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Making the Case for Leveraging the Patient-Centered E-Health (PCEH) Context to Expand Information Systems Theory

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Abstract:

Patient-centered e-health (PCEH) represents a fascinating area of digitized stakeholder interactions characterized by complex information flows, shared decision making, co-created value, and mutual interest in improving health outcomes. Such a context lies in contrast to often contentious firm-consumer relationships characterized by self-interest, surplus maximization (from both producer and consumer sides), and consumer segmentation. This article suggests that PCEH is an ideal context in which to study the emerging class of information systems that include consumers as empowered influencers, stakeholders, and decision makers, rather than only “purchasers” on the other side of the exchange relationship or “mandated” users in the enterprise context. The PCEH context is proposed as an enormous research opportunity that may significantly contribute to expanding information systems research and theory.

Keywords: patient-centered e-health; research opportunities; inductive and deductive PCEH literature

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I. INTRODUCTION

Patient-centered e-health (PCEH) is defined as the delivery of empowering patient-centric health services to those who want to take an active role in their own care [Wilson, 2009]. Few contexts represent a scenario where stakeholders often work together through digital channels to maximize mutually beneficial outcomes. Shared goals between healthcare stakeholders often result in a unique instance in which collaborative, multidirectional relationships are not only desirable, but required. Such a context lies in direct contrast with many traditional, supply-side business practices focused on maximization of revenue, productivity, and shareholder value executed via strategies involving consumer segmentation, price discrimination, and, sometimes, exploitation. Additionally, healthcare consumers, unlike consumers in more traditional markets, are typically driven by health outcome goals, engagement, and overall experience satisfaction rather than only by maximization of consumer surplus and short-term utility. Therefore, rather than quasi-confrontational relationships between stakeholders, PCEH represents a significant opportunity for stakeholders to co-create value and to develop valuable connections through digital intermediation. This article contends that these opportunities within the PCEH context afford significant research potential not yet fully explored in the information systems research literature.

Generally stated, PCEH is focused on digitizing healthcare stakeholder interactions in ways that often challenge traditional, firm-centric theoretical assumptions. Information systems research has typically either focused on the use of technology and information within or between firms or the acceptance of information systems by employees, managers, and/or customers. Causal mechanisms based on models of technology acceptance [Davis, 1989; Venkatesh, Morris, Davis and Davis, 2003], diffusion of innovations [Fichman, 2004], economics of information [Shapiro and Varian, 1999], and even more specific models, such as work systems [Alter, 2002] and the resource-based view [Bharadwaj, 2000], often predict how the relationships and technological interventions between firms, other firms, and employees impact various outcomes (intentions to adopt, productivity, efficiency, etc.). As such, much of our theoretical knowledge is based on the design, adoption, diffusion, use, and management of enterprise information systems as well as the productivity and efficiency impacts of such enterprise systems at firm, industry, and country levels [Banker and Kauffman, 2004]. Bryman and Bell [2007] suggest that this current business research paradigm is focused on firms delivering value to consumers for a profit, but a fundamental shift is occurring toward consideration of outcomes other than just profits (and revenue). As an example, supply-side adoption of innovative information systems is traditionally said to be driven by “dominant” firm characteristics (such as the size of the firm, the amount of resources available, availability of management support, being in a competitive market, etc.) [Fichman, 2004]. The nature of information systems is changing, though, and multiple stakeholders, including consumers, now have a significant stake in the usage and success of information systems, especially in the PCEH context. However, linkages and influences between firms and consumers are not yet fully represented within traditional theoretical views [Jeyaraj, Rottman and Lacity, 2006]. The inclusion of the consumer as a partner in decision-making and outcome-based processes is fundamentally transforming how we think of information systems.

Imagine a future where the only products and services that dominate are the ones designed to capitalize on synergies between supply-side capabilities and empowered customers [Searls, 2012, July 21] and usage of consumer-oriented information systems is sporadic, on an as needed basis [Wilson, Mao and Lankton, 2010]. This article contends that PCEH is representative of such a future. Specifically, this article proposes that PCEH represents a significant research opportunity for exploring and analyzing complex, digitized stakeholder interactions, associated shared decision making, and complex information flows, as well as extracting mutually beneficial value from co-created information. In order to more fully elucidate how the PCEH context may play a key role in future information system research initiatives and provide significant new insights, this article provides examples of extant PCEH research from both inductive and deductive viewpoints, identifies research gaps, and offers an outline of research questions that may be of interest to future researchers.

II. OVERVIEW OF CURRENT PCEH RESEARCH

To more fully describe and explore the current state of PCEH research, this article provides an overview of the existing bases of PCEH inductive and deductive literature. Theory building typically goes through an inductive cycle and then, as foundations of observations, categorizations (and abstractions), and correlations are established, theory building moves into the causal phase by iterating through deductive cycles [Carlile and Christensen, 2005; Christensen, 2006; Christensen, Carlile and Sundahl, 2002]. The following PCEH literature overview section is

organized according to the inductive and deductive aspects of this theory building framework and concludes with a discussion of where there are significant research voids in the PCEH context.

