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Associating consumer perceived value with business models for digital services

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Abstract

As digital services increasingly deal with commodity offerings (i.e., digital content and features that are similar between service providers), service providers are seeking to differentiate themselves with variations in their digital service business models. Research, though, has yet to consider the association of consumer perceived value with digital service business models underlying technological innovations. We seek to demonstrate that consumer value for digital service business models may be quite different even when consumers have similar preferences for standard technology characteristics. In the context of this paper, we specifically consider consumer perceived value associated with Personal Health Records (PHRs) and PHR digital business models, through the use of an integrated latent variable and choice empirical model. We find that although consumer perceived value for PHRs is generally high, when offered a choice between three competing PHR business models, consumers state high value for only two of the business models in the choice set: *PHRs offered directly by groups of medical providers* and *Integrated PHRs*. These findings suggest that while perceived value may be high for generally considered digital services, variations in the underlying digital service business models are likely to have significant impacts on consumer valuations of digital services.
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Introduction

Consumers are typically expected to adopt (or consider adopting) information systems without regard to the underlying business model. In essence, if a technology is perceived to be relatively advantageous, trialable, compatible, observable, and not overly complex (easy-to-use), consumer adoption intentions should be positive (Rogers, 2003). Yet, variations in the fundamental components of digital business models are also likely to have significant impacts on consumer value perceptions of technological innovations – especially in the now burgeoning consumer-oriented information systems market. Research in information systems has seldom considered how variations in digital service business models underlying technology artifacts may impact consumer perceptions. With the advent and augmentation of traditional services through digitization, business models associated with digital services often become the differentiating factor in consumer adoption decisions associated with technologies. We suggest that consumer value for competing digital services is heterogeneous when underlying digital service business models vary, even though the core technologies and features may be similar or based on increasingly commoditized content.

The question of how consumers move beyond general digital service impressions toward actual selection and long-term usage is especially important to information systems researchers and practitioners. Granted, substantial research has been conducted in the areas of behaviorally motivated predictors of consumer adoption and diffusion (Rogers, 2003) and technology acceptance (Davis, 1989; Venkatesh *et al*, 2003). Additional predictors, such as trust and risk (e.g., Pavlou, 2003), have also been shown to impact acceptance. However, such models of intentions to adopt and accept technologies are typically based on research questions applied to behavioral *antecedents* associated with an entire category of information systems. For instance, the Technology Acceptance Model (TAM) has been extended through additional antecedent constructs, such as trust and risk, in the assessment of consumer acceptance of e-commerce as a whole (e.g., Pavlou, 2003). More recent research has refined the acceptance question to more specific contexts – for example, technology acceptance on mobile devices (Wu & Wang, 2005) and acceptance of online banking (Pikkarainen *et al*, 2004) – but such research has not yet examined how digital service business model variation may affect consumer value perceptions. Further, it has been suggested that new research models (other than TAM) be used to explore adoption and diffusion in contexts outside of the traditionally considered 'organization' (Kim & Han, 2009).

We contend that extant literature on technology adoption has mostly ignored the choices consumers have to make on digital service business model differences and has primarily addressed the antecedents of consumer value. However, with most consumer technology offerings, any direct measurement of value will be confounded by the business model choices available. We set out to address the challenge of associating antecedents of perceived value of innovative, digital services with consumer perceived value for underlying digital service business models. The primary contribution of our work is to integrate latent perceived value (associated with a generally considered digital service) and consumer choice (associated with the business model underlying the generally considered digital service) in a single model.

We use the context of free, online Personal Health Records (PHRs) targeted toward consumers. We specifically assess consumer value perceptions associated with three digital PHR business models that offer differing value-propositions and trade-offs for the consumer: (1) PHRs offered by *standalone* medical practices (i.e., doctor's offices that are not part of a group of practices), (2) PHRs offered by *groups* of medical practices, and (3) PHRs offered by *third parties* (e.g., Microsoft HealthVault) without any direct connection to any medical practice. Business models throughout the digital services industry are evolving quickly and, in the PHR market, it has been suggested that 'without substantiated PHR use cases for patients, providers, and other constituents, and *business models* that clearly articulate the value of PHR, PHR adoption will not reach its full potential' (italics ours) (Kaelber *et al*, 2008, p. 731).

The specific objectives of this study are as follows:

- to determine if sampled respondents find the general digital service in question (PHRs) to be of value (e.g., relatively advantageous, compatible with work style, etc.).
- to determine if there are significant associations between the *latent perceived value* of digital services (PHRs, in this case) and the *choice of underlying digital service* (*PHR*) *business models*.

These objectives contribute to the literature and to our practical understandings of information systems in the digital services age by empirically testing whether or not general perceptions of a specific digital service are positive given theoretically motivated antecedents of adoption (which is often also done in TAM-based studies, e.g., Klein, 2007) and then extending these findings down to the level of the business model underlying the digital service.

Through the novel use of an integrated latent variable and choice model, we find that while latent perceived value (i.e., latent utility) of PHRs overall is high among our respondents, *PHRs tethered to groups of medical practices* and *Integrated PHRs* are positively associated with latent perceived value of PHRs. These findings suggest that consumers are acutely aware of value proposition trade-offs associated with digital service business models, especially for increasingly commoditized digital service features. The following sections go into more detail about the theoretical background used for this paper, the differences between specific PHR business models, the development of our research model, our results, and, finally, discussion and conclusions.

Theoretical background and model development

In the traditional sense, business models are typically considered to be fundamental drivers of supply-side strategy that provide the foundation (and direction) for attaining (and sustaining) economic value. Morris *et al* (2005) suggest the following definition: 'A business model is a concise representation of how an interrelated set of decision variables in the areas of venture strategy, architecture, and economics are addressed to create sustainable competitive advantage in defined markets' (p. 727). Business models have also been described as unique combinations of value propositions, processes, resources, and profit formulas (Hwang & Christensen, 2008). Traditional firms based on such business models typically deliver products or services to the market through some combination of unique resources, activities (within the value chain), and strategy (Hedman & Kalling, 2003).

These fundamental principles also guide business model selection in the digital services market. Yet, the range of business models applied in the digital services market is quite broad (Timmers, 1998) and research on digital markets tends to focus on supply-side economic value. For instance, discussions of the 'digital economy' (Henry *et al*, 1999) and 'digital markets' (Smith *et al*, 2000)

are typically focused on how technology and firms will drive GDP growth (Henry *et al*, 1999) and on abstract pricing and market issues that affect market efficiency (Smith *et al*, 2000). It is well understood that economic principles and theories apply to digital markets (Shapiro & Varian, 2000), but demand-side value associated with digital service business models is currently an underrepresented research domain.

In the emerging context of digital services, the delivery of value is a key distinction from traditional business model definitions. For instance, many digital services characterized by commoditized content offerings compete on business models by differentiating themselves on value proposition attributes. In this paper, in order to effectively address our research objectives without confounding the results with overly broad generalizations of business models, we consider a narrower definition of business models associated directly with digital services. Specifically, it has been suggested that business models in the emerging consumer-centric age should be considered as, '…the manner by which the enterprise delivers value to customers, entice customers to pay for value, and convert those payments to profit' (Teece, 2010, p. 172). In our context, we consider the interrelated set of decision variables (Morris *et al,* 2005) associated directly with business model value propositions (Al-Debei & Avison, 2010; Teece, 2010) in the PHR context. Such an approach has been applied in contexts where digital service value propositions are considered in a consumer context (e.g., Wirtz *et al*, 2010; Hienerth *et al*, 2011) and we use a similar approach to assess digital service business models in the PHR context. We believe this approach limits confounding variables and allows for a parsimonious and specific empirical model.

PHR business models

PHRs are digital intermediaries between patients and healthcare providers that are optional for patients (and caregivers), but provide many potential benefits including: active patient participation in health care, aggregated data and knowledge from disparate sources, collaborative disease tracking, and continuous communication between patients and healthcare providers (Tang *et al*, 2006). Despite the expected benefits, PHR adoption faces many hurdles including: physician incentives, concerns about liability and trust, equal access to digital technologies (digital divide), technical concerns (such as a lack of interoperability standards), and business concerns (such as unknown market demand and value appropriation) (Detmer *et al*, 2008; Baird *et al*, 2012). Specifically, we consider the three, primary business models currently dominating the PHR market, each offering a unique value proposition: (1) Standalone medical practice tethered PHRs, (2) Group medical practice tethered PHRs, and (3) Integrated PHRs.

