Modeling Patient Response to Acute Myocardial Infarction: Implications for a Tailored Technology-Based Program to Reduce Patient Delay

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We are examining ways in which a clinical information system can favorably influence the appropriateness and rapidity of decision-making in patients suffering from symptoms of acute myocardial infarction. In order to do so, we have developed a theoretically based cognitive model for patient decision making. Our model includes somatic and emotional awareness, perceived threat (vulnerability and susceptibility), expectations of symptoms, self-efficacy and response efficacy to explain the response of an individual their symptoms. Variables are explained within a framework that details how they are interrelated in the context of other moderating variables. With an understanding of the decision process, we are able to collect, maintain and access patient specific data to tailor technology- based interventions unique to the requirements of each individual at various phases of the decision process. Existing clinical information systems at Columbia-Presbyterian Medical Center already address issues related to patient relevant on-line data. Other patient specific information will be collected through on-line questionnaires. By basing our approach on the use of a cognitive model, we can assess the capacity of our interventions to modify variables important to the decision-making process, allowing us to pinpoint which interventions are effective and the reasons why they are ineffective.

INTRODUCTION

Clinical studies have repeatedly shown that most patients do not seek medical care for two hours or more after symptom onset for acute myocardial infarction (AMI).[1-4] This delay can be costly considering that the first hour immediately after a heart attack is the crucial time when thrombolytic therapy can significantly improve the victims chances for survival. Although the efficacy of thrombolytic therapy has been known for years, only a fraction of those experiencing an AMI receive this treatment. If time can be reduced from the onset of heart attack symptoms to allow for the delivery of appropriate therapy, lives could be saved and long-term cardiac damage avoided.

It is difficult to imagine a more striking example of how information and particularly new information technology can save lives. Persons who experience symptoms need to be informed on how best to respond. However, when patients experience symptoms that may be indicative of a heart attack, their reaction is very complex. Developing an intervention to modify this response requires an understanding of the process so that important variables that contribute to the decision are identified. It is only then that information can be effectively tailored to the unique requirement of each individual.

In this paper we present a cognitive model that allows us to isolate and measure specific factors that contribute to patient decision-making. Implications for developing a tailored technology-based program to reduce patient delay are discussed.

THE CONCEPTUAL MODEL

Our conceptual model expands on previous medical and health behavior models used to reduce delay in seeking care for AMI,[5-9] in that it isolates and explains the reasons why people delay. While most previous research examined variables separately, our model presents a framework to consider how these variables might be interrelated in explaining the act-of decision within the context of moderating variables. We anticipate that the explanatory power of the model will be improved by recognizing that the act-of-decision is best understood within the model of reciprocal determinism, defined as mutual action between behavior, cognitive, and other personal factors, and environmental influences all operating interactively as determinants of each other.[10] As such, the effect of the explanatory act-of decision variables on delay time may change as the context from which they arise changes.

Symptoms Phase

According to our model (see Figure 1), a person can respond to the acute event of experiencing an AMI in different ways. The actual event, the

