

# Motivating, Influencing, and Persuading Patients through Personal Health Records: A Scoping Review

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## Abstract

The manuscript is an evaluative review of the literature pertaining to personal health records (PHRs). The primary focus was on revealing their potential to function as persuasive tools and their efficiency in this role. We demonstrated the ways in which PHRs could motivate, influence, and persuade patients in their adoption of target health behaviors associated with disease and medication management. We based this review on the theoretical framework of captology by B. J. Fogg and colleagues (1998) and the York methodological framework by Arksey and O'Malley (2005). The final sample of studies for review included 22 articles that met eligibility criteria and were retrieved from the SciVerse Scopus database (1999–present). Findings of this review were mixed. Some studies provided evidence that patients found PHRs easy to use and useful. The patients' self-efficacy and motivation in managing health conditions increased as a result of receiving personalized recommendations, guidance, and decision support generated in PHRs. Other studies, however, demonstrated the PHRs' lack of efficiency associated with the target behavior change. We explain the mixed findings by access to an unbalanced pool of study designs as well as the breadth of the applied theoretical framework of captology. We suggest future research in a more targeted direction, for example, focusing on the evidence of the efficiency of reminders as means for motivation, influence, and persuasion.

**Key words:** personal health records (PHRs), health information technology, persuasive technology, behavior change

## Introduction

The concept of computers as persuasive technologies (called “captology”) was first introduced as a new area of inquiry at the CHI '97 Conference on Human Factors in Computing Systems. It included the view of computers as technologies that could motivate, influence, and persuade users toward adoption of target behaviors.<sup>1</sup> The trend of applying the framework of computers as persuasive technologies, although relatively young, has been popular in various domains, including commerce, safety, environmental conservation, preventative healthcare, fitness, disease management, personal finance, and many more.<sup>2</sup> Persuasive technologies have been found to be efficient in helping users set, achieve, and maintain their goals. These findings, although promising, have not been consistent; therefore, more research is needed to understand their full potential.

One recent definition of personal health records (PHRs) addresses them as “a set of computer-based tools that allow people to access and coordinate their lifelong health information and make appropriate parts of it available to those who need it.”<sup>3</sup> The design of modern PHRs allows for their interoperability with electronic health records/electronic medical records (EHRs/EMRs), web applications, and external devices.<sup>4</sup> This interoperability makes computer technology an integral characteristic of PHRs. Drawing on associations between computers as persuasive technologies and PHRs as computer-based tools, we suggest the possibility of considering PHRs as persuasive technologies as well.

According to the Functional Triad framework proposed by Fogg, computers, when functioning as persuasive technologies, can take on the roles of persuasive tools, media, and social actors.<sup>5</sup> In each case, various strategies and techniques could be employed to make computers persuade, for example, by providing simulations, providing social support, or modeling attitudes and behaviors. Although a holistic view of PHRs as persuasive tools, media, and social actors could be a valuable research direction to pursue, due to the time constraints and the amount of effort required, in this review we looked for the evidence of PHRs as persuasive tools only. Accordingly, we focused on the literature that discussed how PHRs could provide tailored or personalized information, guidance, and decision support for disease and medication management.

This analysis includes studies describing electronic PHRs that are both standalone and interoperable with web applications and external devices. For conciseness, we refer to them simply as PHRs. Since the analysis focused on PHRs in the medical domain, we refer to PHR users as “patients.”

## Methods

This review was conducted in accordance with the York methodological framework for scoping reviews proposed by Arksey and O'Malley.<sup>6</sup> We included the following stages: identification of the research questions; identification of relevant studies; selection of studies; charting of information within the included studies; and collating, summarizing, and reporting results of the review. We did not include an optional sixth stage as this review did not require consultation with stakeholders.

### Research Questions

The main goals of this review were to demonstrate the scope of current research on (1) whether or not existing PHRs were capable of functioning as persuasive tools by delivering to their users tailored and personalized health information, guidance for disease and/or medication management, and health-related decision support; and (2) whether or not the presence of such features had a positive effect on patients' sense of empowerment and adoption of target health behaviors associated with disease and medication management.

### Identification of Relevant Studies

SciVerse Scopus (1999–present) became the database of choice. It offered access to research from several fields, including engineering, consumer health informatics, human-computer interaction, psychology, and other areas. Such variety of disciplines was important for offering diverse perspectives on the topic of PHRs as persuasive tools. Articles, conference papers, reports, business articles, and news media reports were included in searches. To obtain more precise search results, we excluded the “Physical Sciences” category from the available titles since we saw no potential overlap in themes between this subject and the current review. Combinations of the following search terms were used: (1) PHRs or personal health records and (2) monitoring or tracking devices,<sup>7</sup> personalized or tailored information, and decision-making or decision support.

### Selection of Studies

During the review of titles and abstracts of the identified citations, the author applied a screening algorithm that comprised the following inclusion criteria. Studies identified as relevant for a full-text review were those describing (1) either existing PHRs or their working prototypes; (2) the ways in which PHRs provided tailored information or recommendations about patients' health conditions, guidance for disease or medication management, and decision support; (3) any PHR types, whether standalone, integrated, or tethered. Additionally, we included studies that were published in the English language only, but the studies could have been conducted in or outside of the United States.

Despite the fact that the quality of the studies was not among the inclusion criteria, we still assessed the main characteristics of each study to understand the nature of the research methods used and the quality of the findings reported. We excluded studies that described only frameworks or concepts of PHRs, studies that talked about patient portals even if referred to as PHRs, and studies in languages other than English.

Through multiple iterations of applying the inclusion criteria to the review of titles and abstracts, we identified the most relevant studies, obtained their full-text versions, and reviewed the studies in full. To finalize the sample, the same inclusion and exclusion criteria that were applied at the title and abstract review stage were used at the full-text review stage.

