If You Build It, Will They Use It? Challenges in Adoption and Use of Patient-centered E-health

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Abstract:

Preventive healthcare services require consumers to coordinate and manage several healthcare activities with multiple service providers. In this paper, we explore the adoption and use of a patient-centered e-health system for managing personal healthcare requirements. Specifically, using the patient-centered e-health (PCEH) framework, we analyzed the data we collected from a qualitative study of consumers who participated in a preventive care program called the Health Enhancement Program (HEP) in Connecticut in the United States and the accompanying e-health service the program offered. Data from the interviews of 15 participants revealed that users found several challenges in adopting and using the e-health system when examined in the context of their lifestyle even though the system had a patient-centric design. These findings provide implications for designing and assessing patient-centered e-health to ensure that users effectively adopt and continue to use them and insights for expanding PCEH theory and practice.

Keywords: Health Information Technology, Patient-centered e-Health, Adoption, Technology, Design.

1 Introduction

To improve the delivery of quality healthcare, several federal agencies [1] have recommended that healthcare services adopt and meaningfully use health information technology (Health IT) (Institute of Medicine, 2001). To this end, the healthcare industry has begun working on not only engaging clinicians more in patient care with technology aids such as electronic health records and decision support tools but also increasing patient engagement via using electronic personal health records (Wang & Huang, 2012).

Researchers have recognized the importance of involving patients in healthcare, broadly understood as patient-centered care, for more than 30 years (Greenfield, Kaplan, & Ware, 1985; Stewart et al., 1995) and have shown engaging patients in their own medical care improves patient satisfaction, quality of care, and clinical outcomes (Kaplan, Greenfield, & Ware, 1989). Preventive care, such as obtaining screening tests and managing chronic conditions, represents an integral part of patient engagement (James, 2013). Health policies in the United States encourage health plans to offer preventive health services as part of the country's vision to detect diseases early and, ultimately, control costs (Levey, 2010). Healthcare organizations have started to offer several patient-centered e-health (PCEH) services to consumers/patients, such as providing them access to their electronic health records and allowing them to monitor their health to encourage consumer/patient involvement (Boulos, Maramba, & Wheeler, 2006; Eysenbach, Powell, Kuss, & Sa, 2002; Krist & Woolf, 2011; Wilson, Wang, & Sheetz, 2014).

On the other hand, consumers also see the value in using technology for their healthcare. Studies have shown that consumers believe that using health IT could aid them in improving and managing their health (Markle, 2008) and that those who used health IT were more likely to adopt preventive care practices (California Health Care Foundation, 2010).

Despite such encouraging findings, the healthcare industry continues to grapple with increasing the extent to which patients involve themselves in their own healthcare. Recent studies have shown that consumers have not widely adopted preventive care services. In 2012, data from the National Healthcare Quality Report (U.S. Department of Health Services, 2013) indicated that consumers used preventive care services well below recommended levels despite efforts to encourage them to use such services. A recent nationwide survey of 1,015 American adults showed that only 24 percent considered themselves to be on top of taking preventive measures (Televox, 2015). Equally challenging has been convincing consumers to adopt and continue to use health IT (Bechtel & Ness, 2010; Google, 2011; Krist & Woolf, 2011; Wang & Huang, 2012). The technology giant Google, when retiring its Google Health service, acknowledged that millions of people did not adopt and use the health tool as it originally hoped for and that mostly only tech-savvy and health-conscious users used it. Further, Google urged others to recognize its decision to retire the tool as a lesson in empowering users in managing their own healthcare (Google, 2011).

<div align="center">Contribution:</div>

The healthcare industry has long recognized the need to design patient-centered e-health systems so as to engage patients in their medical care. Yet, the literature shows that users often do not fully adopt or optimally use patient-centered e-health systems. This paper focuses on the challenges consumers face in adopting and using patient-centered e-health systems and specifically on a Web portal that Connecticut State in the United States designed to support consumers who participated in a preventive care program called the Health Enhancement Program (HEP). Using the PCEH framework to assess the patient centeredness in the Health Enhancement Program Web portal (HEP Web Portal) designed for managing their personal healthcare requirements, we found that developers/designers have instantiated several patient-centered characteristics. However, analyzing real users' perspectives and perceptions of using the HEP Web portal highlight how the instantiated patient-centered features did not fit or were not flexible within the larger context of consumers' technological and social lives, which led to its low adoption and use. From a theoretical perspective, our work provides a nuanced socio-technical assessment of patient centeredness in e-health that includes user perspectives in order to meaningfully predict adoption and continued use. From a practical perspective, our study provides design implications for patient-centered e-health systems.

In essence, the effectiveness of e-health services, even though specifically implemented for consumer/patient use, depends on how well such individuals actually adopt and use them. However, even though many stakeholders believe in the value of using patient-centered e-health services and despite the evidence of their effectiveness when individuals do use them, their adoption remains low. As such, we need to better theoretically and empirically understand and, thus, conduct research on this patient-

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[1] https://healthit.ahrq.gov/program-overview

centered e-health adoption paradox (Baird, 2014; Krist & Woolf, 2011; Wang & Huang, 2012; Wilson et al., 2014). In this research, we contribute to diminishing this research gap by exploring consumers' perceptions about adopting and using PCEH services for preventive care and factors that influence it. Specifically, we use the PCEH framework to analyze patient centeredness in e-health for preventive care and its adoption and use. We use this particular framework for analysis because it delineates and operationalizes the characteristics of PCEH and provides conceptual relationships between these characteristics and user adoption. Previous empirical work in PCEH has looked only at how well e-health services depict or implement the patient-centered characteristics (Kamis, Yao, & Kim, 2014; Wilson et al., 2014). However, to the best of our knowledge, no study has looked at how consumers use e-health artifacts that have the patient-centered characteristics as outlined by the PCEH framework. Thus, with our work, we make the following contributions:

1) Explore adoption and use through the lens of the PCEH framework via a field study.

2) Explain consumers' perspectives about and challenges in using PCEH in the context of their current lifestyles.

3) Provide implications for design of PCEH systems for effective user adoption and continuance of use and insights for expanding PCEH theory and practice.

In particular, we focus on a value-based insurance design program called the Health Enhancement Program (HEP) that Connecticut State in the US implemented and its accompanying PCEH artifact in the form of a Web portal. The HEP program offers incentives to consumers in the form of lower monthly premiums for partaking in age-appropriate wellness exams/screenings/immunizations and cash rewards for regularly following up on chronic conditions such as asthma. While consumers do not have to comply with the HEP program, defaulting on the program requirements results in higher insurance premiums. To this end, the HEP Web portal supports consumers in tracking and managing their HEP requirements as part of their preventive care.

2   Background

Researchers have recognized the challenges of designing and building information systems that people will want to use for many years (Markus & Keil, 1994). Despite substantial work that points to the positive implications of aligning technology with task (Fuller & Dennis, 2009; Goodhue & Thompson, 1995), these fundamental challenges persist because no one size fits all, especially as new domains and contexts of use such as healthcare IT continue to emerge (Bechtel & Ness, 2010; Burton-Jones & Grange, 2012; Markus & Keil, 1994). A substantial extant literature on healthcare IT exists. However, since we focus on how consumers adopt and use PCEH in preventive care in the study we present in this paper, we focus largely on three themes in reviewing the literature: 1) patient-centered care and preventive care (part of the patient-centered approach to medical care), 2) personal health information management (which consumers need to effectively engage in preventive care), and 3) patient-centered e-health (PCEH) (which consumers need to electronically manage their personal health).