Tethered PHR: A tethered PHR is usually connected directly to an Electronic Medical Record (EMR) system provided by a healthcare provider (usually a hospital or ambulatory care provider). Such a PHR represents a digital business strategy implemented by the provider that leverages existing resources (technology, employee time and effort, and information) to keep patients informed and connected, but also imposes switching costs on the patient. As such, this type of PHR is often offered for economic reasons by the provider (e.g., patient retention) as well as health reasons (e.g., improved patient health outcomes based on information sharing and facilitating shared decision making and active health participation). For the consumer (patient), a tethered PHR offers a value proposition focused on convenience and ease-of-use as a trade-off for some level of lock-in. A PHR *tethered* directly to a healthcare provider will be easy-to-use (after initial learning and start-up efforts) with little or no need to import medical records, but may not be able to aggregate medical records from other providers, specialists, or even medical devices. In addition, such records and information may not be easily transferrable to other providers. Such PHRs aggregate the service being provided (health care) with informational needs (medical records management) and can either be tethered to an individual (*standalone*) practice or, alternatively, to a *group* of medical practices (affording additional data sharing capabilities and reduced effort when moving between in-group providers).

Integrated PHR: An integrated PHR is a third-party PHR service, such as Microsoft HealthVault, which is typically not directly connected to any healthcare provider. Integrated PHRs represent a digital service business model where digital medical records and information services and resources are provided for free in trade for increased use of related online services (i.e., search) and additional advertisement impressions (i.e., targeted ads). Integrated PHRs are usually based on a cloud-computing model and provide consumers with access to resources that offer secure, online applications that permit import, aggregation, storage, analysis, and augmentation of PHRs and information (or records and information for family members) as well as additional features. Healthcare consumers can create free accounts within these online services and begin keeping track of their personal health information immediately. Such a business model is very attractive to consumers who desire a value proposition where medical records and information can be aggregated ('integrated') from multiple sources without being tied to any particular medical provider, but such a model also requires additional effort to import records, especially given that medical information is not always easily shareable, and does not offer nearly as much privacy as a tethered model. Therefore, the consumer retains more control over the data and reduced medical provider switching costs in trade for increased effort and reduced privacy.

Each type of digital PHR business model described above involves value proposition trade-offs for the consumer. Recent articles debate which model will succeed with some authors suggesting that integrated PHRs hold the most promise for social welfare (e.g., Detmer *et al*, 2008) and other authors suggesting that intermediaries such as Google Health – which is an example of an integrated

PHR – are only a temporary phenomenon and that tethered PHRs will ultimately succeed (e.g., Tang & Lee, 2009). Therefore, we suggest that consumer perceived value will play a pivotal role on the success and failure of various digital service business models associated with PHRs as consumer values are likely to tip the market in the direction most favorable to the majority.

We specifically focus on four, primary attributes of PHR business models – switching costs, effort, privacy, and data control – that are derived from the literature on PHRs (Tang *et al*, 2006, 2009; Ball *et al*, 2007; Kaelber *et al*, 2008; Kahn *et al,* 2009; Archer *et al*, 2011; Krist and Woolf, 2011; Fuji *et al*, 2012; Steele *et al*, 2012) and discussions of PHR business model attributes with experts in the field. The literature has specifically suggested, 'Consumers who adopt PHRs will require that the information be protected and *private*; that *ownership* lie solely with the consumer; that storage and use of the *data* be approved by the patients; and that the data be easily *portable* and in a format that is understandable… A PHR that adheres to these concepts will provide extraordinary value for consumers and will accelerate the changing of patients into partners for health' (Kahn *et al*, 2009, p. 375). It has also been suggested that consumer access to health records and information as well as patient collaboration can be facilitated by PHRs, if PHRs are 'secure, patient-controlled, lifelong record that aggregates data from all relevant sources and is accessible at any time, any place' (p. 11) and also address transparency and data exchange issues (Detmer *et al*, 2008).

Our selection of these PHR business model attributes was informed through a review of the literature cited above and by discussing fundamental differences between PHR business models with experts in the PHR field. These experts included two physicians from the Mayo Clinic closely tied to the management and research associated with the Mayo Clinic's PHR initiatives as well as a director at the U.S. Office of the National Coordinator of Health Information Technology. These experts confirmed what has been discussed in the health literature: *switching costs, effort, privacy (risk),* and *data control* are essential PHR digital business model attributes that vary significantly between the three types of digital PHR business models analyzed in this study. We suggest that these attributes represent the primary interrelated set of decision variables (Morris *et al*, 2005) consumers face when weighing value proposition alternatives in the digital services market for PHRs. Table 1 provides additional details. All digital PHR business models considered are available free-of-charge over the Internet with little or no variation in the amount of security offered.

Demand-side value associated with digital services

Shapiro & Varian (2000) suggest: 'You can learn a great deal about your customers by offering them a menu of products and seeing which one they choose' (p. 53). Yet, research into the influence of self-selection on markets is limited and often focused on analysis of various firm strategies for effectively dealing with segmentation and self-selection (e.g., Moorthy, 1984; Hanson & Martin, 1990). Developing better 'customer value' has been specifically identified in the marketing literature as a potential next wave of competitive advantage seeking activities (Woodruff, 1997). Woodruff (1997) contributes a definition of customer value: 'Customer value is a customer's perceived preference for and evaluation of those product attributes, attribute performances, and consequences

Table 1 PHR business model attributes

Attributes	*Levels*	*Tethered PHR (to a standalone medical practice)*	*Tethered PHR (to a group of medical practices)*	*Integrated PHR*
Privacy	High	X	X (within the group)	—
	Medium	—	—	X
Effort (start-up costs; importing digital records)	High	—	—	X
	Low	X (for this practice only)	X (within the group)	—
Switching costs (transferring records to and from providers; learning how to use a new provider's PHR)	High	X	—	—
	Low	—	X (within the group)	X
Data control	Patient	—	—	X
	Provider	X	X	—

A list of attributes (privacy, effort, switching costs, and data control) and levels of each attribute that vary between the three business models: Standalone Tethered, Group Tethered, and Integrated

Note: All PHR business models listed here are homogenous with respect to cost (all are available for free) and delivery mechanism (all are available over the Internet).

arising from use that facilitates (or blocks) achieving the customer's goals and purposes in use situations'.

Based on this definition, our analysis first seeks to establish consumer value perceptions for generally considered PHRs (irrespective of the business model). Just as a consumer may consider 'e-commerce' (generally considered) to be valuable (or not valuable), we seek to establish value perceptions for generally considered PHRs. To establish this perceived value, we turn to diffusion of innovations research and well-established predictors of adoption. A strong base of diffusion of innovations research suggests that five characteristics are often positively associated with value perceptions of innovations: relative advantage, trialability, compatibility, complexity (ease-of-use), and observability (Rogers, 2003). *Relative advantage* is the perceived benefits a consumer sees in the innovation (as compared with the current situation – e.g., going to a video store to rent a video *vs* renting it online). *Trialability* is the impact that using the innovation in advance may have on adoption intentions. *Compatibility* is how compatible the innovation is with current patterns of behavior (or 'work style'). *Complexity* is another term for ease-of-use and refers to consumer perceptions of the ease of learning and using the innovation. *Observability* refers to the influence of viewing others use the innovation prior to adoption.

