three healthcare professionals to evaluate each item. To ensure validity and reliability, we conducted a pilot test with a sample that was representative of the actual respondents.

### 4.2 Data Analysis

We conducted structural equation modeling using partial least squares (PLS) estimations for the data analysis because the PLS method requires a minimal sample size and has few residual distribution requirements for model validation [24]. We tested the reliability and validity of the proposed model. The model was deemed reliable if the construct reliability was greater than 0.8 [25]. Convergent validity was assessed based on the following criteria: (a) statistically significant item loading greater than 0.7, (b) composite construct reliability greater than 0.8, and (c) average variance extracted (AVE) greater than 0.5 [24]. The discriminant validity of the constructs was assessed based on the criterion that the square root of the AVE for each construct should be greater than the corresponding correlations with all the other constructs [26].

### 4.3 Sample and Data Collection

The target participants were the middle-aged and elderly in Taiwan. This study employed an online survey for data collection because online surveys provide researchers with various benefits such as saving time and reducing expenses by overcoming geographic distance [27, 28]. Moreover, online surveys assist in accessing unique subjects. For improving generalization of our results, the participants in this study must consider different target groups by gender and geographical. A total of 270 questionnaires were distributed through an online survey company, and 240 questionnaires were returned. We assessed the nonresponse bias by comparing early and late respondents (i.e., those who replied during the first three days and the last three days, respectively). We found no significant difference between the two respondent groups based on the sample attributes (e.g., gender and age).

## 5 Research Results

The 240 valid questionnaires constituted a response rate of 88.89%. Slightly more than half (53.8%) of the respondents were females. The majority of respondents (56.7%) were between the ages of 40 and 49 years. The education level for 50.8% of the respondents was college or below. Nearly all (92.5%) the respondents had more than five years of computer experience, and 52.1% of the respondents had more than five years of mobile device usage experience. In this study, the construct reliabilities are all greater than 0.9. For the convergent validity, the item loadings are all greater than 0.7, and the AVEs range from 0.63 to 0.89. For the discriminant validity, the square root of the AVE for each construct is greater than its corresponding correlations with the other constructs. Table 1 shows the descriptive statistics of the principal constructs and the correlation matrix. These results indicate acceptable reliability, convergent validity, and discriminant validity.

**Table 1.** Reliability and validity of the scale

| Construct | Item loading | CR | AVE | Correlation | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | CA | BA | BE | SE | PS | SU | US |
| CA | 0.74–0.83 | 0.91 | 0.63 | **0.79** | | | | | | |
| BA | 0.78–0.91 | 0.91 | 0.72 | −0.08 | **0.85** | | | | | |
| BE | 0.70–0.94 | 0.94 | 0.75 | 0.01 | 0.24 | **0.87** | | | | |
| SE | 0.93–0.96 | 0.97 | 0.89 | 0.48 | −0.07 | 0.11 | **0.95** | | | |
| PS | 0.92–0.94 | 0.95 | 0.87 | 0.28 | 0.04 | 0.01 | 0.30 | **0.94** | | |
| SU | 0.93–0.94 | 0.97 | 0.89 | 0.17 | 0.16 | 0.26 | 0.01 | 0.25 | **0.94** | |
| US | 0.94–0.96 | 0.98 | 0.89 | 0.62 | −0.12 | −0.18 | 0.56 | −0.30 | 0.12 | **0.95** |

Leading diagonal shows the square root of AVE of each construct. AVE = average variance extracted, CR = construct reliability, CA = cues to action, BA =perceived barriers, BE = perceived benefits, SE = self-efficacy, PS = perceived severity, SU = perceived susceptibility, US = usage intention

Figure 2 presents the test results for the structural model. The statistical test conclusions partially support this research model. In this study, the intention to use the PHIS was predicted by perceived severity ($\beta = 0.13$, $p < 0.05$), perceived benefits ($\beta = 0.18$, $p < 0.01$), self-efficacy ($\beta = 0.31$, $p < 0.001$), and cues to action ($\beta = 0.58$, $p < 0.001$). Together, these variables explained 53% of the variance in the intention to use the PHIS. These results support Hypotheses 2, 3, 5, and 6. Perceived susceptibility ($\beta = 0.05$, $p > 0.05$) and perceived barriers ($\beta = -0.05$, $p > 0.05$) did not significantly affect the intention to use the PHIS. Hence, Hypotheses 1 and 4 are not supported.

