

## **E-Smart Health Information Adoption Processes: Central versus Peripheral Route\***

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Our study adopted ELM (Elaboration Likelihood Model) to measure the impact of central and peripheral cues on e-healthcare website behavior and its consequence on perceived loyalty of users. While most of ELM studies did not elaborate the antecedent of both central and peripheral cues, we measured the antecedents of those information processing routes to clarify how technical and quality factors (i.e. information organization, security concern, and website attractiveness) develop the nature of either central or peripheral route. We found that information organization was the main antecedent of information quality presented on the website. Second, the results revealed that website security has a positive effect on website credibility. Third, we also found that website attractiveness was positively associated with website credibility. Fourth, consistent with elaboration likelihood model, the empirical findings suggested that information quality (central cue) and website credibility (peripheral cue) were strong predictors of behavior intention to use health website. Our findings also suggested that behavior intention to use health website significantly influenced perceived loyalty.

**Keywords :** Elaboration Likelihood Model, e-Smart Health Information, Central versus Peripheral, Website, National Cancer Center

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## 1. Introduction

The use of internet as source of health information has rapidly increased [Bates *et al.*, 2006]. However, among surveys conducted to assess the health information quality on the website, the findings indicated that most of accessible information provided on this media can be considered “bad” information [e.g. Berland *et al.*, 2001; Chills, 2004] and contradict to established medical guidelines [Latthe *et al.*, 2000]. In this situation, customers have a new responsibility for assessing the credibility of the information by using quality argument [Eysenbach, 2007]. Thus, in order to ensure that individuals receive the good health information on the internet, understanding e-healthcare website usage behavior is critical because the expected benefits of e-healthcare usage can be achieved only if individual users accept and use the website properly [Bhattacharjee and Sanford, 2006].

To respond this issue, intensive research has been conducted to examine several concerns such as credibility [e.g. Duta-Bergman, 2004; Rains and Karmikel, 2009], privacy concern [e.g. Angst and Agarwal, 2009], and information context [e.g. Adams, 2003; Eysenbach and Kohler, 2002]. However, while those previous studies tried to answer the myths of technology acceptance in e-healthcare context, they were likely to focus on one dimension, rather than perceive the issue as an elaboration process, in which one factor is connected with the others in explaining user behavior. Very limited exception is study by Angst and Agarwal [2009]. In other words, they fail to explain the attitude change process of e-healthcare users.

One main theoretical approach that can help explaining the association of various dimensions

in affecting attitude or intention formation is Elaboration Likelihood Model (ELM). ELM provides a general framework to understand the effectiveness of persuasive communications [Petty and Cacioppo, 1986]. This theory offers a theoretical explanation for observed differences in the amount of influence accepted by recipients exposed to new information [Angst and Agarwal, 2009]. The ELM has been applied successfully to a variety of contexts including counseling [e.g. Heesecker, 1986] education [e.g. Henningsen *et al.*, 2003] and IS context [e.g. Bhattacharjee and Sanford, 2006; Sussman and Siegal, 2003]. Recently, some scholars have noticed the significance of ELM constructs to study health behavior. For example, Petty and Cacioppo [1996] has found that a better understanding of the impact of cigarette smoking on behavior has led to increase the potential of decreasing the consumption of the substance and of exploring diverse methods to deliver the message. The result of persuasion theory in e-healthcare generally suggests that this theory can help to create effective messages to motivate individuals to engage in health behaviors [Jones *et al.*, 2003].

In this study, we adopted ELM to measure the impact of central and peripheral cues on e-healthcare website behavior and its consequence on perceived loyalty of users. ELM enables us to make predictions about the impact of various factors on healthcare information adoption under different levels of elaboration likelihood [Sussman and Siegal, 2003]. While most of ELM studies did not elaborate the antecedent of both central and peripheral cues, we measured the antecedents of those information processing routes to clarify how technical and quality factors (i.e. information organization, security concern, and website at-

tractiveness) develop the nature of either central or peripheral route. Therefore, based on the literature, three research questions are examined in this study. First, "how do the antecedents of central and peripheral cue influence the persuasive communication of website users?" second, "how do the central cue (i.e. information quality) and peripheral cue (i.e. website credibility) influence behavior intention to use e-healthcare website?" and third, "does the individual difference (i.e. self-efficacy) moderate the relationships between the information processing cues and user behaviors?"

By understanding the information processing route in e-healthcare acceptance context, theoretically we can understand the antecedents and effect of various website components. This study also offers a theoretical explanation for the differences of perception developed by recipients exposed to the healthcare information provided on the website. This research also examines the mediating role of self-efficacy in affecting the information processing route. Practically, this research can assist organization devoted to healthcare to understand individual users' information processing cues and in turn, persuade them to use the website in order to ensure that they can access the "good" information.

The rest of the paper is structured as follows: the next section reviews the current literature on Elaboration Likelihood Model (ELM). The third section presents a research model and hypotheses development. The methodology, results and hypothesis testing are then presented, followed by the discussion of the result findings. The paper concludes by discussing the limitations, theoretical and managerial implications of this study, and offering suggestions for future research.

## II. Literature Reviews

### 2.1 Elaboration Likelihood Model

The theory of ELM offers a conceptual basis for investigating attitude and persuasion [Angst and Agarwal, 2009]. ELM is a dual-process theory of attitude formation and change [Petty and Cacioppo, 1986]. Dual process theory suggests that the external information is the primary driver of attitude change and consequent behavior change [Bhattacharjee and Sanford, 2006]. According to this theory, persuasion can act via a central or peripheral route where personal attributes determine the relative effectiveness of these processes [Petty and Cacioppo, 1981]. When elaboration is high, the recipient will experience a central route of persuasion, however, when elaboration is low, he or she will engage in peripheral route [Petty and Cacioppo, 1986].

Central route processing represents the process of elaborating on an appeal by paying attention to an argument quality and evaluating it. Argument quality refers to an individual's perception that a message's arguments are strong and cogent as opposed to weak and specious [Petty and Cacioppo, 1986]. In comparison, peripheral route processing describes the process of drawing conclusions from rules of thumb or reliance of heuristic cues (i.e. source credibility) without much regard toward the actual merits of an argument [Petty and Cacioppo, 1986]. Source credibility refers to a source that is a recognized expert, that keeps information current, and that has no competing interests in providing the information should be judged a more credible source than one that is not an expert source, that provides outdated information, or that has com-

mercial interests in providing the information [Bates *et al.*, 2006]. Source credibility is a simple cue in the persuasion context that affects attitudes in the absence of argument processing. Such peripheral cue may shape attitudes or allow a person to decide what attitudinal position to adopt without the need for engaging in any extensive thought about the argument s presented [Petty and Cacioppo, 1984]. Individuals who use peripheral route generally do not want to devote the necessary cognitive energy to elaboration or they could not expend the effort [Angst and Agarwal, 2009].

