Developing Targeted Text Messages for Enhancing Medication Adherence

Research-in-Progress

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ABSTRACT

Adherence to prescription medication regimens is one of the main problems that patients and doctors face when trying to manage chronic disease. This research-in-progress paper reports on the development of text messages to be used in a large-scale mobile technology intervention to influence medication adherence. The messages will be developed based upon the Elaboration Likelihood Model (ELM). ELM is a theory about individual processes responsible for making communication more or less persuasive. The model holds that there are two relatively distinct routes to persuasion: core processing and peripheral processing. The wording of the messages being developed in this study will be manipulated to focus on logical message content (for core processing) or emotional cues (for peripheral processing). A rigorous, multi-phase message development plan is currently underway and presented in this research-in-progress paper. The results of the research will be presented at the AMCIS 2013 conference.

Keywords: medication adherence, text messaging, health behavior, elaboration likelihood model (ELM)

INTRODUCTION

Increasing adherence to prescribed medication regimens is one of the main problems that patients and doctors face when trying to manage chronic disease. Medication adherence refers to the extent a patient takes medication(s) exactly as prescribed by his or her doctor, e.g., twice daily for a specific amount of time which might be on-going. On average, only 50% of patients in the United States take medicines as prescribed (Osterberg & Blaschke 2005; Cutler & Everett 2010).

Medication non-adherence is a growing concern among health care providers and insurance payers because of the scope of the problem. In addition, medication non-adherence contributes to less than optimal health outcomes, reduced quality of life, and unnecessary costs. For example, in patients who survive a myocardial infarction, low adherence to beta-blockers will lead to higher risks of death (Munger et al. 2007). Non-adherence behaviors can include never filling the initial prescription, not re-filling the prescription, taking outdated medications, taking medications prescribed for others, or omitting dosages.

Many patients face barriers to adherence ranging from the cost of medication or complex medical regimens to insufficient information on how to take the medication or forgetting a dose. Chronic illnesses often require medications for extended periods of times to prevent the development of complications, as opposed to relieving symptoms, which further complicates adherence. This study is part of a large research project focused on developing interventions to support medication adherence in the context of chronic illness.

This research focuses on the use of mobile technology interventions to influence adherence. Mobile phone ownership is widespread in the US among people in all income and ethnic groups. Eighty-five percent of all US adults own a cell phone and 53% of those own a smartphone (Pew 2012). There are currently 321 million wireless subscribers in the US (or slightly more than 100% of the population) (CTIA 2012).

The sending of targeted text messages (short message service, SMS) to patients using mobile phone technology has been found to promote positive health behaviors, such as weight loss and smoking cessation (Riley, Rivera, Atienza, Nilsen, Allison, Mermelstein, 2011). It is hypothesized that motivationally-oriented text messages sent via mobile phones will increase medication adherence. More specifically, research reported here aims to develop messages that will be used in these mobile interventions. The messages will be developed based upon the Elaboration Likelihood Model, a motivational model of behavior that triggers either an emotional process or a logic and reason-based process.

The paper proceeds as follows. Barriers to medication adherence are briefly discussed, focusing particularly on patients with chronic disease. In addition, background on recent mobile health behavior interventions is provided. The theoretical foundation for the text message development in our study, the Elaboration Likelihood Model, is then discussed. A rigorous, multi-phase message development plan, which is currently underway, is presented. The current status of the research and timeline for completion, as well as presentation plans for AMCIS is described. A short summary of the expected contribution of this research concludes the paper.

BACKGROUND

Medication Adherence and Chronic Disease

There are a variety of reasons why patients do not adhere to prescription medication regimens. Adherence is a multi-dimensional construct with a complex interplay of factors influencing patient behavior under different conditions. The World Health Organization identifies five categories of factors that lead to decreased adherence: social and economic factors; health care system and system-related factors; illness-related factors; therapy-related factors; patient-related factors. (Brown & Bussell 2011).

Non-adherence can be described as being intentional or unintentional (Gatti et al. 2009, Gadkari & McHorney 2012). Intentional non-adherence is an active decision by the patient not to follow the prescribed medication regimen, e.g., non-fulfillment of a new prescription. Unintentional non-adherence is a situation where the patient believes they are follow the physician's directions but they are not. As such, it is a passive process that may include taking the wrong dose or taking the medication at the wrong time of day. (Gatti et al. 2009). Unintentional medication adherence is often the result of inadequate instructions being provided to the patient on the medication. Patients can exhibit both behaviors. In addition, unintentional non-adherence may also be a predictor of future intentional non-adherence (Gadkari & McHorney 2012).

