The Role of Computer Skills in Personal Health Record Adoption Among Patients With Heart Disease: Multidimensional Evaluation of Users Versus Nonusers

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Abstract

Background: In the era of precision medicine, it is critical for health communication efforts to prioritize personal health record (PHR) adoption.

Objective: The objective of this study was to describe the characteristics of patients with heart disease that choose to adopt a PHR.

Methods: A total of 79 patients with chronic cardiovascular disease participated in this study: 48 PHR users and 31 nonusers. They completed 5 surveys related to their choice to use or not use the PHR: demographics, patient activation, medication adherence, health literacy, and computer self-efficacy (CSE).

Results: There was a significant difference between users and nonusers in the sociodemographic measure education ($P=.04$). There was no significant difference between users and nonusers in other sociodemographic measures: age ($P=.20$), sex ($P=.35$), ethnicity ($P=.43$), race ($P=.42$), and employment ($P=.63$). There was a significant difference between PHR users and PHR nonusers in CSE ($P=.006$).

Conclusions: In this study, we demonstrate that sociodemographic characteristics were not an important factor in patients’ use of their PHR, except for education. This study had a small sample size and may not have been large enough to detect differences between groups. Our results did demonstrate that there is a difference between PHR users and nonusers related to their CSE. This work suggests that incorporating CSE into the design of PHRs is critical. The design of patient-facing tools must take into account patients’ preferences and abilities when developing effective user-friendly health information technologies.

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KEYWORDS
patient portal; communication; patients; precision medicine; health literacy
**Introduction**

**Precision Medicine in Cardiovascular Disease**

The Precision Medicine Initiative is a nationwide initiative that was launched in 2015 to transform the United States health care delivery from a “one-size-fits-all” approach to one that takes into account individual variability in genes, environment, and lifestyle when providing patients with treatment and prevention strategies [1]. The primary goal of precision medicine is to provide optimized medical care and outcomes for each patient. Benefits of precision medicine include increased prediction capabilities to determine which treatments work best for particular patients; better insight into the underlying mechanisms by which multiple diseases occur; enhanced methods for preventing, diagnosing, and treating a variety of illnesses; and improved electronic health records (EHRs) integration in clinical care, which promotes easier access to health data [2].

Management of life-threatening illnesses and chronic diseases has been progressing toward precision medicine for many years [3]. There has been exceptional precision medicine advancement related to cardiovascular disease (CVD) [4-8], which aids in the transformation of the management practice for CVD. Despite these advancements, CVD still ranks as one of the leading causes of death in the United States [9]. CVD contributes US $320 billion to health care costs annually. This includes the cost of health care services, medicines, and lost productivity due to death. This cost is projected to increase to US $818 billion by 2030 [10]. In addition to focusing on preventive measures to reduce the incidence of CVD, improving patients’ management of this disease will reduce the CVD’s economic cost on the health care system. Although targeted therapies related to cardiovascular medicine are less developed than in other specialties, such as oncology, these therapies have been acknowledged as a practical next step in patient-centered CVD treatments [4]. Patient-centered care relies heavily on patients becoming more involved in their health and wellness in order to achieve the optimal benefits from the health care system. Effective communication between health care providers and patients is necessary for health promotion efforts to be successful. New strategies, such as the personal health record (PHR), have been implemented to enhance the effectiveness of health information communication between patients and their providers.

**Patient Portal Use**

The Medicare and Medicaid EHR Incentive Programs advocate for patients to be involved in their health care. The PHR allows patients to electronically view their health information, after-visit summaries, credible educational materials, and reconcile their medication list [11]. PHR use should improve patient–provider communication, self-management of chronic illnesses, and medication adherence [12,13]. However, a data brief from the Office of the National Coordinator for Health Information Technology reported that although more than 90% of health care organizations offer patient portal access, less than 25% of patients actually use it [14]. Another study by Powell and Deroche [15] found that 35% of patients with a chronic disease have never used their patient portal. Patients with a chronic illness play an important role in their health improvement because chronic illnesses require continuous self-management efforts [16-19]. A study by Henry et al [20] found that providing educational information in patient portals can improve chronic disease self-management. Patients managing a chronic illness must be involved in and knowledgeable about their health. Patients who are engaged in their care are more inclined to follow treatment plans and manage their health [14,21,22].