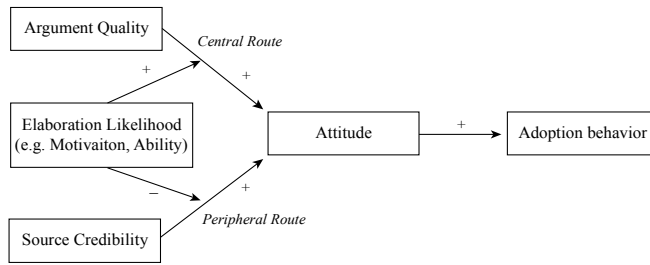
In sum, the central route differs from peripheral route in three ways: (1) the type of information processed; (2) the cognitive effort involved in information processing; and (3) the effect of the perception changes. First, while centralroute processes message-related arguments, peripheral route only processes cues. Second, central route requires thoughtful comprehension of the argument presented, evaluation of the argument quality, and combination of multiple or conflicting arguments into an overall evaluative judgment, whereas peripheral route requires subjects' association with salient positive or negative cues related to the attitude object. Third, perception created via central route is relatively more persistent and powerful to predict attitude than peripheral route is [Bhattacharjee and Sanford, 2006] while attitude changes induced under the peripheral route are pointed out to be relatively temporary and unpredictable of behavior [Petty *et al.*, 1983].

According to ELM, when a message is delivered to individuals in different contexts, the recipients will vary in how much cognitive energy they devote to the message [Petty and Cacioppo,

1986]. The difference of cognitive absorption may be caused by the diversity of recipient's knowledge of learning content, structure, and processes or recipient's ability and or motivation [Angst and Agarwal, 2009]. The ability and motivation to elaborate is captured in ELM by the elaboration likelihood construct [Bhattacharjee and Sanford, 2006]. Elaboration is an effortful process in which one considers all available information about an attitude object and thoughtfully scrutinizes its relative merits and demerits, before forming an informed judgment about the object [Bhattacharjee and Sanford, 2006].

The elaboration likelihood has been indicated to moderate the relationship between persuasive cues and attitudes. Under this persuasive context, when conditions drive people's motivation and ability to engage in issue-relevant thinking, the elaboration likelihood is likely to be high [Petty and Cacioppo, 1986]. Thus, expert in target behavior tend to rely on the quality of arguments while non-experts are likely to depend on peripheral cues such as credibility of the source. Expert users will rely rarely on peripheral cues, because they are likely to be more aware of the possibility of inaccuracy, bias, and lack of realism in such cues [Bhattacharjee and Sanford, 2006]. However, non-expert users, who lack of motivation and ability, may form an attitude regarding the object through relatively less effortful process of association based on peripheral cues. To this extent, information quality becomes less important [Petty and Cacioppo, 1984]. Theoretical framework of ELM is illustrated in <Figure 1> below.

The ELM is based on the notion that people are motivated to hold correct attitudes but have neither the resources to process vigilantly every persuasive arguments nor the luxury of being



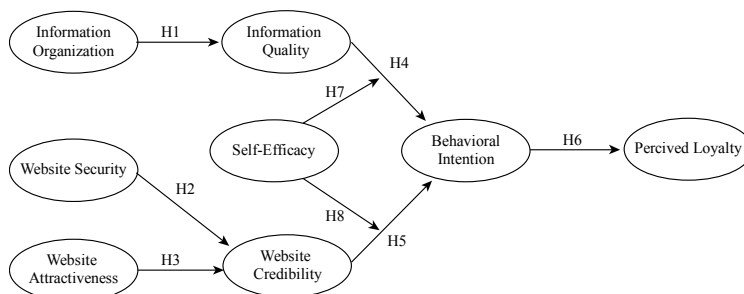
<Figure 1> Elaboration Likelihood Model Framework

able to ignore them [Cacioppo *et al.*, 1986]. Individual difference factors such as self-efficacy [Bandura, 1977] would influence people’s feelings such as fears and anxieties particularly about tasks involving vigilant information processing and behaviors on cognitive tasks would provide a stronger test of hypotheses regarding the importance of issue-relevant thinking in attitude change and attitude-behavior relationship. Therefore, for the study purpose, self-efficacy was chosen as elaboration likelihood construct in e-healthcare context.

### III. Research Model and Hypotheses Development

E-healthcare is “an emerging field in the intersection of medical informatics, public health and business, referring to health services and in-

formation delivered or enhanced through the Internet and related technologies. In a broader sense, the term characterizes not only a technical development, but also a state-of-mind, a way of thinking, an attitude, and a commitment for networked, global thinking, to improve health care locally, regionally, and worldwide by using information and communication technology” [Eysenbach, E20]. Under this context, e-healthcare website is chosen as the target of this study. A website is, naturally, an information technology. Hence, intention to use the website should be explained in part by the technology acceptance [Gefen *et al.*, 2003]. Consistent with the previous studies, we proposed that persuasion is determined by (1) the aspects of the message (information quality and website credibility) and (2) the aspects of message recipient (self-efficacy) [Bhattacharjee and Sanford, 2006; Petty and Cacioppo, 1980;



<Figure 2> Research Model

Sussman and Siegal, 2003]. Proposed research model is presented in <Figure 2> below.

### *Website Quality*

Generally, there are two main research streams in an effort to understand users' reactions to information technology. The first stream, called adoption model, focuses on perceptions related to IT use adoption such as usefulness. Adoption models might be useful during the first step in understanding how intentions toward a message are formed [Sussman and Siegal, 2003]. The second stream is likely to focus on the nature of IT artifact itself. According to this perspective, despite measuring the abstract perceptions of users, the scholars should elaborate the quality factors of an IT artifact. In other words, the quality of information systems is the key initial antecedents for IS success [DeLone and McLean, 2003; Nelson *et al.*, 2005]. Despite focusing on the abstraction of users' perception, we adopted the second stream because quality is the single most important determinant of a long-term success [Nelson *et al.*, 2005]. Moreover, the adoption models fail to explain the influence process itself [Sussman and Siegal, 2003] which is related to the quality of IT artifact.

Nelson *et al.* [2005] identified two distinctive factors of information systems: information quality and system quality. Information quality relates to the output of an information system and system quality reflects the information processing system required to produce the output. They proposed four dimensions of information quality: accuracy, completeness, currency, and format and five dimensions of system quality: accessibility, reliability, response time, flexibility, and integration. However, those dimensions are

adaptable depending on the IT context. These factors can be reduced and adjusted to a relatively concise set of determinants of information quality [Nelson *et al.*, 2005; Wang and Strong, 1996]. Since elaboration likelihood model emphasizes on the issue of information sources, we focus our research model on information quality only. We leave the other aspects of quality for the further research.