2.1   Patient-centered care

Researchers broadly understand patient-centered care (PCC) as involving patients in their medical care, but the literature has not yet provided or followed a unified or a global definition (Constand, MacDermid, Dal Bello-Haas, & Law, 2014; Klecun, 2016; Stewart, 2001). This lack of a single definition in the literature and practice has arisen because healthcare providers and policymakers focus on different aspects of PCC due to their different professional and organizational interests, needs, and norms (Kitson, Marshall, Bassett, & Zeitz, 2013; Klecun, 2016). Even review papers that have searched for core PCC elements that research and practice have used differ in their scope and findings. Kitson et al. (2013) found that the previous literature saw patient participation and involvement, the relationship between patients and healthcare professionals, and the care-delivery context as the core elements of PPC. Constand et. al. (2014) found that effective communication between a patient and physician about the former's illness to understand the patient's experience was the most important aspect of PCC. Klecun (2016) identified five ways that previous literature has conceptualized PPC that vary based on whether they focus on individuals, organizations, or both: PPC as healthcare professional-provided care to patients, PPC as efficient and effective care to all stakeholders, PPC as self-care, PPC as patient-led service, and PPC as face-to-face care. In our research, we acknowledge that the literature lacks a single definition for PCC and

instead focus on PCC as self-care. Specifically, we look at preventive care from a consumer/patient perspective at an individual/personal level.

2.2   Preventative Care

According to PricewaterhouseCoopers 2017 Health and Well-being Touchstone Survey, approximately 79 percent of U.S. employers adopt health-promotion and disease-prevention strategies in the form of wellness programs to combat the costs that they incur from covering employees who experience chronic and life-threatening diseases (PwC, 2017). While health promotion strategies encourage behavioral change towards better health, prevention strategies focus on preventing individuals from ever suffering from acute or chronic diseases or on diagnosing/treating them early on. Thus, preventive strategies typically involve regularly screening individuals for health risks even when healthy and free from diseases.

To encourage consumers to participate in both promoting their own health and preventing themselves from catching diseases, these programs offer several incentives. Some programs offer benefits in the form of premium discounts or improved benefits. In contrast, some programs create costs for employees who refuse to engage in preventive care, such as higher premiums (Hostetter & Klein, 2014). Specifically, in the context of health insurance, value-based insurance design focuses on encouraging consumers to promote their own health and prevent themselves from catching diseases with rewards, reduced premium share, adjustments to deductible and co-pay levels, and contributions to fund-based plans, such as health savings accounts (Huoy, 2009). However, these programs can realize their true value only if consumers take on the value they offer and change their behavior (Hostetter & Klein, 2014). As such, consumers need to actively manage their personal health information related to preventive care in order to reap its benefits. However, doing so provides a unique challenge to consumers unlike other day-to-day "compliance" activities/responsibilities such as paying bills or attending parent-teacher meetings because 1) it involves a set of non-routine scheduling and planning tasks with no specific pre-determined dates except that they meet their personal healthcare milestones at any time in a one–year period, 2) it requires them to effectively communicate and coordinate with clinicians/technicians based on the latter's availability while considering their own personal and professional constraints, and 3) it may require them to monitor not only their own personal healthcare milestones but also their other family members' healthcare milestones (which will vary and change with age, gender, and time). Complexities such as coordination and information overload often cause people to defer compliance tasks, engage in last-minute tasks that may or may not work, or even completely neglect the tasks.

2.3   Personal Health Information Management

Personal health information management refers to the set of activities that help health consumers to access, integrate, organize, and use their personal health information (AHRQ, 2011; Civan, Skeels, Stolyar, & Pratt, 2006; Kohr, 2011). Health consumers need to organize their health information in order to effectively access and use it when the need arises. Examples of personal health information include personal health records, hospital/doctor visits and the reasons for each visit, tests and results, genealogical health patterns in their family, and insurance information. However, this information is distributed across myriad sources, such as healthcare providers (Pratt, Unruh, Civan, & Skeels, 2006), healthcare insurers (Civan et al., 2006), social networks (Osatuyi, 2013), the mass media (Wade & Schramm, 1969), and devices such as pedometers, blood-glucose monitors, and thermometers (Alwan et al., 2006; Wang, Lau, Matsen, & Kim, 2004). Research has shown that various factors challenge individuals' ability to manage their personal health information, such as their health status, economic status, the extent to which they perceive a need to manage the information, and how comfortable they feel managing the information (Civan et al., 2006). Extant literature on personal health information management suggests that researchers need to conduct additional work in this field to better understand the ways health consumers attempt to track, organize, interpret, and manage the different types of personal health information they obtain through various sources (Bandyopadhyay, Ozdemir, & Barron, 2012; Pratt et al., 2006). Health consumers face the burden of remembering and managing every piece of health information they encounter amid their daily endeavors, which can result in information overload (Schnipper et al., 2012). Today's healthcare consumers need to be able to coordinate care across providers, understand how to effectively communicate with those providers, know how to obtain answers to their questions in the limited time they have for an office visit, and learn how to effectively monitor and manage their health between visits. Consumers who can successfully perform these tasks will likely become more active, empowered healthcare consumers who enjoy better healthcare and better health

outcomes (Brennan & Safran, 2005). Thus, consumers clearly need to manage their personal health information to manage their preventative care.

2.4 Patient-centered E-health

Given personal health information management's importance, service providers have begun to offer consumer health IT applications specifically to help consumers manage their personal health information (AHRQ, 2011; Kohr, 2011). While these applications focus on consumers, they have failed in the sense that consumers have not adopted and/or perceived them as inadequate (Bechtel & Ness, 2010; Google, 2011; Krist & Woolf, 2011; Wang & Huang, 2012). Until the turn of the 21st century, most organizations still most commonly used paper-based methods to store and transfer information (Eysenbach, 2000). Even though the last decade has seen a widespread rise in consumers' adopting technology in the e-commerce and banking industries, consumers have adopted technology for personal health management at a much slower rate, and researchers have widely recognized the need to understand why (Baird, 2014; Wilson et al., 2014). Keeping in the philosophy of patient-centered care (PCC), recent literature has suggested that low adoption in general could result from a lack of patient centeredness in e-health (Baird, 2014; Krist & Woolf, 2011; Wilson et al., 2014).

Patient-centered e-health refers to e-health services that concentrate on supporting patients/consumers in actively managing their personal healthcare (Wilson, 2009). While e-health services broadly cover technology that supports all healthcare stakeholders (doctors, nurses, insurance providers, administrators), patient-centered e-health is synonymous with a range of consumer IT applications (Wilson et al., 2014) that help consumers manage, share, and control health information and actively manage their health.

Similar to how PCC lacks a singular, unified definition, PCEH too lacks a single definition in the academic and practitioner communities. Given that the way researchers and practitioners define PCEH reflects the PCC factors that they find important and relevant, we can see that the way the literature defines PCEH focuses on the varied technology-mediated services that cater to supporting various aspects of PCC such as telemedicine, personal health records, patient portals, websites, personal health monitoring devices, and mobile e-health (Baird, 2014; Klein, 2007; Krist & Woolf, 2011; Tufano & Karras, 2005; Whitten & Adams, 2003). However, Wilson et al. (2014) have proposed a guiding theory to understand PCEH. In Section 2.5, we discuss how this theoretical framework characterizes patient-centered e-health and its adoption/use.

