

Test of the Technology Acceptance Model for the Internet in Pediatrics

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ABSTRACT

There is growing recognition of the importance of the Internet and, more generally, information technology to pediatric care. However, acceptance of these technologies has been low. Attitudes of physicians can play a pivotal role in the adoption session. This study tests the extension to a widely used model in the information systems literature: the Technology Acceptance Model (TAM).

Data were collected in a survey of pediatricians to see how well the extended model, TAM2, fits in the medical arena. Our results partially confirm the model; significant parts of the model were not confirmed. The primary factors in pediatricians' acceptance of technology applications relate to their usefulness and job relevance. Little weight is given to ease of use and social factors. We discuss possible explanations for the discrepancies and suggest future research.

INTRODUCTION

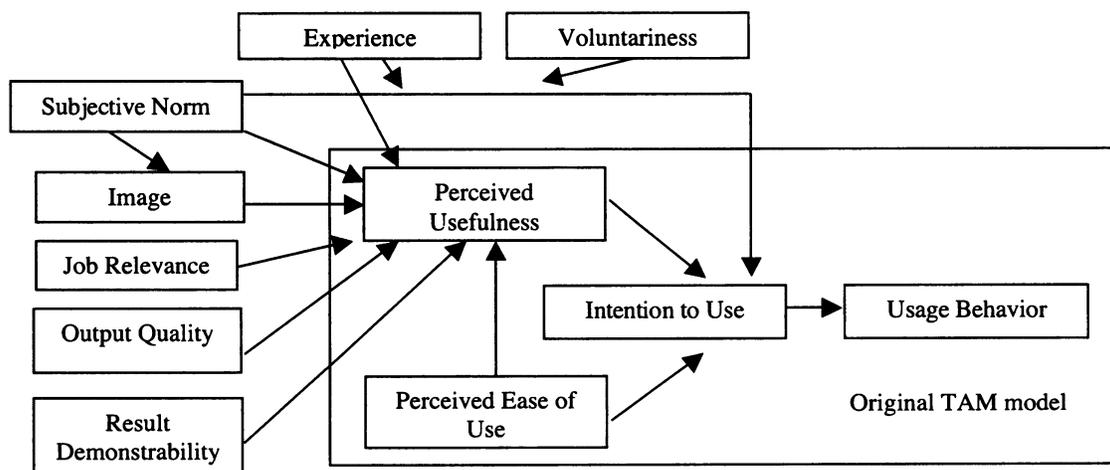
The attitudes of the target users of information technologies (IT) can play a pivotal role in the eventual acceptance and use of the technologies. In looking at the adoption of IT in business research, the Technology Acceptance Model (TAM)¹, proposed 1989, and the Extended Technology Acceptance

Model (TAM2)² have proven to be quite reliable and robust in predicting user acceptance.

TAM and TAM2 posit that an individual's intention to use a system is determined by two beliefs: perceived usefulness and perceived ease of use. In order to better understand the determinants of perceived usefulness, TAM2 incorporates two additional theoretical constructs: cognitive instrumental processes and social influence processes. Four cognitive factors influence perceived usefulness: job relevance, output quality, result demonstrability, and perceived ease of use. Three social forces influence perceived usefulness: subjective norm, image, and voluntariness. (See Figure 1)

Job relevance is an individual's perception of the degree to which the technology is applicable to his or her job. Output quality is an individual's perception of how well a system performs tasks necessary to his or her job. Result demonstrability is the tangibility of the results of using the technology. Perceived ease of use both directly and indirectly impacts on perceived usefulness. Subjective norm is defined as a person's perception that people who are important to him think he should or should not use the technology. Image is the degree to which one perceives the use of the technology as a means of enhancing one's status within a social group. Finally, voluntariness is the

Figure 1: Extended TAM Model (TAM2)



extent to which one perceives the adoption decision as non-mandatory.

TAM2 is operationalized with a series of twenty-six measures and a survey with one question per measure. The model has been widely tested across a number of industries, but only two published studies relate to healthcare. Hu, Chau and Tam³ investigated physician acceptance of telemedicine technology and found evidence that TAM does not fit with physicians. A significantly modified version of the original TAM model has been tested for IT adoption by family physicians⁴, but did not include the enhancements from TAM2.

