The Consumer Health Information System Adoption Model

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Abstract. Derived from overlapping concepts in consumer health, a *consumer health information system* refers to any of the broad range of applications, tools, and educational resources developed to empower consumers with knowledge, techniques, and strategies, to manage their own health. As consumer health information systems become increasingly popular, it is important to explore the factors that impact their adoption and success. Accumulating evidence indicates a relationship between usability and consumers' eHealth Literacy skills and the demands consumer HISs place on their skills. Here, we present a new model called the Consumer Health Information System Adoption Model, which depicts both consumer eHealth literacy skills and system demands on eHealth literacy as moderators with the potential to affect the strength of relationship between usefulness and usability (predictors of usage) and adoption, value, and successful use (actual usage outcomes). Strategies for aligning these two moderating factors are described.

Keywords. Consumer health informatics, consumer health information systems, usability, eHealth literacy, health literacy

Introduction

To begin, a definition of consumer HIS will be derived from definitions of similar concepts. Canada Health Infoway defined a *consumer health application* as "an electronic solution that enables the consumer to collect, retrieve, manage, use and share personal information and other health-related data" [1]. In contrast, the American Agency for Healthcare Research and Quality (AHRQ) defined *consumer health IT [information technology] applications* more broadly as the "wide range of hardware, software, and Web-based applications that allows patients to participate in their own health care via electronic means" [2]. In this paper, the definition for consumer HIS will be inferred from the description of the study of these systems known as *consumer health informatics*. AMIA (the American Medical Informatics Association) argues that the focus of consumer health informatics "is on information structures and processes that empower consumers to manage their own health--for example health information literacy, consumer-friendly language, personal health records, and Internet-based strategies and resources" [3]. Thus, a *consumer HIS* refers to any of the broad range of applications, tools, and educational resources developed to empower consumers with knowledge, techniques, and strategies, to manage their own health.

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Driven by consumers who want tools and information to manage, monitor, and improve their health, there is an increasing demand for consumer HISs. Consumer HISs have the potential to play important role in facilitating patient-centred care and self-management. Consumer HISs are diverse and examples include but are not limited to: online health resources, health risk assessments on the Internet, mobile health applications, and Personal Health Records (PHRs). This paper will be used to outline usefulness, usability, and eHealth literacy with respect to consumer HISs, as well as propose a model of how these factors might interact and influence the adoption, successful use, and value of consumer HISs.

1. Usability, Usefulness, and eHealth Literacy

Once an idea for a useful consumer HIS has been conceived (i.e., a system that serves a specific user need or needs), the next priority should be ensuring that resultant system that is usable for its intended users. "Usability is the effectiveness, efficiency and satisfaction with which specific users can achieve a specific set of tasks in a particular environment" [p. 6, 4]. Effectiveness is measured by the accuracy and the completeness of task, whereas efficiency is related to the resources (e.g., time, effort) expended to complete the task [5]. Usability is argued to have the following five attributes: learnability, efficiency, memorability, errors, and satisfaction [6].

Driven by the increased use of computers, mobile devices, and the Internet for health information seeking and delivery, the concept of eHealth literacy emerged as an elaboration on the concept of health literacy by incorporating the role of health information technology in information delivery. *Health literacy* is "the degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions" [p. 7, 7]. The term *eHealth* has been defined as "the use of emerging information and communication technology, especially the Internet, to improve or enable health and health care" [p. 2, 8]. These definitions were integrated to generate the following definition of *eHealth literacy*: "the ability to seek, find, understand, and appraise health information from electronic sources and apply the knowledge gained to addressing or solving a health problem" [p. 3, 9].

2. The Consumer Health Information System Adoption Model

In contrast to the majority of HISs, consumer HISs are unique in that their users (i.e., consumers or laypeople) often have limited or no healthcare experience and/or knowledge [10]. eHealth literacy, usefulness, and usability are crucial factors in the development and eventual success of consumer HISs. Consumer HIS designers need to ensure that consumers can understand the systems' content [11]. If users cannot understand the content of a system, how can they be expected to use it effectively? Thus, to optimize consumer HISs, it is imperative that they are designed to a) be useful and usable and b) place appropriate demands on consumers' levels eHealth literacy.