Inductive PCEH Research

Much inductive PCEH research has effectively demonstrated that, in specific cases, the implementation of PCEH decision-aids, collaboration, and communication systems have successfully attracted early supply-side and demand-side adopters. For instance, Hassol et al. [2004] surveyed a large number of patients (N = 4,282) within the Geisinger Health System who were registered users of an early patient portal called MyChart. This study found that patients preferred Web messaging in many instances, primary care providers were somewhat reserved in their satisfaction with online communication, and patients considered the portal to be easy-to-use, but had mixed feelings about the effectiveness of the access and display of their medical information (e.g., medical histories were sometimes wrong, the medication list was sometimes inaccurate, etc.). In fact, a number of descriptive studies have stated that barriers to adoption are still present [e.g., Halamka, Mandl, and Tang, 2008; Tang, Ash, Bates, Overhage and Sands, 2006; Whitten and Adams, 2003] and moving beyond usage challenges [e.g., Weingart, Rind, Tofias and Sands, 2006] will be an important first step in working toward more in-depth causal arguments.

Beyond observation that often occurs early in inductive cycles, typologies and frameworks associated with e-health have also been developed [e.g., Chan, Matthews and Kaufman, 2009; Dansky, Thompson and Sanner, 2006; Demirir et al., 2008; Svensson, 2002] and correlations with outcomes have been demonstrated in some studies (e.g., correlation of satisfaction with telemedicine offerings [Gustke, Balch, West and Rogers, 2000]). This suggests that an excellent cycle of inductive research is ongoing and that lessons are being learned in the PCEH context. However, such research is primarily present in the healthcare literature and has not been fully represented in the information systems literature. This is likely due to the newness of the PCEH, the emergence of supporting technologies and information systems, and the push toward patient-centered care within the U.S. healthcare system. Additionally, adoption and diffusion of the prerequisite systems and infrastructure has begun to push past the early sections of the diffusion curve [Emont, 2011]. Much of this push can be attributed to the policy decisions surrounding “meaningful use” that, as of the time of this writing, are still unfolding in the market [Blumenthal and Tavenner, 2010]. Perhaps, too, typologies are typically focused on the healthcare aspects of PCEH and not the contribution of PCEH systems to stakeholder interactions or to information systems theory.

While context-based research is often published in context-specific journals, information systems researchers seem to be missing out on an excellent opportunity to join the inductive cycle of theory building within the PCEH context. This could be due to the fact that theory-based research is typically preferred in the top information systems journals and grounded theory approaches have not yet been fully conducted by information systems researchers in the PCEH context. This could also be due to the fact that PCEH interactions and collaborations extend the information systems discipline into a new domain, beyond firm-centric viewpoints, and such findings may be difficult to fully explain with current theory. For instance, in an article in the *Journal of the American Medical Informatics Association* (JAMIA), a grounded theory approach was used to inductively assess whether or not patients with a chronic medical condition perceived online access to medical records as useful [Winkelman, Leonard and Rossos, 2005]. The study found that simply providing online access to records was not that useful, but integrating the use of such technology into a multifaceted care program (including promoting a sense of disease ownership) as a supportive and personalized tool would result in higher perceived usefulness. The study concluded by saying that behavioral theories, such as TAM, would be potential frameworks for further understanding of consumer-driven information systems in health care, but also stated, “However, since patients with [chronic disease] are not employees of the health care organization, reinforcements for use of information technology by patients are much less obvious. Since a patient’s motivation, setting of actual use, and informational needs are different from employee-users or professional-users, a patient’s perception of ICT usefulness may be quite distinct as well” [Winkelman et al., 2005, p. 312].

Overall, while many specific cases of PCEH adoption and usage have been written up and evaluated in the healthcare literature (e.g., cases of patient portals implementation and results as reviewed by Emont [2011]), questions remain as to how the scale and depth of current inductive PCEH research may impact future normative theorizing. For instance, Emont [2011] points out that the majority of patient portal research has been conducted in the context of large integrated delivery systems (IDSs). If we are to truly understand how the physical environment, social and economic factors, clinical care, and health behaviors impact outcomes [Emont, 2011; Oliver, 2010] as well as how the usage of PCEH impacts health provider operational efficiencies and productivity [Emont, 2011], and then apply these findings to a cycle of normative research, much remains to be done.

The next section describes some of the deductive research that has been occurring in the PCEH context (see Table 1) and suggests that, while more PCEH deductive research is more prevalent in information systems journals than inductive PCEH research, many research opportunities remain.



