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# Modeling Patients' Acceptance of E-Health

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# MODELING PATIENTS' ACCEPTANCE OF E-HEALTH

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## Abstract

*Due to the emerging importance of e-health and the possibility that it can reduce health care costs, we try to explain patients' behavioral intention to use their provider's e-health system. Using the survey method to collect data from patients newly registered with an e-health site, we test three models of user acceptance: two well-known models (TAM and the Motivational model) and one that has recently been proposed that integrates the other two. We also include several antecedents to the models including satisfaction with medical care, health knowledge, information-seeking preference, health care need, and Internet dependence. We find that all three models produce similar results from our data and that several of the antecedents have significant effects on the model constructs. For example, satisfaction with medical care positively influences intrinsic motivation, information-seeking preference positively influences perceived ease of use, and Internet dependence positively influences both intrinsic motivation and perceived usefulness.*

E-health, technology acceptance, motivation model of acceptance

## Introduction

Health-related Internet applications delivering a range of content, connectivity, and clinical care are referred to collectively as *e-health* (Maheu, Whitten, & Allen, 2001). E-health is promoted as a mechanism to bring growth, cost savings, and process improvement to health care (Lazarus 2001, Malcolm 2001). Although health care organizations observed initial developments in e-health mainly "from the sidelines" due to concerns over risk, liability, and initial expense, the industry's attitude toward e-health is increasingly optimistic (Lazarus, 2001, p. 33). A recent survey of 440 health care organizations finds that over 80% now provide some form of e-health to their patients, with more than 50% implementing advanced e-health applications, including online formularies, prescription refills, test results, and physician-patient communication (Lazarus 2001).

In 2000, health care accounted for 14% of the US GDP ($1.31 trillion), and this figure is projected to rise to 16.2% ($2.6 trillion) by 2010 (Plunkett, 2003). Given the massive size of this industry, decisions by health care organizations to implement e-health are likely to have serious economic consequences (Lazarus, 2001) and social ramifications (Wilson, 2003). Patients want a wide range of services to be brought online by their own health care providers (Homan, 2000) in order to increase the access, convenience, and safety of health care, and to reduce health care costs (Bard, 2002). What is less clear is whether or not the services offered by health care organizations and the services that patients desire are the same. Discrepancies between the two could obstruct patients' acceptance and use of the technology (Brooks, 1995). Indeed, the history of IT system development is littered with projects that were rejected by intended users because developers did not attend to key factors of system acceptance (Davis, 1993). For this reason it is important for health care organizations to learn how to model patients' acceptance of e-health. This knowledge will be useful in predicting which patients will use e-health and in understanding what factors underlie their decisions. An effective model will aid in designing and evaluating the ability of specific e-health applications, such as online formularies, to meet the needs of patients in general as well as needs of specific constituencies, such as diabetic patients.

In this paper we test the effectiveness of three models—two well-known models of information technology (IT) acceptance and a recently-introduced approach that integrates the models—in explaining patients' behavioral intention to use their provider's e-health. We also test five conceptually-important characteristics of patients to assess whether these are significant antecedents to

the models. In the remainder of the paper, we develop hypotheses regarding the models and potential antecedents, describe the research methods and results, and conclude with a discussion of our findings.

## Acceptance Models and Antecedents

### *IT Acceptance Models*

Two models of acceptance that are prominent in IT applications are the technology acceptance model (TAM) (Davis, 1989; Davis, Bagozzi, & Warshaw, 1989) and the motivational model (Davis, Bagozzi, & Warshaw, 1992) (see Figure 1). TAM extends the theory of reasoned action (Fishbein & Ajzen, 1975; Ajzen & Fishbein, 1980) by proposing that individuals' perceptions of a technology's usefulness (PU) and ease of use (PEOU) are key contributors to behavioral intention (BI) to use the technology, i.e., technology acceptance. The motivational model proposes that intrinsic motivation (IM) and extrinsic motivation (EM) are key in determining BI. Both models have been applied successfully to predict technology acceptance outside health care domains, and TAM has been used successfully to model physicians' acceptance of telemedicine technology (Hu, Chau, Sheng, & Tam, 1999). We propose Hypotheses 1 and 2 to test these two models in the context of e-health acceptance.