Previous literature also measures argument's quality through information quality in many information adoption studies [e.g. Sussman and Siegal, 2003; Fan *et al.*, 2010]. High quality information is the source of information [Bates *et al.*, 2006] to persuade users to use the website. In marketing environment, Tam and Ho [2005] initiate that the persuasive messages presented on a website influence a users by diverting attention, reallocating cognitive resources, and evoking affective responses and behavior. Because information is presented on a website, online information can be conceptualized as information on a stimuli-based decision-making environment [Tam and Ho, 2005]. That is, the stimuli take the form of text, images, audio, animation, or video. In the context of web personalization, the design, format, modality, and timing of these stimuli, captured by information organization construct, contribute to different persuasive efforts to influence a user (e.g, a website's design and an array of outlets can even affect what products a consumer choose to buy). Information presentation reflects the degree to which information is presented in a manner that is understandable and interpretable to the user, and thus aids in the completion of a task [Nelson *et al.*, 2005]. Information presentation research has found that the suitability of a particular presentation is determined by the

fitness of task and users' perception [Nelson *et al.*, 2005]. Following the existing literature, we hypothesized that information organization has a positive effect on information quality presented on e-healthcare website.

*H1: Information organization has a positive effect on information quality presented on e-healthcare website*

When users interacting with computer information systems such as website, they often need to make a decision about how to utilize the functionality provided by the website [Chen and Bansal, 2010]. As suggested by ELM, credibility is relevant to e-healthcare acceptance because novice users often rely on peripheral cue or credibility of information provider to learn about the latest information related healthcare. Credibility can be identified in various forms. For example, in the marketing context, corporate credibility or firm reputation has been recognized as one of the sources of credibility [Lafferty and Goldsmith, 1999]. In this research, we captured this construct as e-healthcare website credibility which is defined as the extent to which a person believes that the use of a healthcare website will have no *security* or unexpected threats. To this extent, perceived security risk may reflect an individual's judgment of how risky a certain event is [Chen and Bansal, 2010]. Security issue is an important part in affecting website credibility but indirectly influences cognitive information processing. Hence, we argued that website security positively influences e-healthcare website credibility.

*H2: Website security has a positive effect on e-healthcare website credibility*

According to the attribution theory perspective, which is concerned with how individuals interpret events and how this relates to their thinking and behavior, the aspects of website such as attractiveness has been indicated as a strong predictor of perceptions of the abilities and trustworthiness (i.e. reputation) of organization [Gregg and Walczak, 2008; McKnight *et al.*, 2004]. This, in turn, will affect users' expectation about the credibility of source that they will receive. Marketing literature has demonstrated that physical attractiveness can lead to greater perceptions of credibility of both the spokesperson and sponsoring organization [Lynch and Schuler, 1994]. Similarly, Patzer [1983] posits that attractiveness is the underlying construct of source credibility attributes. In his study, he found a positive relationship between communicator attractiveness and source credibility within a marketing context. Hence, in the context of online media, where information is posted on a website, it is reasonable to assume that website attractiveness positively influence e-healthcare website credibility.

*H3: Website attractiveness has a positive effect on e-healthcare website credibility*

ELM posits that argument quality and peripheral cues embedded in the communicated information are the key drivers of users' acceptance decision [Bhattacharjee and Sanford, 2006]. Even though prior ELM literature suggests that information processing will influence behavior intentions through attitude, we argue that beliefs directly related to behavioral intention, especially when attitudes are not well-formed under emerging technology exposure [Angst and Agarwal, 2009]. Jones *et al.* [2003], for example, found the

effect of persuasive factors on message elaboration, intentions, and behaviors, but no effects on attitudes. It is likely that message elaboration and intentions appeared to affect behavior without involving attitudes.

DeLone and McLean [2003] wrote that "Given the difficulties in interpreting the multidimensional aspects of "use"-mandatory versus ineffective, and so on - we suggest "intention to use" may be a worthwhile alternative measure in some contexts. "Intention to use" is an attitude, whereas "use" is a behavior ... However, attitudes, and their links with behavior, are notoriously difficult to measure; and many researchers may choose to stay with "use," but hopefully with a more informed understanding of it." (p. 23). Similarly, Bhattacharjee and Sanford [2006] indicated that attitude in form of connotation dimension can be represented by intentions or behavioral dispositions regarding IT acceptance. Borrowing this literature, this study extended ELM to behavior intention under e-healthcare setting.

Argument quality has been confirmed as a strong determinant of persuasion because when argument quality is strong, the message contains facts that are justified and compelling, and in turn, more persuasive. Persuasive messages focus the attention of the subject, leading to a reallocation of cognitive resources and stimulating responses or a behavior [Petty and Cacioppo, 1986]. Similarly, in IS literature, information quality of website is a strong predictor of intention to use [DeLone and McLean, 2003]. If providers expect prospective consumers to visit and use the website, they should ensure that web content can be personalized, complete, relevant, easy to use, and secure. High information quality can alter persuasibility by increasing a subject's message

relevant thinking [Heesacker *et al.*, 1983]. In addition, high information quality was predicted to cause increased acceptance of a message because it was associated with favorable outcomes. To the same extent, Park *et al.* [2007] adopted ELM in electronic commerce and argued that the higher information quality is, the greater the consumer satisfaction. In turn, a high consumer satisfaction positively influences consumers' purchase intention. Thus, information quality can have a positive effect on purchase intention. Therefore, we hypothesized:

*H4: Information quality has a positive effect on behavior intention to use e-healthcare website*

According to ELM, non-experts less on argument framing and instead use peripheral cues such as the credibility of the source [Angst and Agarwal, 2009]. Jones *et al.* [2003], in their health promotion study, reveal that source credibility and message frame interacted on measures of elaboration with only the credible-source. In turn, the credible source condition led to the most positive behavioral intention. Interestingly, they found that health-promotion messages presented by a non-credible source will not be elaborated and thus message frame will have little impact. Information generated from a credible source can influence opinions, attitudes, and/or behavior through an information processing routes. Lafferty and Goldsmith [1999] suggest that when individuals are aware of the firm credibility, they are likely to elaborate this information into their decision-making and be more motivated to use cognitive processing to evaluate the message. They also indicate that consumers are likely to have greater purchase



intentions when the corporate credibility is high than then it is low. Similarly, in electronic banking context, Wang *et al.* [2003] have distinguished perceived credibility from perceived risks and trust, and found that perceived credibility has a significant positive effect on the behavior intention to use internet banking [Luarn and Lin, 2005]. Consistent with those studies, we indicate that website credibility is positively associated with behavior intention to use e-healthcare website.