Table 1: Examples of Inductive Articles in the PCEH Context

Journal Article	PCEH system(s) considered	Theory/theories	Method	Primary finding(s)
Whitten and Adams, 2003 (<i>Journal of Telemedicine and Telecare</i>)	Telemedicine	None—Case study description and analysis	Comparison of one successful case and one unsuccessful case of telemedicine implementation and use	Constraints (resource-based and geographical) impact telemedicine programs and must be fully considered prior to introduction.
Tang et al., 2006 (<i>Journal of the American Medical Informatics Association</i>)	Personal health records (PHRs)	None—Descriptive	Summarizes a symposium discussion of PHR definitions, benefits, barriers, and strategies	Many important issues must be considered if PHRs are to diffuse widely, especially in regards to policy, barriers to adoption, and stakeholder involvement.
Weingart et al., 2006 (<i>Journal of the American Medical Informatics Association</i>)	Patient portal	None—Case study description and analysis	Case study analysis of implementation and use of PatientSite, a patient portal at Beth Israel Deaconess Medical Center	Found that laboratory and radiology were the most used features and that specific demographics (e.g., lower age, more income, better health) were associated with use.
Glasgow, 2007 (<i>American Journal of Preventative Medicine</i>)	E-health	None—Categorizes, reviews, and summarizes e-health research opportunities	Literature analysis using the Reach Effectives Adoption Implementation and Maintenance (RE-AIM) framework	Future e-health research should be: representative, robust, and replicable.
Halamka et al., 2008 (<i>Journal of the American Medical Informatics Association</i>)	Personal health records (PHRs)	None—Descriptive (and case analyses)	Description of three patient portal implementation and use case studies	Explains the implementation process and identifies several challenges, including data sharing and social interactions between patients with the same chronic condition.

Deductive PCEH Research

Deductive research in the PCEH context is now emerging in information systems journals and many of these deductive studies employ TAM-based approaches. The general consensus of these studies is that perceived usefulness has the strongest impact on intentions to use PCEH technologies [Chau and Hu, 2002; Hu, Chau, Sheng and Tam, 1999]. Additional constructs, such as personal innovativeness and computer self-efficacy [Klein, 2007], have also been shown to have impacts in the patient portal context.

As an example, a systematic review reviewed fifty-two articles that studied acceptance of one or more consumer health information technologies. The general conclusion from this review was that the majority of acceptance-based models used patient-related variables (such as demographic, health, and technology experience variables) and only a limited number of variables related to human-technology interaction, organizational factors, and environmental conditions were considered. This review pointed out that ninety-four different acceptance-related predictor variables were applied in these fifty-two studies, and, yet, “Most of the studies were atheoretical, left out reliable predictors of acceptance, and did not test possible mediators and moderators that could help explain findings” [Or and Karsh, 2009, p. 556]. The authors concluded by stating, “...future research on [Consumer Health Information Technology] acceptance [should] consider a variety of theoretically relevant individual, human-technology interaction, organizational, social, task, and environmental variables” (p. 557).

Quite a few deductive studies, though, have assessed whether or not specific PCEH technological interventions have had an effect on outcomes such as effectiveness or health-related outcomes. While much of this research does not always use a specific theory, performance or economic considerations of associating a technological

intervention with outcome(s) is typically the basis. Systematic reviews of such studies have found: mixed findings associated with the impact of telemedicine on effectiveness [Ekeland, Bowes and Flottorp, 2010], a positive impact of decision aids on active patient participation in their own care but mixed impacts of decision aids on satisfaction and outcomes [O'Connor et al., 1999], a positive impact of the use of cellphones for health reminders on patient health outcomes and care processes [Krishna, Boren and Balas, 2009], and an increase in administrative efficiencies and a limited number of patient health outcomes associated with the offering of PHRs and patient portals [Emont, 2011].

Beyond outcomes-based research, some additional theories have been proposed as providing potential explanations for possible causal predictors in the PCEH domain. For instance, Laugesen and Hassanein [2011] suggest a model based on Protection Motivation Theory (PMT), Task-Technology Fit (TTF), and Patient Activation Measures (PAM) (but this model has yet to be empirically tested). Pingree et al. [2010] suggest that more theoretical work needs to be done in the e-health context and suggest a causal model based on the Comprehensive Health Enhancement Support System (CHESS) framework in which active processing of information is associated with a variety of health and behavioral outcomes (but this too has yet to be empirically tested or validated). Baird, Furukawa, and Raghu [2012a] find that contingency theory plays a key role in supply-side patient-portal adoption decisions.

It should also be mentioned that deductive research in the more broadly considered health information technology (HIT) domain has been growing expansively (see Table 2). For example, a special issue in *Information Systems Research* (ISR) dedicated to the topic of "The Role of Information Systems in Healthcare" resulted in several interesting papers that expanded our theoretical knowledge using the context of healthcare in areas such as healthcare quality, privacy and willingness-to-disclose issues associated with personal health information (PHI), impacts of regulation and competition, and a variety of findings related to coordination, alignment, and usage patterns associated with HIT [Fichman, Kohli and Krishnan, 2011]. While the majority of the studies in the ISR special issue were deductive and provided valuable theoretical insights (beyond TAM-based concepts and constructs), digital interactions in health care remain underresearched. Additionally, an ISR commentary also demonstrated the increasing depth of HIT research associated with the adoption of HIT and the associated impacts on quality and efficiency, but the authors specifically stated, "...very few studies have centered on patient-focused applications that are *outside of the traditional electronic health record (EHR)/electronic medical record (EMR) system*" (italics mine) [Agarwal Gao, DesRoches and Jha, 2010, pg. 803, Goldzweig, Towfigh, Maglione, and Shekelle 2009]. Therefore, while research in HIT is expanding, PCEH and related patient-centered technological intervention research is notably limited and is ripe for further exploration and analysis.

