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# Smart Card Adoption in Healthcare: An Experimental Survey Design using Message Framing

*Research-in-Progress*

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## Abstract

*The smart card is a cloud-based device that enables participating healthcare organization's greater access to a patient's protected health information. This research investigates salient factors including the impact of communication using message framing on the likelihood to use the cards. We integrate the technology acceptance model theory (TAM) with the prospect theory, using message framing to assess the impact of gain-and loss-framed messages on patient's likelihood to use. The conceptual model also adapts TAM by considering new constructs specific to the adoption of smart cards. Using data collected from 331 patients, we use logistic regression to investigate the adoption of this technology. Preliminary results indicate that concern for location monitoring and loss-framed messages have an adverse impact on a patient's likelihood to adopt. Error prevention, smart card benefits, improved decision making and the social influence of healthcare actors have positive effects on the likelihood to use smart cards.*

**Keywords:** Smart card, healthcare information systems, technology acceptance model, clinical communications and collaboration, consent management, Prospect theory, gain/loss message framing

## Introduction

Consent management, clinical communications, and collaboration are factors galvanizing technological development in the healthcare sector (Runyon 2015). In pursuit of the healthcare trifecta - lower cost, higher quality and better patient outcomes – healthcare providers and technology developers have worked arduously to devise amicable solutions to curtail rising expenses and bolster patient outcomes. A cloud-based smart card system is one health information technology (HIT) option that can facilitate clinical communication and consent management. The smart card architecture is engineered to facilitate tri-level authentication to access encrypted protected health information (PHI), enabling HIPPA compliance. The embedded chip allows it to store, access and securely exchange data with card readers and other systems. Smart card technology can interoperate with mobile devices, such as Near Field Communication (NFC) enabled smartphones, laptops, and tablets. Additional features include the ability to access information without an internet connection for example in a natural disaster, or rural and remote locations. First responders can retrieve critical information using the device, and healthcare providers may monitor patient

consumption behaviors at a pharmacy or supermarket to evaluate compliance with diet and medication regimes (Alliance 2012).

New healthcare delivery models such as Medicaid Heath Homes (MHH) and Accountable Care Organizations (ACO) are established under the Affordable Care Act (ACA) to enhance clinical amalgamation and to facilitate the integration and development of technologies such as smart cards (Auxier et al. 2015). By using a smart card providers engage cohesively by providing access to electronic PHI previously unavailable to a patient's entire care team. The patient can maintain control of information sharing since they must first consent to participate. In addition, the patient can enable access rules for specific users of the smart card. Further, they may deny access at any time by refusing to present the card at points of care.

Despite the advantages to patients and providers, little research has been done on how message framing may engender patient adoption and use of smart cards. This study aims to fill that void by assessing the factors that motivate adoption and uses an experimental survey design to study the effects of various constructs. If patients fail to participate, the system performs inadequately, failing to optimize the system benefits. Our contribution to the current literature comes from integrating the prospect theory and the classic technology acceptance model (TAM). Additionally, we developed a conceptual model which adapts TAM considering new constructs specific to the adoption of smart cards. In particular, we used message framing to vary two constructs. One is a first order reflective construct –perceived improved decision making. The other is a second order reflective construct – smart card benefits. The smart card benefits construct includes improved service efficiency and financial incentives acquirable through specific uses of the card. Another contribution lies in the use of sentiment and readability measures to analyze the gain/loss message framing. Further, we nuance the social norms construct to reflect actors in the healthcare context. Finally, we assess concerns for data security, error prevention, and location monitoring.

The structure of the manuscript is as follows. In the next section, we briefly review the relevant literature. Then, we present the theoretical model. This is followed by a discussion of the methods, including experimental survey design, item selection, and message framing. The data analysis and results sections are followed by the discussion, future research, and limitations.