2.5 Patient-centered E-health (PCEH) Framework

The PCEH framework proposes that the extent to which a PCEH service exhibits patient centeredness influences whether patients adopt and use it (Wilson et al., 2014). The framework also explicitly identifies three characteristics (patient focus, patient activity, and patient empowerment) that lead to patient centeredness in e-health.

- Patient focus refers to e-health designs that primarily cater to patients' needs and perspectives. Such designs are achieved through user-centric design methods that focus on building technology that is based on the understanding of user needs, in contrast to technology that is designed based on organizational perspectives of user needs.

- Patient activity refers to e-health designs' ability to enable patients to interactively provide and consume personal health information. E-health enables patient activity with designs that provide users the ability to access, communicate, schedule, and coordinate healthcare activities and health information from multiple healthcare providers and sources. Both policies and content integration across service providers (e.g., insurance, doctors, pharmacies, hospitals/clinics) typically influence the level and nature of activity.

- Patient empowerment refers to e-health designs that have high usability and allow users to meaningfully control their personal health information that they can also access via offline methods such as phone calls and in- person visits.

We use the theoretical definitions for these three characteristics that contribute to patient centeredness to operationalize the patient centeredness in e-health concept. The theoretical definitions open up avenues to quantitatively and/or qualitatively measure patient centeredness (Kamis et al., 2014; Wilson et al., 2014). Wilson et al. (2014) provide an assessment protocol to classify these characteristics as high,

medium, and low, which Kamis et al. (2014) also implicitly used to assess several PCEH websites. In our paper, we also use this assessment protocol to measure the level of patient-centered characteristics in the Connecticut Health Enhancement Program.

Beyond providing means to operationalize patient centeredness, the PCEH framework provides a testable relationship between PCEH characteristics and its adoption and use. The framework proposes that e-health designs that focus on patients via instantiating the above three characteristics will increase the extent to which consumers adopt and continue to use those designs. Thus, we apply this framework to analyze how patient centeredness in the preventive care e-health service that the Connecticut Health Enhancement Program (HEP) offered maps to adoption and use.

3   Research Questions

In this paper, we examine how patients adopt and use PCEH in their everyday lives and, thus, how one might more effectively design PCEH. Specifically, we address the following broad research questions in the context of the Health Enhancement Program (HEP) in Connecticut and its e-health service.

1)   How do users adopt and use e-health services that feature a patient-centered design in terms of patient focus, patient activity, and patient empowerment in their everyday lives?

2)   How do users perceive and what challenges do they face in using and adopting PCEH in their everyday lives?

4   Method

4.1   Study Procedure

To address the above research questions, we conducted an interview study at a state university whose employees had to mandatorily participate in the HEP. We recruited participants through word of mouth and emails. Following the user-centered principles of technology design that stress the importance of understanding users' context, in our interviews, we focused on obtaining a rich contextual understanding of how people managed their personal health information via the HEP portal. The semi-structured interview questions focused on understanding the practices that the participants followed to manage their health information in the social and technical context of complying with the HEP requirements. We conducted the interviews over a 30-day period at the participants' workplace or home. They included the following broad questions, and, when the participants' responses dictated further probing, we asked new/more questions:

- What is your employment background, age, gender and family demographic information?

- What do you understand about the HEP program and its requirements?

- How do you currently manage/schedule/coordinate your social and professional appointments/deadlines? What tools offline and online do you use and how do you use them?

- How do you currently manage/schedule/coordinate your own and your family members' HEP healthcare requirements? What offline and online tools do you use for managing/scheduling/coordinating HEP healthcare requirements and how do you use them?

- What aspects of managing the HEP requirement processes do you find easy and what aspects do you find challenging?

4.2   Participants

We collected interview data from 15 Connecticut state employees in total (10 males and five females). Respondents were between 20 and 70 years old. They worked as a professor (5), associate professor (3), social worker (1), library technician (1), social media liaison (1), assistant to the director of housing (1), construction worker (1), sports statistician (1), and secretary for academic services (1). Seven respondents were married and eight were single; eight of the respondents had dependent children and two were dependents of state employees. Since we conducted semi-structured interviews, they varied in length depending on the extent to which the guiding questions and probes pertained to each participant. We used purposive sampling with the criteria that participants worked for the Connecticut State Government since such individuals would need to meet HEP requirements and that they came from

various walks of life to reduce professional bias. We believe that these criteria sufficed to understand initial challenges in adopting and using a fairly new Web portal that kept track of the HEP requirements that employees had to meet once a year. We chose a sample size of 15 given the context of the research questions and our purposive sampling based on guidance that Guest, Bunce, and Johnson (2006) provide about sample sizes for qualitative studies and purposive samples.

4.3   Data Analysis

4.3.1   Interview Data

We recorded 281 minutes of semi-structured interviews and transcribed all interviews. Using interpretive principles that prior research has outlined (Strauss & Corbin, 1990; Klein & Myers, 1999; Pratt, 2008), we analyzed the transcriptions and found several themes. Table 1 below provides the results of the coding analysis we used. We first conducted open coding in which we looked for emerging themes and then conducted axial coding in which we identified and combined the initial codes into larger categories (Strauss & Corbin, 1990). In order to code the interview transcripts accurately, the first author trained a research assistant to ensure that they had understood the research questions in the same way to identify emerging themes from the data. The first author and the research assistant then coded each transcript independently and identified six and eight themes each, respectively. They then discussed and consolidated these themes to the three that we present in Table 1. The first author reviewed all transcripts that the research assistant coded to ensure their reliability and validity. The two coders resolved the few coding disagreements that emerged via discussion.

Table 1. Major Themes Based on Interview Data

Major themes	Associated codes
Usability	Experiences and concerns associated with finding the website, logging in to the website, navigating the website, finding information, updating information, and desiring to use the website.
Scheduling and coordinating preventive care	Experiences and concerns associated with interacting with one's family members, knowing their availability, balancing family availability with health service provider availability, uncertainty about future availability at the time of scheduled appointments, scheduling appointments, scheduling time off for healthcare visits, and having multiple physicians for oneself and one's family members.
Managing and tracking preventive care	Experiences and concerns regarding being aware of appointments for one's self and/or one's family members, having to act on last minute reminders, managing and using one's own electronic/non-electronic reminder tools and/or those from service providers, differentiating between work and personal reminders in the reminder tools used, the website not providing notifications about completed appointments and requirements, coordinating between healthcare providers to ensure the website reflected accurate data, lack of awareness about whether the website displayed accurate information.

4.4   Assessment of Patient Centeredness

We use two different perspectives to assess the patient centeredness of the HEP Web portal that we examined: one based on our analyzing the portal's design features (design perspective) and the other based on our analyzing how users perceived the portal's design features according to the interview data (user perspective). For both assessments, we used the protocol that Wilson et al. (2014) provide as a guide, though we fine-tuned it based on the way that the PCEH framework defines patient focus, patient activity, and patient empowerment. In assessing the design features for patient centeredness, we (the two authors) independently worked on reviewing the portal design and found only minor disagreements that we subsequently resolved via discussion.

5   Findings

We present our findings in three sections. In Section 5.1, we describe the HEP Web portal design and assess how it instantiated patient centeredness. In Section 5.2, we present users' perspectives about and challenges in using and adopting PCEH in their everyday lives based on our data from the semi-structured interviews. Finally, in Section 5.3, we describe how users used and adopted the HEP website overall based also on the semi-structured interview data.