Making the Case for Expanding PCEH Research

Many PCEH correlation-based and causal questions remain unanswered (or incompletely answered) when considering the use of PCEH to achieve mutually beneficial desirable outcomes, facilitate multi-directional information flows, and empower consumers (and informed service providers). For instance, consider the following questions: Are the current cases of PCEH implementation, design, and usage explained at a sufficient scale and depth to provide the needed foundation for future normative research cycles of PCEH research? Have constructs been fully developed that explain antecedents, usage, and consequences of PCEH? Are the categorizations and correlations between proposed PCEH constructs already known, or only just emerging? What are the key social, psychological, and economic predictors for continued use and effectiveness of PCEH? Are our current causal mechanisms sufficient for evaluating adoption, diffusion, and outcomes associated with PCEH?

Many of these questions would be difficult to fully answer with our current PCEH understandings and predictive capabilities. Granted, a growing amount of research has been conducted on consumer-oriented information systems in other research contexts such as e-commerce, online banking, and online travel. Therefore, it could be argued that stakeholder interactions, especially firm-consumer interactions, have already been studied in the information systems literature and PCEH represents just another context. For instance, acceptance has been thoroughly researched in the online banking context [e.g., Pikkarainen, Pikkarainen, Karjaluoto, and Pahnla, 2004; Tan and Teo, 2000] and similar constructs as discussed earlier in the PCEH context, such as innovativeness and personal characteristics [Lassar, Manolis and Lassar, 2005], have been shown to have an impact. E-commerce has been used as a context to study firm-level adoption [Hong and Zhu, 2006] and customer-related variables such as satisfaction [Kohli, Devaraj and Mahmood, 2004] have also been considered. Additional theories, such as expectation-confirmation theory, have been used in these contexts to demonstrate why customers may not continue using information systems [Bhattacharjee, 2001]. However, many such studies are typically conducted from the supply-side view, with limited applicability to complex stakeholder interactions (e.g., patient-provider, patient-patient, payer-patient, and policymaker-patient interactions). Therefore, the following section suggests a number of outstanding PCEH research opportunities that could fill these gaps and significantly contribute to information systems theory and research.

Table 2: Examples of Deductive Articles in the PCEH Context

Journal Article	PCEH system(s) considered	Theory/Theories	Method	Primary finding(s)
Hu et al., 1999 (<i>Journal of Management Information Systems</i>)	Telemedicine	Technology Acceptance Model (TAM)	Survey of physicians to determine if physicians intend to use telemedicine	Physician perceived usefulness and attitude had positive and significant impacts on intention to use.
Chau and Hu, 2002 (<i>Information and Management</i>)	Telemedicine	Empirical test of TAM versus Theory of Planned Behavior (TRB)	Survey of physicians	Suggest that TAM is superior to TRB for explaining physician acceptance of telemedicine. Perceived usefulness has the strongest impact on physician acceptance.
Tufano and Karras, 2005 (<i>Journal of Medical Internet Research</i>)	Mobile E-health (in the context of obesity)	Review/analysis of several theories including: Health Belief Model, TRA, Transtheoretical Model, Learning and Conditioning Theory, Decision-Making Theory, and Diffusion of Innovations	Literature review, critique, and analysis	Suggests that weight management may be effectively managed with interventions based on mobile devices using principles from new social theories including Social Cognitive Theory and the Social Marketing Model
Klein, 2007 (<i>European Journal of Information Systems</i>)	Patient portal	Empirical test of TAM	Survey of patients	Affirms impact of TAM constructs as well as a positive effect of computer self-efficacy (CSE) and personal innovativeness (PI) on intentions to adopt.
Crutzen, Cyr and de Vries, 2011 (<i>Journal of Medical Internet Research</i>)	E-health	e-Loyalty (new model built on constructs from prior research)	Survey of study participants who interacted with the selected intervention websites	Effectiveness and enjoyment, mediated by trust, have a positive and significant impact on e-loyalty with e-health websites.

III. IDENTIFICATION OF PCEH RESEARCH OPPORTUNITIES

A complete understanding of PCEH pre-consumption (motivation, search, and selection), consumption (usage, engagement, and retention), and post-consumption (satisfaction, loyalty, switching, and re-purchase) is currently lacking. For instance, little is known about what motivates healthcare providers, producers, and payers to take on the additional risk and reward potential associated with the adoption and offering of PCEH systems. Additionally, little is known about how policy makers may ultimately influence the market for digitally intermediated stakeholder interactions in a shared decision-making context.

In the pre-consumption stage of PCEH systems and devices, potential adopters (healthcare consumers, providers, producers, and payers) may be motivated by norms, social and industry pressures, the potential for convenience and efficiencies, the potential of various technical capabilities (both expected and known), and/or the need or desire to share information and leverage information to create value (e.g., physician needing more information about the daily routines and vital signs of the patient). In order to reach this point, though, supply-side stakeholders (providers, payers, and producers) must decide to take on the risks, rewards, and responsibilities associated with offering patient-centric digital services or devices. Such a decision-making process is not likely to be taken lightly as adoption of such technologies is likely to yield many questions that have not yet been answered by research or practice. There will likely be many antecedents, constraints, and indirect effects (mediators and moderators) that impact such decision making on both the supply side (e.g., providers and payers asking themselves, "Should I offer a PCEH system/device to my patients?") and the demand side (e.g., patients asking themselves, "Am I willing to invest time and effort into an information system that may help improve my health in the long run?"). Additionally, service providers must consider how certain features and capabilities of internal systems (e.g., EHRs) will be

provisioned, shared, and/or integrated with PCEH systems (e.g., patient portals). And, PCEH may not be needed on a continuous basis as sporadic or episodic use [Wilson, Mao and Lankton, 2010], which may define much of this unique market. Assessment of such correlations and causal impacts at this early stage of PCEH assessment will be vital to understanding how healthcare consumers and healthcare providers perceive PCEH technologies.