## Overview of Literature and Research Questions

Patient's intention to use medical devices is studied extensively in healthcare and information systems literature. Shah et al. (2012), evaluates the following factors: perceived ease of use (PEOU), perceived usefulness (PU), cost, trust in the doctor, quality of the device, subjective norms and technology self-efficacy. The results indicate that all six factors positively impact the intention to use point of care medical testing. The intention of older adults to use e-Health is assessed by de Veer et al. (2015), using the Unified Theory of Acceptance and Use of Technology (UTAUT) model. The findings of the study provide some evidence that gender, age and educational differences in participants impact e-Health adoption. Research also indicates cultural and racial differences in the acceptance of technology (Jackson et al. 2008; Or and Karsh 2009). The literature on mobile health applications (mHealth apps) proposes various other factors that impact the intention to use. These factors include effectiveness, satisfaction, understandability, learnability, attractiveness, operability and efficacy (Zapata et al. 2015).

The fear that data could be altered or deleted may also affect technology acceptance (Ziefle et al.). Error prevention and accountable approaches to managing errors help patients maintain confidence in the healthcare system (Schwappach and Koeck 2004). Kantarcioglu et al., (2011) asserts that security concerns pose a risk to adoption in the cloud computing context; note that the smart card may function entirely from a cloud-based platform. Though location monitoring is a secondary utility of the smart card, the functionality is available to providers. Multiple studies have cited privacy concerns emanating from location monitoring (Han et al. 2015; Hong et al. 2004). Gaps still exist in the literature as it applies to the adoption of technologies such as smart cards that provide benefits which are not directly clinically observable.

As the healthcare industry implements new technology to fulfill the triple aim - lower cost, higher quality and better patient outcomes –; it is critical in the study of adoption to address issues of context as we export constructs and research methodologies across disciplines (Rousseau and Fried 2001). Johns describes "context as situational opportunities and constraints that affect the occurrence and meaning of organizational behavior as well as functional relationships between variables" (2006: 386). He further notes that contextual stimuli can dampen or magnify an effect. Our constructs were selected specifically bearing

in mind the unique context of smart card adoption, high-risk patients, and the Medicaid Health Home. The smart card context is of particular importance, given the benefits discussed in the introduction and the substantial financial and organizational investment that it demands of the healthcare entity. The significance of Medicaid Health Home is fueled by the fact that it is specifically charged with providing care coordination and monitoring for high-risk, vulnerable populations facing high mortality rates from typically non-fatal chronic conditions (Auxier et al. 2015). With this context in mind, our theoretical contribution entails the development of alternative representations of established frameworks (Alvesson et al. 2007). Therefore, in this study we assess various factors that potentially affect patient likelihood to adopt smart cards. Further, we answer the question how does communication through gain/loss-framed messages impact the adoption of technology? We use an experimental survey design to test the impact of two vignettes for message framing along two dimensions pertaining to proxy constructs for perceived usefulness.

## *Hypothesis Development*

### Prospect Theory

The seminal work of Tversky and Kahneman 1979, posited the prospect theory. The authors evaluate the preference between options —one posing little risk and another with a higher degree of risk. They assert that an individual will weigh the value of each option and choose accordingly. Making a choice has two stages. The decision is initially filtered through an editing phase and then the evaluation period. In the early development of the prospect theory, decisions were centered around financial outcomes (Tversky and Kahneman 1981). Subsequent studies have extended the theory to include health message framing. Message framing is a form of communication that can improve patient compliance. Framing is defined as the description of reasonably comparable choice situations in distinct ways (Edwards et al. 2001; Wilson et al. 1988). Persuasive messages stress the significance of acquiring (or not acquiring) positive outcomes when framed in gain (or loss) language (Wilson et al. 1988). We used the goal framed approach in which the potential consequences are presented to the participant (Levin et al. 1998). The messages stress either the positive consequences of performing a behavior or the negative consequences of not performing the action (Gallagher and Updegraff 2012; Levin et al. 1998).