*H1: PEOU and PU will have significant positive influence on BI, as predicted by TAM.*
*H2: IM and EM will have significant positive influence on BI, as predicted by the motivational model.*

As development and testing of the two models has progressed, it has become clear that the PU construct of TAM and the EM construct of the motivational model measure the same underlying construct (Venkatesh, Speier, & Morris, 2002). In recognition of this situation, Venkatesh et al. (2002) developed an integrated model that uses IM, PEOU, and a unitary perceived usefulness-extrinsic motivation (PU-EM) construct to predict BI (see Figure 1). Their initial test of this model resulted in better fit statistics than either TAM or the motivational model alone. We replicate these tests in an e-health context with two hypotheses.

*H3: The integrated model will be a better fit than TAM.*
*H4: The integrated model will be a better fit than the motivational model.*

### *Potential Antecedents*

In many studies regarding IT acceptance, antecedent factors relating to the individual, organization, and system have been shown to significantly affect IM, PEOU, and PU-EM (e.g., Gefen & Straub, 1997; Venkatesh & Davis, 1996; Jackson, Chow, & Leitch, 1997; Hong, Thong, Wong, & Tam, 2001). Because these factors have temporal precedence to system acceptance and occur independently from the model constructs, they may be used to predict users' tendencies toward technology acceptance before the technology is actually implemented. Assuming that predictions involving e-health can be made from antecedent characteristics of patients, it will be important for health care organizations to examine these factors prior to making decisions on e-health design and deployment. After a careful review of the health care literature, we identified several patient-centered factors that have potential to affect acceptance of e-health. These are described in the following sections, and hypotheses are developed to test effects of each factor on IM, PEOU, and PU-EM model constructs. For brevity, a single hypotheses that shows the three separate tests is each written for each factor.

Satisfaction with medical care. Research shows that the more satisfied a patient is with medical care the more likely he or she is to follow the physician's advice (Sherbourne, Hays, Ordway, DiMatteo, & Kravitz, 1992). Dissatisfaction with medical care can motivate patients to change physicians (Rubin, Gandek, Rogers, Kosinski, McHorney, & Ware, 1993) or leave a health plan (Kerr, Hays, Lee, & Siu, 1998). In addition, satisfaction with a prior hospital experience has been shown to influence evaluations of current experiences (John, 1992). These findings suggest that patients who are more satisfied with their current medical care will tend to be more receptive to their health care provider's additional offerings, including e-health.

*H5: Patients who are more satisfied with their health care will have higher acceptance of e-health as measured by (a) IM, (b) PEOU, and (c) PU-EM.*