Perhaps not surprisingly, unintentional non-adherence is associated with chronic illness (Gadkari & McHorney 2012, Gadkari & McHorney 2012). Chronic illnesses, such as diabetes and hypertension, require on-going medication administration. Patients with chronic illness face additional barriers in adhering to their prescription regimens compared to those with acute illness because of the need for on-going medication administration. (Brown & Bussell 2011). In addition, chronic illnessess may be asymptomatic resulting in little if any reinforcement for taking the medications. (Saini et al. 2011). These conditions present an especially challenging condition for patients. The complexity of the drug regimen is also associated with decreased adherence (Saini et al. 2011). Moreover chronic disease is increasing worldwide and disproportionately affects the poor (Brown & Bussell 2011). Many interventions designed to improve medication adherence have been tested in randomized controlled trials (Peterseon, Takiya, Finley 2003; Kripalani, Yao, Haynes 2007). In general, interventions designed to improve adherence in patients with chronic illness are less effective than those in patients with acute, short-term medication needs. (Granger & Boswroth 2011).

Kripalani, Yao, Haynes (2007) review studies targeting interventions for patients with chronic conditions. The reviewed interventions are categorized as informational, behavioral, and combined (including some combination of informational, behavioral, and social support strategies). Informational interventions describe strategies designed primarily to educate and motivate patients by instructional means while behavioral strategies are designed to influence behavior through shaping, reminding (cues), or rewarding desired behavior (reinforcement). The authors find that most informational interventions do not improve clinical outcomes for patients with chronic disease. The most effective interventions were dosage simplification and repeated assessment of medication use with feedback. Results of the combined interventions are inconsistent, however, those that are successful interventions include multiple components delivered over time (Kripalani et al. 2007).

Kriplani et al. (2007) primarily reviewed face-to-face interventions between patients and health care providers. New communication channels, such as mobile phones, offer an opportunity for interventions that combine information and behavioral strategies and efficiently deliver these components over time. A discussion of mobile interventions for enhancing health behavior follows.

Mobile Interventions and Health Behavior Change

Mobile technologies have generated much interest as a tool for administering health behavior interventions. Mobile technology applications have been developed to address smoking cessation, weight loss, chronic illness management, and medication adherence (Krishna, Boren, Balas 2009; Riley et al. 2011). Compared to other information and communication technologies, such as desktop or laptop computers, the mobile phone is a very personal device. The characteristics of situatedness, temporality and interactivity of a mobile phone lead to a highly individualized experience for users. (Hassenzahl & Tractinsky 2006). The potential for integration of sensors or other contextual data capture devices with mobile technologies provides the basis for individualized health behavior interventions (Riley et al. 2011). In addition, mobile phones have been nearly universally adopted in the US and worldwide (Riley et al. 2011). Eighty-five percent of all US adults own a cell phone and 53% of those own a smartphone (Pew 2012). There are currently 321 million wireless subscribers in the US (or slightly more than 100% of the population). Moreover, 35.8% of households in the US are now wireless-only, i.e., they have no landline phone (CTIA 2012).

Despite the widespread use of cell phones and the interest in mobile health behavior interventions, relatively few studies have targeted treatment adherence, including medication adherence (Riley et al. 2011). In their recent review Riley et al. (2011) found only 2 studies addressing medication adherence and those used 2-way pagers, not cell phones. Eight studies used cell phones to deliver other treatment adherence interventions, such as appointment reminders. In general, these studies reported positive behavioral changes, e.g., significant increase in appointment adherence. However, their review also pointed to a significant lack of theoretical basis for the interventions.

In summary, there has been little research on the delivery of mobile health behavior interventions focused on medication adherence in patients with chronic illness. Moreover, the interventions that have been developed have not been guided by theory thus the mechanisms underlying any behavior changes are unclear. In addition, the ability for future research to increase the effectiveness of the interventions is limited. Our research aims to address this gap.

THEORETICAL FOUNDATION

Mobile phone interventions involving the sending of targeted text messages have been found to promote positive health behavior change and improve health outcomes (Krishna et al. 2009). An important consideration for developing a mobile intervention of this type is the content of the text messages that will be sent to the patients. These messages must be designed in a manner that triggers the patient to follow through on a prescribed medication regimen and to continue to take the medication. In other words, the messages must be persuasive to the receiver.