In this study, we test the applicability of the TAM2 model in the healthcare setting, specifically within pediatrics. The growing importance of the Internet in pediatrics³, lead us to investigate the adoption of the Internet and Internet-based health applications (IHA) within pediatrics. In addition to testing TAM2, we investigate differences in attitudes across three demographic variables: age, size of the practice, and experience with computers. Our goal is help address the needs of the pediatric community in applying information technology.⁵

METHODS

We made modifications to the TAM2 questionnaire to better fit the physician community. The construct "voluntariness" was dropped because use of the Internet and IHA was not being mandated, nor was there any expectation that it would be mandated in the foreseeable future. The construct "experience" is intended to be used for studies after subjects have worked with a system. Since we were not testing a particular system, we dropped that construct. We reworded a number of the questions to be more specific to pediatricians. The full list of questions and their associated constructs is in the appendix.

The TAM2 questions were included in an eight-page survey with sections on the current use of computer and Internet-based technologies, anticipated future use of the Internet, barriers to the use of Internet-based health applications, attitudes toward the technologies, and open-ended questions allowing respondents to express their views. For the study in this paper, only the demographic and attitude questions were analyzed. (A complete copy of the survey is available from the authors.)

Demographics questions ask for age, size of practice, and a self-assessment of knowledge about computers, the Internet in general, and health care applications of

the Internet. Respondents rated themselves on a five-point scale from "novice" to "expert".

In cooperation with the Hawai'i Chapter of the American Academy of Pediatrics (AAP), we sent out 205 surveys to the Chapter's active members, excluding residents. Surveys were collected over a ten-week period, March-May, 2001. Three postcard reminders were sent to non-respondents, two, four, and eight weeks after the survey was mailed. In addition, phone calls were made to every third non-respondent in the sixth week, and every fifth non-respondent in the seventh week. We received 91 completed surveys, of which 89 were useable, yielding a response rate of 43%. Since we estimate that five to ten percent of the people on the mailing list were not actively practicing pediatricians, the responses represent about 45-50% of the practicing pediatricians in Hawai'i.

In testing the applicability of the TAM2 model, we first did a scale reliability test of the survey instrument. We used the Cronbach alpha to test the reliability of the questions. We then did two regression analyses to identify the relative importance of the factors in intention to use the technology. The results of the regression analysis were compared to those of other studies using TAM2.

Finally, we investigated differences in attitudes across three demographic variables: age, size of practice, and computer knowledge. Pearson's Chi Square was used to evaluate differences across populations with respect to each of the twenty-five attitude questions. A significance level of 0.05 was used to identify important differences.

RESULTS

Demographics

The respondents to our survey were very representative of the pediatrician population in Hawai'i: a fairly even split between the sexes, 58% males and 42% females, and a good distribution across the age ranges from 30 and up. Almost half of the respondents work in a solo practice and seventy-one percent work in a practice with ten or fewer physicians (See Table 1).

The Hawai'i chapter of the AAP confirmed that these demographic figures were consistent with those of their active members. So, there was no evidence of a non-response bias on these factors. Also, these data are comparable to US figures as reported by the AAP in its survey of members⁶ with the exception of

practice size. The national average of solo pediatric practices is only 10.6%.

The respondents were evenly spread over the length of time they have been in practice, with about a third in practice ten years or less, a third in practice eleven to twenty years, and a third in practice more than 20 years.

Table 1: Demographic Distribution

Age	Percent
20-30	3.5%
31-40	23.6%
41-50	33.7%
51-60	20.2%
61+	19.1%
Size of Practice	Percent
Solo	42%
2-10	29%
11-30	8%
>30	21%

Our respondents are experienced with computers and the Internet. For personal use, 83% reported using a computer at least once a week and 67% reported using a computer everyday. Less than 7% reported never using a computer. Similarly, with respect to the Internet, 74% of the respondents use the Internet at least once a week for personal reasons; only 11% have never used the Internet for personal reasons.