If health providers, producers, and/or payers ultimately decide to overcome supply-side adoption barriers and accept the associated risks of offering innovative PCEH solutions, healthcare consumers are also likely to consider potential adoption risks and barriers from a demand-side perspective. For instance, healthcare consumers are likely to consider the value and reputation of the service provider, prior experiences with the service provider or related products (or prior experiences of those in their social network), recommendations by others, and the degree to which PCEH systems match their immediate and long-term needs. It is important to consider that unlike a corporate environment, healthcare consumers are often the ultimate decision makers (rather than management). Such considerations of motivation in a voluntary use context will be especially important in the physician-patient relationship where usage cannot be mandated, but rather encouraged. Perceived ease-of-use and perceived usefulness may indeed be high when considering the technology itself, but more is at stake than acceptance. Healthcare consumer motivations are highly likely to be moderated by policy considerations (e.g., privacy of personal health information), technical considerations (e.g., security and infrastructure reliability), motivation considerations (e.g., intrinsic and extrinsic motivation), as well as hedonic considerations (e.g., the pleasure derived from using the system) and utilitarian considerations (e.g., will the end result be worth my effort?).

Finally, if direct and moderating effects are not overtly negative, purchase (or exchange—as is often the case with free products or those that do not require monetary exchange) may occur and usage (consumption) is likely to follow. Encouraging repeat usage, engagement, and retention of a user-base often requires overcoming barriers of immediate vs. long-term needs, habit forming (or non-habit forming) behaviors, healthcare consumer satisfaction, the ongoing value of usage and the potential of diminishing returns, and market and technology trends. PCEH systems are often digital services (and devices) available nearly instantly (e.g., downloading a needed app on a smart phone or using PHR services available online) and operate in a highly differentiated market (e.g., monopolistic competition). However, even though the PCEH context is unique, interesting, and full of potential, adoption is often low [e.g., Emont, 2011], resulting in incomplete understandings of the PCEH usage, retention, and post-consumption factors.

Given the considerations mentioned, the following sections consider potential PCEH research agenda topics in more detail (summarized in Table 3). Motivated by identified PCEH research gaps, these proposed research questions encourage the development of new models and the use of additional theory to answer emerging and fascinating PCEH-based research questions.

Platform and Portfolio Decisions

Platform development (or combining products into a portfolio that uses a common platform) can offer many benefits to software producers and vendors, including tighter integration between products and lower costs for producing variants [Krishnan and Gupta, 2001]. Many Microsoft products, Apple operating systems for Macs and mobile devices, and even more niche products such as Intuit products (Quicken, TurboTax, QuickBooks, etc.) are all notable examples of platforms and portfolios of products that consumers can select. In the PCEH context, selecting a single platform that integrates all medical devices, information, and records may be a choice that consumers face in the future (e.g., perhaps Microsoft HealthVault will become such a platform in the future). However, the selection process is likely to require finding an optimal balance between trade-offs associated with many decision attributes (i.e., access, cost, quality, future performance and innovation, etc.) that we currently know little about. In addition, selecting incumbent platforms may lock the consumer out of emerging markets. Such negative effects could be mediated by standards, but standards may allow for easier consumer switching. Therefore, several PCEH platform- and portfolio-related questions remain open:

- Are healthcare consumers more apt to select PCEH systems (such as patient portals or medical information/service hubs) that are part of platforms or portfolios, rather than entirely independent?
- What attributes and trade-offs do consumers consider when deciding whether or not to select a PCEH product or service offered as part of a platform or portfolio?
- Are platform and portfolio decisions moderated by the “newness” of the technology (i.e., early in the diffusion cycle, platforms are less important than they are later in the diffusion cycle)?
- What sorts of design, architecture, and human-computer interaction (HCI) considerations must be addressed when encouraging selection and long-term usage of such platforms and portfolios?

Table 3: Summary of Proposed Expansions to PCEH Research Agendas

Topic	Sample of proposed research questions
Platform and portfolio decisions	Are healthcare consumers more apt to select PCEH systems (such as patient portals or medical information/service hubs) that are part of platforms or portfolios, rather than entirely independent?
Locus-of-informational control	Is there an optimal point of PCEH informational control where supply-side competitive advantages can be balanced with consumer interests, leading to maximum overall welfare?
Value appropriation, market structure, and value chains	What is the effect of collaboration and co-production of information within PCEH contexts? Are there instances where value co-production is ineffective?
Capabilities and strategy	How does the degree of PCEH capabilities mediate patient-provider and patient-to-patient relationships?
Information system features and feature fatigue	Do consumers select and adopt based on features advertised, but only use core features until comfortable with the PCEH system? If so, what implications does this have?
Policy	What are the legal and economic implications of overregulating or underregulating PCEH?
Social norms, social exchange, and social contracts	Will firms be willing to accept social contracts that afford them less market power in trade for greater PCEH market share?
Design science/IT artifacts	How will the design of PCEH artifacts impact consumer adoption intentions, PCEH product and service diffusion, and the market for PCEH products and services?
Agency theory and consumer Empowerment	How will consumers monitor clinicians (and vice versa) in PCEH markets where mutually beneficial information is shared between multiple parties, such as in the doctor-patient relationship?
Behavioral economics	How influential are emotions and behavioral factors in the pre-consumption, consumption, and post-consumption phases of PCEH consideration, use, and continued use or discontinuance?