Precision medicine offers promising improvements to health care. However, for this potential to materialize, it is necessary to involve patients in the process. In addition to generating targeted therapies, precision medicine will also generate complex risk and benefit information that will be hard to interpret for low-literacy populations [23]. Adoption of precision medicine in CVD will require patients to interact with complex results in their PHR. A literature review by Wynn et al [24] found that a patient’s health literacy impacts his/her ability to understand precision medicine materials; therefore, providing patient-facing materials that are understandable to all health literacy levels must be a priority when designing health information technology (HIT) tools.

Educational gaps in precision medicine exist for patients, which requires interventions to be implemented to improve knowledge, awareness, and attitude on how precision medicine will be incorporated into the patient experience and the PHR [25]. For patients to receive the most value from their PHR, the information presented within must be written at a level comprehensible to a lay audience so that they have the ability to act on the information received [26-30]. Research is needed to determine appropriate data display, visual aids, and understandable language that will foster adoption of the PHR; however, evidence remains limited in this area [24,31]. Previous research has focused on patient portal use among patients with multiple chronic illnesses, but none have focused solely on patients with CVD.

**Objective**

The promotion of technology-assisted disease self-management is increasing as PHRs continue to be adopted by health care organizations. Therefore, the objective of this study is to describe the characteristics of patients with heart disease who choose to adopt PHRs. Sociodemographic and propensity characteristics were explored among PHR users and non-PHR users.

**Methods**

**Study Design**

This study involved multiple, previously validated surveys completed by cardiovascular medicine patients affiliated with the University of Nebraska Medical Center (UNMC). This survey was administered between August 2015 and June 2019. UNMC’s Institutional Review Board approved this study as an expedited research project.
Organizational Setting
UNMC is an academic medical center whose clinical partner is Nebraska Medicine. The Division of Cardiovascular Medicine operates 3 clinics with over 28,000 annual patient visits. The team includes experts in general cardiology and a team of leading subspecialists in areas such as cardiac electrophysiology, interventional cardiology, structural heart disease, diagnostic cardiovascular imaging, congenital heart disease, advanced heart failure, mechanical circulatory support, and heart transplants. A nonprofit organization, Healthcare Information and Management Systems Society, rated UNMC with Stage 7 of the Electronic Medical Record (EMR) Adoption Model in 2016 [32]. A Stage 7 rating is awarded to hospitals and clinics with a fully integrated EHR that transports data using Continuity of Care Documents, utilizes data warehousing to assess clinical data, and demonstrates summary data continuity for all hospital services [33]. The PHR offered at UNMC is Epic (Verona) MyChart, a tethered PHR, and was available to patients at the beginning of 2014.

Recruitment
For our study, we recruited patients who received care at the UNMC’s Heart and Vascular Center. When eligible patients were identified, a nurse coordinator contacted patients via a telephone call. The recruitment phone call introduced the voluntary nature of the study, and explained what the patient’s participation in study would entail. Data collection sessions were scheduled and conducted in a clinic or adjacent conference room. Whenever feasible, the data collection session was linked to patients’ scheduled appointment for convenience. This method of connecting the data collection session with patients’ upcoming clinic visit was especially appealing to busier young and middle-aged adults. Participants were not compensated for their participation.