Scale reliability

To assess the consistency and reliability of the psychometric properties of measures, Cronbach's alpha coefficients were calculated for all of the subscales. As shown in Table 2, all of the values were above 0.70 the acceptable range recommended by the literature and most above the 0.80 considered very good.⁷

Table 2 Analysis of Measurement Reliability

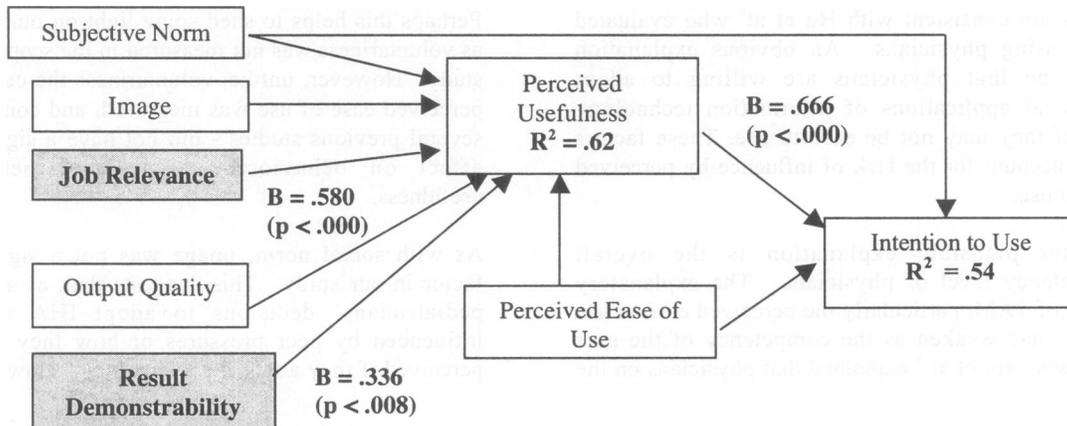
Construct	Cronbach's Alpha
Perceived Usefulness	.86
Perceived Ease of Use	.85
Intention to Use	.83
Subjective Norm	.86
Image	.92
Job Relevance	.75
Output Quality	.86
Result Demonstrability	.72

TAM2 Fit

Regression analyses were used to explain intention toward usage (ITU) also referred to as behavioral intention. Consistent with prior research [1, 2, 3], perceived usefulness (B = .666 p <.000) was a strong determinant of intention to use. The effects of perceived usefulness, perceived ease of use and subjective norm explains 54% of the variance of usage intentions by pediatricians. While perceived usefulness had a significant effect on intention to use, perceived ease of use and subjective norm did not.

Stepwise regression analyses were performed for perceived usefulness, as it is the determinant variable posited by the literature. TAM2 explained up to 62% of variance in perceived usefulness. The factors determining perceived usefulness were Job relevance (B=.580, p < .000); and Results demonstrability (B=.336, p < .008). Subjective norm, image, and output quality were not significant at the 0.05 level in this model. Figure 2 shows these results.

Figure 2: Results of Regression Analyses (Significant relationships at p<.05)



Demographics cross tab

The cross tab analysis of the twenty-five attitude questions against the three demographic variables—age, size of practice, and self-reported computer knowledge—yielded eight significant differences at the 5 percent level. Table 3 shows these eight significant results.

As expected respondents in the 20-40 age group believed that IHA would be easier to use and understand. However, respondents in the 51+ age group were very neutral, rather than believing that IHA would be very difficult to use and understand. Respondents in larger practices, over 30, believed much more strongly that IHA would be beneficial to their practice. Also, respondents in these larger practices agreed more strongly the peer pressures exist to adopt the technologies. Finally, respondents who rated themselves as “novice” with respect to computer technology were much more optimistic about the future quality of IHA. And the novices felt more pressures to use IHA from colleagues who are important to them

average have a higher level of competence, intellectual and cognitive capacity, adaptability to new technologies and reliable access to assistance in operating technology. Physicians are considerably different from the students, administrative staff, knowledge workers and system developers typically examined in previous TAM studies. For these reasons the variables of perceived ease of use may not be sufficient or perceived as critical with this professional user group.