Locus-of-Informational Control

Information control is an important source of competitive advantage [Porter and Millar, 1985]. This is a particularly important issue in the context of PCEH as medical information is particularly valuable for both health and economic outcomes, but can lead to market failures if not managed appropriately [Baird, Raghu and Tulledge-Scheitel, 2012b]. Information can also be used to moderate potentially volatile relationships. Firms have already realized that sharing information with suppliers is a great way to undermine the bullwhip effect [Lee, Padmanabhan and Whang, 1997] and consumers have realized that many free products must be monetized in some way, often with targeted advertising [Gordon and De Lima-Turner, 1997]. However, informational control and associated control mechanisms are likely to be hotly debated for some time to come as providers, payers, and patients wrestle with giving up some control in the hopes of jointly reducing costs, making decisions jointly, increasing quality, and finding new competitive advantages that rely on a more balanced consideration of firms, consumers, and regulators in a participatory market, rather than an adversarial market.

- Is there an optimal point of PCEH informational control where supply-side competitive advantages can be balanced with consumer interests, leading to maximum overall welfare?
- How are PCEH markets affected by control mechanisms? Are stringent control mechanisms necessary for diffusion in the earlier phases of diffusion within such digital markets?
- Are there situations or contexts where the locus-of-control of information must remain with the firm or with the consumer? How should firms and policy makers determine where stringent controls are necessary (versus unnecessary adoption and usage barriers)?

Value Appropriation, Market Structure, and Value Chains

Traditionally, value creation has been based on a production model of inputs and outputs with Porter's [1985] value chain of firm inputs, activities, and the margin on outputs at the center of most research on value creation. Implicit in this value chain are the assumptions that firms add value to raw materials and deliver value-added products to the market, consumers and markets do not add value, and the value added by the firm will be appropriated back to the firm when the consumer purchases a product. This artifact of the industrial age is a very useful tool in markets based on traditional production models (and even in digital markets, such as software markets, where raw "code" is

transformed in products, such as operating systems, that are purchased by consumers), but a linear, firm-centric view of value appropriation is not always as applicable to information-based markets.

Priem [2007] argues that the consumer has been ignored in the value creation process and shows that, in information-based markets, value is created during consumption, each consumer experiences value differently, and consumers' perception of value are tied to willingness to pay for products and services. Therefore, the paradigm of adding value in a linear value chain is becoming antiquated. Prahalad and Ramaswamy [2004] also argue that the value chain is firm-centric and completely ignores the value that could be created within a market. They argue that the locus-of-value is moving toward the interaction between the firm and the consumer. They suggest that the value created by visiting the doctor is no longer the equipment and expertise; it is the co-creation of a personalized healthcare plan developed through interactions between the patient and the doctor. In this model of interactions creating value, they also believe that the government will play an important mediating role.

Just as the Internet has created an entirely new set of competitive dynamics that effect value creation, value appropriation, and the structure of markets [Cassiman and Sieber, 2007], consumer adoption and usage of information systems is likely to have similar effects on markets. The co-creation of value [Lusch, Vargo, and Wessels, 2008; Prahalad and Ramaswamy, 2004] with a consumer-centric approach [Dev and Schultz, 2005] is an emerging research opportunity that will likely require a significant amount of research if strong theories of value in the context of consumer adoption are to be formed.

However, even though the co-creation of value between firms and consumers [Lusch et al., 2008; Prahalad and Ramaswamy, 2004] is a fascinating concept, it will require new ways of thinking about how the responsibilities and actions of all market participants will affect the value creation process, beyond fighting cost pressures associated with commoditization. Consumers may initially perceive changes in the locus-of-value and the locus-of-control as favorable, and there will be significant benefits to such a shift, but there will also be costs and responsibilities. Technology adoption literature, to my knowledge, has never before considered the consumer as a responsible market participant with certain responsibilities and obligations required for market efficiency to be achieved. In addition, many economic considerations—such as network effects, switching costs, complementarities, lock-in, path dependence, and so on (see Shapiro and Varian [1999] for a comprehensive review of economic issues)—must be reconsidered as we move toward new modes of value production that are not focused primarily on control mechanisms and linear value chains.

- What is the effect of collaboration and co-production of information within PCEH contexts? Are there instances where value co-production is ineffective?
- How do issues such as path-dependence, complementarities, tradition, and leap-frogging (where an entity skips an entire generation of technology in favor of the more advanced generation, such as skipping land-line phones for a mobile phone infrastructure) impact PCEH adoption?
- How will the traditional value chain be affected by a shift toward PCEH? Will intermediation and disintermediation play important roles?
- What types of devices (mobile, kiosk, etc.) and interactions (interface design, HCI, etc.) will yield the most value in selected contexts?