These diffusion of innovation characteristics have been applied to the adoption of IT within organizations (Moore & Benbasat, 1996), adoption of information systems by small businesses (Thong, 1999), and even evaluations of relative advantage of digital channels (Choudhury & Karahanna, 2008). The long tradition of applying these behavioral constructs to information system innovations has empirically suggested that each of these constructs typically have positive impacts on innovation perceptions (Frambach & Schillewaert, 2002; Meuter *et al,* 2005; Jeyaraj *et al,* 2006; Karahanna *et al,* 2006; Choudhury & Karahanna, 2008). Therefore, in our model, we hypothesize that each of the diffusion of innovation constructs will have a positive impact on the perceived value of generally considered PHRs (irrespective of the underlying business model). We note that testing the effects of behavioral diffusion of innovation constructs on perceived value of a digital service (PHR) is not necessarily novel, but it is a necessary step in our simultaneously estimated two-stage model. If consumers do not perceive a PHR (irrespective of the specific business model) to be of high value (e.g., relatively advantageous, compatible, etc.), then the association between perceived value for the PHR and the digital business model would be irrelevant. Therefore, we test the following hypotheses as a first step toward further understanding of consumer value for specific digital business models:

H1: *The following diffusion of innovation behavioral characteristics will each have a positive effect on consumers' perceived value of PHRs.*

(a) *Relative advantage*
(b) *Trialability*
(c) *Compatibility*
(d) *Complexity (ease-of-use)*
(e) *Observability*

We also hypothesize that PHR digital business models, differentiated by variations in the levels of the attributes identified previously, will be significantly associated with consumer perceived value of PHRs. Therefore, the following paragraphs discuss each of the PHR business model attributes identified in this paper in more detail and provide insights into how each attribute may impact consumer perceived value and drive choice. We follow-up this attributes discussion with specific hypotheses associated with each of the digital PHR business models identified in this study.

Switching costs have been shown to have mixed impacts on the perceived value of a digital service. In the PHR market, it has been shown that consumer surplus can increase when switching costs are reduced through the use of an integrated PHR, but producer welfare (of the medical practice agreeing to share records) is affected both negatively (by those patients who switch) and positively (by those who become new patients due to the reduced switching costs) (Ozdemir *et al*, 2011). In other contexts, switching costs are often treated as a moderator between satisfaction and loyalty. For instance, high switching costs often create the appearance of loyalty even when a consumer is dissatisfied because the consumer cannot easily switch to an alternative (Lee *et al*, 2001). Yang & Peterson (2004) find that switching costs only play a significant role when a firm's services are considered above average and, at that point, switching costs have a positive moderating effect on satisfaction and perceived value. The authors go on to suggest that such an effect may occur because net utility is higher when a consumer has a positive perception of a company and switching may not outweigh the benefits of the current relationship. In addition, it has been suggested that firms can enhance lock-in and even enhance profits through 'incompatible competition' where consumers would garner considerable costs when switching to a competitor (Farrell & Klemperer, 2007). Such switching costs can be substantial when considering the range of switching costs that consumers may have to deal with, including procedural switching costs, financial switching costs, and relational switching costs (Burnham *et al*, 2003). All of these forms of switching costs are applicable in the PHR context. For instance, in the PHR context, the network benefits of access to a larger group of health providers may outweigh the potential negative impact of lock-in associated with switching costs (i.e., I can switch between providers within the group without incurring substantial switching costs). The network benefits afforded by a PHR tethered to a standalone provider will be negligible as the 'network' is only one health provider. Therefore, the switching costs associated with lock-in when network benefits are not present will likely result in reduced perceived value. Overall, we suggest that consideration of switching costs will play an important role in a consumer's decision of which PHR business model

to select and specifically that switching costs are higher when the network benefits are not present.

Reduced *effort* has been shown to have a positive impact on decision-making strategies (Todd & Benbasat, 1994). Consumers are highly likely to consider the start-up costs of using a PHR (i.e., learning how to use the features and potentially importing medical records into the PHR) as well as the interoperability of medical records (i.e., the ability to transfer medical records from a provider into a PHR) (see Kahn *et al*, 2009 for more details). Consumer learning has repeatedly been shown to have an impact on adoption of new innovations, especially given the heterogeneity of prior experience that may be associated with adoption (Gregan-Paxton & John, 1997; Xu *et al*, 2010). For instance, those with more experience with similar technologies may be more apt to adopt an innovation (Xu *et al*, 2010) and a long tradition of TAM studies have demonstrated that ease-of-use is a key construct when considering adoption intentions (e.g., Venkatesh *et al*, 2003). Finally, consumer efforts associated with learning and related switching costs have been shown to significantly impact consumer decision-making in new product environments (Osborne, 2011).

Increased perceptions of *risk* have been shown to have a negative impact on the perceived value of a digital service (Featherman & Pavlou, 2003; Pavlou, 2003). In the context of PHRs, *privacy* risk is considered to be a major barrier for adoption (Iakovidis, 1998; Kaelber *et al*, 2008; Baird *et al*, 2012). In addition, we acknowledge that security is also a potential risk, but suggest that competitors within the PHR market do not compete on security (e.g., low *vs* high security) and, thus, there is little to no variation in commitments to security between business models. Privacy, however, tends to vary between business models.

Finally, increased perceptions of *control* have been shown to have a positive impact on the perceived value of a digital service, especially in the context of self-service technologies (SSTs). Meuter *et al* (2000) found that 8% of their interview cases reported that being in control was a motivating factor for 'satisfying incidents' in the use of SSTs. This qualitative work substantiated prior empirical work by Dabholkar (1996), finding that expected control (and expected enjoyment) have positive and significant impacts on the perceived quality of SSTs and the intention to use SSTs. In addition, it has been suggested that control of personal data and privacy are not necessarily synonymous (Tavani & Moor, 2001). These authors suggest an example where one may not have control over how a credit card number is used in an e-commerce transaction once it is submitted online, but the individual does have an expectation of privacy in this scenario (i.e., the credit card number will be kept private and not shared).

Overall, due to the fact that consumers typically consider trade-offs in situations characterized by multiple alternatives and uncertainty and ultimately seek sets of alternative(s) with positive utility (Kenney & Raiffa 1993), we theorize that consumers will also carefully consider value-proposition trade-offs inherent to digital PHR business model selection. Specifically, when considering each of the digital PHR business model attributes explained in the preceding paragraphs and in Table 1, we theorize that consumers will seek the most beneficial (utility maximizing) balance between these attributes, given that producer welfare and consumer surplus often involve competing interests. Literature discussing privacy and control in the context of the theory of restricted access (e.g., Tavani & Moor, 2001), information sharing (Constant *et al*, 1994; Cayton & Denegri, 2003), and the ethics associated with evolving business models and associated social contracts in the digital age (Mason, 1986; Baird *et al*, 2012) have all considered trade-offs inherent in information-based social exchanges and we suggest that consumers, too, will consider trade-offs when evaluating digital service business models.

Specifically in regards to the PHR digital business model where a *PHR is tethered to a standalone medical provider*, it is well known in the health literature that network effects can play a positive role in the flow of information and communication between member organizations, but that technology standards within health care are not universal and sharing information between non-network members is often very challenging (Rye & Kimberly 2007; Christensen & Remler, 2009). A standalone medical provider is typically not able to offer the network benefits of larger medical systems (e.g., Kaiser Permanente) and, therefore, consumer switching costs are likely to be high, the resources available are somewhat limited, the start-up costs (effort) associated with using the PHR may be considered costly as the efforts may not be transferrable, and, as a result, the value proposition will likely not be as attractive. Even though privacy may be high, this will likely not outweigh the negative impacts of the other attributes. Therefore, we suggest that the business model for the PHR where the PHR is tethered to a standalone provider is too restrictive to elicit high perceived value:

H2a: *In the presence of multiple PHR business model choices, the PHR digital service business model tethered to a standalone medical provider will be negatively associated with PHR perceived value.*

We also theorize that *PHRs tethered to groups of medical providers* offer consumers with a more attractive value proposition that balances the aforementioned trade-offs. Specifically, such a business model offers reduced switching costs within the group of providers and reduced effort when switching between providers within the group. In addition, data are controlled by a group that will afford network benefits and privacy within the group of providers is typically high. In other contexts, balancing trade-offs in value considerations has been shown to impact consumer perceived value (Sweeney & Soutar, 2001). Studies have modeled perceived value in the context of adoption intentions as finding the optimal balance between perceived benefits and sacrifices (e.g., Kim *et al*, 2007) and it is well known that consumers must weigh the