5.1   PCEH Characteristics Instantiated in the HEP Web Portal

5.1.1   HEP Web Portal

Connecticut first launched the HEP Web portal in 2013. The state's employees' healthcare option planner 2015-2016 describes the HEP Web portal as one with features and tips to help participants' manage their health and HEP requirements (Lembo, 2015). In particular, the planner listed the following activities that users could accomplish by visiting the portal: 1) view HEP preventive and chronic requirements, 2) download HEP forms, 3) check their HEP preventive and chronic compliance status, 4) complete their chronic condition education and counseling compliance requirements, 5) access a library of information and articles, 6) set and track their personal health goals, and 7) exchange messages with HEP nurse case managers and professionals.

We now describe the portal's design and its features. The HEP homepage[2] had seven major elements (see Figure 1).

Figure 1. HEP Homepage

1) **Log in/create new account window**: allowed users to log in and access their private and secure information.
2) **HEP requirements**: took users to a static image of the table that listed the current year's HEP requirements and a link to download/print a print friendly PDF copy of it.
3) **Chronic conditions**: took users to an information page on chronic conditions and the actions users needed to take to be HEP compliant for such conditions. Actions included completing an information survey online, reading and acknowledging a fact sheet provided (either online or offline), or talking to a HEP nurse. For users who wanted to print and send the acknowledgement by postal mail/fax, this page provided direct links to print the fact sheets for each condition.
4) **Help and forms**: provided general instructions on what users could do through the website and links to certain forms that they may need.

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[2] https://www.connect2yourhealth.com/ParticipantPortal/Default.aspx/

5) **Contact**: provided contact details of timings, telephone, fax, and email.

6) **Schedule a physical**: provided users with a list of HEP-approved physicians and their contact details.

7) **Enrollment information**: provided information and forms for individuals who wanted to change their medical/dental plans and new enrollments in a specified period (e.g., 9 May to 3 June).

All of the above seven webpages also provided a link to log in from that page. Users could access the following features as tabs after logging in:

1) **My contact information**: showed personal information that users could edit.

2) **Home**: showed users' progress towards being HEP compliant on individual requirements. The check sign meant that users had met the requirement and a cross sign meant they had not. Requirements not met had a "fix this" link next to the "cross" that took users to a page that told them how to meet the requirement (e.g., it suggests seeing a doctor/dentist, taking an online survey, reading a disease fact sheet, or contacting a nurse for a chronic condition).

3) **Forms**: provided printable PDF files of: 1) chronic condition fact sheets, 2) HEP forms and exemption forms that users could take to physicians, 3) any other forms that nurses shared with users.

4) **Health resources**: allowed users to: 1) connect their medical devices the website portal and 2) set their medical and wellness goals. For the latter, users need to make self-reported entries into online journals to track their progress.

5) **Messages**: provided users with a facility to send, receive, and archive asynchronous electronic messages to the HEP support team about any general questions they may have had about HEP.

Assessment of patient centeredness (design perspective): following Wilson et al.'s (2014) definitions and the assessment protocol they provide, we examined how the HEP Web portal design instantiated the three characteristics that contribute to patient centeredness.

1) Patient focus: the Connecticut State Government built the Web portal to serve consumers' needs with respect to their HEP requirements. Since this study could not gather data on whether user studies, interviews or surveys were used to construct the PCEH, we do not know if the designers adopted such requirements gathering methods. Regardless, the Web portal primarily served to help consumers track their HEP requirements and related activities. Thus, while the Connecticut State Government may have primarily created the program in order to enforce its mandatory policies, the tools that the Web portal provided allowed consumers to manage these needs. As such, we conclude that the HEP service had at least a medium level of patient focus

2) Patient activity: the Web portal provided several features as we describe above that supported patient activities such as monitoring their HEP compliance, accessing information and guidance on how to meet the requirements, and communicating with the HEP nurses. The portal also provided tools that users could use to integrate their health and wellness devices (such as a heart monitor) with the portal so that healthcare providers could access integrated data. These features suggest that the HEP service featured a high level of patient activity.

3) Patient empowerment: the Web portal allowed users to complete access forms and communicate with HEP nurses and provided education fact sheets. The fact that the portal required authentication for users to log into their HEP account indicates that it included privacy and security features. Furthermore, the Web portal itself did not require any special skillset beyond the ability to use a Web browser. However, we do not know what usability issues that users could face if one conducted a usability study on the portal. In addition, the Web portal provided contact information including phone numbers to help users make offline enquiries (i.e., the portal) and access healthcare providers. These capabilities indicate that the portal empowered patients with control over their healthcare through other modes of interaction with healthcare providers.

Based on the above assessment, we conclude that the HEP Web portal demonstrated patient centeredness since it exhibited all the three essential characteristics as the PCEH framework defines them.

5.2   User Perspectives and Challenges of Using the HEP Web Portal

Our study participants communicated their perspectives about and challenges in using the HEP Web portal in terms of how poorly the technology fit into their lifestyle. We analyzed interview data from our semi-structured interviews using the interpretive principles that Klein and Myers (1999) and Pratt (2008) outline and found three major themes (Table 1) that we illustrate via representative quotes (responses) below. We have changed respondents' names to preserve their anonymity.

5.2.1   Usability

We define usability as how easy users found accessing and using the HEP Web portal. Our data showed our respondents found both accessing and using the portal challenging. Only two participants said that they found the portal "fine" to use, but, in describing how they did so, clearly mentioned that they faced challenges like the other respondents but felt motivated to use the technology no matter what challenges they faced.

On visiting portal, respondents mentioned several usability issues about signing in and accessing it. They expressed frustration about not knowing how to even access the website even if they knew about availability. For example, Charles, an assistant to the housing director and in his 20s, said: "I don't even know how to access the website honestly. I wouldn't even know what to be looking for at this point.". Adam, a professor in his 30s, expressed his frustration over accessing the portal:

> For a while you couldn't find it, I would go onto the CT government website, and I couldn't find it, then the office of the comptroller, it wasn't very easy to find…. You can log onto their website, it's all on line to find the information…. Unfortunately, I can't remember the username and password. It's like a thousand different ways you can get to it. …But by the time you have to visit again, you probably lose your user name and password, so then you have to go through that extra step.... I just wish it were more streamlined.

Respondents also expressed difficulty in finding and updating information on the portal. Jason, an academic associate in his 50s, talked about how he had difficulty in finding an online survey as one of the HEP requirements for a chronic condition he had:

> But I couldn't find the online survey anywhere, there was no link anywhere. I looked around on their website and I couldn't find it…. If they are going to put the option on the website, you would think they would make the option available.

Similarly, Lily, an associate professor in her 30s, expressed frustration over her inability to use the system when she wanted to update her scheduled eye appointment information on the Web portal:

> It wouldn't let me say, let me specify that one was scheduled, for other things you could say oh well this is being scheduled, you could give a date, you could give them a provider and they accepted that before that point…. I tried putting it in three different times and it wouldn't take the fact that I had an eye appointment scheduled.

Interestingly, respondents who did not use the Web portal expressed confidence that they would easily be able to access and use it if they needed to. While all participants knew that, under the HEP, they had to follow certain preventive healthcare requirements, they found that finer details such as the exact requirements, compliance deadlines, and non-compliance penalties less clear. For example Hannah, a secretary in her 50s, said:

> No. I don't know a lot about it, other than they send me a lot of things in the mail to remind us that we're supposed to be scheduled for certain types of appointments, doctors' appointments, like yearly physical exams, gynecological exams, eye doctor and that kind of thing.