Participants
Overall, recruitment response was positive. A total of 95 patients were screened for participation in this research project. Of those, 16 declined while 79 accepted and participated in the research. Eligible participants were current patients of UNMC, scheduled for a clinic visit follow-up, 19 years old and older, and able to give consent. Use of the PHR was not a screening criterion. PHR users were defined as research patients who signed up for Nebraska Medicine’s Epic MyChart and sending at least one message prior to enrollment in this research project. Of the 79 who participated in the research there were 48 users and 31 non-users of the PHR.

Data Collection
Each data collection session lasted 15-30 minutes. After consent was obtained, the survey was administered. Sociodemographic data were collected followed by administration of 5 survey tools: the Computer Self-Efficacy (CSE) Survey, the Health Literacy Survey, the Medication Adherence Survey (MAS), and the Patient Activation Measure (PAM). These battery of surveys measure the patient’s comfort using computers, their general medical knowledge, their likelihood of taking prescribed medications, and their engagement in their care.

Measures
Computer Self-Efficacy
The CSE questionnaire is a 10-item survey that utilizes an 11-point Likert scale, and asks the patients their confidence in completing a task under a variety of scenarios, such as when given step-by-step instructions, utilizing on-call user help, or initial training in getting started. Scores for each question range between 0 and 10, with the total score then being between 0 and 100. The CSE has long been used to assess users’ belief that they can successfully interact with a computer system. Based on social psychology, self-efficacy has been found to influence the users’ behavior related to their use of the system [34].

Health Literacy Survey
The Health Literacy Survey is a 3-item survey that measures patients’ adequacy in understanding health information. Developed and validated by Chew et al [35,36], the Health Literacy Scale works well in a busy clinical environment. Health literacy and PAMs are both correlated with health outcomes, however Smith et al [37] noted a poor correlation between the 2 measures and argued that both should be targeted to improve patient safety and engagement.

Medication Adherence Survey
MAS is an 8-item patient survey that provides reliable predictions of patient medication compliance [38]. MAS has a strong correlation with clinical outcomes in patients with hypertension and other conditions [39]. Patients with greater knowledge, attitude, satisfaction, and coping skills were more likely to have high medication adherence, whereas those stressed or requiring a complex medication scheme were less likely to be adherent [40].

Patient Activation Measure
The PAM (Insignia Health) is a 13-item survey using a 4-point Likert scale. It is a robust and well-validated assessment tool developed by Hibbard and colleagues [41] to measure the level of patients’ engagement in their health. The PAM scale reflects a developmental model of activation. Activation appears to involve 4 stages: (1) believing the patient role is important, (2) having the confidence and knowledge necessary to take action, (3) actually taking action to maintain and improve one’s health, and (4) staying the course even under stress.

Data Analysis
Survey data were recorded and stored in a secure database and analyzed using SAS 9.4 (SAS Institute) in conjunction with a biostatistician (EL). The data were summarized using descriptive statistics which included counts and percentages, means, SDs, medians, and interquartile ranges. Patient characteristics were compared between PHR users and non-users using the Fisher exact test for categorical data and the 2-sample unpaired t test for continuous data. The 2-sample t test was used to compare the composite scores for the survey instruments between the groups. Missing data were handled using pairwise deletion (available-case analysis). In other words, results were reported for the nonmissing values for each variable analyzed. All tests
were 2-sided and a $P$ value of <.05 was considered statistically significant.

**Results**

Table 1 shows the demographics of patients with CVD that participated in this study. Responses are classified according to PHR users (48 participants) and PHR nonusers (31 participants). There was a significant difference between users and nonusers in the sociodemographic measure education ($P=.04$). There was no significant difference between users and nonusers in the sociodemographic measures age ($P=.17$), sex ($P=.35$), ethnicity ($P=.43$), race ($P=.42$), and employment ($P=.75$).

There was a significant difference ($P=.006$) between PHR users and PHR nonusers in CSE (Table 2).

Figure 1 shows the mean CSE scores by survey items for PHR users and nonusers. Both users and nonusers reported being less able to complete a task using a computer software application if they had never used a computer application like it before.