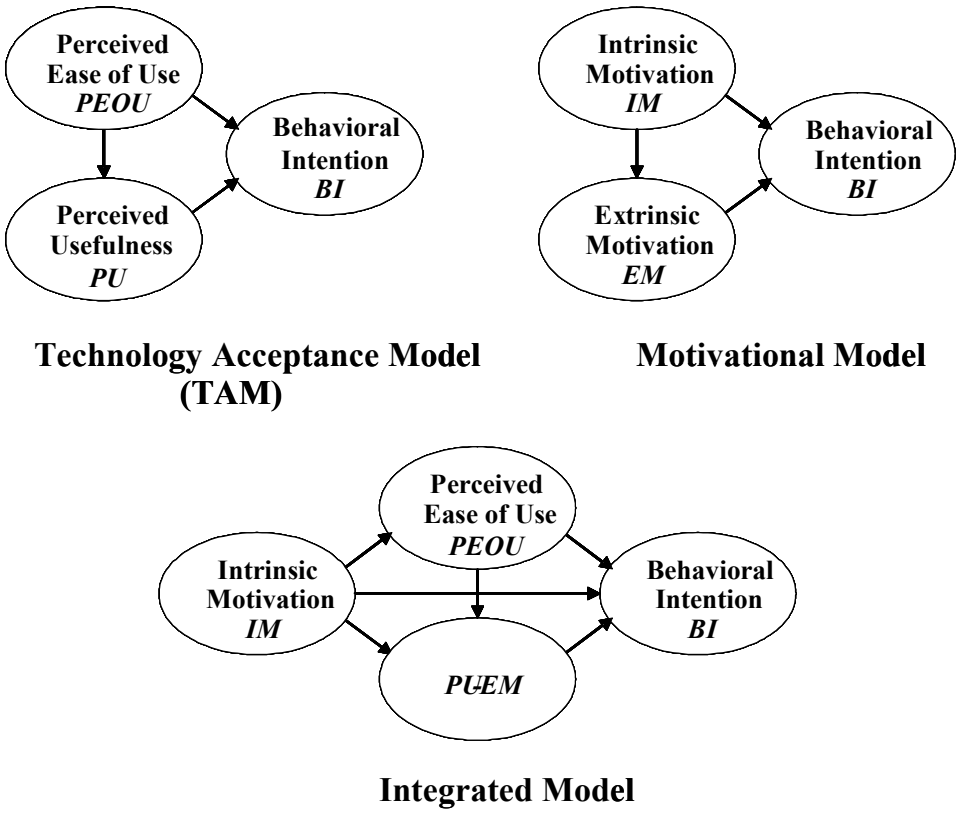


**Figure 1. Three Models of User Acceptance**

**Health knowledge.** Patients often use e-health sites to gain information about a health condition or disease (Ferguson 2000) and increase their knowledge about health topics (Fulton 2002). This suggests that patients who feel they have relatively little knowledge about caring for their own health will tend to accept e-health.

*H6: Patients with lower perceived health knowledge will have higher acceptance of e-health as measured by (a) IM, (b) PEOU, and (c) PU-EM.*

**Information-seeking preference.** In response to an increasing number of health care programs that require patients to be more involved in their care, several studies have examined patients' information preferences. While most patients do not want to make all the decisions regarding their health care, they do want to be informed (Ende, Lewis, Ash, & Moskowitz,1989; Nease & Brooks, 1995; Deber, Kraetschmer, & Irvine, 1996). Among patients with chronic conditions, Strull, Lo, and Charles (1984) report that 41% would prefer to have received additional information from their health care provider. E-health increases availability of information and may provide a less difficult means of gaining that information compared to finding it in a medical library or asking a physician. This suggests that patients with high information-seeking preference will tend to accept e-health.

*H7: Patients who have a higher information-seeking preference will have higher acceptance of e-health as measured by (a) IM, (b) PEOU, and (c) PU-EM.*

**Health care need.** Certain health conditions increase patients' need for health care beyond that of the general patient population. These conditions include chronic diseases, such as diabetes, severe injuries, and lengthy recuperation or rehabilitation periods, all of which can necessitate frequent visits to the primary care physician (PCP) or to multiple physicians. It is anticipated that high need for health care will increase patients' tendencies to accept e-health as a means to receive additional care or reduce time spent in receiving care.

*H8: Patients with higher health care need will have higher acceptance of e-health as measured by (a) IM, (b) PEOU, and (c) PU-EM.*

**Internet dependence.** Over 60% of Americans now have Internet access, and the U.S. population is becoming increasingly dependent on the Internet for information and communication involving health care, government, and other institutions (Horrigan & Rainie, 2002). High levels of internet dependence will increase patients' tendencies to accept e-health.

*H9: Patients with higher internet dependence will have higher acceptance of e-health as measured by (a) IM, (b) PEOU, and (c) PU-EM.*

## Research Method

An online questionnaire was administered to subjects who had recently registered for access to e-health from by a large health care provider in the Midwest U.S. The questionnaire implemented items representing the constructs in TAM, the motivational model, the integrated model, and the five hypothesized antecedent factors.