Elaboration Likelihood Model (ELM) is a theory about the individual processes responsible for making a communication more or less persuasive (Cacioppo & Petty 1986; Lien 2001). The theory provides insight into how attitudes evolve and change over time and the strength of resulting attitudes (Lien 2001). ELM has been broadly applied in the fields of psychology and marketing, for example, to examine the persuasiveness of advertising information. In this model, elaboration is the extent to which people think about an issue-relevant argument. The ELM model holds that there are two relatively distinct routes to persuasion: central (or core) processing and peripheral processing (Cacioppo & Petty 1986).

The central processing route to persuasion involves effortful cognitive activity. Individuals focus their attention on relevant information. They draw on prior experience and knowledge to assess and elaborate the presented information, generating their own thoughts to make a decision (Beale & Bonsal 2006; Frewer et al. 1997). Changes in attitude resulting from core processing of information are postulated to be relatively enduring and predictive of behavior.

Alternatively, persuasion based on peripheral processing is reliant on decision rules or heuristics, such as source credibility or the emotional appeal in the message (Frewer et al. 1997; Frewer & Miles 2003). In the peripheral processing route, individuals do not think much about the content of the presented information. Messages can be manipulated to reduce motivation or ability to elaborate. For example, the message could be designed to increase the perception that the 'sender understands me' or enhance source credibility leading to acceptance of recommendations with little critical analysis (Hawkins et al. 2008). Under these conditions, individuals are thought to use non-content elements associated with the message (i.e., peripheral cues) as a basis for attitude formation. The resulting changes in attitude are postulated to be relatively temporary and not predictive of future behavior. Thus, ELM fits the goal of current study, which attempt to identify persuasive text messages that help patients adhere to their prescription medication regimen. To distinguish message types based on cognitive characteristics is necessary to discover communication that is effective and convincing to patients.

Involvement is an important moderator of the amount and type of information processing elicited by a persuasive communication (Petty et al. 1986). High involvement messages have greater personal relevance and consequences or elicit more personal association than low involvement messages. People are more motivated to devote cognitive effort when involvement is high, thus core processing is expected to be more persuasive. Therefore, it is expected that the extent of involvement with the message communication will moderate the influence of cognitive cues on message persuasiveness.

The aim of the current research is to develop a set of messages expected to facilitate patient adherence to a prescription drug regimen based on ELM. The set of messages will be composed to trigger central and peripheral processing for persuasion. The wording of the messages will be deliberately manipulated to focus on logical or instructional message content (for core processing) or emotional cues (for peripheral processing). The set of messages will then be used in future field-based testing of a mobile technology intervention to increase medication adherence.

MESSAGE DEVELOPMENT

This research project takes place at a large, public university in the Midwest United States. The university has a large teaching hospital as well as large and active health care facilities, including outpatient clinics and pharmacies. The research team is comprised of faculty from the College of Business Administration (CBA), Medicine, and Pharmacy as well as graduate students from CBA and Medicine.

Message development will be conducted in four phases involving students and faculty from across the multiple colleges, as well as clinical faculty and patients from campus health care facilities. First, the research team, working with graduate students in Pharmacy, will create a bank of messages based on the two different routes of persuasion suggested by the ELM model. Next, an experiment with undergraduate students from CBA will be conducted to test the perception of differences between the two types of messages among lay individuals. Third, qualitative feedback from university physicians and pharmacists as to the appropriateness and validity of the messages will be obtained. Finally, a set of patients with chronic disease recruited from the university clinics will provide feedback on a sample of the messages to assess clarity and appropriateness.

Generation of Initial Message Bank

Under the supervision of one co-author of this paper, a class of first-semester Doctor of Pharmacy (Pharm.D.) students (n=211 students) generated initial text messages in November 2012 focused on helping patients improve medication adherence. A lecture on improving medication adherence addressed why non-adherence is a persistent problem in the U.S. and noted need to address policy barriers and interpersonal patient factors. Potential practitioner strategies discussed included more effective patient education and counseling, adherence-related quality measurement benchmarks, and use of new technologies and services. Lecture discussion revisited the goal of patient empowerment and implications for adherence, then segued into cell phone applications in healthcare, including SMS messages. The instructor discussed the use of mobile texting as an adjunct communication device for pharmacists and provided a short training session on the two different types of messages, i.e., core and peripheral, which influence behavior. The ELM core and peripheral message types were defined in class, including 7 examples of SMS messages for each message type. As part of active lecture engagement, several students provided additional examples verbally in the classroom, and class feedback supported general understanding of the concepts. The students were then asked to create 2 SMS messages that could be sent to patients in the attempt to improve medication adherence, with one message intended to appeal to core processing and one for peripheral processing. They were instructed to make sure that the messages fit the 160-character size limitation of SMS messages (with a minimum of 90 characters to be used for the assignment) and to label the messages as core or peripheral, as appropriate. Each student needed to inform whether the created core message was intended to be: logical, reason-based, practical, factual, educational, or informative. Similarly, each student indicated whether the peripheral message generated was intended to be: inspirational, expression of caring, expression of danger or warning, encouraging, relating personally, or making a reader feel good or bad. The Pharm.D.