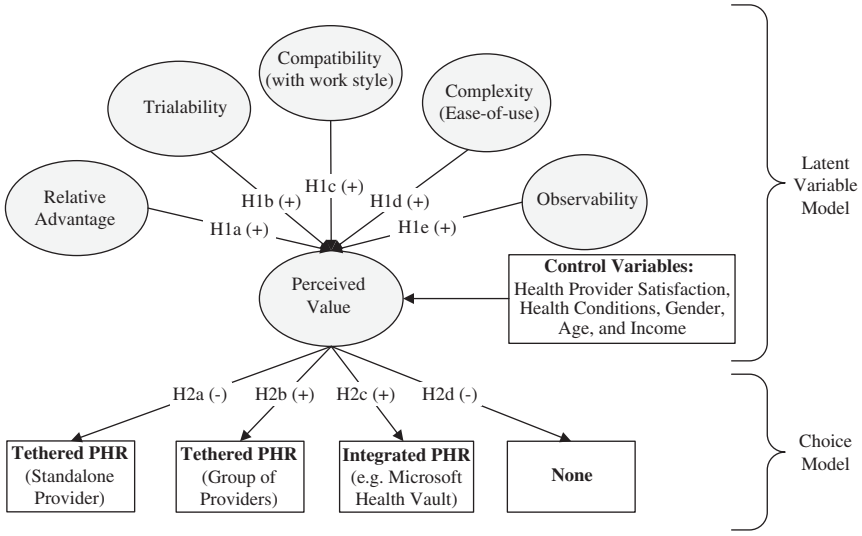

Figure 1 Research model: visualization of relationships between latent constructs and business model choices based on the Ben-Akiva *et al* (2002) integrated latent and choice variable model.

pros and cons of alternatives when making choices (see the discussion of 'mental accounting' by Soman & Ahn, 2011 for further information). Within firms, value creation is often dependent on balanced consumer perceptions of costs and benefits associated with value propositions (Smith & Colgate, 2007) and tethering digital services to groups of medical providers has been shown to have many benefits (Emont, 2011). A recent study conducted in a hospital system context (i.e., multiple healthcare providers within a group) found that offering a tethered PHR increased patient loyalty, indirectly suggesting that such a PHR was not only perceived as valuable, but also increased the perceived value of the service provider (Turley *et al*, 2012). Therefore, we theorize that the benefits of adopting a PHR that is tethered to a group of medical practices are likely to outweigh the costs, given the more balanced approach to the PHR business model attributes previously identified, and will result in positive value perceptions.

H2b: *In the presence of multiple PHR business model choices, the PHR digital service business model tethered to a group of medical practices will be positively associated with PHR perceived value.*

It has also been suggested that the integrated PHR approach could significantly increase overall social welfare in the healthcare market (Detmer *et al*, 2008; Blechman *et al*, 2012). When using an *integrated PHR*, the informational switching costs when moving to a new medical provider, given that data control is solely in the hands of the consumer, are nearly zero. In addition, start-up costs associated with integrated PHRs are incurred initially as a consumer learns to use the system, but are considerably less when switching between providers within the group. Finally, it has been suggested that patient-centric (rather than health provider centric) PHRs offer a range of features that may increase PHR adoption rates (e.g., Archer *et al*, 2011; Krist & Woolf 2011). Therefore, we theorize that *integrated* digital PHR business models will be positively associated with perceived value as a result of lower switching costs, reduced long-term effort, and consumer control of the data as well as privacy of data within the group of medical providers.

H2c: *In the presence of multiple PHR business model choices, the PHR digital service business model that integrates records and information from medical providers into a third-party system (e.g., Microsoft HealthVault) will be positively associated with PHR perceived value.*

Finally, not all consumers will perceive PHRs as valuable and, therefore, we theorize that none of the PHR business models will be attractive to this segment. Including a 'None' option is a typical approach to models that involve multiple choices (e.g., Rubin *et al*, 2006).

H2d: *A lack of perceived value with PHRs will lead to a non-adoption preference, even in the presence of multiple PHR business model choices.*

Based on these hypotheses and our method (discussed in the next section), our conceptual model is presented in Figure 1. The conceptual model is composed of two (simultaneously estimated) parts, based on the model proposed by Ben-Akiva *et al* (2002): (1) The latent variable model and (2) The choice model. The latent variable model is designed to establish overall latent perceived value associated with generally considered PHRs. The choice model is designed to establish associations between latent perceived value for generally considered PHRs and the PHR business model choice set.

Method

To estimate the association of consumer perception value for digital services with underlying digital service business

model choices, we applied an integrated latent variable and choice model (Ben-Akiva *et al,* 2002). Such models have been used to explain how latent, behavioral predictors impact latent utility (termed 'latent perceived value' in our models) and how stated choices are associated with latent perceived value. Integrated latent variable and choice models combine latent variable modeling (typically used in SEM) with a discrete choice model. A discrete choice model typically assumes that the decision-maker is faced with a finite set of choices and makes the choice that results in maximum perceived value. In a typical discrete choice model, latent perceived value is modeled as a function of explanatory predictors, indicators, and the observed choice (Ben-Akiva *et al,* 2002). However, in an integrated latent variable and choice model, the behavioral aspects of the choice (modeled as latent variables) are combined with the discrete choice model to simultaneously derive latent perceived value and associations between latent utility and individual choices. For instance, Wassenaar & Chen (2003) used an integrated latent variable and choice model to demonstrate how performance and comfort are associated with the consumers' choice of a specific type of automobile, beyond standard product attributes (e.g., fuel efficiency). The benefit of such a model is that utility maximizing assumptions, as is the case with the base random utility theory, are based not only on observed explanatory variables and indicators, but also on the behavioral aspects of the choice. Such simultaneously estimated models are beneficial in instances where multiple choices are available and are typically less biased than limited information models based on two stages of estimation (i.e., estimating factor scores and then using the scores as predictors in the utility estimation equation) (Ashok *et al*, 2002).

We propose that it is difficult for consumers to express how they perceive a technology without also considering the underlying value-proposition inherent in the business model. Therefore, in our model, the value perception of the technology remains a latent variable whereas choice for a specific business model may emerge through the latent formation of the preference for the technology, in the context of the business model. We apply an integrated latent variable and choice model to the simultaneous estimation of: (1) The latent perceived value associated with PHRs (irrespective of the business model), and (2) The association between latent perceived value with PHRs and the specific digital PHR business model choices considered. In our models, the five behavioral characteristics from Rogers (2003) (relative advantage, compatibility, complexity/ease-of-use, observability, trialability) form the basis of the behavioral, latent variable model (along with a latent control variable for provider satisfaction) and are used to establish the second-order, latent perceived value (utility) variable. The choice model consists of four potential stated choices provided to respondents corresponding to the three different business models (PHR tethered to a standalone provider, PHR tethered to a group of providers, and an integrated PHR) or an option for 'none of the above'. Estimation was performed using MPlus (based on integrated structural and choice model outlined using MPlus by Temme *et al*, 2008).

Research design

The data were collected through the use of a one-time (cross-sectional) survey e-mailed to 2498 patients who had recently completed medical appointments at a large, multi-facility, urgent care and primary care health services provider for a large university system in the western U.S. The survey was pilot tested in a large undergraduate class prior to final administration and received 661 responses. The survey instrument was refined prior to final administration based on statistical analysis of the data collected in the pilot test. The results of the choice model analysis in the final model were not significantly different than the choice model results within the pilot test, even though the average age in the pilot test was lower than that of the final sample.

The final survey was e-mailed to all patients who visited the clinics within the health system during a two-week period in the spring of 2011. The survey was conducted online and was sent out along with a request for filling out a standard patient satisfaction survey e-mailed to patients after every visit by the provider. All 2498 patients who visited the health system during the two-week period were sent a follow-up e-mail after their office visit with information about the survey and a link to the survey. Even though the sample was limited to a specific set of sites on a convenience basis, a census of patients visiting the practices during the two-week period (all 2498) were given the opportunity to take the survey. A two-week window during a busy season was chosen for sampling to obtain as representative a sample as possible.

This site and sampling method were chosen due to the somewhat transient nature of the patient population. Patients at these clinics often came in for episodic needs (e.g., colds, flu, etc.) and long-term primary care did not typically extend past 4 or 5 years. Therefore, we chose this site because we did not want to bias the results in the following ways: (1) Selecting clinics where patients have an extended relationship with the clinician(s) and would base their survey responses on their desire to stay personally connected with a specific clinician (which can lead to negative views of technological interventions that may impact the 'high touch' nature of an in-person patient-provider relationship), (2) Surveying a population that did not have current health concerns (i.e., surveying those who have not visited a health provider recently and must consider their potential use of a PHR as more abstract than those who have had a recent encounter), and/or (3) Only obtaining a sample of older aged patients (i.e., this often happens in such surveys because health concerns and provider visits often increase with age and obtaining a more representative sample was one of our goals). Surveys of PHRs conducted on larger samples (e.g., Undem, 2010)

often employ random sampling, but can be limited by the hypothetical nature of the responses where healthy consumers are providing responses based on their projections of whether or not they might use a PHR if they become sick or chronically ill. However, the opposite can also occur where surveys are conducted at a health provider site where patients have a very strong relationship with their clinician(s) and do not want technological interventions to damage the physician-patient relationship. We believe that our sample balances these concerns by representing consumers with true health concerns and who have typically not had a relationship with this single health provider for more than 5 years.