On the other hand, Jake, a library technician in his 20s, knew a little more but did not know about the link to his insurance. He said: "I learned about the requirements but I am not aware that it affects my insurance". This lack of knowledge arose either because respondents did not actively keep track of it since they thought that the portal constituted a clearly defined one-stop place they could go to if needed or because another family member took responsibility for it. When asked where they would go to get more information and details, they often referred to the family member who looked after the household's healthcare or hoped that the HEP website or a human resources (HR) representative at work would provide that information. Beth, a professor in her 60s, explained how she did not know what the

compliance dates/deadlines were: "No. I'd ask my husband. He knows.". Meanwhile, Jake mentioned that: "My mother delegates all of our HEP related tasks". Charles explained how he believed his HR representative could answer his questions:

> I know some of my requirements. I'm pretty sure I could probably contact my HR people about that to see where to go for that but other than that I don't know where I would specifically find that information.

Sam, a professor in his 60s, thought that the website provided all the information he needed and that he could access it whenever he wanted: "I do know but I haven't memorized them. If they are online then I don't need to memorize them.".

Assessment of patient centeredness: the above usability issues that the respondents cited suggest that the HEP Web portal affected the quality of patient focus, patient activity, and patient empowerment as characterized by the PCEH framework. The usability problems that some faced suggest that the Connecticut State Government conducted either no usability test or that it did but did not adequately uncover issues in discovering and updating information. As a result, the problems suggest that the website featured a low level of patient empowerment and patient activity. Further, the challenges that the respondents experienced in finding the Web portal and/or logging into it suggest that it featured a low level of patient focus.

5.2.2   Scheduling and Coordinating Preventive Care

We define scheduling and coordinating preventive care as the tasks that individuals need to undertake to set up appointments to meet HEP requirements for themselves and/or their family members and to coordinate everyone's availability.

Respondents used different strategies to schedule appointments. Some planned elaborately with the entire family as Raul, a social media activities liaison in his 20s, explained:

> Every year we kind of sit down and we just go over what we need to do, what we need to get done. Health insurance as you can imagine is really important to me and my family, so we always make sure we are on top of the ball, when it comes to things like that.

Others scheduled appointments around breaks and birthdates as Adam did:

> It mainly functions around the same time of the year. January 1st which is still the break around here. So I have the thought, let's get my dental cleaning. It is by semester, my life has been by semesters my whole life. I have had a summer break and a winter break my whole life. It has less to do with the calendar that they tell you and more about the actual time of the year that I remind myself. And my wife's birthday is during the holidays so it is easy to track it by that.

On the other hand, Jason and Beth scheduled the next appointment at the end of the current one. Jason said: "Most of them the same time I saw them before, six months to a year before that. Made appointments upon leaving every appointment.". Beth said: "At my annual checkup, I make an appointment for my next annual checkup. They are always a year apart.".

Respondents often mentioned that they experienced difficulty in meaningfully scheduling appointments due to multiple service providers for various family members, long waits at the service providers, family availability, and uncertainty about work/the future. Indeed, Beth and Hannah both mentioned availability. Beth said: "We have to make sure, when we make appointments that the people are available, the family members are available". Hannah said:

> My doctors are right over here on C... street. So it is very, very close. I just go to my appointment and come right back to work. He [my husband] has to take off time, not me, because he works in Hartford…. It's [the appointment] based on availability, of course, also too when you can actually get an appointment because doctor hours are always going to be different.

Several respondents noted the complexity involved in scheduling their entire family's appointments with multiple service providers. For example, Beth said:

> Oh God, I have to work this out. I've got 4. Molly has 2. Uli has 3 physicians, eyes, and dentist, so that is 5. Sally has 2 physicians and dentist. Jonny has 3…. The overlap would be Jonny & Sally go to the same dentist. Uli, Molly & I go to the same dentist. Uli & I go to the same eye

doctor. Actually, since it is the same practice, Uli & I have the same medical physician and Jonny & Sally have the same physician. So there is a lot of overlap.

Similarly, Chris, a professor in his 50s, said: "Last year around four [appointments with healthcare providers] for each of us. We have both the same primary care physician, we have the same dentist, but the rest are different.".

Others mentioned difficulties in scheduling appointments due to long waits with service providers. Charles said:

Some of the difficulties is making appointments in advance because of the time tables that are provided per the physician I am seeing or the person I am seeing in the office. It may be a month or two before they can get me in there, so I don't know my schedule necessarily a couple of months in advance, so it is definitely difficult to.... Sometimes I am not able to make those appointments and I have to wait again.

John, a sports statistician in his 20s, explained his challenges given his school schedule:

As far as getting people on the phone and getting someone to talk to it's very easy, but as far as the difficulty I see I would say is scheduling appointments. They are very backed up and as a student you don't have much time to miss classes and go down to appointments so you have to find the perfect slot with their little availabilities. I think that would be the only difficulty.

Assessment of patient centeredness: the above scheduling and coordination challenges that the respondents faced suggest that the HEP Web portal had low patient focus, patient activity, and patient empowerment. The portal did not have features that allowed the respondents to easily schedule and coordinate appointments for their family members with service providers, which resulted in their using external tools and strategies to accomplish these tasks and suggests low patient activity and low patient empowerment. Furthermore, the respondents used a diverse set of strategies and tools to schedule and coordinate appointments such as following work schedules or birthdays. The fact that the HEP portal did not provide scheduling features such as calendars and links to service providers let alone support such as user preferences and flexibility suggests that the HEP program (rather than users' needs) dictated its design and, thus, provides evidence for low patient focus.

5.2.3   Managing and Tracking Preventive Care

To manage and track preventative care, users need to be aware of the HEP appointments they have to schedule, meet the HEP appointments, ensure that the HEP portal reflects the status of these appointments, and use their personal or the official reminder systems to accomplish these actions. As such, users need personal calendaring and scheduling tools and/or information on the HEP Web portal.

To meet the HEP requirements, the respondents needed to keep their appointments with health providers. Many relied on the paper-based reminders that HEP sent via postal mail and appreciated its utility. For example, Chris said: "Around the beginning of September [was sent a reminder] by letter, and I got a card that was sent sometime in June. Oh yes, definitely [they are useful].". Hannah explained how she used these notifications as a reminder to set up appointments:

Whenever I have a letter and it says that I have to act on it, or whatever, I put it in my purse, I contact my doctor and then I set up an appointment and go from there…. I do it as soon as humanly possible.

On the other hand, Jason appreciated the paper-based reminders as they confirmed what he already knew he had to take care of:

So far at the end of the year they will send me something telling me what I haven't met and I usually know already that I haven't met it, but it's nice to get the reminder. Then I will make sure I will have it scheduled.

However, some respondents noted they sometimes felt frustrated about the reminders' nature and timing. Charles talked about how the reminders often arrived at times that made last minute scheduling a problem:

I would get something saying "Hey you're not in compliance with A, B, & C. You have to meet these requirements by December 31st" or whatever it is or whatever the date was. So I would be scrambling to that…. You're telling me in December that I have a month to get three

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> *requirements done when I am just finding out and it's gonna cost me a few hundred dollars to take care of some stuff that may need to be taken care of. I may not have that money right then to be able to do what I need to do or have the time to go and do that.*

Others felt overwhelmed as Hannah mentioned: "They send stuff for whatever, but I don't always have time to open it up to read everything on it. I haven't seen any of those letter things.". Many respondents did not depend on the HEP official reminders and proactively scheduled their appointments. Some felt the reminders were superfluous as Adam described: "Yeah thanks for the reminder, but we did it 2 months ago.... I appreciate the reminders in the email, but I am already on top of it.".