### Table 1. Distribution of population characteristics categorized by PHR users and PHR nonusers ($N=79$).

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Nonuser (n=31)</th>
<th>User (n=48)</th>
<th>$P$ value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (years), mean</strong></td>
<td>63</td>
<td>57</td>
<td>.20</td>
</tr>
<tr>
<td><strong>Sex, n (%)</strong></td>
<td></td>
<td></td>
<td>.36</td>
</tr>
<tr>
<td>Male</td>
<td>18 (58)</td>
<td>22 (46)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>13 (42)</td>
<td>26 (54)</td>
<td></td>
</tr>
<tr>
<td><strong>Education, n (%)</strong></td>
<td></td>
<td></td>
<td>.04</td>
</tr>
<tr>
<td>Some high school</td>
<td>3 (10)</td>
<td>1 (2)</td>
<td></td>
</tr>
<tr>
<td>High-school graduate/general educational diploma</td>
<td>9 (29)</td>
<td>9 (19)</td>
<td></td>
</tr>
<tr>
<td>Some college/associate degree</td>
<td>10 (32)</td>
<td>17 (35)</td>
<td></td>
</tr>
<tr>
<td>College graduate</td>
<td>8 (26)</td>
<td>9 (19)</td>
<td></td>
</tr>
<tr>
<td>Postsecondary education</td>
<td>1 (3)</td>
<td>12 (25)</td>
<td></td>
</tr>
<tr>
<td><strong>Ethnicity, n (%)</strong></td>
<td></td>
<td></td>
<td>.43</td>
</tr>
<tr>
<td>Hispanic/Latino</td>
<td>4 (13)</td>
<td>7 (15)</td>
<td></td>
</tr>
<tr>
<td>Not Hispanic or Latino</td>
<td>27 (87)</td>
<td>41 (85)</td>
<td></td>
</tr>
<tr>
<td><strong>Race, n (%)</strong></td>
<td></td>
<td></td>
<td>.42</td>
</tr>
<tr>
<td>American Indian/Alaskan Native</td>
<td>1 (3)</td>
<td>0 (0)</td>
<td></td>
</tr>
<tr>
<td>Black/African American</td>
<td>6 (19)</td>
<td>6 (13)</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>24 (77)</td>
<td>42 (88)</td>
<td></td>
</tr>
<tr>
<td><strong>Employment, n (%)</strong></td>
<td></td>
<td></td>
<td>.63</td>
</tr>
<tr>
<td>Employed</td>
<td>11 (35)</td>
<td>19 (40)</td>
<td></td>
</tr>
<tr>
<td>Unemployed</td>
<td>20 (65)</td>
<td>29 (60)</td>
<td></td>
</tr>
</tbody>
</table>

### Table 2. Characteristics of PHR users and PHR nonusers.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Nonuser</th>
<th>User</th>
<th>$P$ value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Mean (SD)</td>
<td>Median (IQR)</td>
</tr>
<tr>
<td>Computer Self-Efficacy</td>
<td>30</td>
<td>46.23 (34)</td>
<td>45.5 (65)</td>
</tr>
<tr>
<td>Health Literacy</td>
<td>31</td>
<td>8.42 (29)</td>
<td>8 (2)</td>
</tr>
<tr>
<td>Medication Adherence</td>
<td>15</td>
<td>6.87 (1.25)</td>
<td>7 (2.25)</td>
</tr>
<tr>
<td>Patient Activation</td>
<td>31</td>
<td>64.34 (17.8)</td>
<td>55.62 (21.6)</td>
</tr>
<tr>
<td>Patient Activation Level</td>
<td>31</td>
<td>2.61 (1.05)</td>
<td>3 (2)</td>
</tr>
</tbody>
</table>
**Discussion**