Variations of the message framing used in healthcare focus primarily on the detection and prevention of chronic illnesses. Researchers evaluate the impact of message framing on cancer, obesity, safe sex, heart disease and vaccinations. A typical example of message framing looks at exercise or dieting: a. if you have a balanced diet, it may help you lose weight, b. without a balanced diet, you may gain weight. Additional message framing examples are included in (Apanovitch et al. 2003; Mann et al. 2004; Rothman et al. 2006). The smart card can be used as a medium to encourage prevention and detection behaviors. There is an ongoing debate on whether gained-framed (Toll et al. 2007), or loss-framed messages have a more significant impact on intention, and under what circumstances (Garcia-Retamero and Cokely 2011). In our conceptual model, we integrate the prospect theory with TAM by manipulating the smart card benefits and perceived improved decision making constructs, and systematically varying the degrees of risk using message framing. Rothman et al. (2006) propose that if a behavior is less risky, a positive message framing should be used. It is challenging to assess the risk perception of the smart card; many individuals use artifacts such as credit cards daily with varying degrees of risk-aversion. Message framing may determine the perception of risk when using the smart card. If the card is perceived to be a less risky artifact, then adoption should be more influenced by messages of gain. Findings from message framing can motivate additional studies on the classification of the smart card as a prevention or detection medium. Few information systems (IS) researchers have used message framing to evaluate the likelihood to use. This research extends the body of literature in IS and healthcare information technology by assessing the impact of gain/loss message framing on patient likelihood to adopt smart cards.

Hypothesis 1a: Gain-framed messaging may affect patient likelihood to adopt smart cards.

Hypothesis 1b: Loss-framed messaging may impact patient likelihood to use smart cards.

H 1c, 1d: Gain-framed messaging may impact the relationship between benefits of use/perceived improved decision making and patient likelihood to adopt smart cards.

H 1e, 1f: Loss-framed messaging may impact the relationship between benefits of use/perceived improved decision making and patient likelihood to adopt smart cards.

### Technology Acceptance Model (TAM)

The classic elegance and parsimonious structure of the technology acceptance model (TAM) (Davis 1989) will serve as the foundation for testing the prospect theory in smart card adoption. Numerous studies assessing the likelihood to use HIT are grounded in the technology acceptance model. Likelihood to use is a measure of the strength of one's probability to adopt a device (Ajzen 1991). To optimize the balance between the IS and HIT disciples, this study focuses on the rudimentary TAM as opposed to the more adapted UTAUT. By using the TAM, our study emphasizes the constructs replicated in the UTAUT that apply to serious devices. We assess the likelihood to adopt smart cards based on the perceptions of high-risk patients, including Medicaid Health Home enrollees. This context-specific research extends theory by adding relevant predictors such as concern for location monitoring, data security, and errors prevention. Social norm is a fundamental construct in TAM; the current study focuses on healthcare actors a patient may interact with while receiving care. Perceived ease of use (PEOU) is also a vital construct in adoption and use models (Amin 2007; Kleijnen et al. 2004). The smart card is unique in that the enhancement to the device is internal rather than aesthetic; thus no new skills are required for its use. The card is presented at a point of care by the patient; however, it is used primarily by healthcare providers. We excluded PEOU from the conceptual model because it is less relevant in this context.

### Concern for Location Monitoring

Location monitoring is typically associated with geographic research; however, organizations have evolved to include location-based services. To maximize efficiency and profits companies use location-sensitive resource management and location-aware content delivery (Gedik and Liu 2006). Consumers may perceive location monitoring as both a security and privacy concern (Snekkenes 2011). In the online domain, a user's location can be tracked using an IP address to enhance user functionality; however, privacy concerns may impact the use or acceptance of a website or browser (Huang et al. 2005). Similarly, the interconnectedness of the smart card allows administrators to monitor the location pattern of users by assessing large amounts of data collected at points of care. Data collected may then be used to construct geoMaps. Barkhuus et al. (2003) conducted a study that determined location-monitoring services generate concern for privacy. The frequency of smart card use has increased; however, limited studies assess the impact of location monitoring on the likelihood to adopt. Thus we develop hypothesis 2.