Data analysis and results

Of the 2498 surveys sent to potential respondents, 178 responses were received (7.1% response rate). While the response rate is a little low, this seems consistent with declining e-mail response rates, especially for longer surveys, reported by Sheehan, 2001, and is further explained by being combined with the request for the patient satisfaction survey. Forty-four surveys had missing data on one or more questions (24% missing data in final response set). A test of differences between early respondents and late respondents was conducted with respect to several demographic and descriptive variables (health condition, age, gender, income, family structure, Internet usage, travel frequency, and PHR usage/familiarity). No significant differences were present with respect to any of these variables between early and late respondents.

The sample characteristics are described in Table 2. While this sample is somewhat younger than the national average and has a higher incidence of female respondents, these respondents represent actual patients of a large health provider with real (not hypothetical) health concerns. This population is also transient (mix of traditional and non-traditional undergraduate and graduate students who will need to find health care elsewhere once they graduate) and the health service provider emphasizes speed of care over relationship development (e.g., for typical cases, whichever physician, nurse practitioner, or physician assistant is available sees the patient). Therefore, the respondents represent consumers who have recently interacted with a health provider, but have not necessarily developed a strong relationship with that provider. It is also interesting to note that the respondents in this sample report high Internet use and relatively frequent travel. Both of these indicators may motivate PHR usage and further enhance our findings by demonstrating value among potential early (innovative) adopters.

All research measures used within the survey are described in Table 3 and are available in detail in the Appendix, which contains the full survey and full descriptions of the digital PHR business models present within the choice set. The measures for the first-order, latent variables (diffusion of innovation constructs and satisfaction) were all taken from previously validated scales and were adapted to seek general perceptions of PHRs (latent perceived value). The choice model questions (the PHR business models) were developed by the authors of this study.

Table 2 Sample characteristics[a]

Characteristic	*Quantity*	*Percentage (%)*
Current PHR usage		
I currently use a PHR	5	2.79
I plan to use a PHR in the future	82	45.81
I don't plan on using a PHR	48	26.82
Personal health perception		
Excellent	29	16.20
Good	74	41.34
Fair	26	14.53
Poor	6	3.35
Age		
Under 20	21	11.73
20–29	69	38.55
30–39	26	14.53
40–49	9	5.03
50–59	8	4.47
60 or older	2	1.12
Gender		
Male	32	17.88
Female	103	57.54
Annual income		
Under $25,000	67	37.43
$25,000–$49,999	20	11.17
$50,000–$99,999	25	13.97
$100,000 or more	23	12.85
Family structure		
Single without children	90	50.28
Single with child(ren)	3	1.68
Spouse or partner without children	26	14.53
Spouse or partner with child(ren)	16	8.94
Internet usage (per week)		
None (zero)	0	0.00
1–10 h	17	9.50
10 or more hours	118	65.92
Medical insurance coverage		
Yes	124	69.27
No	10	5.59
I don't know	1	0.56
Travel (in past 12 months)		
None (zero)	6	3.35
1–5 times	80	44.69
More than 5 times	49	27.37

Descriptive statistics for the sample including intent to use a PHR, demographics, health perceptions, technology usage, travel frequency, and medical insurance coverage

[a]Percentages are calculated based on 178 total responses. Forty-four responses (or 24.7%) had missing values for all of the above variables.

Table 3 Research measures

Construct	*Abbr*	*Description*	*No. of items*
Theoretically based constructs			
Satisfaction (with provider)[a]	SAT	The perceived satisfaction with the current health care provider.	3
Relative Advantage[b]	RA	The perceived advantage the respondent sees in using a PHR instead of an alternative (such as leaving the records on paper or letting the provider manage the records).	6
Trialability[b]	TR	The preference to use a PHR on a trial basis prior to making an adoption commitment.	3
Compatibility (work style)[b]	CPT	The perceived compatibility of a PHR with the current method of managing records (i.e., someone who already keeps organized records may be more attracted to a PHR).	3
Complexity (ease-of-use)[b]	CPX	The perceived ease-of-use associated with learning and using a PHR.	4
Observability[b]	OBS	The degree to which you have seen others use a PHR.	3
Choice set (different types of business models currently offered in the PHR market)			
Tethered PHR (Standalone provider)	CH1	A web-based PHR that provides online access to pertinent records within the EMR of an individual medical provider (and only that provider).	1
Tethered PHR (Group of providers)	CH2	A web-based PHR that provides online access to pertinent records within the EMR of a group of medical providers.	1
Integrated PHR (e.g., Microsoft HealthVault)	CH3	A web-based PHR offered by a technology company (e.g., Microsoft HealthVault) and is not directly affiliated with a specific provider or group of providers and acts as an 'aggregator' of information.	1
None of the above PHRs	CH4	The respondent would prefer not to use any of the PHRs described above.	1

Theoretically based measures forming the basis of the latent variable model as well as explanations of the discrete business model choice set
Source: [a]Hausknect (1990). [b]Moore and Benbasat (1991), Rogers (2003).

In regards to control variables, we considered various demographic characteristics associated with the respondent (age, gender, and income), health perceptions, as well as the impact of satisfaction with the service provider on perceived value of the digital service. Satisfaction with the physical service that a digital service augments has been generally shown to have a positive impact on perceived value of the digital service (given that the digital service meets expectations). In the context of e-commerce, when the consumer views the online retail channel as convenient and speedy with readily available product information and customer service, satisfaction is often high (Burke, 2002). However, a recent study suggested that use of a patient portal is often associated with dissatisfaction with the doctor (Zickmund *et al*, 2008). Therefore, we include this important control in our model (Table 3).

To assess the association between latent perceived value for PHRs and digital service business model choices, we applied the principles of a Discrete Choice Experiment (DCE) in our integrated latent variable and choice model. In a DCE, a set of choices, which vary by specific attributes, is presented to the respondent and the respondent must select which overall choice is valued (or select 'None of the above choices') (e.g., Rubin *et al*, 2006). In our study, each respondent was randomly assigned to see descriptions of two of the three business models (which vary by the attributes in Table 1) and always received the option to select a preference for 'Neither of the above choices'. We opted to only ask respondents to choose between two business models due to the cognitive load (and amount of time) required to process the differences between more than two business models at a time. The full descriptions provided to the respondents for each of the business model choices are available in the Appendix. For the business models randomly displayed, each respondent was asked, 'If you had to make a SINGLE choice, which ONE would you choose?' The respondent was then asked to choose between the two business models described or 'Neither of the above choices'.

Therefore, one of the following three discrete choice sets of PHR business models was provided to each respondent to choose from (randomly ordered, with 'Neither' always appearing as the last choice):

- A: {Standalone Tethered, Group Tethered, Neither}
- B: {Standalone Tethered, Integrated, Neither}
- C: {Group Tethered, Integrated, Neither}

In all, 33.9% of the respondents responded to discrete choice set A, 34.8% responded to discrete choice set B, and 31.4% responded to discrete choice set C. These discrete choice sets did not have a significant impact when included as indicators in our models (described below). Therefore, exposing respondents to only two of the three available choices did not significantly impact the results.

The means, standard deviations, and Cronbach's α (test of composite score reliability) as well as the correlations between the latent constructs are reported in Table 4 (all calculated within Stata). The constructs were developed

Table 4 Descriptive statistics and correlations for constructs

	Mean	*SD*	α	*SAT*	*RA*	*TR*	*CPT*	*CPX*	*OBS*
SAT	2.37	1.29	0.84	1.00	—	—	—	—	—
RA	4.91	1.29	0.89	0.02	1.00	—	—	—	—
TR	5.29	1.11	0.66	0.16	0.48	1.00	—	—	—
CPT	4.95	0.98	0.78	0.14	0.68	0.52	1.00	—	—
CPX	–0.86	1.03	0.91	–0.09	–0.32	–0.17	–0.49	1.00	—
OBS	1.97	1.09	0.83	–0.17	0.09	–0.25	–0.08	0.18	1.00

Means, standard deviations, Cronbach's alphas, and correlations between satisfaction and the five innovation constructs from Rogers (2003)
Note: These composite scores represent average perceptions on a 7-point Likert scale ranging from 1-Strongly Disagree to 7-Strongly Agree.