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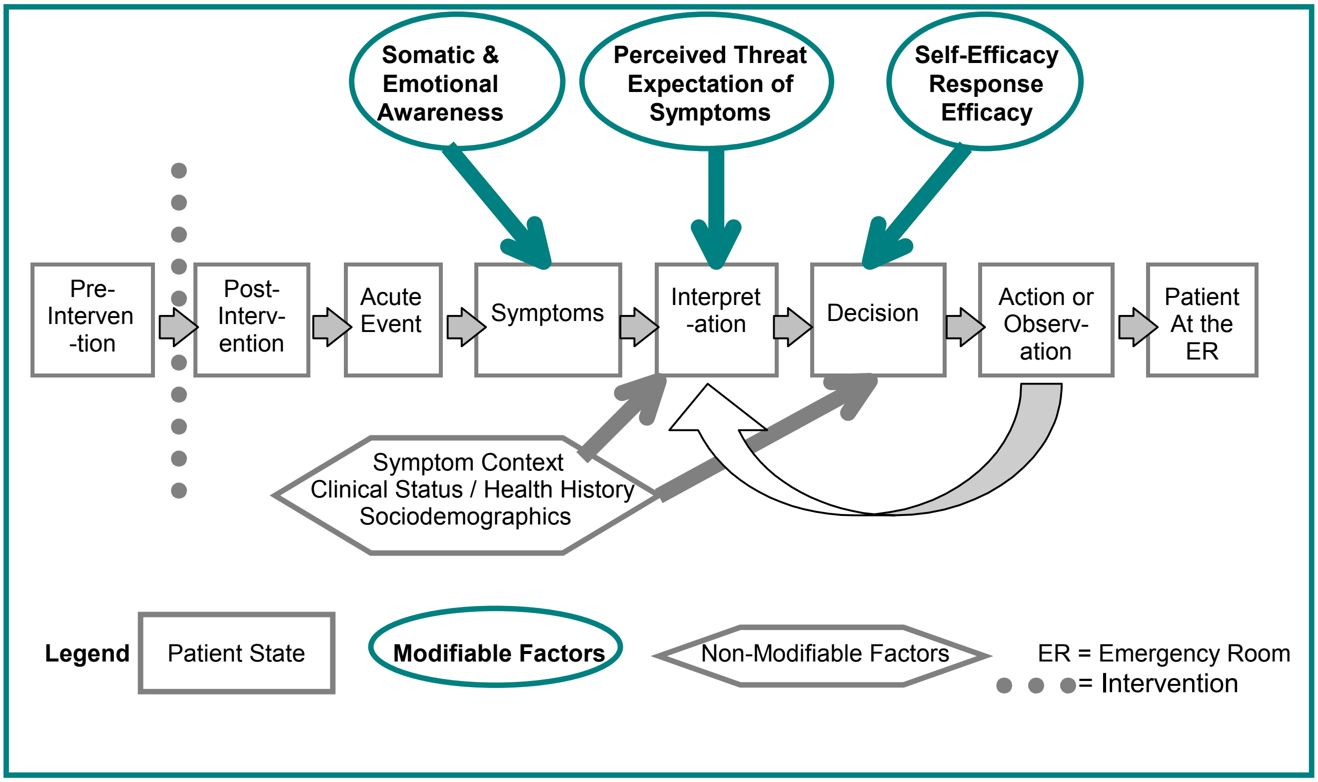
Figure 1: Model of Patient Response to an AMI



physiological episode, provides the external stimuli and the patient enters the Symptom Phase. Symptoms from the episode may be experienced with varying degrees of sensitivity related to the **somatic and emotional awareness** levels of the individual. Low somatic and emotional awareness are characteristics that tend to diminish the perception and/or reporting of cardiac symptoms thereby leading to excessive delay in seeking medical attention.[11] Prior published studies concur that subjects who report higher levels of bodily and emotional awareness were more likely to seek treatment for symptoms of AMI earlier within the time period of effective thrombolytic treatment whereas patients who were less capable of identifying inner experiences of emotion and body sensations were much more likely to delay beyond the limit advised for effective use of thrombolytics.[12] Patients unable to identify their symptoms are likely not to attend to them and may only respond when the symptoms experienced are compelling enough that it is not easy to ignore. Accordingly, the disruptive qualities of symptoms will determine whether the patient pays attention to or ignores symptoms. Disruptive symptoms are typically regarded as those that interfere with the normal flow of everyday events, and are so bothersome, intense, persistent and overwhelming that the conflict with a person's ability to focus on the usual activities of the day or disturb nighttime rest.

Interpretation Phase

Providing that symptoms are attended to, the individual enters into the Interpretation Phase. In this phase, symptoms attended to are ascribed to a cause by the individual e.g., indigestion, nothing important, or cardiac. This labeling process requires that the signs and symptoms attended to be put within an understandable framework.

Few patients are able to determine rapidly that their signs and symptoms represent a heart attack. Rapid self-diagnosis is more likely to occur when the individual is able to match these signs and symptoms to their concept of how a heart attack should feel.[13] We label this variable ***expectation of symptoms*** in our model referring to the matching of signs and symptoms to the patients preconceived prototype of what symptoms should feel like. According to a recent published study, knowledge of chest pain is recognized as an important heart attack symptom, however knowledge of the complex constellation of heart attack symptoms is deficient in the U.S. population, especially in socioeconomically disadvantaged and racial and ethnic minority groups.[14] Therefore, one component of our intervention will be to educate regarding the lesser known symptoms of AMI.