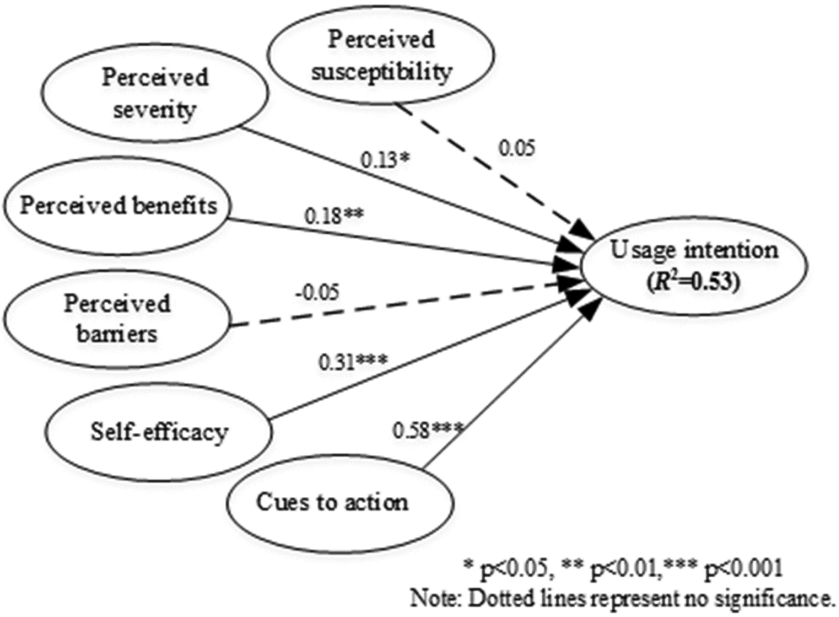


**Fig. 2.** Results of the structural model

## 6 Discussion

We explored how the selected variables affected middle-aged and elderly people's intention to use the PHIS for self-health management. The study results indicate that the HBM provides an adequately explains middle-aged and elderly people's intention to use the PHIS, as the R-square of usage intention is 0.53. This implies that the HBM might be a robust research model for predicting middle-aged and elderly people's intention to use information systems. This result is consistent with the theoretical model of Rosenstock [10] and a number of other studies [14, 22, 23].

The results indicate that perceived severity, perceived benefits, self-efficacy, and cues to action are key determinants of middle-aged and elderly people's usage intentions. First, perceived severity is an influential factor in the intention to use the PHIS, although its effect is smaller than that of perceived benefits, self-efficacy, and cues to action. This finding is consistent with the result obtained by Ivanov et al. [22]. Thus, individuals who perceive a higher degree of severity are more likely to know their healthcare information so that they can manage their own health status. Second, perceived benefits also have a direct positive effect on behavior intentions, which is consistent with the findings of Huang [16]. As such, higher perceived benefits will increase middle-aged and elderly people's intention to use the PHIS. If the middle-aged and elderly believe that using the PHIS will improve their self-health management, then they will use it. Thus, the PHIS should be designed and developed to deliver value to them. Third, self-efficacy has a significant positive effect on behavior intentions. This result coincides with the findings of previous studies on IT adoption [11, 16, 23] and suggests that the middle-aged and elderly are likely to engage in self-health management when they believe they have the ability to use the technology. Finally, cues to action is the most influential factor in usage intentions. This finding is consistent with the results obtained by Hsieh and Tsai [23]. Cues to action are triggers that make the individual take action, such as physicians' advice, symptoms of disease, the communication medium, and family members or relatives who suffer from health problems. Thus, more internal and external cues will increase middle-aged and elderly people's intention to use the health IT.

Perceived susceptibility and perceived barriers do not have a significant effect on the intention to use the PHIS. This implies that the middle-aged and elderly have sufficient health promotion knowledge and resources. If the middle-aged and elderly perceive the risk of contracting a condition as high, then they may go to the hospital directly and meet the physician face to face for a physical check-up or treatment. The lack of a significant effect may also be because the respondents did not find inconvenience in or barriers to practicing personal health information management.

## 7 Limitations and Conclusion

The limitations of our study should be acknowledged. First, a key limitation is the sample size. Future research could replicate this study using a larger sample size. It would also be useful to compare the results of this study with survey results from other population groups, as the determinants of health technology behavior may differ across population

groups. Second, the relevance of this study is confined to the health technology acceptance behavior of the middle-aged and elderly. The findings and implications drawn from this study cannot be generalized to other groups such as medical personnel. A study targeting medical personnel, who might have different information needs and different levels of computer support and abilities, could generate different results. The main contribution of this study is that it is the first to use existing health belief theory to explore middle-aged and elderly people's usage behavior. Compared with other theories, the HBM approach which was adopted for the model, provides a more complete set of antecedents that better explain the intention to employ a specific technology (i.e., personal health IT), thereby enhancing the practical contributions of this study. Several practical implications can be derived from the study. First, as perceived severity has a significant impact on adoption intention, the NHIA and healthcare providers should carry out strategies to promote the PHIS among the middle-aged and elderly with chronic diseases. This will increase middle-aged and elderly people's tendency to adopt self-health management, which can reduce the seriousness of their disease and its consequences. Second, perceived benefits is an important factor in the adoption of personal health IT; thus, service providers should try their best to improve their system performance to attract more middle-aged and elderly people. Third, self-efficacy is an important factor influencing behavior intentions. Therefore, the NHIA and healthcare providers should adopt user-friendly design features to ensure that the PHIS can be easily learned and used; they should also provide training on PHIS use for the middle-aged and elderly. Fourth, since cues to action can positively affect user behavior, the NHIA and healthcare providers should implement promotion strategies to attract adopters and then expand the number of PHIS users through internal cues and external cues. Finally, we hope that this study will stimulate interest in the health IT acceptance phenomenon and motivate researchers to examine in greater depth this unexplored yet potentially fertile area of research.

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