students were informed they could decline use of their messages for the research, and answering yes or no would not affect their grade.

A total of 186/211 (88.2%) students volunteered use of their messages for this study. The instructor checked the initial set of 372 messages generated to insure fit with the SMS message size restriction; those that did not meet the requirement were deleted. In addition, the instructor culled messages that were not appropriate for the project. For example, messages that referred to specific medications, such as antibiotics or antidepressants, and those that referred to specific directions, such timing or dosage, were deleted. Other messages that were deemed to be too confusing or frightening were deleted. After this purification procedure was applied, approximately 320 messages remained. In December 2012, each member of the research team was assigned to be primary reviewer for 40 messages and to suggest needed modifications or deletion of messages within the reviewer's allocated set. All team members provided their written comments in spreadsheet files. Most suggestions for deletion were adopted as reviewers noted confusion of message intent, message duplications, or other issues of poor fit. Subsequently, 4 members of the research team met in late December to edit the remaining messages for redundancy, clarity, and appropriateness and further reduced the set to 100 core messages and 100 peripheral messages. A sample of the remaining messages is included in Table 1:

Core Messages	Peripheral Messages
If you have a hard time remembering to take your meds, try placing the meds somewhere you can see them or ask family to help out.	Your friends and family want you to be happy and healthy! Make sure you take your medications as prescribed.
Even if you don't feel sick, you need to take your medications to prevent further medical problems.	It can be hard to remember to take your medications each time, but it is better than ending up in the emergency room!
To remember to take your medications, try creating a routine of taking them at the same time each day.	Be healthy! Feel good! Take care of yourself! Remember to take your meds!

Table 1 Sample Messages

Student Experiment

Method

Approximately 600 undergraduate students enrolled in an Introductory Information Systems, Management, and Marketing classes will voluntarily participate in the experiment in exchange for 1% extra credit on their final grade in the class.

The initial message bank resulted in 200 messages. Our goal is to obtain approximately 120 messages that are significantly different in measure of core and peripheral processing. The experiment will take place in two phases. First, approximately 250 students in one undergraduate course will complete a survey with 5 messages. In this first phase, each message will have 5 observations. Based these preliminary results, messages that appear to be most appropriate will be retained, i.e., those messages that the study participants clearly identify as either core or peripheral. The survey will be updated with the remaining messages and a second student experiment in the remaining classes will be conducted. Our goal is to obtain 20 observations per message.

Procedure and Design

During the week prior to the experiment, the instructor will inform the students of the experiment and the voluntary nature of the experiment. The following week, the experiment will take place in computer-based lab sessions with about 30 students in each session. Researchers will read the students an introductory script describing the experiment and emphasizing the voluntary nature of the experiment. The script will include a brief descriptive statement on medication adherence. All students who choose to participate will be given a web address to gain access to the survey.

The survey includes an introductory section that describes the experiment. The text indicates that participants will be asked to read five messages related to medication adherence and complete a series of exercises for each message. Students are asked to imagine that they have a chronic disease, such as high blood pressure, as they read the messages. The text includes a short description of a chronic disease and some common traits of patients with a chronic disease, e.g., they must take medication

every day even if they do not feel bad. The students are also asked to imagine that they have received each message as a text message on their cell phone. The instructions will emphasize that there are no right or wrong answers to the questions they will be asked about each message.

After the students complete the exercise, they will be given a handout that provides additional information about the research project as well as potential benefits of technology-based interventions in the healthcare field.