Capabilities and Strategy

Not all firms will have the capabilities necessary to offer self-service and decision-aid capabilities to their consumers. For instance, many smaller ambulatory care clinics and physician practices may not have the resources available to provide PCEH to their patients. However, more and more software vendors are building such capabilities into canned, off-the-shelf products that are being priced for businesses of all sizes—not just the large enterprises. Consider the electronic health record (EHR). EHR vendors strategically position their products for both hospitals (medium-to-large organizations) and ambulatory care providers (small-to-medium organizations). These vendors typically offer add-ons that provide PHRs and patient portals for consumer self-service and decision making. Additionally, firms that offer such systems will be gathering valuable information about how consumers use PCEH systems and such information can inform new generations of products, services, features, and capabilities.

- How does the degree of PCEH capabilities mediate stakeholder relationships?
- How do we map healthcare consumer categories to supply-side (provider, payer, producer) strategies? For instance, should firms develop (or adopt) platforms or standalone products? Is either vertical or horizontal integration a wise strategy in consumer markets?
- How will PCEH vendor selection on the supply-side impact demand-side offerings?

Information System Features and Feature Fatigue

Myriads of features are often touted in the marketing of information systems (e.g., our product does many very useful things) to “enhance and differentiate product[s],” but consumers can be overwhelmed by such capabilities; this “feature fatigue” can result in sub-optimal consumer satisfaction [Thompson, Hamilton and Rust, 2005, p. 431]. Unlike in organizational settings, consumers do not have full-service IT departments and training staff as resources. Additionally, consumers often have a scarcity of time to dedicate to learning new products. This may be especially true for PCEH where not all features will be required by those without chronic conditions, but who still want to take an active role in managing their interactions with the health system. Therefore, features may enhance selection and adoption, but constrain usage. Perhaps a new strategy would be for producers to signal feature usage prior to purchase, but only enable non-core features when needed (i.e., an “adaptive” approach to feature enablement and design where features are “rationed”). Such a strategy would focus on selling the potential of the product without overwhelming consumers.

- How might design factors and human-computer interaction (HCI) considerations play a role in encouraging PCEH adoption and usage continuance?
- Do consumers select and adopt based on features advertised, but only use core features until comfortable with the PCEH system? If so, what implications does this have?
- Are adaptive interfaces the future of PCEH systems? How might rationing features (i.e., limiting features at the outset in the hopes of encouraging long-term use) impact usage continuance and/or discontinuance?
- Does the dynamic nature of PCEH systems provide an opportunity to develop new sales and marketing strategies that focus on the potential of the product or service rather than the current state of the product or service?

Policy

Medical records and information markets are likely to stagnate if policy makers do not form a strong base of consistent policy that provides reasonable and equitable means of resolving differences and appropriating value [Baird et al., 2012b]. Consumer adoption of information requires enough regulations to prevent over-exploitation while simultaneously encouraging the monetization of innovations and further investment under uncertainty. This balance will only be achieved if researchers can suggest how various approaches to policy making may affect the needed balance between stakeholders and interests in an evolving environment. Comparisons across various countries and localities provide a natural experiment for considering which policies lead to the most successful outcomes as well as how certain incentives and interventions are likely to affect adoption, diffusion, and even softer characterizes such as trust and perception. Such research is likely to combine theories and findings from multiple disciplines including law, economics, marketing, psychology, management, and information systems.

- What are the legal and economic implications of overregulating or underregulating PCEH? Are stronger or weaker regulations necessary in certain contexts or phases to promote adoption and diffusion?
- How do other contexts and approaches (from other countries, localities, or even between firms or networks) to policy making and regulation affect PCEH?
- Do policies affect all technologies the same or are differentiated policies (specific to certain industries or innovations, for instance) necessary to encourage growth and diffusion across all sectors?
- If some innovations are ahead of others in the market, will “all-encompassing” policies favor incumbents or challengers to the detriment of the other?
- Are discretionary policies better than rule-based/mandatory policies within certain phases or contexts?

Social Norms, Social Exchange, and Social Contracts

Given the nature of interactions between firms and consumers (and even consumers with other consumers) in digital markets, social theories are vital to our understanding of consumer adoption. In social exchange theory, social actors are aware of their options and make rational choices, often based on cost/benefit analyses, when transacting with other social actors [Cropanzano and Mitchell, 2005]. Such rational approaches can also be influenced by social norms and by other participants within a social group [Cialdini and Trost, 1998]. In addition, digital markets are nearly always regulated in some fashion (whether by corporate policies, by governmental oversight, or through norms) and such regulation results in the development of social contracts [Rousseau and Cranston, 1968]. In a social contract, consumers often must give up some of their freedoms in trade for the security of regulation and oversight. While the doctor-patient relationship is often considered to be paternalistic, this traditional view toward managing care is changing rapidly and shared-decision making is likely to require new approaches to social

exchanges and contracts. Additionally, emerging ways of sharing information, such as the social site PatientsLikeMe.com, are encouraging patient-to-patient interactions that will drastically alter the nature of social interactions in health management and information seeking.

