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USERS' INTENTION ON ADOPTION OF SMARTPHONE BASED HEALTHCARE SERVICE

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Abstract. *The purpose of this study was to explore explaining power of health behavior theory in smart healthcare. The research model of this study was developed with technology acceptance research. The results show the different results from prior health/ medical literature. Due to smart blood glucose system, the survey questions are developed about diabetes and blood conditions. Perceived susceptibility and severity constructs are rather critical factors in health behavior, but it does not work as important drivers in smartphone based health behavior. According to portability, mobility, and convenience of smartphones, it is easy to access them and not deeply concerned to use smartphone based systems. It works same principle in another construct, health self-efficacy, that it is not so important whether users have confidence on taking action for their health performance. Using smartphone has become one of daily activities and people do not hesitate using them unless required much time and cost. Overall we conclude smartphone based health behavior is different from traditional health behavior. And, it may be needed to research more technological perceptions than illness related perceptions. It is easy to accept new systems when users believe them to help their health performance, but the system should be reliable and affordable. There are no many differences between age and healthy or unhealthy groups. In elder group, if allowed the environmental conditions they tend to use and accept new systems, while in young group, their own thinking and opinions work important.*

Keywords: Smartphone, Technology acceptance model, User behavior, Healthcare system

1. **Introduction.** With rapid development of Information Technology (IT) including Internet and wireless communication network, the day when ubiquitous technology operates absolutely comes not so far [1,2]. This ubiquitous technology would change the whole society even more than what we imagine. Particularly, it is expected to change more in an effective and efficient way in healthcare called Ubiquitous Healthcare (u-Health) [3]. However, this u-Health terminology is commonly used in Korea and diverse terminologies such as e-health, mobile health, telemedicine, telehealth, and home healthcare are used in USA or Europe. South Korea demographic statistics showed highest proportion of rising elderly population in the world. Such demographic changes lead to consequent increase in chronic diseases and according to the report chronic diseases share more than 80% of all other diseases in 2001 [4]. The primary purpose of this study was to explore the factors that affect the adoption of smart blood glucose system focused on non-users.

2. **Literature Review.**

2.1. **Smart Healthcare (s-Health) service.** A smartphone has generated amazing ch-

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anges and shifts in many societies due to their computer functions such as e-mail and web browsing. Even though, first a smartphone was designed by IBM in 1992 [1], it popularized with Apple's iPhone in 2009 [5]. In South Korea, u-Health service has aroused as a more effective solution for coping current healthcare demands such as well aging and well dying. Accordingly, various kinds of the demonstration projects have been continuously implemented by joint of hospitals and ICT organizations or public agencies. It aims to improve environment in hospital and remote healthcare provision, and it also includes healthcare devices development. Furthermore, it makes sure that u-Health could be classified according to target group such as patients care, public care, and elder people. Lee makes up three types of u-Health service: u-Medical, u-Wellness, and u-Silver in 2010 [6].

2.2. **Technology acceptance research.** Technology Acceptance Model (TAM) was developed to explain workers adoption in ICT for their work effectiveness and productivity [7-11]. However, there are several kinds of healthcare interventions developed for end-users who want to improve and perform their own health. In this term, TAM is expected to be able to explain and predict not only healthcare providers but also common users or patients' acceptance. As one of the few patient acceptance studies, Unified Theory of Acceptance and Use of Technology (UTAUT) model explained home care patients' acceptance of a web-based interactive self-management technology and extracted the four variables including perceived behavioral control, subjective norm, perceived ease of use, and perceived usefulness from UTAUT and patient-centered factors such as perceived upper extremity functional ability, perceived visual functional status, health information seeking preference, and healthcare knowledge. There is such obvious contrast between numbers of studies in patients' acceptance and providers. The objective of this study was to identify whether TAM could validate patients acceptance in smartphone based healthcare system.