Knowledge alone is insufficient to motivate action, and may be insufficient to cause the patient to ascribe familiar symptoms to AMI. In addressing other cognitive and emotional consequences of symptoms attended to in the previous stage, the individual may perceive a ***threat*** from the prototypical meaning of symptoms. Since the act of decision process involves the labeling of these deviant pattern of symptoms, i.e., assessment of the imminent health threat, our model proceeds to adopt the value-expectancy notion contained within the Health Belief Model suggesting that the notion of threat has its greatest impact in this initial decision.[15] The Health Belief Model suggests that the labeling of the deviant health pattern, response to symptoms, is influenced by the person's beliefs about how susceptible he or she is to a heart attack or other heart trouble, how serious the illness is, and how effective specific actions will be in reducing the perceived threat.

It is the individuals **perceptions' of vulnerability** to heart attack coupled with the **individuals perceptions' of seriousness** of heart attack that combine to form belief about an imminent health **threat** (see Table 1 for a description of threat and other variables in the model). Perceived levels of threat affect correctly ascribing symptoms to cardiac origin. If an individual does not feel vulnerable to an AMI event, he or she is not likely to ascribe these symptoms accordingly. Furthermore, patients who view the AMI event as not serious may discount potential consequences and therefore the need to act. If the threat is perceived as irrelevant or insignificant, then there is no motivation to take action. Or, if the interpretations of the symptoms are as non-cardiac, the action taken may be inappropriate.

The more individuals believe themselves to be vulnerable to a serious threat, the more motivated they are to begin the process of engaging in an action that will reduce their perceived threat.

Perceptions of threat are compiled by the individual suggesting that the individual employs two types of memories: episodic, which are autobiographic memories from the individual's past experiences and include affective responses, and semantic memories which reflect more abstract and conceptual information about symptoms provided by health care associations, for example the American Heart Association's warnings of a heart attack.[16]

For some individuals, arousal from the threat is so intense that they become unresponsive to the symptoms. These individuals may present with a presumably silent AMI, or be among those who die outside the hospital with sudden cardiac deaths.

The Interpretation Phase ends when the individual has a label or hypothesis as to the meaning of the symptoms and proceeds to the Decision Phase to address the demands in terms of developing an action strategy.

Table 1: Modeling Patient Response to AMI Summary of Variables

Variable	Description
Somatic and Emotional Awareness	Individuals ability to identify inner experiences of emotion and body sensations
Perceived Threat •	
Vulnerability	Individuals perception of his or her risk of getting an AMI
Seriousness	Feelings concerning the extent of harm that could result from an AMI
Expectations of Symptoms	Individuals ability to match the signs and symptoms to their concept of how a heart attack should feel
Response Efficacy	Individuals estimate that their behavior will lead to a certain outcome
Self-Efficacy	Individuals confidence in his or her ability to take action by performing the behaviors necessary
Symptom Context	Consultation with others (spouse, coworker); decision to consult a physician, time and place of symptom onset
Sociodemographic/ Health History	Demographic and health history type variables e.g., history of diabetes, angina, age, sex, etc.

• Based upon Health Belief Model, the combination of vulnerability and seriousness has been labeled the perceived threat

Decision Phase

Once into the **Decision Phase, *response efficacy***, i.e., beliefs about the effectiveness of the recommended response, and ***self-efficacy***, i.e., beliefs about one's ability to perform the recommended response and confidence in labeling symptoms,[17] determine whether the patient will become motivated to accept or reject the proposed action plan. Within this study "accept" defines the decision to go to the emergency room for medical care whereas "reject" defines the decision not to go to the emergency room. The "accept" action is defined in protocols to reduce delay with messages tailored to the patients specific profile, i.e., history of diabetes or previous MI. In accordance to our proposal the "accept" action will be carried out when the individual believes that proposed actions are easily, feasibly, and effectively able to avert or reduce the serious potential consequences possible from an AMI event. Thus, high perceived efficacy (i.e., people feel able to perform an effective recommended response and confident that they are responding correctly) coupled with high perceived threat (i.e., people believe they are vulnerable to a significant threat) promote the "accept" response.