### *E-Health Application*

The e-health application under study provides encyclopedic health content with both browse and search access, email-style connectivity with the clinic office, and online prescription refill ordering and appointment scheduling. Access for users is unrestricted, but they must first register online and thereafter login using a self-assigned ID and password.

### *Procedure*

An invitation to participate in the study was sent to the email addresses of 1750 individuals who had recently registered for access to e-health. Of these, 163 (9%) responded to the invitation and completed the entire online questionnaire. The health care provider declined to allow the researchers to send additional requests to participate. Subjects' average age is 50 years and 79% are female. Items administered in the questionnaire are presented in the Appendix. The online questionnaire used a randomized administration order of the scaled items for each subject to avoid contamination of responses through item-adjacency effects. Non-scaled items assessing health care need and demographic characteristics were placed at the end of the questionnaire.

### *Measurements*

Items measuring constructs of TAM, the motivational model, and the integrated model were drawn from validated scales (Davis et al., 1989; Davis et al., 1992; Venkatesh et al., 2002). Items measuring satisfaction with medical care were drawn from Marshall et al. (1993), and items measuring information-seeking preference came from Ende et al. (1989). Items for health care knowledge, Internet dependence, and health care need were developed within the present study. Health care knowledge items were developed to measure the extent of knowledge and understanding of personal health problems. Internet dependence items were developed to measure usage frequency of and dependence upon Internet and email. Health care need items were developed to measure three facets of need: frequency of visits to physicians, number of physicians visited during the prior six months, and presence of a chronic health condition. Reliability measures for the constructs are reported in the Appendix.

## Results

Data were screened to ensure that responses were entered to all items. In the cases where subjects spelled out numbers in their textbox entries, these were manually converted to numeric values. All model constructs show reliability (Chronbach's alpha) in excess of .90. All of the four scaled antecedent factors show reliability in excess of .70 except information-seeking preference ($\alpha = .60$), a construct derived from Ende et al. (1989).

### *Effectiveness of Acceptance Models*

Hypotheses 1-4 address the effectiveness of TAM, the motivational model, and the integrated model in predicting BI of patients to use e-health. To test these hypotheses, structural equation modeling (SEM) was conducted to assess relationships among each

model's constructs using AMOS 4 software (Arbuckle & Wothke, 1999). Results of these analyses are shown in Table 1 and Figure 2. All predicted relationships were significant except the relationship between IM and BI that is predicted by the integrated model. TAM and the motivational model each accounted for 70% of the measured variance ($R^2$) in BI, and all constructs in each model made significant positive contributions toward the predictions. This supports Hypotheses 1 and 2. The integrated model produced fit statistics that are equivalent to, but not clearly better than, those of its constituent models, failing to support Hypotheses 3 or 4. We found the PU-EM construct by itself predicts 68% of the measured variance in BI. Since PU-EM is a key construct in each of the tested models, the result is that all models produce similar results in our tests.

**Table1. Model Results**

| Model | $\chi^2$ | df | $\chi^2$/df | CFI | RMSEA | GFI | AGFI | NFI | TLI | BI $R^2$ |
|---|---|---|---|---|---|---|---|---|---|---|
| TAM | 52.97 | 17 | 3.115 | 0.976 | 0.114 | 0.923 | 0.837 | 0.966 | 0.961 | 0.70 |
| Motivational Model | 57.08 | 17 | 3.358 | 0.961 | 0.121 | 0.919 | 0.828 | 0.967 | 0.961 | 0.70 |
| Integrated Model | 94.00 | 39 | 2.410 | 0.975 | 0.093 | 0.905 | 0.839 | 0.958 | 0.964 | 0.71 |
| Model including antecedents | $\chi^2$ | df | $\chi^2$/df | CFI | RMSEA | GFI | AGFI | NFI | TLI | BI $R^2$ |
| Motivational Model | 153.65 | 84 | 1.829 | 0.970 | 0.053 | 0.889 | 0.842 | 0.937 | 0.963 | 0.69 |
| TAM | 249.07 | 144 | 1.730 | 0.954 | 0.067 | 0.864 | 0.821 | 0.898 | 0.945 | 0.69 |
| Integrated Model | 343.04 | 200 | 1.715 | 0.952 | 0.066 | 0.843 | 0.801 | 0.892 | 0.944 | 0.70 |