H2: Concern for location monitoring (CFLM) is negatively related to patient likelihood to adopt smart cards.

### Trust in Physician

Trust is viewed as the cooperation or compliance of an individual based on their perception of another's willingness to perform an action that is beneficial or not detrimental (Gambetta 2000). Information systems researchers indicate that trust in internet vendors has a positive impact in e-commerce. According to Gefen et, al. (2003) along with perceived ease of use and usefulness in the online arena; trust influenced the customer intention to use online commerce (Gefen 2000). Patients who trust their physicians are more likely to comply with recommendations (Krein et al. 2005). Similarly, the likelihood to adopt smart cards may be affected by the patient's trust of the physician who made the recommendation (Lee and Lin 2009). Healthcare research findings support the direct and indirect effects of physician trust on patient intention to adopt self-testing devices (Shah et al. 2012). We surmise that trust in a healthcare provider could impact the likelihood of using smart cards.

H3: Trust in a physician (TIP) is positively related the likelihood of smart card adoption.

### Data Security Concern

Data security refers to the safety of PHI when stored and during transfer (Van Deursen et al. 2013). Media broadcast and print highlight numerous cases of significant data breaches at major insurance companies (Hautala 2015). A patient's awareness of potential data breaches may heighten security concerns and affect their likelihood to adopt smart cards. Data protection is critical since smart card data may be intercepted during cloud-based access or violated by end users (Messerges et al. 2002). Unauthorized access to protected information may increase an individual's concern about the security of electronic records. Smart

card users may face data security concerns emanating from the banking industry such as fraud and identity theft may also affect a patient's likelihood to adopt (Flavián and Guinalíu 2006). The smart card is a storage device that may be lost or stolen; thus, it may be more subject to security breaches. Unlike entirely cloud-based storage, the security of a physical device is dependent on the consumer's behavior. Therefore we developed hypothesis 4.

H4: Concern for data security (CFDS) is related to a decrease the patient's likelihood to adopt the smart card.

**Error Prevention**

To err is human (Hughes et al. 2008); however, occurrences of medical errors are potentially psychologically and financially taxing for patients. Landrigan et al. (2004) define a medical error as any error harmful or trivial that occurs during the delivery of patient care. Errors have been associated with the time spent working, the skill of the medical practitioner (Landrigan et al. 2004), poor handwriting, lack of electronic medical records and failure of healthcare professionals to work together as a team (Blendon et al. 2002). Additionally, errors associated with increased, entry and retrieval of information from electronic health records (Ash et al. 2004). Researchers have assessed patient concerns about medical mistakes and the findings imply patients agree with the use of health information technology to mitigate adverse hazards (Buntin et al. 2011). Among the strategies for limiting errors and unfavorable events include implementing HIT that can provide decision support, improve communication and make knowledge more readily accessible (Bates and Gawande 2003). Devices like the smart card may prevent errors when prescribing medication or deliberating on the correct diagnosis (Bates et al. 2001). However for the system to perform efficiently, the patient must be willing to share medical information. Individuals expect the highest possible safeguards before willingly disclosing personal information (Caine and Tierney 2015; Campos-Castillo and Anthony 2015). Protection against deliberate and accidental errors in PHI could result in the increase adoption of the smart card (Mazor et al. 2004).

H5: Error Prevention (EP) is positively related to patient likelihood to use smart cards.