People used a varied number of digital and non-digital methods to remember and manage appointments to meet the requirements. Often, they used more than one tool to ensure that they had access to information in multiple places, provide access to multiple people, and be able to set up multiple reminders and backups.

Some used explicit calendaring tools such as cellphone or wall-based calendars, while others used other tools such as sticky notes, appointment cards in wallets, little personal planners, and text messages. Hannah, a secretary in her 50s, talked about using non-digital tools: "Just the agenda book. I have a calendar at home in the kitchen. I use appointment cards to fill in dates on both agenda and home calendar.". On the other hand, Jason explained how he used a combination of digital and non-digital tools:

> *Either scribble a date on a piece of paper. Try to keep them all in one place near the phone. Informal calendar at home. If it is something that I am going to have to do right after work or something like that I do put it in my Outlook calendar at work.*

Respondents also used a combination of paper-based and digital technology in order to access information in multiple places and to allow access to multiple people. John explained how he used multiple tools as a backup:

> *I write it down, put it in my phone, make note of it in my room…. Sticky notes and all that— keeping information in front of you is key to remembering…. I always like to use both because if one doesn't work out I have (other) ones to fall back on.*

Derek, a construction worker in his 20s, expressed a similar sentiment with a different combination of tools: "If it's really important I'll put it in my phone…. Uh, maybe use a calendar—mark some stuff down on it—on the calendar too to remind myself.". Sam, on the other hand, used multiple tools to help his family members and himself remember appointments: "I set up appointments by telephoning the doctor and I keep track of them by entering the dates and times on the calendars—the cell phone calendar and the big wall calendar so that everybody knows".

The different tools respondents used also reflected how they differentiated between their work and their personal appointments. Beth spoke of her choices: "Day planner. A paper day planner and the home calendar. …I use an electronic calendar, a computerized electronic calendar for work.". Charles said:

> *Outlook calendar mainly. I put my work related deadlines in there. When it comes to personal and educational appointments they do go in the calendar, but the majority of those are just written on a pen and paper list/calendar.*

Jake explained how he separates the tools he used to schedule his appointments based on how secure he perceived them to be: "I keep track of things [social events] like this, just by holding all my text messages with plans I have with others". However, when it comes to work related coordination and scheduling appointments, he said that he took care of them "certainly by email. I wouldn't text any work information. Email is much more secure.".

Equally important as keeping appointments was to track and ensure that all family members met the HEP requirements. Even though respondents often met the requirements, the HEP website or the paper reminders/notifications they received did not reflect that fact. Adam described how the lack of communication between the service providers and insurance companies contributed to this problem: "Yes..., they [requirements] have been fulfilled, but they do not know that. They have not been very good at coordinating with insurance along with coordinating with the provider.". As such, consumers had the responsibility to follow up with providers, which often required them to switch to offline methods, such as bringing the necessary paper work to the doctor's office.

Sometimes, this process was relatively straightforward as Hannah explained:

> *My doctor's office always reports my statistics to the insurance company already, and I don't know if they were aware of the HEP, but when I have the paperwork with me I show them everything that I have with me, so it is easy to verify and they know. They are pretty much in sync with it now because they told me what and where I had to fill out and that kind of thing. I get it done when it is humanly possible, if it is not humanly possible then it's just not going to happen.*

Sam explained how, even though he helped his family manage the requirements, he had no way to confirm that they met them:

> *I'm not quite sure. I tell everybody [family] that they have to have certain things done, the HEP requirements met and usually the appointments are then made and everything is taken care of…. I don't know—she's a fellow state employee and she has her own HEP account.*

Beth expressed concerns over enforcing the requirements with children:

> *Sometimes the children aren't up to date…. Call doctors, call providers..., make appointment..., put on family calendar, large, very large family calendar and tell children who record appointments electronically on their phones. …The easy part is actually making the appointment. The difficult part is making sure the kids get there, because they don't listen or there is a soccer game.*

On the other hand, Lily expressed frustration over the lack of communication when the website did not reflect updates about her son's meeting the HEP requirements:

> *Through the HEP they have their own nurses that is associated with that website, where you can consult with a nurse. …Calling them that time to…figure out what was going on—I sent several notes where I explained the situation and I heard nothing back. It was like hell for me, and so having an online system in theory is really good thing, it just wasn't working.*

Once they met all the requirements, respondents noted they did not receive a notification that confirmed that fact. The only method they could use to confirm their compliance involved visiting the website or calling the HEP office; as such, they (rather than the Connecticut State Government) had the burden to confirm their compliance. On the lack of confirmation about meeting requirements, Chris said: "I don't think they give me anything, but I had to make sure they had the information so I remember I had to call them in December to verify that they had everything".

While some respondents made efforts to confirm their compliance, others remained in the dark and hoped they would be able to confirm it if needed. Derek said: "Uh, yeah I'm sure we all made, met the requirements. I have no way to confirm that but I'm sure I can find out on HEP website.". Jake expressed a similar sentiment: "Honestly, I have no idea if I met them or not. I have to ask my insurance provider or get the information on the health care enhancement program website, which I haven't visited in the past.".

Assessment of patient centeredness: the Connecticut State Government designed the HEP Web portal to help people manage and track their preventive care visits. However, consumer experiences and perspectives suggest that they found doing so a huge challenge both in the sense that the portal provided inadequate support and had low usability (e.g., it lacked electronic reminders and complete compliance information, which meant respondents had to use personal and offline strategies to remind themselves about appointments and obtain compliance information). As such, the portal had low patient activity and low patient empowerment. The HEP Web portal's design did not focus on simplifying the complexity of using multiple online and offline tools and consumers' need for meaningful, personalized reminders based on their individual lifestyles, which suggests that the portal had a low patient focus as well.

5.3   Adoption and Use of HEP Web Portal

Our findings show that respondents generally either did not adopt, partially adopted, or temporarily adopted and eventually abandoned the HEP Web portal. On that note, recall that that this e-health service operated as part of a health benefit program that all state employees had to participate in. While all but two participants knew about the website, not everyone adopted it for use. As respondents' accounts in Section 5 show, some users did not adopt the website because other family members took care of their requirements for them, and many seemed reluctant to switch from their offline scheduling and tracking methods. The respondents who did use the website to schedule or track their appointments faced several hurdles in successfully using it due to the challenges we describe above. As such, they switched back to

offline methods such as calling the HEP center and visiting the doctor with paperwork. Thus, we can conclude that, while the respondents did adopt the HEP e-health service to some degree, they did so at a minimal level at best.

The adoption and use challenges that the respondents faced highlight that the HEP e-health system lacked patient focus, patient activity, and patient empowerment, which we summarize below.

- **Patient focus**: respondents' accounts about the challenges they faced in scheduling and tracking their HEP compliance activities indicates that the system design glaringly lacked in patient focus. While the Connecticut State Government created the service for consumers to schedule and track their compliance activities, the design did not consider their needs in the real world. The context in which our respondents coordinated, scheduled, and tracked their HEP requirements activities was complex and often involved multiple family members and healthcare providers. The HEP e-health service did not consider these challenges in supporting users. Certain respondents served as the primary health coordinator for their family members but could not access their compliance status information (children in particular). As their family's primary health coordinator, they did not have easy access through the website to schedule tests/doctor visits for several family members with their respective healthcare providers. In order to help their family members schedule the necessary compliance activities such as tests/visits, the HEP e-health service sent email and paper reminders. However, the service did not customize these reminders to individual respondents' schedules. As such, respondents used various strategies based on their personal work and social context because they did not find the stock reminders useful. Proactive respondents who needed to schedule appointments/tests during a particular period such as school holidays found these reminders annoying. Reactive respondents who depended on a reminder to schedule appointments/tests found them to occur too late in the year, which resulted in last-minute scheduling challenges or a failure to meet the schedule. The respondents used not only various digital and non-digital technologies as means of self-reminders but also multiple tools such post-it notes, wall calendars, phone calendars, and so on. As such, the e-health service failed to support users' needs in scheduling and tracking their HEP compliance activities.