3. **Research Model.** This section presents a research model and the formulation of several research hypotheses. This study will explore the determinants from both Health Belief Model (HBM) and TAM, and eventual purpose is proposing the new model in smart healthcare. In this section, the development of the core constructs of the research model constructs is discussed. These constructs include perceived barriers, perceived benefits, perceived susceptibility, perceived seriousness, and health self-efficacy from the HBM [12-14], and subjective norm, results demonstrability, technology self-efficacy, perceptions of external control, perceived enjoyment, perceived usefulness, perceived ease of use, and intention from the TAM. The research model representing the constructs and their relationships are shown in Figure 1.

4. **Result of Analysis.** The objective of the study is determining key drivers on using smartphone application for blood glucose control and diabetes care purpose. The study data set is collected using a survey distributed in person. The sample set as collected contains 387 responses.

The following describe the results of the analysis to determine the adequacy of the questions used to construct the syntax found in the model. According to PLS-SEM, it is slightly different from the Covariance-Based Structural Equation Model (CB-SEM). SmartPLS software provides both configuration validity and reliability analysis. First, in order to estimate the relationship between reflective latent variables and indicators, it is necessary to check all external loads of reflective structures. The critical value of the external load is higher than 0.708 [15]. To validate the measurement model, we considered convergence and discriminant validity in the following part. Composite Reliability (CR) and Average Variance Extracted (AVE) scores were checked for convergence validity. CR

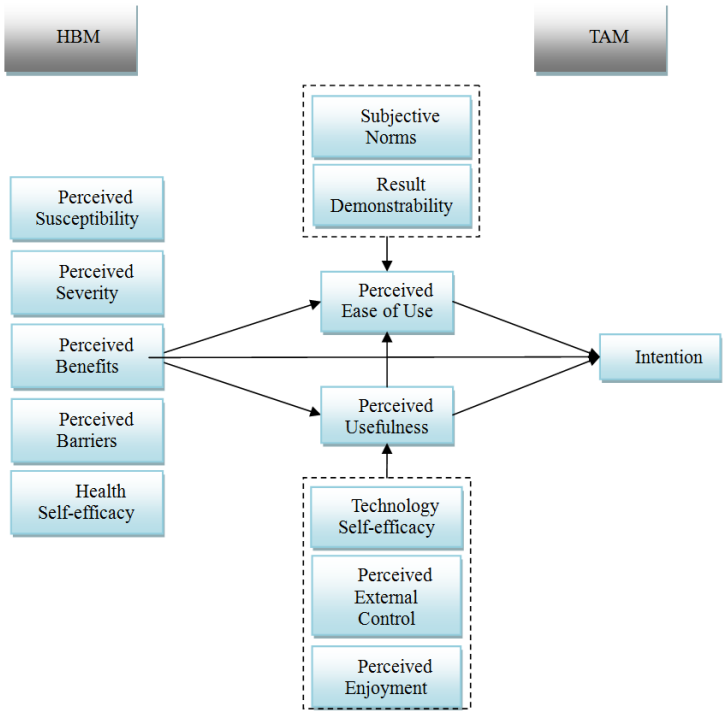

FIGURE 1. Research model

TABLE 1. Sample characteristics

	Question	Frequency	Percent (%)
1	Gender		
	Male	205	53.0
	Female	179	46.3
	No response	3	0.7
2	Age		
	20-29	111	28.7
	30-39	125	32.3
	40-49	101	26.1
	50-59	43	11.1
	60 or over	7	1.8
3	Education		
	Less than middle school/no edu	10	2.6
	High school or equivalent	56	14.5
	4 or 2 year college	214	55.3
	Graduate school	18	4.7
	No response	89	23.0
4	Occupation		
	College or graduate student	55	14.2
	Health related professional	7	1.8
	Government employee	34	8.8
	Specialized job	52	13.5
	Office clerk	84	21.7
	Independent businessman	54	14.0
	Other options	89	22.9
	No response	12	3.1
	Total	387	100