Table 5 Descriptive statistics and correlations for PHR business model choices

	Mean	*SD*	*CH1*	*CH2*	*CH3*	*CH4*
CH1: Tethered PHR (Standalone)	0.16	0.37	1.00	—	—	—
CH2: Tethered PHR (Group)	0.24	0.43	–0.25	1.00	—	—
CH3: Integrated PHR	0.07	0.25	–0.12	–0.15	1.00	—
CH4: None of the above PHRs	0.53	0.50	–0.46	–0.61	–0.28	1.00

Descriptive statistics for the responses to the discrete business model choice set

as composite scores within Stata for the purposes of developing descriptive statistics. The alphas with values at about 0.80 and above suggest strong reliability. Trialability has an alpha somewhat lower (0.66), but is still within an acceptable limit. The correlations between the composite scores are all less than 0.80 while one correlation (the correlation between Relative Advantage, RA, and Compatibility, CPT) was in the marginal range of 0.60–0.80. This issue was reviewed in the final model by requesting modification indices within MPlus, but correlation between these two latent constructs was not flagged as a needed modification.

The means, standard deviations, and correlations between the discrete choice set items (the business models the respondents chose between) are reported in Table 5. The correlations were all below 0.80, but 'None of the above PHRs' (i.e., the respondent would rather not use a PHR than select one of the available business models) was correlated with the other three choices at –0.46 (Choice 1), –0.61 (Choice 2), and –0.28 (Choice 3). Such correlation is to be expected, though, because respondents will either pick a business model or select none (i.e., two implicit 'groups' of respondents). Therefore, the negative correlation between 'None of the above PHRs' and the remaining choices suggests that most respondents value at least one of the PHR business models (which is affirmed in the latent variable model results).

The standardized, SEM estimation results of the combined latent variable model and choice model are reported in Figure 2. The fit statistics suggest a relatively good fit ($\chi^2 = 122.572$ at $P<0.000$ with 52 d.f., CFI = 0.936, TLI = 0.953, RMSEA = 0.087). Within the latent variable model, Relative Advantage (RA) (H1a), Trialability (TR) (H1b), and Compatibility with work style (CPT) (H1c) all had positive and significant ($P<0.001$) impacts on perceived value associated with a PHR, confirming the associated hypotheses. These findings are consistent with prior research (discussed previously and outlined in the conceptual model). Complexity (ease-of-use) (CPX) (H1d) had a negative and significant association with perceived value while Observability (OBS) (H1e) was not significantly associated with perceived value, which did not support the associated hypotheses. These contrary findings are discussed further in the next section, but suggest that respondents do not see PHRs (as a whole) as easy-to-use or widely observable. Overall, these results partially support H1(a)-H1(e) suggesting that the five behavioral diffusion of innovation characteristics from Rogers (2003) would have a positive association with latent PHR perceived value.

In the second simultaneously estimated portion of the model, the association of general PHR perceived value with specific digital PHR business model choices was estimated. We find significant differences between the perceived values associated with the different business models included. Specifically, we find: (1) An insignificant perceived value for *PHRs tethered to standalone medical providers* (which does not support H2a), (2) A positive and significant perceived value for *PHRs tethered to a group of medical providers* (supports H2b) and *integrated PHRs* (supports H2c), and (3) A negative and significant perceived value for *None of the above PHRs* (supports H2d) (Figure 2).

Additional models were estimated that replaced the latent perceived value variable with a binary variable representing those respondents who had positive adoption intentions (1 = Currently use a PHR or plan to use a PHR in the future) *vs* those who did not plan to use a PHR in the future (value of 0). In these additional models, the results of the choice model were not significantly different from the choice model results reported. The results of the latent variable model (satisfaction and behavioral diffusion of innovation constructs) were somewhat different in that many of the latent variables did not have a significant impact on adoption intentions. However, in all models, the Relative Advantage (RA) latent variable always had a positive and significant impact and this suggests overall positive perceived value associated with PHR adoption (without regard to the underlying business model).

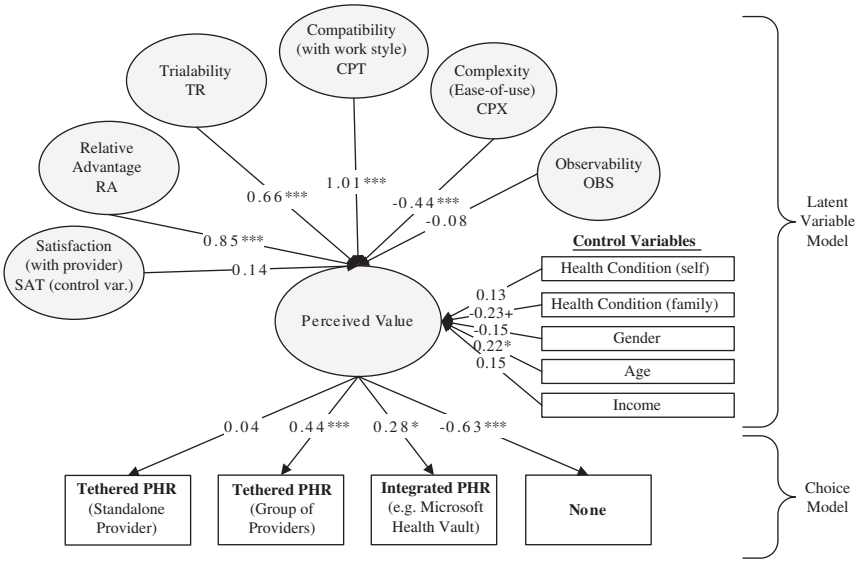

Figure 2 Results for the research model: standardized estimation results for the full structural equation model.
Only latent variables, PHR business model choices, and control variables are shown; Standardized regression coefficients reported; ***P<0.001 **P<0.01 * P<0.05 +P<0.10; Fit statistics: $\chi^2 = 122.572$ at P<0.000 with 52 d.f., CFI = 0.936, TLI = 0.953, RMSEA = 0.087

We also ran a model including only three choices (tethered, integrated, none) where the two tethered choices (1: *A PHR tethered to a standalone medical provider* and 2: *PHR tethered to a group of medical providers*) were merged into one choice (aggregate *tethered* choice). The results were much the same as that presented in the final model in Table 6. The *tethered* choice had a positive and significant association with perceived value (standardized path coefficient = 0.47, $P < 0.001$). The *integrated* choice also had a positive and significant association with perceived value (standardized path coefficient = 0.28, $P = 0.036$). The choice of none of the business models (*None*) had a standardized path coefficient of –0.64 and a P-value of < 0.001. However, in this merged model, the fit statistics were not as strong (CFI = 0.80, TLI = 0.85, RMSEA = 0.16). This suggests that separating the two tethered choices (standalone and group) results in a stronger model fit. A final model run with maximum-likelihood robust (MLR) estimation also confirmed these final results. Overall, these results confirm H2b and H2c that suggested that business models choices would play a significant role in the consideration of PHR perceived value and H2d suggesting that non-adoption value would be associated with decreased perceived value.

To formally test for differences between the coefficients for each digital PHR business model choice, models including Wald-tests of the differences between each of the choice model coefficients were run. In a full model, the Wald-tests for differences between each of the coefficients for the business models were insignificant. However, in a limited model that only correlated *satisfaction* with perceived value (instead of including it in the latent regression), the differences between the business model coefficients were significant. In this limited model, the Wald-test for the difference between the *Tethered PHR (Standalone Provider)* and the *Tethered PHR (Group of Providers)* choice coefficients was significant at $P < 0.001$ (Wald-test value = 18.022, d.f. = 1). The Wald-test for the difference between the *Tethered PHR* (*Group of Providers*) and *Integrated PHR* choice coefficients was significant at $P = 0.035$ (Wald-test value = 4.451, d.f. = 1). The Wald-test for the difference between the *None* coefficient and the other choice model coefficients was also significant (Wald-test value = 68.368, d.f. = 3, P-value < 0.001). While the standardized coefficient values and significance levels between the PHR business model choices and perceived value were nearly identical in this limited model (0.04, 0.44, 0.27, and –0.64), the fit statistics suggested that model fit need improvement (CFI = 0.88, TLI = 0.90, RMSEA = 0.12). This could be an area for future research.