*H5: Website credibility has a positive effect on behavior intention to use e-healthcare website*

Oliver [1999] proposed four stages of brand-loyalty based on the cognition-affect-conation pattern. The first stage is cognitive loyalty. In this stage, customers are loyal to a brand based on their information that brand. The second stage is affective loyalty, a condition when customer liking or positive attitudes toward a brand. The third step is conative loyalty or behavioral intention. In this stage, consumers have a good intention, which in turn, may result in unrealized action. The last stage is action loyalty, where customers convert intention into actions [Yang and Peterson, 2004]. Based on this literature, we argued that behavior intention to use e-healthcare is positively associated with perceived loyalty to use e-healthcare website.

*H6: Behavior intention to use e-healthcare has a positive effect on perceived loyalty to use e-healthcare website*

### ***Self-Efficacy***

Self-efficacy was developed well under Social Learning Theory [Bandura, 1977]. According to

this theory, the stronger their perceived self-efficacy, the more robust and resolute their efforts will be. In contrast, those who have a lower perceived self-efficacy level will expend less effort and will be more inclined to abandon their attempts [Bandura and Cervone, 1983]. Derived from this theory, Compeau and Higgins [1995] conceptualized the computer self-efficacy theory. Computer self-efficacy refers to “a judgment of one’s capability to use a computer” [Compeau and Higgins, 1995, p. 192]. Individual are likely to enjoy behaviors they feel they are capable of performing and to dislike those they do not feel they can successfully master [Compeau and Higgins, 1995]. Consistent with elaboration likelihood context, self efficacy influences choices about which behaviors to undertake, the effort and persistence exerted in the face of obstacles to the performance of those behaviors, and in turn, ultimately, the mastery of the behaviors [Compeau and Higgins, 1995].

Self-efficacy may represent the cognitive ability of a recipient to process a very simple message [Angst and Agarwal, 2009]. This construct has been shown to moderate the associations between persuasive cues and IT usage behaviors [Bhattacharjee and Sanford, 2006]. Petty and Cacioppo [1986] wrote “as motivation and or ability to process arguments are decreased, peripheral cues become relatively more important determinant of persuasion. Conversely, as argument scrutiny is increased, peripheral cues become relatively less important determinants of persuasion.” (p. 152). In other words, individuals in the high elaboration likelihood state (high self efficacy) are more likely to engage in thoughtful processing of an information message, and in turn, are more persuaded by argument quality

(information quality). In contrast, those in the low elaboration likelihood state (low self efficacy) are likely to rely more on peripheral cues (website credibility) in making a judgment about the message [Bansal *et al.*, 2008]. Thus, when a message contains information that is consistent with an individual's attitude, high self-efficacy individuals should be more motivated and generally more able to elaborate the strengths of the arguments. Consistent with ELM, we posit that:

*H7: Self-efficacy has a positive moderating effect on the relationship between information quality presented on e-healthcare website and behavior intention to use e-healthcare website*

*H8: Self-efficacy has a negative moderating effect on the relationship between e-healthcare website credibility and behavior intention to use e-healthcare website*

## IV. Research Methodology

### 4.1 Study Setting

The survey was conducted in South Korea. The e-health infrastructure in this country has been developed since the establishment of the Korea e-Health Association in 2003 by the Korean Ministry of Commerce, Industry, and Energy. In only five years period, e-health has become an important growth industry for Korean economy [Lee *et al.*, 2009]. The fact that Korea has one of the most advanced IT technologies and IT infrastructure in the world, has benefit this country to spread e-healthcare technologies not only across the domestic region, but also in international market [Lee *et al.*, 2009]. Consequently, e-health has become one of the most important elements

for public healthcare, health informatics, and other related technologies in Korea. As one of the primary public healthcare services in this country, National Cancer Center (NCC), initiated Ministry of Health and Welfare also delivers its service through internet. One of the main functions of this website is providing cancer information in various forms, including electronic learning, e-book, multimedia presentation, and testimonial content. In this research, NCC website as national e-healthcare website was surveyed and evaluated.

The research uses Website Satisfaction Survey, conducted in 2009 by Korea National Cancer Center. Prior to the survey, a pilot test was conducted to a small group of respondents to enhance the psychometric properties of the measurement scales. In addition, interviews and discussions with the experts were also performed to confirm the measurement properties of the final items. The survey was officially administered by National Cancer Center (NCC), South Korea. The questionnaire was administered as online form by posting the electronic form on the NCC website. When users entered the website, the questionnaire was presented on a new browser window (pop-up window). The respondents who were the registered website members were offered cash incentives in form of US \$8. The respondents were informed that the results would be reported collectively to ensure their anonymity. Data were collected from September 2009 to January 2010. The total number of completed responses was 200. Out of this total number, we excluded 16 invalid responses, resulting 184 usable responses for further analysis. Demographic and descriptive statistics are presented in <Appendix A>.

## 4.2 Operationalization of Constructs

Scales to measure each of the constructs in the model were developed based on the presented sources and existing scales were used where possible. Information quality items were adapted from Wixom and Todd [2005]; the measures for information presentation were adapted from Rai *et al.* [2002]; website attractiveness were measured using Montoya-Weiss *et al.* [2003] items; and measurement items for perceived security and website credibility were adapted from Fogg and Tseng [1999] and Hu and Sundar [2010]. Self-efficacy was measured using items suggested by Compeau and Higgins [1995]. Intention to use was assessed using an adapted version of Venkatesh [2000]. Perceived loyalty was measured using two items adapted from Yang and Peterson [2004]. Each questions was measured on a 5-point, Likert-type scale, ranging from 1 (strongly disagree) to 5 (strongly agree) (see <Appendix B>).

## V. Data Analysis and Result

### 5.1 Scale Validation

The research model was tested using Partial Least Square, a structural modeling technique that may handle the highly complex predictive models [Chin, 1998]. PLS-Graph 03.00 was used for data analysis. For the measurement validation, we followed the criteria recommended by Gefen and Straub [2005]. Reliability was measured using internal consistency scores, calculated by the composite reliability scores. Internal consistency scores all exceed 0.90, indicating all variables is considered acceptable. Convergent validity is shown when each of the measurement

items loads with a significant t-value on its latent construct. Discriminant validity is shown when two criteria are met: (1) the correlation of the latent variable scores with the measurement items shows an appropriate pattern of loading, that is, the measurement items load much higher on their hypothesized factor than on other factors, and (2) when the square root of each factor's average variance extracted (AVE) is larger than its correlations with other factors.

We run the raw data in PLS and excluded the poor loading scores. After the exclusion, all the outer loadings showed significant value at  $p < 0.001$ , suggesting convergent validity was met. For the next step, we performed Confirmatory Factor Analysis in PLS, where the pattern of loadings of the measurement items on the latent constructs is specified explicitly in the model. Each item loads more highly on their own construct than on other constructs and that all constructs share more variance with their measures than with other construct <Table 1><sup>1</sup>). The square root of all AVEs is also much higher than all other cross correlations <Table 2>. In sum, these findings suggest acceptable convergent and discriminant validity.