**Principal Findings**

**Overview**

Our results show a significant difference between PHR users and PHR nonusers’ education ($P=.04$) and CSE ($P=.006$). This study adds to the ongoing discussion about the adoption of PHRs with a focus on patients with CVD. However, these results cannot be generalized to patients with an acute illness because of the different care required from chronic diseases. Although chronic disease is a major health care issue in the United States, the health care system is slow to re-adjust from an acute care focus to a system that addresses the complexities of chronic disease [42]. The use of HIT, such as PHRs, can support the management of chronic diseases. There is a lack of studies that look at PHR adoption among patients with heart disease. Patients with heart disease are an important group to study because CVD is a complex chronic disease and is one of the leading causes of death in the United States. Heart disease and stroke account for almost 801,000 deaths annually, costing US $316 billion in health care expenditures and lost productivity annually [43]. CSE plays a role in PHR acceptance and use. Previous literature on PHR adoption shows a difference between race and ethnicity in PHR use. Multiple studies found that Black and Hispanic patients were less likely to use a PHR as well as individuals with Medicare or Medicaid insurance [44-49]. Most of those studies recruited based on specific demographics as dependent not independent variables. Our results suggest that awareness of these disparities may have bolstered strategies focused on the demographics with lower usage rates in an effort to increase adoption [50]. A deeper analysis is needed to validate these results.

**CSE’s Role in PHR Use**

Our results demonstrate a difference between PHR users and nonusers in CSE, but not in other measured scales. CSE is significantly influenced by one’s computer knowledge and previous computer experience [51]. Having prior computer knowledge before using a PHR would increase CSE scores and likelihood of PHR use. Patients are more open to trying a PHR because they are familiar with how computer applications work.

**Patient Activation Was Not a Factor in PHR Adoption**

Another interesting finding is that patient activation was not a factor in PHR adoption. Previous studies have shown an association between PHR use and improved levels of patient activation [52-54]. Patients who are engaged in their care are less likely to adopt the PHR if they also have low self-efficacy. Our results implicate that patient’s comfort using technology plays a more important role in PHR use than patient activation.

**Recommendations**

It is important to address the challenges in using HIT for patients with lower literacy levels [55]. It is critical that the PHR’s display be tailored to the comprehension abilities of individuals with low computer literacy. Further, technological support should be made available when possible. Future research should examine the feasibility of computerized adaptive tests as screening tools to identify patients’ literacy skills [56,57]. Future research should also compare characteristics of patients receiving acute care versus chronic care in terms of their PHR.
adoption and use. Understanding these differences will assist in developing targeted interventions to improve PHR use.

**Limitations**

This study was limited to patients with cardiology issues; therefore, this study needs to be reproduced in other practice settings because of the specific information needs of the different specialties [58,59]. Recruitment came from a single academic medical center and the results need to be validated in multiple academic centers. This study had a small sample size and may not have been large enough to detect differences between groups. There may be specific patient characteristics that were not measured in this cohort that may have an effect on patients’ PHR usage.

**Conclusions**

CSE played a role in whether or not a patient would be a PHR user. Design of patient-facing tools must take into account patients’ preferences and abilities when developing effective user-friendly HIT tools [60]. Providing tools designed for the “average patient” will result in isolation of patients that do not fit into the “average” mold. Future research should explore the PHR features most used by patients with cardiologic issues to understand how to prioritize functionality. Future HIT tools should be developed to overcome gaps in CSE. PHRs have the promise of improving chronic disease management and increasing patient engagement. Optimizing the PHR to support its intended users will provide the momentum needed to increase patient engagement in their care [61-63].

**Acknowledgments**

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**Conflicts of Interest**

None declared.

**References**


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Abbreviations

- **CSE**: computer self-efficacy
- **CVD**: cardiovascular disease
- **EHR**: electronic health record
- **EMR**: Electronic Medical Record
- **HIT**: health information technologies
- **MAS**: Medication Adherence Survey
- **PAM**: Patient Activation Measure
- **PHR**: personal health record
- **UNMC**: University of Nebraska Medical Center

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