Table 6 Summary of findings

Constructs/Choices	*Hypothesis*	*Predicted*	*Finding*
Relative Advantage	1a	+	+
Trialability	1b	+	+
Compatibility (with work style)	1c	+	+
Complexity (ease-of-use)	1d	+	–
Observability	1e	+	n.s.
Choice 1: Tethered PHR (Standalone Practice)	2a	–	n.s.
Choice 2: Tethered PHR (Group of medical practices)	2b	+	+
Choice 3: Integrated PHR (Third-party)	2c	+	+
Choice 4: None	2d	–	–

Summary of the findings reported in Figure 2

Finally, among the control variables, increasingly poor health conditions associated with family and friends had a negative impact on perceived value (indicating lower perceived value associated with being a caregiver) and age had a positive impact (indicating increased perceived value with age). Health condition associated with self, gender, income, and satisfaction with the clinical provider (SAT) did not have impact on perceived value. It is also interesting to note that Satisfaction with the health service provider was generally low in this sample (mean composite score of 2.37 on 7-point Likert scale ranging from 1-Strongly Disagree to 7-Strongly Agree) and did not have a significant impact on perceived value. This suggests that the relationship with the healthcare provider was not a primary motivator for PHR value considerations and affirms the selection of respondents from a provider where satisfaction is not a primary indicator of use (and, thus, does not bias the results negatively due to the desire to maintain a 'high-touch' relationship with a long-time, well-known physician).

Our findings are summarized in Table 6 and suggest that the majority of the latent constructs have significant impact on perceived value. Overall, our findings suggest that when modeling the association between perceived value and PHR business models, an increase in perceived value is observed for a *PHR tethered to a group of medical providers* or an *integrated PHR*, but not for a *PHR tethered to a standalone medical provider*. The Wald-test results of coefficient differences on a limited model suggest that there is a significant difference between the effect of *PHRs tethered to a group of medical providers* and *integrated PHRs*, but the fit statistics are not as strong (even though the coefficient values are nearly identical).

Discussion

This paper sought to demonstrate that while behaviorally motivated constructs associated with the diffusion of innovations (relative advantage, trialability, compatibility, complexity, and observability) may predict perceived value of an information system (PHR), the business model the digital service is built upon is likely to be significantly associated with consumer choice. We believe business models to be an important consideration in digital service adoption and diffusion due to the recent explosion of consumer-oriented information systems, but little research focus on the impact of varying business models on consumer choice in technology adoption contexts.

Our main finding is that while latent perceived value of generally considered PHRs is high among our sample (as suggested by the positive and significant impact of many of the latent constructs known to be associated with perceptions of innovations) and overall satisfaction with this particular health service provider is generally low, *PHRs tethered to a group of medical providers* and *integrated PHRs* are positively associated with PHR perceived value. And, if the results from the Wald-tests of the comparisons of perceived value coefficients between the business models choice are considered (albeit with a weaker model fit), the results suggest that *PHR tethered to a group of medical providers* have the greatest association with PHR perceived value. This particular business model exhibits high privacy, low (or zero) initial effort to import records into the PHR (the medical group typically does it for you), low switching costs within the group of medical providers (but high switching to a provider outside of the group, which is a trade-off consumer must consider), and limited data control (the medical group controls the data). This is an interesting finding for two reasons: (1) It demonstrates that the adoption of digital services is influenced not only by initial perceptions, but also by considerations of the amount of effort required and the potential for exploitation, and (2) The integrated model, suggested to have the most potential for social welfare (Detmer *et al*, 2008; Tang & Lee, 2009) and potentially better suited to a more transient population (especially one with low service provider satisfaction), may be less valued by consumers.

The PHR market has recently begun to move away from the *integrated PHR* business model (as evidenced by the exit of Google Health from the market, Andrews, 2011; Lohr, 2011), and toward a *patient portal* model (Emont, 2011; Wakefield *et al*, 2012). In a patient portal model, PHRs are tethered directly to a health provider and additional self-service features are also offered. For instance, patients not only have access to their medical records and information (as is the case in a PHR), but can often use additional self-service features, such as requesting appointments online and maintaining an online profile that limits the amounts of forms that must be filled out at the office. Therefore, the findings of this study are substantiated by a market move toward a new business model that balances the pros and cons of the business model attributes included in this study. Specifically, within the PHR market, consumers appear to be prioritizing privacy and effort over data control (i.e., prefer higher privacy and lower initial effort, but find limited data control acceptable) while preferring middle-ground with switching costs and interoperability by indicating a preference for PHRs tethered to *groups* of medical practices that can share records and information between practices. (For more information, see a recent study demonstrating how e-mail between physicians and patients at Kaiser Permanente improved quality, Zhou *et al*, 2010).

In regards to privacy, these findings demonstrate that consumers recognize the complex trade-offs inherent in needing to share data (with medical providers) while limiting the potential for exploitation by third parties, such as entities desiring to use personal health information for marketing purposes (discussed further in Wang *et al*, 1998 and Baird *et al*, 2012). A high value for a *PHR tethered to a group of providers* could be explained as a balance between privacy and data control: the data are not shared with third parties (outside of the provider-patient relationship) and, in turn, some of the control is relinquished by consumers (patients).

In regards to effort, high value associated with a *PHR tethered to a group of medical providers* suggests that

consumers prefer minimized effort in trade for additional switching costs (as compared with using an *integrated PHR*, which has little to no switching costs when a patient moves to a new medical provider). However, switching costs are lower than those associated with a *PHR tethered to a standalone provider* (especially for patients who switch often or see multiple providers). This again suggests that consumers prefer middle-ground when considering such trade-offs. Therefore, just as firms often seek middle ground in B2B relationships (e.g., Clemmons *et al*, 1993), consumers may be exhibiting similar preferences. This too could be an area for future research.

Secondarily, we find that PHRs (as a whole) are not perceived as being particularly easy-to-use and that observing others use a PHR is not likely to have a significant impact on perceived value. This sample, however, uses the Internet frequently (about 66% use the Internet 10 or more hours per week), plans to use PHRs in the future (about 45% report planning to use a PHR in the future), and is relatively young (about 64% are under the age of 40). Many may not have seen others use a PHR yet (likely due to the fact that PHRs are in an early diffusion stage and only about 3% of this sample report PHR usage). Thus, technology aversion is not likely to explain their skepticism with ease-of-use. Consider, though, some of the comments that were made by respondents to our survey: 'Everything has to be seamlessly linked or tethered', 'Would this record be protected like my tax information, not available to prescription drug companies looking to pay for patient information to zero in on a new market?', 'Biggest barrier to PHR's seems to be compatibility with multiple systems'. These comments suggest that consumers may be considering much more than how easy it is to use certain features within an information system and are delving deeper into more personal concerns associated with actual usage (effort, privacy, data control, etc.). Therefore, we suggest that the negative impact of ease-of-use on perceived value indirectly suggests that the factors we included in our business models (privacy, switching costs, effort, and data control) are likely to be simultaneously considered by consumers when picturing themselves using a digital service.

Conclusions, implications, and future research

We find that prior technology adoption research and constructs need to be extended when considered in the digital services context. In particular, consumers are voluntary adopters (rather than employees who are often required to adhere to mandates) and are sensitive to factors not traditionally considered in adoption research. Given that consumer choice is complex in digital markets characterized by many alternatives, research into how consumers perceive and value the underlying factors between such alternatives is paramount to our understanding of diffusion and adoption in this new area of consumer-oriented information systems. Especially poignant to consumer choice are business model factors that affect non-monetary costs and benefits of using the digital service. This paper has demonstrated that digital service business models varying on the dimensions of privacy, effort, switching costs, and data control significantly affect consumer choice in a market where the technology is relatively homogenous. Therefore, business models are a key component to understanding how consumer preferences may impact technology adoption and diffusion.