To deal with the issue of common method bias, we first assessed the common method variance by using Harman's one-factor test [Podsakoff *et al.*, 2003]. One principal construct explains 42.11% of variance, indicating there was no evidence of common method bias. Secondly, following Pavlou and Gefen [2005], the first factor from the principal components factor analysis (perceived credibility) was entered into the PLS

1) It is common to have much higher loadings when performing CFA in PLS than does so in a Principal Component Analysis [Gefen and Straub, 2005].

model as a control variable on all dependent variables. This control factor did not produce a significant change in variance explained in any of the dependent variables, indicating a lack of

common method bias [Podsakoff *et al.*, 2003]. Lastly, we performed a single method factor test in PLS [Liang *et al.*, 2007]. The results indicated that score loadings from the latent method fac-

<Table 1> Confirmatory Factor Analysis

Scale Item	Mean	SE	SD	Item Loadings						
				IO	WS	WA	IQ	WC	IT	SE
IO1	3.929	0.053	0.725	<b>0.827</b>	0.328	0.466	0.571	0.450	0.427	0.212
IO3	3.995	0.047	0.640	<b>0.839</b>	0.305	0.327	0.651	0.400	0.497	0.298
IO4	3.815	0.054	0.731	<b>0.747</b>	0.251	0.417	0.517	0.399	0.375	0.174
WS1	3.391	0.063	0.849	0.385	<b>0.841</b>	0.547	0.273	0.707	0.320	0.117
WS2	3.630	0.053	0.720	0.317	<b>0.911</b>	0.528	0.305	0.634	0.372	0.093
WA1	3.652	0.058	0.788	0.486	0.494	<b>0.856</b>	0.404	0.528	0.477	0.120
WA2	3.674	0.061	0.831	0.411	0.439	<b>0.844</b>	0.360	0.499	0.406	0.069
WA3	3.723	0.060	0.819	0.393	0.508	<b>0.873</b>	0.351	0.539	0.354	0.039
WA6	3.440	0.061	0.828	0.352	0.581	<b>0.828</b>	0.296	0.597	0.374	0.021
IQ1	4.158	0.049	0.671	0.577	0.232	0.334	<b>0.828</b>	0.387	0.495	0.261
IQ2	3.962	0.060	0.812	0.528	0.264	0.314	<b>0.738</b>	0.305	0.427	0.180
IQ3	4.179	0.058	0.793	0.559	0.251	0.281	<b>0.856</b>	0.363	0.478	0.185
IQ4	3.989	0.057	0.768	0.607	0.278	0.344	<b>0.870</b>	0.443	0.469	0.203
IQ5	3.940	0.055	0.740	0.682	0.301	0.385	<b>0.870</b>	0.464	0.504	0.198
WC1	3.755	0.053	0.717	0.511	0.610	0.559	0.482	<b>0.914</b>	0.507	0.160
WC2	3.429	0.062	0.840	0.379	0.708	0.537	0.331	<b>0.798</b>	0.363	0.055
IT1	3.995	0.056	0.757	0.410	0.344	0.389	0.458	0.471	0.709	0.229
IT2	3.891	0.060	0.816	0.411	0.401	0.439	0.412	0.472	0.650	0.273
PL1	4.114	0.050	0.680	0.461	0.359	0.419	0.520	0.457	<b>0.959</b>	0.302
PL2	4.130	0.052	0.705	0.456	0.368	0.448	0.542	0.511	<b>0.938</b>	0.287
SE1	4.293	0.077	1.051	0.193	0.090	0.063	0.191	0.128	0.306	<b>0.890</b>
SE2	4.326	0.075	1.015	0.224	0.050	0.032	0.198	0.090	0.303	<b>0.904</b>
SE3	4.168	0.077	1.045	0.275	0.118	0.030	0.218	0.111	0.218	<b>0.916</b>

Legend: IO: Information Organization; WS: Website Security; WA: Website Attractiveness; IQ: Information Quality; WC: Website Credibility; IT: Intention; PL: Perceived Loyalty; SE: Self-Efficacy.

<Table 2> Inter-Construct Correlations

Construct	Mean	SD	Inter-Construct Correlations							
			IO	WS	WA	IQ	WC	IT	PL	SE
IO	3.913	0.585	<b>0.838</b>							
WS	3.511	0.707	0.368	<b>0.901</b>						
WA	3.622	0.706	0.443	0.592	<b>0.865</b>					
IQ	4.046	0.646	0.662	0.301	0.377	<b>0.854</b>				
WC	3.592	0.687	0.514	0.716	0.620	0.461	<b>0.882</b>			
IT	3.943	0.751	0.432	0.399	0.428	0.463	0.502	<b>0.954</b>		
PL	4.122	0.665	0.470	0.376	0.445	0.540	0.503	0.710	<b>0.961</b>	
SE	4.263	0.982	0.277	0.101	0.050	0.241	0.137	0.250	0.294	<b>0.947</b>

tor were insignificant and indicators' substantive variances were much greater than their method variance. Therefore, we concluded that common method bias does not seem to be a serious problem in this study. Regarding concern of multicollinearity, VIF (Variance Inflation Factor) scores were measured following the method suggested by Gable *et al.* [2005]. All measures were below the common VIF threshold of 10, indicating all items were subjected to further analysis [Gable *et al.*, 2005]. Lastly, nonresponse bias was measured by verifying that the early and late respondents were not significantly different [Armstrong and Overton, 1977]. Moreover, since the respondents who participated in this survey were nominated by female, we tested for significant difference in descriptive variable between males and females. The results showed insignificant difference for most of variables, except for website security perspective.

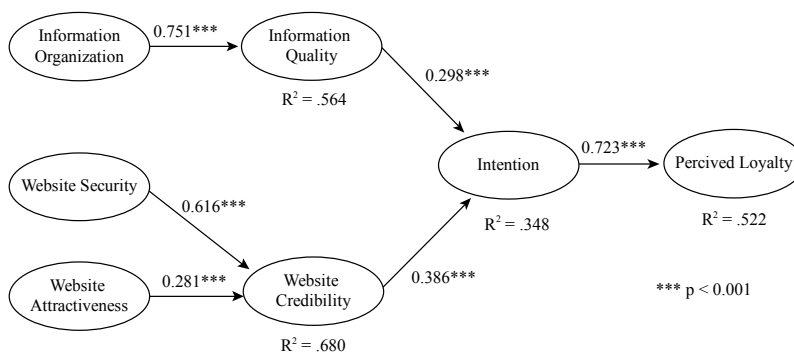
## 5.2 Hypotheses Testing

### Main Effect

Overall, the results indicated that all the proposed main hypotheses were significant. Infor-

mation organization is a significant driver of information quality ( $\beta = 0.751; p < 0.001$ ), supporting H1. Website security was also influenced significantly by both website credibility ( $\beta = 0.616; p < 0.001$ ) and website attractiveness ( $\beta = 0.281; p < 0.001$ ), supporting H2 and H3 respectively. Moreover, consistent with ELM, both information quality ( $\beta = 0.298; p < 0.001$ ) and website credibility ( $\beta = 0.386; p < 0.001$ ) had significant effects on behavior intention to use e-healthcare website. Thus, H4 and H5 were supported. Behavior intention to use e-healthcare website also had a positive effect on perceived loyalty to use e-healthcare website ( $\beta = 0.723; p < 0.001$ ), supporting H6.