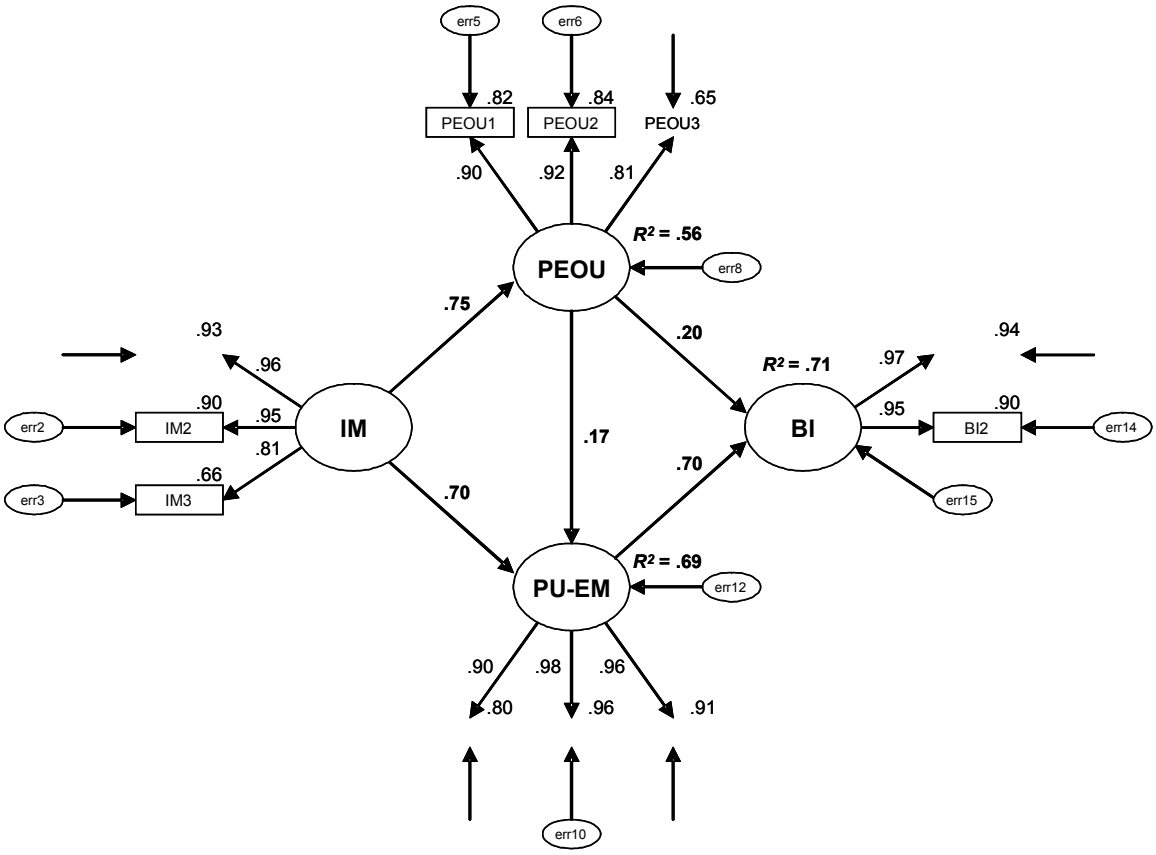


**Figure 2. Integrated Model Showing Standardized Estimates**

All models show good fit on some measures, e.g., NFI > .90, but are outside target limits on other measures, e.g., RMSEA > .08. In general, the fit results are numerically close to those reported by Venkatesh et al. (2002). These results suggest that the structures of the current models are reasonably accurate and are reliable across studies. Yet, since model fit is somewhat less than ideal there may be room to improve upon the models in future research.