A high level framework has been proposed for exploring consumer health informatics [12], yet it is also important to examine this topic from a more in depth perspective. To this end, we draw upon the Technology Acceptance Model (TAM) [13]. TAM is popular information systems model supported by evidence that the two best

predictors of technology usage are perceived usefulness and perceived ease of use (usability), respectively [13].
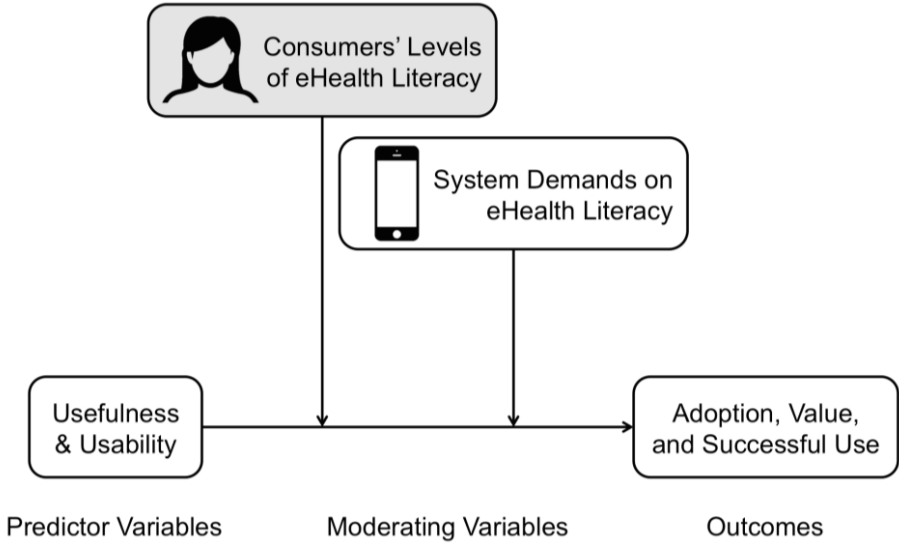

Figure 1. The Consumer Health Information System Adoption Model

We posit that eHealth literacy is a critical two faceted factor demanding consideration, which impacts not only usage but system value and successful consumer HIS use. The identification of eHealth literacy issues during functionality (an index of usefulness) and usability evaluations without seeking them intentionally [e.g., 10, 14] suggest that issues around eHealth literacy can impede usefulness, and usability. Further, designing for low literacy may improve usability (i.e., more tasks completed, reduced task times) [15]. These findings suggest that the capabilities of the user (such as eHealth literacy skills) and the system design (including demands on eHealth literacy skills) impact the usefulness and usability of consumer HISs, which according to the TAM [13] would then influence adoption. Thus, we posit that consumer HIS demands on eHealth literacy and users' levels of eHealth literacy moderate (i.e., strengthen or weaken) the relationship between usability and usefulness and adoption in the Consumer Health Information System Adoption Model (Figure 1). In this model, consumers' levels of eHealth literacy and system demands on eHealth literacy (moderating variables) moderate the relationship between usefulness and usability (predictor variables) and adoption, value, and successful use of consumer HISs (outcomes). Thus, usefulness and usability have a direct impact on consumer HIS adoption and success, but the strength of this relationship depends on users' eHealth literacy skills and the demands the system places on eHealth literacy. This model emphasizes the potential impact of both users' eHealth literacy skills and system demands place on eHealth literacy and how either, or both of these factors can affect whether a consumer HIS will be adopted or abandoned, its perceived value, and whether or not users will be able to use the system effectively.

As insinuated by the positioning in Figure 1, it is imperative users' eHealth literacy skills are aligned or exceed the demands these systems place on eHealth literacy that to ensure consumer HISs are useful and useable. When a mismatch or discrepancy

between the demands consumer HISs place on eHealth literacy and the users' eHealth literacy skills (as depicted in Figure 2a) exists, the usefulness and usability of the systems may be compromised. Specifically, if the consumers' eHealth literacy skills are not adequate to access, process, and understand and the health information provided by a consumer HISs, both the usefulness and a usability of the system may be negatively impacted. That is, if the information in a consumer HIS is written such that it exceeds the users' capability of understanding, the system cannot be considered useful to the consumer and as the user is unlikely to be able to use the system to achieve her goals (e.g., understanding relevant health information). Similarly, if consumers have difficulty using the system to find relevant health information, user goals are impeded regardless of the appropriateness of the system content.
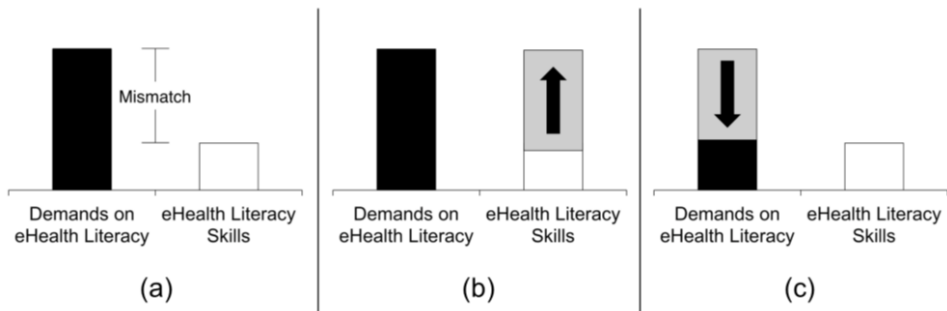