The direct effects of information organization accounted for 75.1% of the variance in information quality. Moreover, website security and website attractiveness accounted for 68% of the variance in website credibility. Information quality and website credibility together explained approximately 34.8% of the variance in behavior intention to use e-healthcare website. Finally, this behavior intention accounted for 52.2% of the variance in perceived loyalty. After confirmed the main effect model, we entered the moderating variables into the model.



<Figure 3> Main Effects Model

**Moderating Effects**

We hypothesized that self-efficacy would moderate the relationship between persuasive cues and behavior intention. To test the hypotheses, we included self-efficacy as a moderating variable into the main model. The interaction items were modeled in PLS following a method suggested by Chin *et al.* [2003], yet we deleted some poor interaction items. As shown in <Figure 4>, including self-efficacy as a moderating variable into the model increased variance explained in behavior intention from 34.8% to 37.4%. However, while the interaction effects of self-efficacy were significant, the relationship between information quality and behavior intention became insignificant.

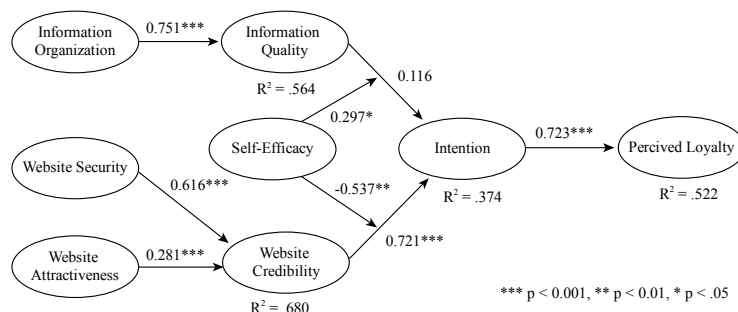
The tests for the moderating effects were conducted by following Chin *et al.* [2003]. Cohen’s  $f^2$  was performed to calculate the change in R-square values between main and interaction effects.

Cohen [1988] suggested that  $f^2$  of 0.02 may be regarded as weak, effect size from 0.15 as moderate, and effect size above 0.35 as large effect at the structural level. The moderating relationships were investigated by performing F-test which is calculated as follow:

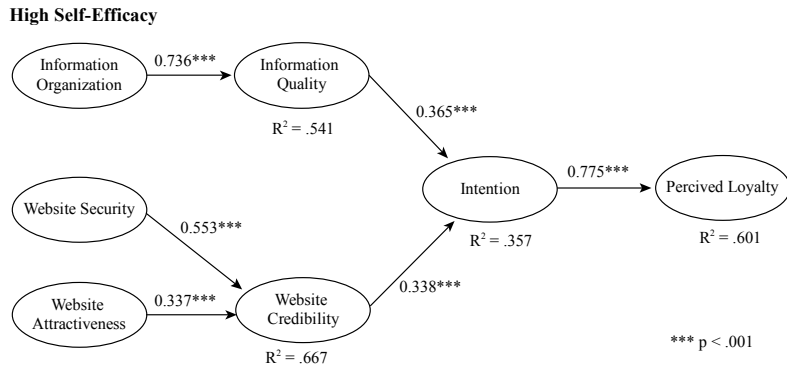
Using the formulas above, the value of moderating effects was 0.04 ( $F = 8.67, p < 0.01$ ) indicating the moderating effects were weak and significant. Chin *et al.* [2003] state that a low effect size does not specify that the underlying moderator effect is negligible. “Even a small interaction effect can be meaningful under extreme moderating conditions, if the resulting beta changes are meaningful, then it is important to take these conditions into account” [Chin *et al.*, 2003, p. 211]. The results showed that the moderating effect between self-efficacy and information quality was positive and significant ( $\beta = 0.297; p < 0.05$ ), accepting H7. Additionally, self-efficacy also negatively moderated the effect of website credibility on behavior intention ( $\beta = -0.537; p < 0.001$ ). Thus, H8 was also accepted.

**Post Hoc Analysis**

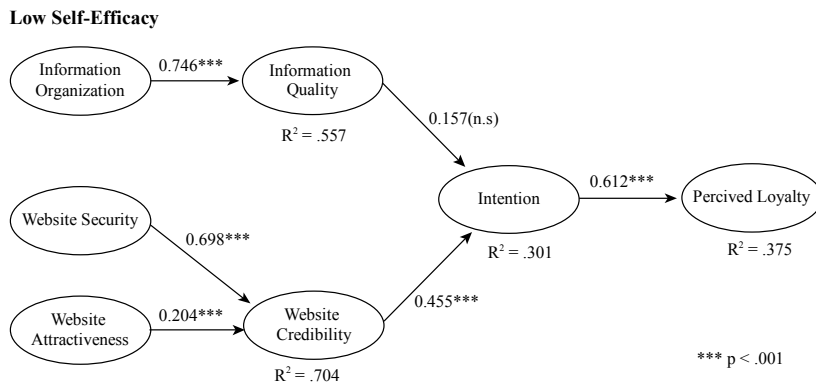
To obtain further explanation about the interactions, we conducted a *post hoc* analysis. Consistent with ELM, we hypothesized that information quality is more influential under high high-efficacy condition, while website credibility is more influential under low self-efficacy condition. Thus, we divided the entire sample into two groups (high self-efficacy and low self-efficacy



<Figure 4> Full Model



<Figure 5> Elaboration Likelihood Model for High Self-Efficacy Group



<Figure 6> Elaboration Likelihood Model for Low Self-Efficacy Group

group) based on the median score of self-efficacy. We ran separate PLS analysis for each group and found interesting findings. As illustrated in <Figure 5>, information quality has a stronger effect on behavior intention to use health website ( $\beta = 0.365$ ;  $p < 0.001$ ) than website credibility has ( $\beta = 0.338$ ;  $p < 0.001$ ) for high self-efficacy group. However, website credibility is still considered strong predictor of behavior intention, indicating information quality is likely to be judged under the credibility of information providers. As we hypothesized, the low self-efficacy group is likely to entirely rely on website credibility ( $\beta = 0.455$ ;

$p < 0.001$ ) (see <Figure 6>).