- Are there specific costs or benefits that consumers tend to prioritize in social exchanges facilitated by PCEH? What trade-offs do consumers consider and how might such considerations impact perceptions of PCEH?
- Can social norms and influences (i.e., informal institutions) be shaped by firms? Are consumers likely to exit PCEH markets where they feel that norms are being manipulated by firms?
- Will firms and health entrepreneurs be willing to accept social contracts that afford them less power in trade for greater PCEH market share? What types of social contracts (rule-based, discretionary, a balance between the two) lead to optimal diffusion of information systems and technologies in health-oriented digital markets?

Design Science/IT Artifacts

Orlikowski and Iacono [2001] advocate for focusing on the “IT artifact” in IT research, and PCEH research will certainly require a strong foundation of artifact research. Some emerging research has been done on the search artifact in e-commerce [Kumar, Lang and Peng, 2005], consumer adoption of multifunction information appliances with a special emphasis on consumer (rather than organization) determinants of adoption [Hong and Tam, 2006], and the aesthetics of artifacts [Tractinsky, 2004]. While this early research is certainly informative, much remains to be done. For instance, traditional systems development often flows through a linear set of steps from problem formulation and requirements to implementation and maintenance (much like the aforementioned value chain). However, consumers are likely to influence the development and architecture of PCEH technologies and artifacts, even if innovative firms create demand by generating markets rather than through head-to-head competition. For instance, Apple created the market for the iPhone, but consumers are influencing future generations of smart phone designs, smart phone software applications, and information consumption and production on mobile platforms. Additionally, adaptive structuration theory [DeSanctis and Poole, 1994] suggests that information systems are affected by group dynamics and consumer adoption could result in similar circular influences that will force firms to rethink linear system development models.

- How will the design of PCEH artifacts impact consumer adoption intentions, PCEH product and service diffusion, and the market for PCEH products and services?
- How will PCEH system selection, adoption, and usage influence artifacts and how will this influence affect digital markets? Will early artifacts be developed with or without consumer input?
- Will design science move toward a prototyping focus (rather than developing a complete product before going to market) in order to garner consumer input before completing full-scale production? Can collaboration between firms and consumers lead to better designs and improved artifacts?
- Should firms develop PCEH markets through the consensus of their consumers or should they instead dictate market direction with only small refinements made once consumer input has been received?

Agency Theory and Consumer Empowerment

As the locus-of-control of information moves to the markets between firms and consumers, traditional conceptualizations of principals and agents in markets may become blurred. Agency theory has traditionally been applied to principal-agent issues and costs within firms [e.g., Jensen and Meckling, 1976]. As the consumer becomes empowered [Wathieu et al., 2002], however, a variety of principal-agent issues could arise as firms desire control over market participants, including consumers, but consumers desire control and monitoring of their own. For instance, in a market for medical records, what if a doctor's office does a poor job of digitizing records and the patient must continually monitor whether or not the information being imported into the PHR or patient portal is accurate and complete? Such monitoring costs are likely to have significant effects on market interactions.

- How will consumers monitor clinicians (and vice versa) in PCEH markets where mutually beneficial information is shared between multiple parties? Is such monitoring welcomed by firms who will be able to shift some of their costs to consumers?
- Can shared data ownership and control be beneficial in PCEH markets? How will traditional paternalistic paradigms make the transition? In what cases must firms retain complete control over information?

- Are consumers willing to take on the responsibility of monitoring and maintaining information integrity in digital markets where consumers must make a commitment to long-term usage of a product (as can be the case with personal health records [PHRs] and certain medical devices)? What are the possible outcomes if consumers are unwilling to accept such responsibility?

Behavioral Economics

Behavioral economics challenges some of the assumptions of rational-utility theory and suggests that psychological aspects play an important role in decision-making processes [Camerer, 2004]. In the context of PCEH, many behavioral aspects are likely to impact purchase and usage decision-making processes. For instance, there may be an optimal point for an individual to start using medical records management software (such as a PHR, patient portal, or information gathering systems), especially if multiple physicians and/or specialists are involved. If an individual exhibits time-inconsistent behavior, assuming that the cost to themselves in the future to manage their own records and information will be less than what it really will be (due to an inconsistent discount rate), procrastination may lead to non-use and reduced information aggregating capabilities.

- How influential are emotions and behavioral factors in the pre-consumption, consumption, and post-consumption phases of PCEH consideration, use, and continued use or discontinuance?
- How might time-inconsistent behaviors impact the use of PCEH and the outcomes associated with their use?
- Do those who use PCEH systems seek satisfaction, utility-maximization, or both? Are contrasting desires or approaches seen in heterogeneous consumer segments (e.g., young vs. old, sick vs. healthy, etc.)?

IV. CONCLUSION

In information systems research, many outcome variables, theoretical constructs, and relationships have been predominantly studied within organizational boundaries. Information systems researchers have extended such perspectives to customer oriented contexts with some success, but much remains to be done. This article suggests that the PCEH context represents an excellent domain within which to study this shift away from a primarily enterprise information systems focus. This paper has suggested that excellent opportunities abound in the PCEH context, and, ultimately, may extend much of our IS theory base into the context of firm-consumer and complex stakeholder digital interactions.

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