Our study suggests that pediatricians are willing to adopt and use Internet-based health applications if those applications are perceived as beneficial in helping the physician to accomplish his or her daily task. Usefulness is operationalized as increasing the pediatricians’ productivity, improving their quality of care, enhancing their effectiveness and providing overall practical service. Two of the three cognitive instrumental determinants of perceived usefulness, job relevance and result demonstrability, theorized in TAM2 were significant in this study.

The insignificant effect of subjective norm is

Table 3: Significant findings from cross tab analysis

Variable	p-value	Question
Age	0.009	IHA will be easy to use
	0.043	The results of using IHA will be apparent to me
Size of practice	0.009	IHA could improve the quality of care I deliver
	0.025	Pediatricians who influence my behavior think I should use IHA
	0.048	IHA could enhance my effectiveness
Computer knowledge	0.003	I expect the quality of future IHA to be high
	0.038	Pediatricians who are important to me think I should use IHA
	0.045	The quality of pediatric information currently on the Internet is high

DISCUSSION

Overall, TAM2 was partially supported, as perceived usefulness was found to have a significant and strong influence on physicians’ usage intention. However, perceived ease of use was not significant. These results are consistent with Hu et al³ who evaluated TAM using physicians. An obvious explanation might be that physicians are willing to adopt beneficial applications of information technology even if they may not be ease to use. These factors could account for the lack of influence by perceived ease of use.

Another plausible explanation is the overall competency level of physicians. The explanatory power of TAM, particularly the perceived ease of use factor, may weaken as the competency of the user increases. Hu et al.³ explained that physicians on the

interesting as it relates to other studies of TAM2. Venkatesh and Davis² reported that subjective norm had a direct effect on intention to accept that weakens over time. In the studies where usage was perceived as voluntary, subjective norm had no direct effect on intention over and above what was explained by perceived usefulness and perceived ease of use. Perhaps this helps to shed some light on our results, as voluntariness was not measured in the scope of our study. However, unlike, voluntariness the construct, perceived ease of use was measured, and contrary to several previous studies - did not have a significant effect on behavioral intention or perceived usefulness.

As with social norm, image was not a significant factor in our study. This suggests that, as a whole, pediatricians’ decisions to adopt IHA are not influenced by peer pressures or how they will be perceived if they adopt the technology. However, as

noted above in the cross tab analysis, the degree to which this is true may vary across size of practice and experience with computers.

Our analysis indicates two recommendations:

1. A modified version of TAM2 would be very useful in assessing physicians' attitudes toward acceptance of Internet-based health applications. In developing this model, more studies of physicians other than pediatricians are needed.

2. Additional research is needed to examine the effects of physicians' characteristics on information technology adoption, evaluation and comparison of physicians across specialties, disciplines, geographic boundaries, and cultures. In addition, future studies should look at the effects of "hands-on" educational interventions on the on the basic TAM2 relationships.

ACKNOWLEDGEMENTS

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APPENDIX: Survey Questions

Intention to Use

- Assuming that significant barriers to the use of IHA are overcome, I intend to use IHA.
- If significant barriers did not exist, I predict I would use IHA.

Perceived Usefulness

- IHA could increase my productivity.
- IHA could improve the quality of care that I deliver.
- IHA could enhance my effectiveness.
- IHA could be useful in my job.

Perceived Ease of Use

- My interaction with IHA will be clear and understandable.
- IHA will be easy to use.
- Interacting with IHA will not require a lot of mental effort.
- It will be easy to get IHA to do what I want them to do.

Subjective Norm

- Pediatricians who influence my behavior think I should use IHA
- Pediatricians who are important to me think I should use IHA

Image

- Having IHA will be a status symbol.

- Pediatricians who use IHA have more prestige than those who do not.

- Pediatricians who use IHA have a high profile.

Job Relevance

- Usage of IHA is relevant to the delivery of pediatric care.

- Usage of IHA is important to the delivery of pediatric care.

Output Quality

- The quality of consumer health information on the Internet is high.

- The quality of pediatric information currently on the Internet is high.

- The quality of professional information on the Internet is high.

- I expect the quality of future IHA to be high.

Result Demonstrability

- IHA could reduce the cost of my care delivery.

- I believe I could communicate to others the consequences of using IHA.

- The results of using IHA will be apparent to me.

- I would have difficulty explaining why using IHA may or may not be beneficial.

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