## VI. Discussion

This study addressed three research questions: (1) How do the antecedents of central and peripheral cue influence the persuasive communication of website users?, (2) How do the central cue (i.e. information quality) and peripheral cue (i.e. website credibility) influence behavior intention to use e-healthcare website?, (3) Does the individual difference (i.e. self-efficacy) moderate the relationships between the information proc-

essing cues and user behaviors? We adopted ELM as a theoretical basis and an empirical foundation to answer the research questions. We proposed a research model with nine hypotheses. In this study, information quality is selected to represent a variable affecting elaboration through the central route while website credibility reflects a peripheral cue affecting elaboration through the peripheral route. In addition, elaboration likelihood construct was measured by perceived self-efficacy. The result indicated several important findings confirming the validity of our model. The details finding of each hypothesis were as follows.

First, information organization was the main antecedent of information quality presented on the website (H1). The better organized and structured the online information, the higher quality of the information. Second, the results revealed that website security has a positive effect on website credibility (H2). To this extent, a secured website influenced users' perception by reducing the degree of risks and threats when users access on the website. Prior research has reported the importance of security issue on e-commerce website where the interaction with consumers generally involves a financial transaction (e.g. Gregg *et al.*, 2008, Belanger *et al.*, 2002]. We found that security is also most crucial for e-healthcare website. It is likely that when users use an e-healthcare website to search information related to health concerns, they usually need to create a personal account to personalize the website. In other words, users left their personal data (including their medical history) online. Thus, ensuring the security of the website will increase the website credibility. Third, we also found that website attractiveness was positively associated

with website credibility (H3). Supporting the study of Rains and Karmikel [2009], we also found that the structural features of health website reflect heuristic cues and in turn, the more structural features such as attractive screen website, screen background, and pattern, eye-catching images or title, and multimedia presentation that appeared on the website, the more credible a website was rated by respondents.

Fourth, consistent with elaboration likelihood model, the empirical findings suggested that information quality (central cue) and website credibility (peripheral cue) were strong predictors of behavior intention to use health website (H4 and H5). However, when self-efficacy was added into the model, the relationship between information quality and behavior intention became insignificant. We provided some explanations to support this inconsistent finding. First, our *post hoc* analysis confirmed that both information quality and website credibility influenced behavior intention to use health website for high self-efficacy group. On the contrary, website credibility was the only predictor of intention for low self-efficacy group. Therefore, combined together, the direct effect of information quality on behavior intention was decreased, moderated by self-efficacy. To this extent, a high quality of information processed by individuals with high self-efficacy would have a positive effect on behavior intention to use health websites (H6). Second, as initiated by the original ELM framework, central and peripheral cues should be viewed as a single elaboration framework [Bhattacharjee and Sanford, 2006]. Thus, at moderate elaboration likelihood levels, influence processes involve a complex mixture of both central and peripheral route [Sussman and



Siegal, 2003]. In other words, individuals with high self-efficacy who received information from a credible website are likely to judge that information itself is reliable than those who received information from no-credibility website.

The results also revealed that self efficacy negatively moderated the relationship between website credibility and behavior intention to use health websites (H7). Under low perceived self-efficacy condition, people do not evaluate information quality, but the credibility of website presented serves as a peripheral cue [Petty and Cacioppo, 1984]. The peripheral cues does not necessarily change the quality of information itself, however, its effects become salient when users lack of self-efficacy to process the persuasive message [Tam and Ho, 2005]. The important insight from our extended analysis is that people with low self-efficacy are likely to entirely depend on website credibility while overlook the quality of information itself. A further research is necessary to measure the long-term effect of peripheral cues under low elaboration likelihood condition.

Our findings also suggested that behavior intention to use health website significantly influenced perceived loyalty (H8). While previous ELM studies never extended the model beyond the attitude context, we argued that such positive behaviors as perceived loyalty should be incorporated in ELM study. Thus, we encourage future researchers to extend the ELM model by measuring the effect of attitude or behavior intention on actual IS use or IS use continuance.

## VII. Research Limitations

Prior to discussion the implications of our findings, we provided some limitations that should

be acknowledged upon their interpretation. Firstly, we conducted the survey based on the survey of National Cancer Center, South Korea. The fact that this country has an advanced technological infrastructure, might affect the self-mechanism measurement presented in this study (e.g. self-efficacy). Thus, further research conducted in various countries is needed to verify the findings. Secondly, this study observed the cancer website only. The results may be different with other healthcare website (e.g. diet, general healthcare website). This suggests that cross-comparison research is needed. Thirdly, in this study we only consider self-efficacy construct to capture elaboration likelihood. Other individual difference factors such as self-motivation or situational factors such as issue involvement may result in different findings. Subsequent studies should consider these other factors in order to generalize the findings. Another potential limitation of this study is related to the effect size. The analysis showed the moderating effects were small for the study construct. Further research with a larger sample is considerably needed, thus, the effects from the presented constructs can be better measured.

## VIII. Implications for Research

This study yields several implications for IS research. First, this is the first study that examines the health information adoption process with information quality as the central cue and website credibility as the peripheral cue. Adopting ELM in e-healthcare setting is necessary to determine the belief people hold about the consequences of health behaviors and their evaluation of these consequences [Petty and Cacioppo, 1996]. Through this study, we provide an important insight of

how elaboration likelihood influences users' behavior intention to use health website. While anyone from different level of society can access the information online, a concern of how users process either "good" or "bad" information can be explained by our model.

Second, this study may enhance our understanding toward the antecedents of information processing cues. Although previous studies such as IS success model [Nelson *et al.*, 2005] have shown the importance of quality perceptions in forming users' behavior, the inductive findings of these studies have not been elaborated in earlier persuasive literature. Our proposed model integrated website attributes into the ELM framework. To this extend, information presentation was conceptualized as the antecedent of information quality whereas website security and website attractiveness were theorized as the predictors of website credibility. The results reveal that IS/IT attributes surely influence information processing cues. While our study only measured three components of website, further study is encouraged to examine the other components of health website such as system reliability, perceived playfulness, and perceived privacy influence central and peripheral cues.

Third, early research in e-healthcare suggests the importance of online health information in influencing consumers' behavior [e.g. Angst and Agarwal, 2009; Rains and Karmikel, 2009]. However, those studies only measured customer perceptions to understand how consumers accept the information. They overlooked the process of how those perceptions determine users' behavior. As Bhattacharjee and Sanford [2006] suggested, not all information sources are equally effective in influencing users' behavior toward a technology.

Toward this study, we successfully explained how the difference of information process determines users' behaviors. As a process oriented theory, ELM provides us with a new understanding of how central and peripheral route vary in forming users' behavior intention to use health website. Even though ELM indicates that changes produced by central route are more powerful to predict behavior, this trend could not be confirmed in this study. Therefore, future researchers should identify the possibility of a long-term effect of central processing route under e-healthcare setting.