Measures

Students will be asked to complete five tasks for each message to test perceptions of the different messages. The first task is a thought listing exercise. Students are asked to read the message and write down whatever thoughts and feelings they have during and after reading the text message. The following 4 items measure the efficacy of each message with respect to the goal of influencing medication adherence, i.e., the extent to which the message was believable, persuasive, relevant, and effective in getting me to take my medication (1=Strongly disagree, 5 =Strongly agree). Four items assess aspects of the appeal to core processing, i.e., extent to which the message is reasonable, useful, fact-based and informative (1=Not at all, 5 = Extremely), and four items assess aspects of appeal to peripheral processing, i.e., the extent to which the message is inspirational, encouraging, expresses care, and expresses caution (1=Not at all, 5 = Extremely). Two items are included to more directly measure the extent to which the message is perceived as core or peripheral, i.e., the degree to which the statement is based on logic and the degree to which the message is based on emotional appeal (1= Not at all, 5 = Extremely). Finally, 3 items are included to assess the perceived appropriateness of the message to the individual, i.e., extent to which the message is relevant, valuable, and clear (1= Not at all, 5 = Extremely). These measures were developed for this experiment.

FIELD EVALUATION

The goal of the student experiment is to obtain a bank of approximately 120 messages, 60 of each type, that are significantly different in measure of core and peripheral processing. To further refine the message bank, experts in the field as well as actual patients will next evaluate the messages.

Evaluation by physicians and pharmacists

A small group of physicians and pharmacists practicing in the health care clinics at the university will be recruited to participate in a focus group to obtain feedback from health care experts as to the appropriateness of the messages. The group will review all messages that remain the message bank after the experiment. The clinical faculty will evaluate messages for appropriateness. For example, are the messages suitable for patients with chronic disease? Messages that are not deemed appropriate to be sent to patients will be removed from the message bank.

Evaluation by patients

The final step of the message development process is to obtain feedback from a sample of patients from the population who will participate in the large-scale mobile technology interventions. A small number of patients from the outpatient university-based clinics will be recruited to participate in a focus group. A set of randomly selected messages will be provided to these patients. The feedback from the patients will be used to assess clarity and appropriateness of messages in the target population. In addition, patient feedback on suitable message frequency, i.e., daily, weekly, etc., and time of day, e.g., before or after lunch, will be obtained.

CURRENT STATUS

The initial message bank has been developed. A student experiment has been conducted in one large Introductory Information Systems class. Two hundred sixty-two undergraduate students participated. The results are currently being analyzed. The second phase of the student experiment will take place in March. The instructors of the involved classes have agreed to allow the experiment to be conducted. The results will be analyzed in April and the message bank updated. A focus group composed of clinical physicians and pharmacists will evaluate the messages remaining after this process in May. The results of this phase will be analyzed. Any messages found unsuitable by the group will be removed from the bank. The remaining messages will be presented to the patient focus group in June. The results from all phases of the research will be presented at AMCIS 2013.

CONCLUSION

This research in progress paper reports on the development of text messages to be used in a large-scale mobile technology intervention to influence medication adherence. In this research, we endeavor to make both theoretical and practical contributions to the development of mobile technology interventions to influence health behavior. Mobile phone ownership

is widespread in the US among people of all income and ethnic groups. However, there has been little research on the delivery of mobile interventions focused on medication adherence in patients with chronic illness. Moreover, the interventions that have been developed have not been guided by theory thus the mechanisms underlying any behavior changes are unclear.

This research extends the application of ELM theories into the context of health behavior interventions with mobile technology. A rigorous, multi-phase plan to develop a set of messages expected to facilitate patient adherence to a prescription drug regimen based on ELM is presented. The set of messages will be composed to trigger central and peripheral processing for persuasion. The wording of the messages will be deliberately manipulated to focus on logical or instructional message content (for core processing) or emotional cues (for peripheral processing). The set of messages will then be used in future field-based testing of a mobile technology intervention to increase medication adherence.

The contribution to theory is to provide a test for ELM theory in the context of patient medication taking. To our knowledge, ELM--a major information processing theory--has not been applied to the context of text messaging or to the issue of persuading patients to adhere to their medications. If the study determines the theory is useful in these regards, future research can focus on the different means of generating central and peripheral processing beyond logic- and emotion-based messages, as indicated in the sizable ELM literature. An example of this is the use of experts (e.g. a doctor) for triggering peripheral processing.

The implications for practice would be: (1) testing whether text message technology is a useful tool in helping patients to improve medication adherence; (2) what types of messages are more effective, i.e., messages focusing on logical content or emotional influence. These results will provide guidelines on how to best utilize text messages to improve medication adherence.

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