**Smart Card Benefits and Perceived Improved Decision Making**

An important antecedent in the technology acceptance model is perceived usefulness. In a systematic review of healthcare studies Or et al. (2009) indicated that perceived usefulness (PU) is one of the most significant predictors of technology adoption. Holden et al. (2010), proposes extending the definition of PU to include improving quality, safety of care and increasing efficiency; since current definitions are too narrow. We equated perceived usefulness with the value of using the smart card. In this context, we have replaced perceived usefulness with benefits of smart card use - (financial incentive and greater efficiency (Giles et al. 2015) and perceived improved decision making. Studies indicate that the use of financial incentives in healthcare may influence people to do what they otherwise wouldn't have done (Madison et al. 2011) for example participating in a smoking cessation program. Pay for performance diabetic programs also improved outcomes and the patient-physician partnership (Wu 2012). The promise of financial gain can foster compliance among disadvantaged groups with limited monetary resources (Voigt 2012). Using the smartcard to provide financial incentives may improve patient compliance and supports two aspects of the triple aim; greater efficiency fosters the third – improved quality. Patient satisfaction is linked to efficiency. In healthcare organizations discrete event simulation (DES) and data envelopment analysis (DEA) are used to assess operational effectiveness (Komashie and Mousavi 2005; Weng et al. 2011). We propose that increased operational efficiency may impact the patients' likelihood to adopt the smart card.

Decision making is a well-researched topic in healthcare; it is facilitated by four patient-physician relationship models (Emanuel and Emanuel 1992). In the primary care setting which promotes the Medicaid Health Home, two types are dominant. In the paternalistic model, the physician selects an intervention best suited for a patients' health and well-being. The physician authoritatively informs the patients of the treatment choice, and when it will commence (Arora and McHorney 2000). The smart card provides a way to modify this dynamic by providing greater integration with various healthcare providers; thus, the options presented to the patient are based on the opinions of multiple healthcare providers. Supporters of the deliberative model believe it provides the most desirable health outcomes (Légaré et al. 2013), where the physician is more like a friend than an informer. The provider is expected not only to

provide the list of interventions and understand the patient's values but engage in discussion with the patient to point out the best health-related option. By implementing the smart card, the decision-making process may change as healthcare providers have greater access to current and historical information about the patient's testing, diagnosis, and treatment. Improving the quality of provider decision making (Hunink et al. 2014) and providing benefits may impact the patient's likelihood to use the smart card.

H6: Smart card benefits (SCB) is positively related to a patient's likelihood to adopt.

H7: Perceived improvement in provider decision making (PIDM) is positively related to a patient's likelihood to use smart cards.

**Social Influence of Healthcare Actors**

Researchers continue to examine factors that influence the adoption of technology (Schepers and Wetzels 2007). Studies have shown people are programmed to act in socially acceptable ways due to influences from others. To survive as part of a social structure, an individual may simply carry out various request (Holden and Karsh 2010). The initial obedience is the patients' perception that people important to them think they should perform a behavior (Davis 1989; Hagger and Chatzisarantis 2009; Han et al. 2015). In the healthcare context, patients may perceive pressure from professionals actively participating in their care. The perceived pressure from others to perform certain behaviors is described as a social influence (Venkatesh et al. 2003). This study refines the boundaries of social norms by evaluating the impact of the insurance company, other patients, and doctors on a patient's adoption of the smart card.

H8: Social influence of healthcare actors (SIHA) is positively related to patient's likelihood to use smart cards.