TABLE 2. Composite reliability and convergent validity

Latent variable	Composite Reliability > 0.7	AVE > 0.5
Susceptibility (SUS)	0.897	0.745
Severity (SEV)	0.910	0.719
Benefits (BEN)	0.906	0.707
Barriers (BAR)	0.843	0.731
Health Self-Efficacy (HEF)	0.900	0.820
Subjective Norm (SN)	0.945	0.775
Result Demonstrability (RD)	0.921	0.745
Technology Self-Efficacy (TEF)	0.918	0.695
External Control (PEC)	0.902	0.707
Enjoyment (ENJ)	0.959	0.854
Ease of Use (PEOU)	0.897	0.685
Usefulness (PU)	0.916	0.685
Intention (INT)	0.958	0.853

TABLE 3. Significance testing results of the structural model path coefficients

Paths	Path coefficients	t-values	Significance level	p values
SUS $\rightarrow$ PU	-0.083	1.893	*	0.05
SUS $\rightarrow$ PEOU	0.188	3.669	***	0.00
SUS $\rightarrow$ INT	0.045	0.850	NS	–
SEV $\rightarrow$ PU	-0.084	1.832	*	0.05
SEV $\rightarrow$ PEOU	0.016	0.321	NS	–
SEV $\rightarrow$ INT	0.131	2.648	***	0.001
BEN $\rightarrow$ PU	0.619	11.756	***	0.00
BEN $\rightarrow$ PEOU	0.209	3.306	***	0.00
BEN $\rightarrow$ INT	0.350	5.142	***	0.00
BAR $\rightarrow$ PU	-0.169	3.228	***	0.00
BAR $\rightarrow$ PEOU	0.147	2.607	***	0.001
BAR $\rightarrow$ INT	-0.160	2.950	***	0.001
HEF $\rightarrow$ PU	-0.053	1.335	NS	–
HEF $\rightarrow$ PEOU	-0.007	0.178	NS	–
HEF $\rightarrow$ INT	-0.023	0.562	NS	–
SN $\rightarrow$ PU	-0.081	1.291	NS	–
RD $\rightarrow$ PU	-0.125	2.229	*	0.05
TEF $\rightarrow$ PEOU	0.296	4.540	***	0.00
ENJ $\rightarrow$ PEOU	0.139	2.393	**	0.01
PEC $\rightarrow$ PEOU	0.320	4.493	***	0.00
PU $\rightarrow$ INT	0.249	3.599	***	0.00
PEOU $\rightarrow$ INT	0.169	2.445	***	0.005
PEOU $\rightarrow$ PU	0.398	7.775	***	0.00

*p < 0.1, **p < 0.05, ***p < 0.01

represents internal consistency where all items represent the same latent structure. The CR value should be at least 0.7.

The given convergent and discernible validity indicates that the measurement model has been validated. We also used PLS Bootstrap (BT) to find the t-value to identify the relationship among the latent variables.

As shown in Table 3, most paths have significant statistical levels. What is unusual, however, is that health self-efficacy has no significant value while technology self-efficacy is significant. This, in turn, shows that the technical factors are meaningful for the intended use.

5. **Conclusions.** The primary purpose of this research was to explore the adoption process of smartphone blood glucose system targeted for both diabetes patients and normal (healthy) people. There are many previous researches about the tele-blood glucose managing systems that have high effect on managing with good condition of diabetes. Therefore, it makes sure that the blood glucose managing systems provide efficiency of telecare for diabetes patients who need monitoring and caring of blood glucose all the time. Even though, these systems are efficient enough, it is question about how patients adopt them. When research is conducted in hospitals, it shows high effectiveness. However, more important thing is that these systems could contribute to preventing from the diabetes occurrence and managing. There are very few researches related with adoption on using smartphone blood glucose systems. In this term, our study gets started to conduct and examine the determinants in accepting blood glucose systems using smartphone. The research model of the study contains constructs from HBM, rather recognizable model among health behavior theories, and TAM, highly cited model in IS literature. The study utilizes a paper-based survey to test the theoretical model. Based on the literature review, a questionnaire is developed and administrated self-report.

Overall we concluded smartphone based health behavior is different from traditional health behavior. And, it may be needed to research more technological perceptions than illness related perceptions. It is easy to accept new systems when users believe them to help their health performance, but the system should be reliable and affordable. In future studies, as in the present study, it is shown that there should be a study to try an integrated model of TAM and HBM [16,17].

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