- **Patient activity**: given that the respondents had to obtain HEP compliance, most tried to ensure that they met the compliance requirements with or without the help of the e-health service. When they obtained compliance but their account in the e-health service did not reflect that fact, they could not provide this information to update the Web portal with proof. Instead, users needed to wait for a business process that involved several parties such as insurance and healthcare providers to complete. Because these parties did not adequately integrate the content that each handled, respondents could not sufficiently access and communicate up-to-date information about their HEP compliance via the HEP e-health service. Further, even though the e-heath service had features to allow users to communicate with the HEP office via the website, it did not acknowledge or confirm the information that the respondents sent in. Further still, the service did not electronically notify patients about their compliance status once the portal did contain updated information, which often caused respondents to either check on their own accord or, in more extreme cases, simply not bother to check at all. These situations often left the users feeling uncertain.

- **Patient empowerment**: the Connecticut State Government created the HEP e-health service to help users schedule and track their HEP compliance activities. However, first and foremost, our respondents reported that they experienced difficulties in knowing how to get to the website and then trouble in accessing and navigating it. These difficulties involved password issues, expected but missing features such as updated compliance status, and an inability to find documentation on chronic disease management. These issues point to a lack of usability and meaningful control that characterize patient empowerment. That the users relied on offline methods to solve these problems suggests that the e-health service did not empower the respondents enough to continue using it.

Together, the above challenges that the respondents faced in using the e-health service provide evidence for a non-patient-centered design even though the Connecticut State Government created it to serve them and several features implemented made it theoretically patient centered. We summarize this discrepancy in Table 2.

Table 2. Assessment of Patient Centeredness from the Design vs. Use Perspective

Design assessment	User perspective
Patient focus: medium-high • Designed for consumers to help them keep up with mandatory HEP requirements • Designed to serve needs and activities • HEP Web portal developers/designers may or may not have conducted user studies	Patient focus: low • High degree of user complaints and challenges • User needs in a real-world context not considered • Lack of meaningful reminders and patient customization such as healthcare contacts
Patient activity: high • Allows users to monitor their HEP compliance status • Allows users to access information and guidance to meet the requirements • Allows users to communicate with HEP nurses • Allows users to integrate their health and wellness devices (such as a heart monitor) with the HEP Web portal • Allows users to share this integrated health/wellness data with healthcare providers	Patient activity: low • Delayed or incorrect HEP compliance status records • Inability to access and communicate up-to-date information on compliance • Inability to effectively communicate with HEP nurses or staff through the portal resulting in switching to off line tools such as paper, phone, and fax • Inability to set reminders
Patient empowerment: medium-high • Provides digital forms and education fact sheets equivalent those that one can get after a phone call • Enforces user authentication to maintain privacy and security • Does not require any special skill set beyond Web skills such as browsing, emailing, downloading, and uploading • HEP Web portal developers/designers may or may not have conducted user studies	Patient empowerment: low • Uncertainty of website address • Difficulties in accessing due to password issues • Difficulties in finding certain documentation on chronic disease management • Lack of content integration involving several parties such as insurance and healthcare providers

6 Discussion

Our findings point to the challenges in accurately assessing patient centeredness in PCEH and predicting the adoption and use of PCEH because while there may be numerous factors present in the PCEH to indicate the presence of patient centeredness, there simultaneously may be numerous factors missing that suggests the lack of patient centeredness. Table 2 shows how several patient-centered factors are not present when one obtains user perspectives about adopting/using the PCEH in contrast to simply assessing how developers/designers instantiate patient-centered characteristics. We found that, when using the PCEH framework and assessment protocol that Wilson et al. (2014) propose, the HEP Web portal seemed to have a medium to high level of patient centeredness due to the presence of several PCEH features. However, from analyzing real users' perspectives and perceptions, a different story emerged: that HEP Web portal was low in patient centeredness because it lacked several other PCEH features. These insights provide implications for theory, practice, and design in how we understand patient centeredness in e-health.

6.1 Influence of Relationship among PCEH Characteristics on Adoption

Wilson et al. (2014) found that the three PCEH characteristics showed a strong correlation even though they differ conceptually. Our data provides one interpretation for how these correlations could manifest. Specifically, we found several deficiencies in patient activity and patient empowerment. As a result, one could argue that resolving such deficiencies via understanding users' adoption and use contexts would positively influence the patient activity and patient empowerment characteristics and, thus, adoption. On the flip side, even if one designed a PCEH to support patient activity and patient empowerment at a high level when it failed to fit with patients' wider context of use, our findings suggest that this poor fit would not only reveal deficiencies in the two characteristics but also negatively influence adoption. Thus, when a PCEH has a poor patient focus due to an inadequate user-centric design, patient activity and patient empowerment may be false positives in predicting adoption and use because one can more easily see several factors in a PCEH that suggest the presence of patient activity and patient empowerment as long

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as the PCEH implements them but not easily see what factors the PCEH lacks until one obtains users' perspectives on using it.

6.2   Assessment of Patient Centeredness to Predict Adoption and Use

At its core, user-centric design involves understanding how users use a system in the real world. However, even if designers use rigorous user-centric methods in the design process, when it comes to adoption and use, the proof of the pudding is in eating it. Using the PCEH framework assessment protocol, one would score a system as high in patient focus if it adopted user-centric methods. Likewise, one would score a system as high in patient activity and patient empowerment if it implemented a large number of design features to support patients in these dimensions. Our data show that a lack of features either because they were unforeseen or simply not implemented in a system may influence whether users adopt and use it, which makes the use of PCEH framework premature in predicting adoption and continued use. Hence, we suggest adding a distinct user perspective along with non-user e-health practitioners/researchers assessment in using the PCEH framework for predicting adoption and use. We explain this recommendation further in Section 6.2.1.

6.2.1   Enhanced Approached to PCEH Assessment

We propose a two-prong methodological approach to assessing PCEH akin to two interface design-evaluation approaches that practitioners and researchers in the interaction design field use: 1) heuristic evaluation and 2) user testing. The two methods have distinct advantages and disadvantages. Heuristic evaluation involves three to five evaluators who use the heuristics or principles of good design to evaluate a system. They evaluate the system in question by seeing how well the system adheres to these heuristics while performing a specified range of comprehensive tasks that the system is expected to support. User testing, which one can do in a lab or in the field, involves testing users on real tasks to identify design elements that cause them to stumble or fail in using a system. While user testing provides a more realistic picture of adoption and use, it requires more time and financial resources in recruiting and compensating participants and conducting the study. On the other hand, experts who understand standard design principles can conduct a heuristic evaluation in one to three hours. However, even though heuristic evaluations can uncover common and expected problems easily, one runs the danger of finding false positives and missing unexpected problems in real use. Hence, one often conducts heuristics evaluation first to uncover common and expected problems and user testing with real users second to avoid wasting them as a resource and to identify unexpected problems in real use. Thus, the two approaches serve different but complementary needs in fully evaluating a system's design.