In contrast, people engage in the "reject" action when they do not think they are able to adopt the recommended response. In this situation the individual may perceive the action as too difficult, lack the confidence to take the recommended action (i.e., low self-efficacy), or they think that the recommended action will not effectively avert the threat (i.e., low response efficacy). Thus, low perceived efficacy (i.e., people feel unable to perform the recommended action and/or believe the response to be ineffective) coupled with high perceived threat (i.e., people believe that they are vulnerable to a significant threat) promote the "reject" response. The "reject" response promotes delay since patients are not taking the recommended actions and may instead react with a variety of control response or irrational biases. Examples of alternative inappropriate responses include defensive avoidance and denial.

Transition between Interpretation and Decision may be more interactive than linear in that patients will enter the Decision Phase based upon their interpretation of symptoms and reassess this interpretation when actions prove ineffective. For example, when a patient experiences intermittent chest pain he may hypothesize an interpretation e.g., muscle pain from over exertion, and initiate action based on this hypothesis. Failure to eradicate symptoms from resting or ingestion of muscle relaxants may cause him to reappraise, and re-enter the Interpretation Phase. The patient may test, revisit and reconstruct lines of action in an effort to cope with the threat produced by symptom and emotional arousal. One goal of our intervention is to quicken this process so that the patient proceeds to action with reduced delay.

The ***sociodemographic*** and ***health history variables*** in the model will be measured at baseline as moderating variables and will also identify subgroups for tailoring to those most likely to delay the seeking of medical treatment. For example, persons with previous chronic illnesses such as diabetes will receive tailored interventions with particular instruction on how to differentiate AMI symptoms from the symptoms related to their chronic disease. Our evaluation strategies will be designed specifically to measure delay time for these subgroups and to determine whether tailoring improved outcomes. The ***symptom context variables*** shift the focus of the model from individualized processes to a person's interaction with the environment. Consultation with others, spouse or coworker, the decision to consult a physician, time and place of symptoms are among the variables that influence the outcomes of the processes. According to our model these variables affect delay time at the Interpretation and Decision Phases, indicating the need for intervention strategies to specify a role for "significant others" as to their behavior in assisting potential AMI patients in obtaining definitive medical care.

DISCUSSION

Our conceptual model guides the development of a tailored technology-based program to reduce patient delay. By isolating and explaining the reasons why people delay, we are able to design effective strategies grounded in behavioral theories. For example, using Bandara's theory we are taught that vicarious experiences can produce significant, enduring changes on self-efficacy appraisals.[10] Seeing or visualizing other similar people perform successfully can raise self-percepts of efficacy in observers that they too possess the capabilities to master comparable activities. They persuade themselves that if others can do it, they should be able to do it as well. In the world of technology, we can create the virtual image of persons with characteristics similar to the viewer responding to AMI symptoms according to the appropriate protocol. Thus, the viewer can "vicariously practice responding" and repetitively witness successful implication of the protocol, so that when and if the reality of AMI symptoms occur, their increased self-efficacy will enable them to respond with confidence expeditiously.

In order to create tailored interventions, it is necessary to collect, maintain, and access the information for each individual at different points in the decision process. At Columbia-Presbyterian Medical Center, existing clinical information systems address issues related to patient relevant on-line data. Additional patient data will be gathered for our project using on line questionnaires. In order to maintain the privacy of the patient's online data, we have security features that include encryption, identification, authentication, and authorization. Other security functions are addressed through an initial log on function and on-going surveillance of all accesses to patient data. The importance of creating tailored interventions cannot be underscored enough. Prior research consistently demonstrates that tailored interventions have a significantly greater effect on patients' behavior than generic messages.[18] Tailored messages are information intended to reach one specific person, based on characteristics unique to that person. It is information technology that will allow us to deliver the individualized specific interventions through ubiquitous technology windows. These seamless communication channels will enable the recipients of our project to be reached with patient specific messages using a one-by-one technique.

CONCLUSION

We propose a model for patient decision-making that incorporates several behavior models. We have progressed in our project designed to reduce patient delay by theoretically modeling patient response to acute myocardial infarction. Equipped with a model of the decision process, we are able to proceed with an understanding of what patient specific information we need to collect and maintain in order to develop effective and targeted technology based intervention strategies. The next steps will be to empirically demonstrate that information technology can affect the variables described in our model, and that these variables will favorably influence the appropriateness and rapidity of decision making in patients suffering from symptoms of acute myocardial infarction.

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