Figure 2. Strategies for Improving Alignment of System Demands on eHealth Literacy and Users' eHealth Literacy Skills: (a) Discrepancy Between Demands on eHealth Literacy and eHealth Literacy Skills (b) Lowering Demands on Health Literacy (b) Increasing Consumers' Levels of Health Literacy.

There are two primary strategies for mitigating discrepancies between consumer HIS demands on users' levels of eHealth literacy and users' actual eHealth literacy levels. First, consumers' levels of health literacy can be increased to meet demands consumer HISs place on eHealth literacy, as shown in Figure 2b. Alternatively, the demands placed on eHealth literacy by consumer HISs can be lowered to meet users' levels of eHealth literacy, as depicted in Figure 2c. Additionally, both of these strategies can be used in conjunction.

3. Discussion

This paper defined what is meant by a consumer HIS and proposed a new model for how the adoption of consumer HISs may be influenced by such factors as usability, usefulness, demands on eHealth literacy and users' eHealth literacy skills. However, the factors identified here are not considered the only factors that influence adoption. For example, younger designers neglecting to accommodate the unique requirements of older consumers has been argued to lead to low adoption of consume HISs [16]. In response, the value of developing personas to represent different types (including needs, goals, behaviour patterns etc.) of users is important for the development of consumer HISs [16]. User-centered design (UCD) methods should be practiced to ensure that consumer HISs are appropriate for their target users. Although many factors are likely to influence the uptake of consumer HISs, demands on eHealth Literacy and consumers' eHealth literacy skills are considered of primary importance. These factors are considered imperative because evidence indicates that these factors influence the

predictor variables (i.e., usefulness and usability), which has been shown to affect the outcome variables (i.e., adoption, value, and successful use).

This model is not meant to imply that use patterns of consumer HISs are static. Usage is likely variable due to specific needs at certain time points, which will create fluctuations in use patterns. For example, after initial diagnosis, consumers may have an increased need for information about factors that exacerbate their condition and how to manage it. If consumer HISs are successful in equipping consumers with strategies to control their conditions, these behaviours may become more automatic and therefore consumers would rely on the system less.

This model was developed with three objectives. First, the Consumer Health Information System Adoption Model emphasized the important roles that demands on eHealth Literacy and eHealth literacy skills are likely to play in the success and adoption of consumer HIS based on indirect evidence. Second, this model was meant to draw attention to the argument that consumer HIS adoption, successful use, and perceived value hinges on the alignment between system demands on eHealth Literacy and users' eHealth literacy skills. That is, a usable consumer HIS for users with advanced eHealth literacy skills is not necessarily appropriate for users with limited eHealth literacy, which might in turn result in lowered adoption or unsuccessful use for this latter user group. Further, approaches to mitigating mismatches when demands on eHealth literacy exceed users' capabilities were discussed. Third, this model sought to elucidate how eHealth literacy skills as well as demands on eHealth literacy have the potential to moderate (i.e., strengthen or weaken) the relationship between 1) usefulness and usability 2) adoption, value, and successful use. Importantly, these issues are garnering attention. For example, efforts are being made to develop interventions to scaffold eHealth literacy [17] as well as lowering demands on users' eHealth literacy skills through design guidance [e.g., 18, 19]. Additionally, research on methods for evaluating consumer HISs from this combined perspective is beginning to emerge [e.g., 20, 21]. The Consumer Health Information System Adoption Model promises to provide a useful framework for exploring how these factors interact and impact adoption and success of consumer HISs. Future work will involve testing and validating the model and identifying other important factors influencing the adoption of these systems.

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