Theory implications

Much of the theory in the information systems field has been developed in the context of *enterprise information systems* (see Banker & Kauffman, 2004, for a review). While recent research has begun to explore contexts that are more inclusive of the consumer in the information systems context, such as models that evaluate the use of online banking (e.g., Xue *et al*, 2011) and online travel (e.g., Nusair & Kandampully, 2008), many of these models are still primarily focused on how the firm can effectively offer and manage such information systems. The findings of this paper suggest that linkages between firms and consumers are especially important to the future of information systems research. Jeyaraj *et al* (2006) suggest that such linkages are missing from adoption and diffusion research. This study has demonstrated that consumer value will have (and already is having) a significant impact on how information systems are delivered. Therefore, in regards to theory, we suggest that future models delve deeper than considerations of antecedents of perceived value (and adoption intentions) of technological innovations, and more fully consider how business model attributes in digital service offerings impact consumer value perceptions.

Managerial implications

Our results suggest that choice is being driven by convenience (low effort) and a balanced approach to privacy and switching costs, even at the cost of a loss of data control. Therefore, firms considering digital services that directly engage consumers can still maintain producer welfare and lock-in by retaining control of data (which increases switching costs), but must realize that such benefits will only be realized if the underlying digital services business model is designed in a 'balanced' manner that provides consumers with enough incentives to accept potential lock-in. Most importantly, a balanced approach to convenience, privacy, and switching costs are required if the data are to be controlled by the firm. These results suggest that a network of firms (or a large network of business units) is valued more highly than interacting with a single business unit or location. Therefore, established, incumbent firms with a large network of associates, partners, providers, or business units can leverage such network externalities to their benefit when offering new digital services. Challenging firms that do not have the benefit of such a network of partners or business units will likely need to compete by increasing privacy, decreasing switching costs, and/or increasing convenience, even at the risk of losing consumers who are not locked-in.

Limitations

Our study is limited by a relatively low sample size, a survey conducted in a limited set of locations, and a specific context (PHRs) which may limit generalizability. However, we believe this research to be an important first-step in considering 'packages' of supply-side offerings (i.e., digital service business models that package together certain assumptions about factors such as privacy, effort, switching costs, and data control) that consumers consider when selecting a specific digital service. Future research could extend these findings in other contexts and could also consider additional business model properties such as pricing and economic strategies (e.g., Porter, 2001). Comparing and contrasting emerging business models *vs* traditional business models (such as comparing current online banking practices with newly emerging aggregated models such as Mint.com, or by comparing competing digital delivery and consumption models between companies such as Blockbuster, Netflix, and Amazon Instant Video) could yield additional insights. We also acknowledge the hypothetical nature of our survey (i.e., respondents were responding to abstractly considered PHR usage, not actual usage). Future research could extend these findings by analyzing actual usage of PHRs or revealed preferences rather than stated preferences. Finally, we acknowledge that our selection of business model attributes – privacy (risk), effort, switching costs, and data control – was based on unstructured discussions with industry experts rather than formal analysis of all possible attributes and associated inter-rater reliabi;lity ratings associated with the selection of the final attributes.

Future research perspectives

Future research could examine differences in business strategies between small firms (such as individual medical practices or small providers of digital services) and larger firms with a much larger network of providers and business units. Future research could also examine more distinct differences between business models and look for additional covariates. For instance, emerging research has suggested that health literacy and the digital divide may play a key role in patient portal use and access (Sarkar *et al*, 2010, 2011). This study has suggested that digital services provide key linkages between firms and consumers and we contend that future research must acknowledge these linkages, rather than remaining entirely firm-centric. In addition, future studies focused on actual usage of digital services characterized by variations in business models and/or on revealed preferences (rather than stated preferences) may provide additional insights. For instance, hypothetical acceptance and adoption intentions cannot be used to describe usage continuance (and discontinuance). The implications of short-term *vs* long-term usage may be significant in the context of digital services in hyper-competitive markets. As previously mentioned, our study is limited by a single context (PHRs). Further insights are likely to be gleaned when considering other contexts that may differ in terms of channel substitution *vs* complements (e.g., do users prefer digital or physical channels over the other or a combination of both) as well as contexts ranging on a continuum from utilitarian digital services (perhaps targeted toward productive) to hedonic digital services (e.g., entertainment). Finally, future research could examine digital services at an even more granular level, by assessing perceived value at a feature-level (i.e., which specific features do I find valuable?) rather than at a system level. The interactions between feature valuations and business model attribute valuations are likely to yield interesting insights.

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Appendix A

Table A1 Questionnaire items

Construct	*Item*	*Measure*
Theory-based constructs[a]		
Satisfaction	SAT1	I am satisfied with my current health care provider(s).
	SAT2	What I get from current health care provider(s) *falls short* of what I expect.[b]
	SAT3	I plan to remain with my current health care providers(s).
Relative Advantage	RA1	I believe the benefits of using a PHR would be greater than the costs.
	RA2	There are more advantages than disadvantages when using a PHR.
	RA3	PHRs are better than only keeping health records and information on paper.
	RA4	PHRs are better than solely relying on healthcare providers to manage health records and information for me (or for my family).
	RA5	Using a PHR would save me (or my family) money.
	RA6	Using a PHR would save me (or my family) time.
Trialability	TR1	I would prefer to use a PHR on a trial basis before making a full commitment.
	TR2	Experimenting with a 'demonstration' version of a PHR would be helpful.
	TR3	The opportunity to tryout various uses of a PHR *is not* available to me.[b]
Compatibility	CPT1	Using a PHR would be a good fit with my personal health record and information needs.
	CPT2	Using a PHR would fit well with how I manage personal health records and information.
	CPT3	If I used a PHR, I would *not* have to make drastic changes to the way I manage personal health records and information.
Complexity	CPX1	I believe that a PHR would be cumbersome to use.[b]
	CPX2	Using a PHR would be frustrating.[b]
	CPX3	Overall, I believe a PHR would be easy to use.
	CPX4	Learning to operate a PHR would be easy for me.
Observability	OBS1	I have seen other people use a PHR.
	OBS2	In my community or social group, many people use PHRs.
	OBS3	I have had plenty of opportunities to see a PHR being used.

[a]Instructions to respondents were: 'Please SELECT the number which best represents your level of agreement or disagreement with the following statements'. Respondents were provided with a 7-point Likert scale ranging from 1 (Strongly Disagree) to 7 (Strongly Agree).
[b]Reverse coded in the analysis.

Table A2 Discrete choice set of PHR business models[a]

Choice	*Description*
Tethered PHR (Standalone)	You are a patient (or are a caregiver of a patient) at a medical practice (doctor's office) that *is not* part of a group of medical practices. This medical practice is offering a Personal Health Record (PHR) that ties directly to your patient records (or the records of those in your care) and information at *this* medical practice *only*. *Privacy:* High Privacy (HIPAA Compliant) *Effort required to get records into the PHR:* Little effort *Effort required to retains records when switching to a new provider:* High effort *Primary control of your data:* Healthcare provider
Tethered PHR (Group)	You are a patient (or are a caregiver of a patient) at a medical practice (doctor's office) that *is* part of a group of medical practices. This medical practice is offering a Personal Health Record (PHR) that ties directly to your patient records (or the records of those in your care) and information at this medical practice *AND* any medical practice within the group. *Privacy:* High Privacy (HIPAA Compliant) *Effort required to get records into the PHR:* Little effort *Effort required to retains records when switching to a new provider:* High effort (little effort required *within* the group) *Primary control of your data:* Healthcare provider
Integrated PHR	A Personal Health Record (PHR) is being offered by a big technology company (such as Microsoft or Google), but is *not* connected directly to any healthcare provider. *Privacy:* Medium privacy: HIPAA compliance does not always apply *Effort required to get records into the PHR:* High effort *Effort required to retains records when switching to a new provider:* Little effort *Primary control of your data:* You (as a patient or caregiver)
None of the above PHRs	NA

[a]Respondents were randomly presented with two choices (selected from the three potential business models listed above). Instructions to respondents were: 'If you had to make a SINGLE choice, which ONE would you choose? Please place an X next to your preferred choice'. If the respondent did not prefer either choice, he or she could select, 'Neither of the above choices'.

Example choice question (after seeing descriptions for the 'Tethered Standalone PHR' and the 'Tethered Group PHR'):

If you had to make a SINGLE choice, which ONE would you choose? Please place an X next to your preferred choice:

_____ CHOICE #1: Online PHR attached directly to an *individual* medical practice.

_____ CHOICE #2: Online PHR attached directly to a *group* of medical practices.

_____ Neither of the above choice.