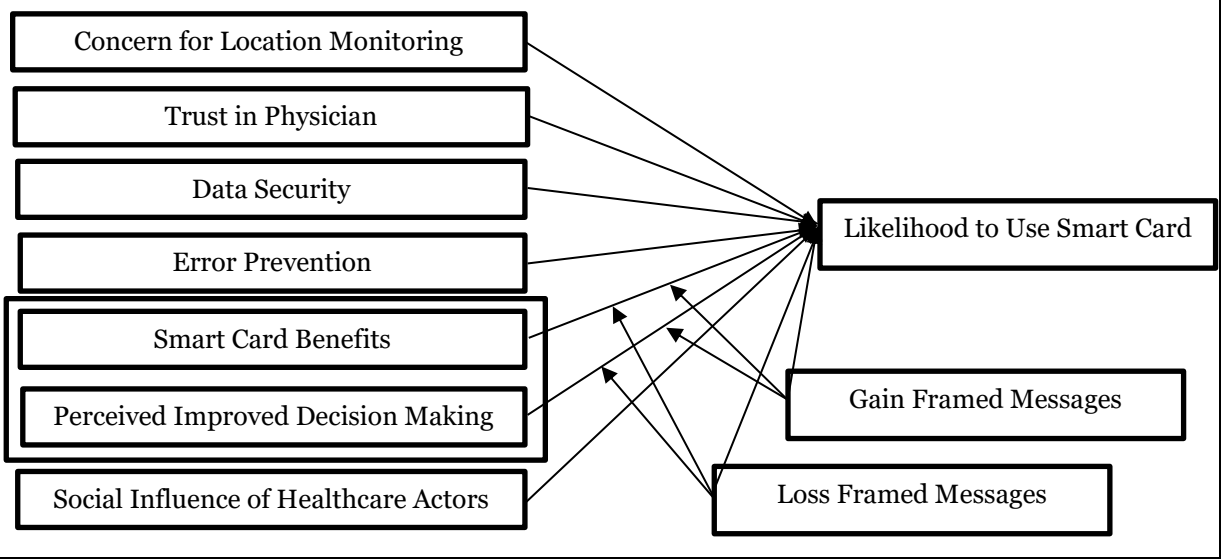


Figure 1. Research Model

# Method

The instrument was developed based on the model illustrated in Figure 1. The survey was anonymized to reduce acquiescence, protect privacy and maintain the confidentiality of patients. It assesses the factors associated with the likelihood to adopt smart cards and operationalizes the impact of gain and loss-framed messages on perceived usefulness. Participants are randomly selected patients from urban physician practices in the Eastern United States. They are also randomly assigned to one of three blocks experimental. The sample includes 331 urban adult patients, however, due to missing values the final sample was 277. Participants are 65% female, 61 % African-American, 22% Hispanic, 11% White-Non-Hispanic and 6% other races. Mean age 51 (stdev. +/- 14.8).

## *Measures*

After literature review and interviews with subject matter experts including information systems professionals, physicians, and patients; we then generated a survey instrument. The model in Figure 1 depicts the likelihood to use smart cards in healthcare with several reflective indicators. The six reflective items for location monitoring were formed based on Xu, (2004). The benefit of smart card use incorporates four items, perceived improved decision making, data security concern and trust are three item reflective constructs developed for this study. The benefit of smart card use is modeled as a second order reflective construct with two first order constructs comprising of two items each. A binary item for likelihood to adopt was formulated based on Venkatesh et al. (2012). Error prevention uses two items adapted from (Smith et al. 1996). Scale scores were computed as the average of individual items. Finally, items on social influence are adopted from Han et al. (2015) and calculated by multiplying the aggregation of motivation to comply with reference *i* by the normative belief concerning referent *i*. The gain and loss-framed messaging are dummy coded. Independent variables are measured on a seven-point Likert scale. The scales are anchored strongly agree, agree, somewhat agree, strongly disagree, disagree and somewhat disagree. The likelihood to adopt was dichotomous.

### Message Framing

An experimental survey is used to evaluate the patient's judgment of the potential benefits of using the smart card and perceived improvement in provider decision making. Within each dimension, we systematically varied the message framing making it either gain-framed or loss-framed vignette (Auspurg and Hinz 2014). All participants received the same items for each construct. For the manipulated perceived usefulness constructs, patients were randomly assigned to three blocks. A control group that received no messaging and two blocks consisting of a gain or loss-framed message. Each block received a distinctly coded survey to distinguish each vignette. By using the experimental survey design, we can stimulate the benefits of smart card use even though in reality the patient has not received it. One neutrally framed description of the smart card is included in all the surveys. Each message frame was evaluated for readability and sentiment level. We use software developed by well-known text analysis provider Lexalytics Inc's called Semantria for sentiment analysis. The Excel plug-in enables the analysis of neutral, negative and positive sentiments (Abeywardena 2014; Aston et al. 2014; Lawrence 2014). Absolute values of sentiment analysis and readability establish ceteris paribus.