Fourth, we adopted self-efficacy to capture elaboration likelihood construct. By narrowing our discussion on one single elaboration likelihood construct, we have confirmed the moderating effect of individual difference dimension in ELM framework. Indeed, an individual differences strategy could be used to measure variations among people in elaboration likelihood context [Petty and Cacioppo, 1986]. Furthermore, the results also suggested that persuasion can occur in situations where individuals lack self-efficacy to extensively evaluate health information. However, we believe that other motivational and situational factors such as issue involvement and number of message argument will also moderate the relationships between information processing routes and attitude or behavior. This possibility should be addressed in further research.

Fifth, unlike most of ELM research that measured attitude as the dependent variable, this study examined the direct effect of information processing dimensions on behavior intention to use health website. Scrutinize study of existing literature, we found that only a few scholars have extended ELM to explain use behavior [e.g. Bhattacharjee and Sanford, 2006]. Even though we

excluded the direct effect of attitude, we still found a positive relationship between information processing cues and behavior intentions. In this respect, we encourage future scholars to confirm the consistency of belief-attitude-behaviors relationship in determining health information acceptance. Moreover, we also extended ELM by measuring the effect of behavior intention on perceived loyalty and found a positive relationship between them. Hence, a further integration of ELM with other IS adoption/acceptance theories is encouraged to understand the information processing routes in technology domain.

## IX. Implications for Practice

A key benefit of this study is that national or non-commercial healthcare providers and physicians may have a new insight from Information System perspective to persuade the potential users to use their website. By understanding how people adopt health information, we can design websites that encourage effective health information adoption. A "process-oriented" approach to persuasion helps us to identify when content factor or non-content factors may be important in determining attitude or behaviors.

Practitioners can also benefit from addressing the health information processing routes as a dual-process. The first route is central route, occurs when motivation and ability to observe information are relatively high. The second is peripheral

route, occurs when motivation and or ability are relatively low and attitudes or behavior intentions are determined by positive and negative cues or by peripheral cues [Petty and Cacioppo, 1986]. Our findings indicate that at a moderate level, users are likely to rely on both cues to evaluate the information presented. By understanding the central route, organizations devoted to healthcare may provide a high quality of health information to target high self-efficacy group and by recognizing peripheral route method helps organization to identify structural features of websites to attract potential users with low self-efficacy. In addition, organizations also have an opportunity to create a knowledge intensive website as a health information reference [Koo and Wati, 2010].

Practitioners will also be interested in the other implication of this research for the design of health website. Our finding suggests that high quality information should be presented on attractive website. The designer of health website should consider the effect of e-image, color selection, and background selection. Novice and moderate users are likely to judge the credibility of websites from those features. And in turn, information presented on a credible website will help users to feel safety and secure when they enter the website. The institutions may also establish more interactive website by involving more active users. These efforts are supposed to increase the perceived credibility of the website.

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## 〈Appendix A〉

Variable	Item	Freq	Percentage (%)
Gender	Male	53	28.80
	Female	131	71.20
Age (years)	20s	95	51.63
	30s	48	26.09
	40s	17	9.24
	50s	11	5.98
	60s	5	2.72
	<20	8	4.35
Education	Middle school	0	0.00
	High school	59	32.07
	University graduate	125	67.93
Information Sources	Medical	16	8.70
	Friend	7	3.80
	Book	11	5.98
	Internet	90	48.91
	Family	13	7.07
	Newsletter	1	0.54
	Cancer Club	1	0.54
	Television	36	19.57
	Instruction (hospital)	7	3.80
Other	2	1.09	
Information media	World of mouth	83	45.11
	Received brochure	11	5.98
	Internet	75	40.76
	Cancer newsletter	6	3.26
	Advertisement/editorial publication	3	1.63
	Recommendation	3	1.63
	Other	3	1.63
Type of respondent	Patient	8	4.35
	Patient's family/relatives	39	21.20
	Researchers/academia	27	14.67
	General person	110	59.78



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Variable	Item	Freq	Percentage (%)
Marital status	Married	61	33.15
	Single	121	65.76
	Divorced	2	1.09
Occupation	Agriculture, fisheries, forestry	4	2.17
	Self-employed	6	3.26
	Salesman	5	2.72
	Feature/skilled workers	1	0.54
	Field work in civil relations	1	0.54
	Office/technical staff	66	35.87
	Managerial/Directorate officer	1	0.54
	Professional worker	23	12.50
	Housewife	15	8.15
	Unemployed	8	4.35
	Student	37	20.11
	Other	17	9.24
Income (US\$)	825 or less	30	16.30
	833~1658	53	28.80
	1667~2492	39	21.20
	2500~3325	24	13.04
	3333~4158	16	8.70
	4167~4992	11	5.98
	5000~5825	5	2.72
	6676~more	6	3.26
Website Usage	Self-learning	50	27.17
	Resource/reference material	135	73.37
	Teach/train colleagues	4	2.17
	Teach/train students	3	1.63
	Educate patients about cancer	28	15.22
	Others	23	12.50

## 〈Appendix B〉

Construct	Items
Self-Efficacy	I'm very experienced using website I feel that website is easy to use I feel competent using website I understand how to use all the features of the website
Information Organization	The overview, table of contents, and/or summaries/headings are clearly organized The structure of information presentation is logical The objectives of the module are clearly presented The information presented is understandable The amount of information presented was just right
Information Quality	The website provides accurate information The website provides up-to-date information The website provides relevant information The website provides the content that supports website's intended purpose The website consists of appropriate detail level of information
Website Attractiveness	Overall, the website's color use is attractive This website has visually attractive screen layouts This website has attractive screen background and pattern This website has eye-catching images or title on homepage The multimedia contents are attractive This website is fun to explore
Website Security	This website requires access authorization (e.g. enter a password) This website provides only the authorized users with the NCC data for anticipated purposed This website assures that user-entered data is encrypted
Website Credibility	This website has a good reputation This website is recognized externally (e.g. number of times it has been visited, site has won awards)
Behavior Intention	I intent to use this website as my information source I plan to increase my use of this website over the next year
Perceived Loyalty	I will say positive things about this website to other people I will recommend this website to other people

◆ About the Authors ◆



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Chulmo Koo is an associate professor at the College of Hotel and Tourism Management in Kyung Hee University, Korea. He received a Ph. D. in Management Information Systems from Sogang University, Korea. His research area is on Smart Tourism, Convention and Exhibition Management, and Social Media Technologies Usage. His papers have been appeared in the International Journal of Electronic Commerce, International Journal of Information Management, Journal of Internet Commerce, Industrial Management and Data Systems, and Information Systems Frontiers, Computers in Human Behavior, Cyberpsychology, social, and behavior. Currently he has been studying on 'Smart Tourism' and 'Hospitality and IT'.



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