### *Importance of Antecedent Factors*

Assessing the importance of the five hypothesized antecedent factors in predicting acceptance proceeded in three stages. First, correlations were produced between the factors and model constructs (see Table 2), providing a test of simple association. Four factors showed a significant association with at least one of the model constructs. Health care need was implemented through three items that measure number of physicians seen and number of visits during the past six months, and existence of chronic disease. None of these measures showed significant associations, failing to support any part of Hypothesis 8.

Second, to test the remainder of the hypotheses a measurement and structural model was run associating the four correlated antecedent factors with the IM, PEOU, and PU-EM factors from the integrated model (see Figure 3). The results indicate that three of the four antecedents are important unique predictors of e-health acceptance, however, none of these provided overall predictions of IM, PEOU, and PU-EM. Satisfaction with provider predicts IM, supporting Hypotheses 5a, and information-seeking preference predicts PEOU, supporting Hypothesis 7b. Internet dependence predicts both IM and PU, supporting Hypotheses 9a and 9c. Health care knowledge did not provide any significant unique predictions.

Finally, stepwise regressions were run to test the cumulative strength of relationships between the antecedent factors identified in SEM and the individual model constructions. The antecedent factors accounted for 20% of variance (adjusted $R^2$) in IM, 13% in PEOU, and 20% in PU-EM. These figures suggest the antecedents will have good predictive power across the three acceptance models.

## Discussion

All the acceptance models performed reasonably well in our tests. Although we anticipated these models would be applicable to e-health acceptance based upon substantial research in other domains, it is reassuring to find that they are robust in the previously untested context of e-health and among a subject group primarily composed of middle-aged to elderly female medical patients, a population that has not previously been studied by technology acceptance researchers.

The findings indicate that health care organizations have flexibility in choosing which model to apply to e-health acceptance. The choice of models in *a priori* situations, i.e., predicting patients' e-health acceptance prior to application use, should be driven by the antecedent factors which are available for measurement. We recommend applying the integrated model in situations where measurements of satisfaction with medical care, information-seeking preference, and internet dependence are available.

Health care providers can use this information in several ways. First, findings from the present study identify several characteristics of patients who tend to accept e-health, which may be useful both in guiding the overall decision of whether to deploy e-health and in clarifying the prospects for e-health within specific patient populations. Patients who are satisfied with their current medical care, those that prefer to seek information about their health care, and those who are already dependent on the Internet tend to accept e-health. Thus, it is likely patients will use e-health to expand and augment interactions with their health care provider rather than replacing interactions they dislike. This suggests that e-health will not be instrumental in its early stages in mitigating problems in the relationship between health care provider and patient or changing the form of interactions that patients initiate.

Second, the findings demonstrate a mechanism for investigating acceptance of specific aspects of e-health. The studied e-health application implemented a range of components related to content, connectivity, and care that the application designers intended to be useful and attractive to patients. However, research has shown that some of the e-health components designers have the highest hopes for and expend the most funds to produce are used only infrequently by patients (Payton & Brennan, 1999). *A priori* surveying of patients can reveal their behavioral intentions to use e-health components based primarily upon model constructs, such as perceived usefulness, and secondarily upon antecedent factors, which offer the added benefit to designers of clearly delineating key characteristics of potential users.

**Table 2. Correlations between Hypothesized Antecedents and Model Constructs**

| Hypothesized Antecedent | IM | PEOU | PU-EM |
|---|---|---|---|
| Satisfaction with provider | .335*** | .229** | .275*** |
| Health care knowledge | .105 | .213** | .081 |
| Internet dependence | .248** | .221** | .327*** |
| Information-seeking preference | .175* | .270** | .209** |
| Number of physicians seen during the past six months | -.011 | -.065 | .000 |
| Number of visits to physician during the past six months | .044 | -.116 | -.011 |
| Chronic disease that requires special medical attention | -.059 | -.047 | .031 |