## *Preliminary Results and Analysis*

The psychometric properties of the survey and the research model were analyzed using SAS 9.4. Exploratory factor analysis determined that twenty-four items fit into seven conceptually distinct factors. From the principal component analysis, only factors with Eigen values greater than 1.0 were selected. Discriminant validity is satisfactory as each item loads higher on its factor than on other factors illustrated in Table 1. Validity and reliability are satisfactory with Cronbach's Alpha, $\alpha > .70$. All factors have met the conventional threshold value of 0.6 for correlation between independent is adequate (Peng and So 2002).

Table 1. Factor Loadings and Cronbach's Alpha

| Factor | CFLM | TIP | CFDS | EP | SCB | PIDM | SIHA |
|---|---|---|---|---|---|---|---|
| Loadings | 0.8873 | 0.7929 | 0.90468 | 0.84354 | 0.83362 | 0.8853 | 0.81534 |
| | 0.85714 | 0.77091 | 0.89009 | 0.8393 | 0.79953 | 0.8727 | 0.65677 |
| | 0.84215 | 0.71715 | 0.81082 | | 0.69729 | 0.60152 | 0.55547 |
| | 0.84044 | | | | 0.69122 | | |
| | 0.81664 | | | | | | |
| | 0.76322 | | | | | | |
| Cronbs. α | 0.93 | 0.83 | 0.96 | 0.89 | 0.96 | 0.92 | 0.77 |

*Cross loading are not included due to space constraints

The significant chi-square test for the difference between the -2LL ratios for the intercept and covariates model (Model 1 -2 Log Likelihood (LL) = 312.576, Model 2 -2 LL = 97.148, Model 3 -2 LL = 104.179 and Model 4 -2 LL = 91.570) and the base model that includes only the intercept (-2 LL = 456.973) demonstrated a better fit for the data than did the base model. The models average c = 0.803; it ranges from 0.5 to 1. A model with a c statistic higher than 0.8 is strongly discriminating the subjects to the corresponding group of outcome. The model is tested using binary logistic regression (Hosmer et al. 2013). The model results suggest that location, error prevention, benefits of use, perceived improved decision making, social influence of healthcare actors and negative message framing impact the likelihood to adopt smart cards. Table 2 illustrates the model path coefficients (ß).

Table 2: Model Testing Results

| Constructs | Model 1 | Model 2 - Control | Model 3 – Gain | Model 4 – Loss |
|---|---|---|---|---|
| Intercept | -4.4146*** | -4.904*** | -3.6302*** | -9.2265*** |
| Location | -0.2271** | -0.1727 | -0.2546 | -0.1139 |
| Trust | -0.0944 | -0.3263 | -0.2823 | 0.3867 |
| Security | 0.1318 | 0.0911 | 0.1619 | -0.1061 |
| Error Prevention | 0.1988* | 0.49** | 0.1718 | 0.3361 |
| Benefits of Use | 0.3878*** | -0.1339 | 0.4649** | 0.9172*** |
| Decision making | 0.3464*** | 0.5755** | 0.3711 | 0.2253 |
| Social influence | 0.0101** | 0.0311*** | 0.00251 | -0.00474 |
| Gain | -0.4165 | | | |
| Loss | -0.7046** | | | |
| n | 277 | 96 | 91 | 90 |