In a similar fashion, we propose two methods of using the PCEH framework to predict PCEH adoption and use: using experts to assess PCEH characteristics and using users to assess PCEH characteristics. Expert evaluation would involve identifying patient-centered characteristics in a system's design that are influenced by policies, processes, and procedures of the organization/designers who implement the PCEH. In contrast, a user evaluation would shed light on these characteristics based on the system's use in the field.

6.3   Implications for Design

The findings from our semi-structured interviews provide insights into consumers' perspectives and challenges in using the HEP Web portal. Specifically, they highlight the challenges our respondents faced in using the HEP e-health service across three dimensions: 1) usability, 2) tracking and managing preventive care, and 3) scheduling and coordinating preventive care. The respondents highlighted these challenges in discussing how they experienced uncertainty about HEP requirements, felt confusion over delayed reporting or incorrect compliance updates, juggled both digital and non-digital tools, lacked automatic confirmation updates from the portal, and had to contend with poorly coordinated/scheduled/tracked appointments for family members with service providers. Together, these challenges highlight the need to lower the cognitive burden that the respondents experienced in knowing, remembering, coordinating, and/or tracking the HEP requirements. Thus, we offer several design implications for technology that would help make HEP e-health more patient centered. We discuss these implications according to the three dimensions we discuss above.

6.3.1   Usability

First and foremost, users need to know where to go if they need to find relevant HEP information. The fact that our respondents had trouble recalling a website address or login password suggests not only that they required a clearly defined one-stop place to access information but also that it needed to be ubiquitous, easily accessible from anywhere at any time, and support recognition rather than recall. Seamless access to the Web portal can be achieved by using push technology to deliver HEP information regularly via email or text messages to enable easy transfer to the website through hyperlinks in the body of the message.

Mandatory password resets are a security measure to prevent unauthorized use. However, if one accesses the HEP Web portal only once or twice a year, being forced to change the password every year comes with a usability and access cost. Further, previous research has shown that mandatory password change policies can be counterproductive leading to users choosing weak passwords (Zhang, Monrose, & Reiter 2010). In using the HEP Web portal, for users to recall a password that they use on a non-regular basis which changes every year places a heavy cognitive burden on them. The usability of the HEP Web portal can be improved by implementing backend security measures that support the use of stable passwords.

6.3.2   Scheduling and Coordination of Preventive Care

When our respondents wanted to learn about their HEP requirements, they used the website or a paper-based list. When they needed to meet their HEP requirements, the Web portal provided a list of HEP-approved service providers—a great feature for individuals who did not already have an established relationship with doctors and nurses. However, many of our respondents already had doctors and other service providers in their personal contact lists on their phones/calendars. In either case, they had to switch to voice calls to schedule appointments with the providers. One could minimize such switching by designing a complete electronic process in the HEP e-health service that provides links to doctors' offices and their calendar and indicates doctors' availability and schedules to make the process of scheduling seamless. Alternatively, consumer apps could host doctors' information and HEP compliance information to allow users to more seamlessly schedule their activities based on their compliance status. Further, for users who already have an ongoing relationship with health service providers, users would need to be able to store their healthcare providers' information in the app to reflect that fact.

6.3.3   Managing and Tracking Preventive Care

Improved and streamlined communication and content sharing among relevant stakeholders such as service providers, HEP program staff members, and insurance companies would represent one way to reduce users' frustration over a lack of information and confusion over delayed or incorrect compliance updates to a large extent. However, one could also make HEP e-health services more patient centered by design.

First, our respondents used tools that they found convenient and intuitive to set reminders and notifications. Accordingly, some used paper-based calendars and books while others used electronic devices. As such, reminders and notifications should cater to people's preferences. When designing a mobile or Web app, one would need to consider these preferences to minimize users' frustration over undesirable notification methods and notification overload. Such an app would also need to integrate with personal devices such as phones and emails and allow users to print documents.

Second, our respondents either exhibited proactive or reactive scheduling habits in response to the HEP requirements. Proactive users would benefit from the flexibility to set reminders on devices and the Web app from HEP based on their own preferred dates, such as birthdays or work breaks. In contrast, reactive users would benefit from being able to enable a progressive reminder service that began early in the year with multiple reminders that indicated physician availability and schedules.

Third, our respondents often had to ensure their family members met the HEP requirements as well and, thus, acted as a coordinator for this process. Thus, users can benefit in being able to act in both a patient and coordinator role in using the e-health, in other words, to 1) access each family member's relevant physicians, 2) see updates on family members' appointments and compliance status, 3) send personalized reminders to the family member in charge (such as from the parent to the child or one spouse to the other).

The design implications identified above also provide new directions for further research that examines the effectiveness of various PCEH designs. For instance, one could design different interventions to investigate users' adoption intentions across various types of push technology to deliver HEP information. One could also examine the moderating influence that demographic variables such as age, gender, and employment status have on users' adoption to gain additional insights into how different user constituencies can take an active role in managing their health information.

7   Limitations

Our study has several limitations that readers should consider when interpreting our findings. First, we focus on a government-run Web portal. Although government websites benefit from the awareness and advertisement through mandates and legislation, they also commonly have limited IT resources and support (Schwester, 2009). As such, one may uncover different findings when analyzing a privately owned health IT website that paid more attention to understanding customers in order to win their repeat business. Further, the approach we used to examine PCEH adoption limits our findings: we interviewed only individuals who worked in a state university in Connecticut, which could have resulted in unintended bias in terms of high technology access and use. Our data could also contain bias related to our respondents already being motivated to engage in regular preventive medical care. However, if these biases did exist, they subsequently make a stronger case for challenges identified with adoption and use.

Mandatory participation in the HEP program may have skewed our findings. Hence, we have reason to believe that the respondents' responses to the interview questions and their attitude toward PCEH adoption may have differed were participation not mandatory. While we conducted the study more than a year after the Web portal was launched, our respondents could have differed in the time they required to learn navigating the Web portal based on their comfort with using technology. Although we did not control for technical expertise in our study, the results indicate that most of the respondents were technically savvy, which may have also skewed their responses and perceptions about adopting the PCEH.

Other researchers could provide further insights into PCEH adoption via examining it across multiple healthcare providers and healthcare programs. Nonetheless, this study provides important insights on reasons users resist adopting or abandon using health IT and implications for improving PCEH design.

8   Conclusion

In this paper, we examine how consumers used a purposively designed patient-centered e-health system, which makes it the first to examine the efficacy of the PCEH framework in a field setting. With particular focus on a e-health system created for a preventive care program in Connecticut in the United States, we discovered that actual users experienced several challenges in using it and, thus, that it had less patient centeredness than we assessed it to have beforehand. These insights provide several design implications for how designers should design PCEH to ensure that users adopt and, more importantly, continue to use them. We also entertain the possibility that our failure to observe patient centeredness in the HEP Web portal could have resulted from status quo bias (Kahneman, Knetsch, & Thaler, 1991) on the part of the employees such that their resistance to the HEP program could have infiltrated how they reviewed the system. However, we do not examine such bias in this study, so we have no evidence in our data to corroborate that possible explanation. We found the need for a more nuanced assessment of patient centeredness in e-health that includes user perspectives in order to meaningfully predict adoption and continued use. Our work contributes broadly to the literature on designing information systems for effective adoption and use. The research we present in this paper not only empirically examines various factors of the PCEH framework but also sets the stage to expand and further test PCEH theory.

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