***Significant at the 0.001 level **Significant at the 0.01 level *Significant at the 0.05 level

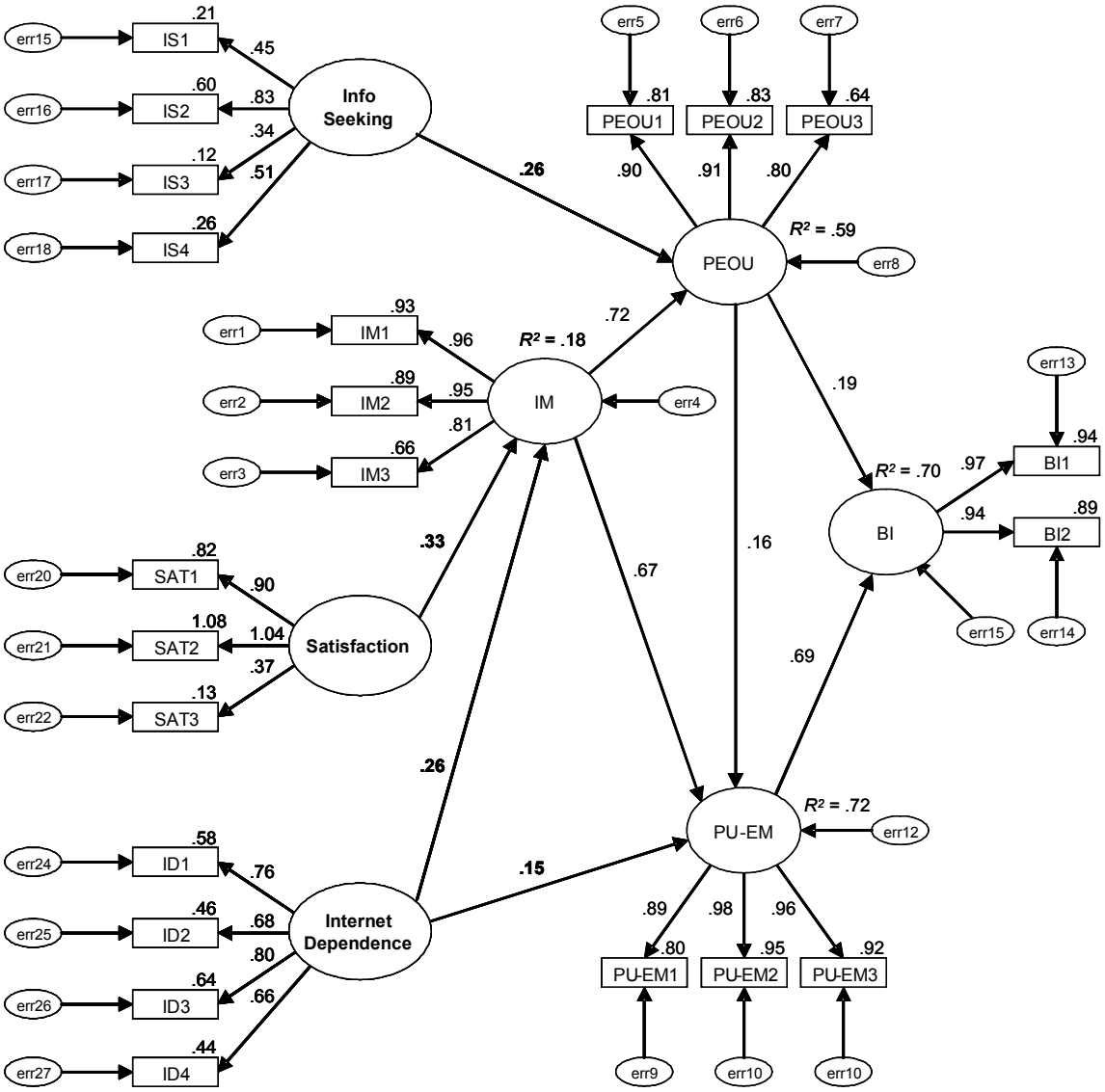


**Figure 3. Integrated Model with Antecedents Showing Standardized Estimates**

### *Limitations*

This research is necessarily limited by the geographic location of the health care provider and its patients, by the configuration of the e-health application the provider implemented, and our choice of antecedent factors. Therefore, we suggest caution in generalizing the findings to substantially different locations or to specialized e-health applications, and we recommend future researchers explore other potential antecedents. Some interesting examples might include patients' health care involvement, normative influences, and social-economic status. It is also possible that there may be systematic differences between patients who responded to our questionnaire and those who did not respond, and this could have biased our findings.