*** p<0.01, ** p<0.05, * p<0.10

The results from Model 1 indicate that concern for location monitoring has an adverse impact on patient's likelihood to use. The results also show that error prevention, smart card benefits, decision making and social influence of healthcare actors have positive impacts on likelihood to use smart cards. There is no evidence of a significant impact of trust or concern for data security on likelihood to adopt. A practical implication of these results for providers is that focusing on the factors as mentioned above during the enrollment process may increase adoption and use of the smart card. The non-significance trust may result from the limited connection of the smart card to outcomes in which the physician will play a more active role. Security concern is not a significant factor in this model; however, this is unusual and requires additional exploration. The loss framing message has significant negative impact on the likelihood of adoption while the gain framing message does not have a significant impact on the likelihood of adoption. Therefore, loss framing may bias patients' adoption behavior and reduce engagement. Our finding suggests that gain- framed messages may be better in this context. This result provides a practical implication to healthcare providers on the type messages that will improve patients' engagement.

Model 2 represents the control group with no message framing. It appears that in the absence of message framing three factors are significant, error prevention, decision making, and social influence. The magnitude of the significant coefficients in this model are greater than any other model; future study is required to investigate this finding. Some of our most interesting findings are the results of Model 3 and 4; blocks of participants who received gain and loss-framed messages. Counterintuitively, the impact of message framing may have reduced the effects of all other variables on likelihood to adopt. This interpretation is not conclusive, future research using a multimethod approach is warranted. Model 3 and four also show the impact of experimental message framing on the relationship between smart card benefits and improved decision making on the patient's likelihood to adopt. There is some evidence that both gain and loss-framed messages have a significant impact on benefits. The loss-framed message appears to have

a stronger effect on the relationship between benefits of use and patients likelihood to adopt than positive message framing. Message framing does not appear to have an impact on the relationship between decision making and likelihood to adopt. See Table 3 for a summary of hypothesis testing results.

| Table 3. Hypothesis Testing Summary | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hypothesis | 1a | 1b | 1c | 1d | 1e | 1f | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Result | ns | **S** | **S** | ns | **S** | ns | **S** | ns | ns | **S** | **S** | **S** | **S** |
| Model | 1 | | 3 | | 4 | | 1 | | | | | | |
| (**S**) Supported (ns) Not Supported | | | | | | | | | | | | | |

# Discussion and Future Research

## *Theoretical Contribution*

This paper makes various theoretical contributions. The study adapts the classic technology acceptance theory by adding concerns for location monitoring and error; also, by enhancing the perceived usefulness construct and narrowing the boundary of social influence to include only health care actors. Previous research on technology acceptance in the medical field focuses primarily on a general definition of perceived usefulness. Secondly, we integrate the technology acceptance theory with the prospect theory, using message framing to assess the impact of gain and loss message framing on patient likelihood to use. There is little evidence in the literature to support the extensive use of the prospect theory to assess patient likelihood to adopt by many information systems researchers. Additionally, our results provide some clarity on the debate whether loss or gain-framed messaging is most influential in the adoption context.

## *Practical Contribution*

This study also provides important practical implications. The smart card is proposed for implementation in a Medicaid Health Home in the Northeastern United States. This organization has the potential to foster consent management, clinical communications, and collaboration by maximizing the functionality of the smart card. Therefore, administrators or other healthcare entities should work on a few main factors: before enrollment, patients should be informed of all the benefits of using smart cards. Specifically the smart cards potential to reduce errors, provide financial incentives, improve the efficiency of care and decision making. Technology such as the smart card should follow a collaborative approach during implementation. The results of our study indicate a significant impact of social influence on the likelihood of adoption. Marketing material is potentially more influential on the likelihood to adopt when gain-framed messages are used. Additionally, though the loss-frame can be used to express financial and efficiency benefits of the smart card; providers should limit its use due to a negative impact on adoption.

## *Future Research and Limitations*

The results of this research show promise for healthcare and information systems theory and practice. Future research is needed to access the impact of gain loss message framing on other significant variables in the model. Additional study is required to assess all counterintuitive finding, to get a better understanding of the implications on practice and theory. Future research may also expand the experimental survey design to a factorial-factorial design which incorporates additional dimension and vignettes. Actual use behavior warrants future study.

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