## Conclusion

The present research represents a first step in understanding acceptance of e-health technology. For this reason, we chose to apply well-known acceptance models and test their associations with logically-related patient characteristics. From these beginnings, it will be important to expand the research in two directions. First, it is key to understand which aspects of e-health are valued by different types of patients and in different situations. Because of the wide range of health care offerings and patient needs that exist, it is difficult to envision a single "best of breed" e-health application that would be able to cover all uses without overloading users. For this reason, there is likely to be greater demand for applicable theories, models, and guidelines for configuring e-health applications than is the case with most custom software. Second, although we have argued that modeling e-health acceptance is useful to health care organizations, it is important to extend research to understand why patients *continue* to use these applications. Research in the area of continuance is likely to provide deeper insights into the process of improving e-health to meet ongoing patient needs and become an increasingly valued part of health care services.

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# Appendix

The following items were administered to subjects in the study. Scale items accept responses on a 7-position scale where 1 = Strongly Disagree and 7 = Strongly Agree. Presentation order of the scale items was randomized prior to each new administration of the online questionnaire. Reliability scores (Chronbach's alpha) for items in each construct are shown in parentheses.

**Satisfaction with Medical Care Scale (α = .78)**
SAT1: I am very satisfied with the medical care I receive.
SAT2: All things considered, the medical care I receive is excellent.
SAT3: There are things about the medical system I receive my care from that need to be improved. *(Reversed)*

**Health Knowledge Scale (α = .73)**
HK1: I am very knowledgeable regarding care for my health problems.
HK2: I understand my health problems and how to care for them.

**Internet Dependence Scale (α = .82)**
ID1: Having access to the Internet is important to me
ID2: I spend a lot of time using the Internet.
ID3: The ability to send and receive email is important to me.
ID4: I send and receive numerous email messages.

**Information-Seeking Preference Scale (α = .60)**
IS1: I believe that as a person becomes sicker that person should be told more and more about his/her illness.
IS2: I believe that doctors should explain the purpose of laboratory tests.
IS3: I believe that people should know all the side effects of their medications.
IS4: When there is more than one method to treat a problem, I should be told about each one.

**Health Care Need (Measured as three separate aspects of need, each as a single item)**
HN1: Number of face-to-face visits [to your physician during the last six months]. *(Textbox response)*
HN2: How many different physicians have you seen at your health care provider during the past six months? *(Textbox response)*
HN3: Do you have a chronic disease (such as diabetes or asthma) that requires special medical attention? *(Binary response)*

**IM: Intrinsic Motivation Scale (α = .93)**
IM1: I will find [e-health] to be enjoyable.
IM2: The actual process of using [e-health] will be pleasant.
IM3: I will have fun using [e-health].

**PEOU: Perceived Ease of Use Scale (α = .91)**
PEOU1: My interaction with [e-health] will be clear and understandable.
PEOU2: [E-health] will be easy to use.
PEOU3: I will find it easy to get [e-health] to do what I want it to do.

**PU-EM: Perceived Usefulness - Extrinsic Motivation Scale (α = .96)**
PU-EM1: Using [e-health] will support critical aspects of my health care.
PU-EM2: Using [e-health] will enhance my effectiveness in managing my health care.
PU-EM3: Overall, [e-health] will be useful in managing my health care.

**BI: Behavioral Intention to Use E-Health Scale (α = .96)**
BI1: I intend to use [e-health].
BI2: I predict I will use [e-health].