### Charting the Information

A spreadsheet was used to create a tabular presentation of the information extracted from each full-text article. General citation information (e.g., country of research origin, disciplines, publication date and type, and study design); characteristics of PHRs (e.g., PHR types, support of a special health condition, examples of devices or applications interoperable with PHRs, and the ability to send alerts, reminders, and/or notifications); examples of information personalization, guidance, or decision

support; findings on PHRs' efficiency including patients' opinions; and overall findings were recorded as information that could be useful for answering research questions.

## Collating, Summarizing, and Reporting Results

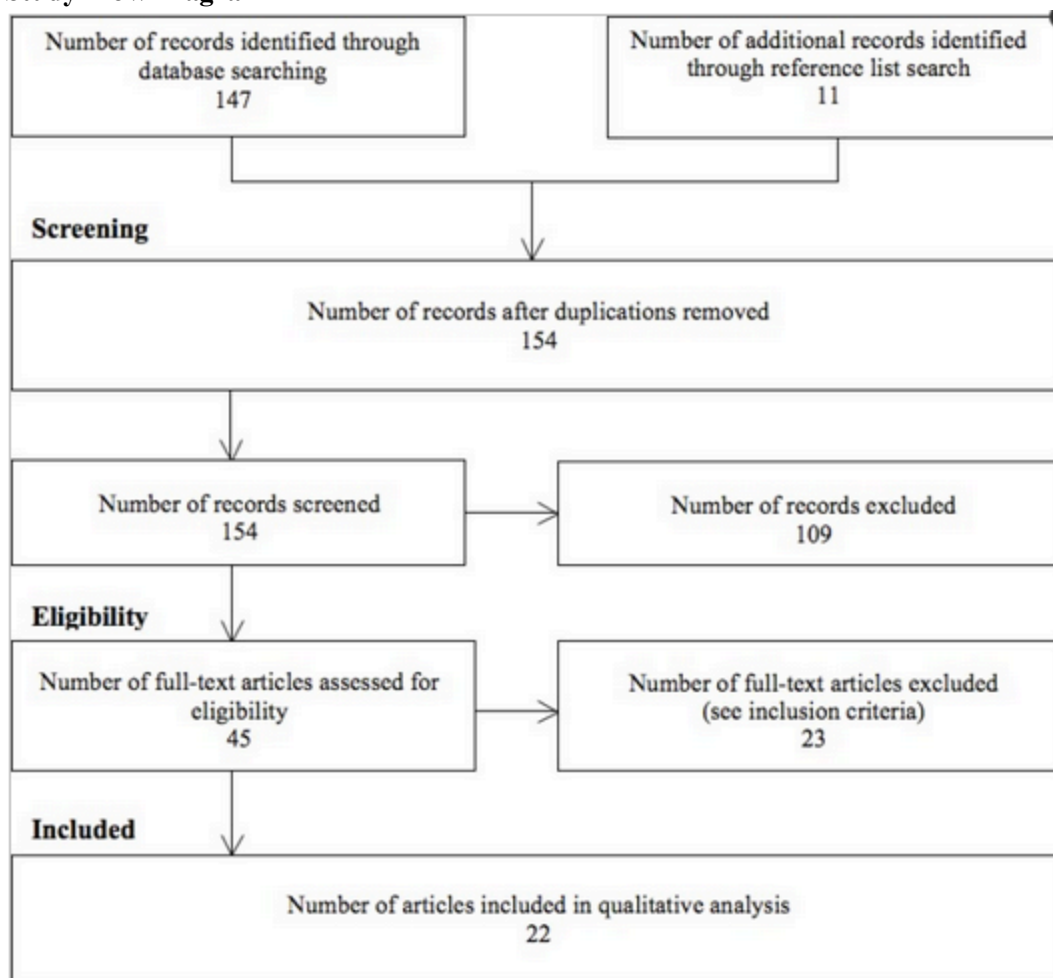
To provide a description of the scope of the literature on the topic, the following information relevant to this review was extracted: (1) examples of PHRs as persuasive tools; and (2) evidence of PHRs' efficiency as tools for persuasion and motivation, including user attitudes about PHRs' usefulness and ease of use. Such categorization allowed for the presentation of review findings in a structured way.

## Results

### Overview of Results

Initial literature searches resulted in 147 records. As SciVerse Scopus allowed for access to reference lists of articles without necessarily obtaining the full text of the articles first, we screened the reference lists of potentially relevant articles and identified 11 more records. After duplications were removed from the list, the titles and abstracts of 154 records were read, and after the predetermined inclusion criteria were applied, 45 articles were identified as potentially relevant. After the 45 full-text articles were obtained and read, 23 articles were excluded because they did not meet the inclusion criteria, and 22 were included in the qualitative analysis (see Figure [Figure 1](#)).

**Figure 1**  
**Study Flow Diagram**



### General Citation Information

Most studies were conducted in the United States. Three studies represented collaboration of researchers from various countries, including Greece, Germany, Turkey, Austria, Spain, France, Italy, and Sweden;<sup>8,7,8,9,10</sup> one study was conducted in the Netherlands;<sup>11</sup> one was conducted in China;<sup>12</sup> one was conducted in Germany;<sup>13</sup> and one was conducted in Canada.<sup>14</sup> The array of sources included in the review resulted in perspectives from a number of disciplines, such as human-computer interaction, health professions, computer studies, bioinformatics, and medical informatics. Despite the specified time period of searches, 1999–present, all of the studies included in this review were conducted during the last eight years (2005–present), which may indicate an increase in research interest on this matter. Eighteen studies were published as journal articles, three studies were presented at conferences, and one study was published in a book.<sup>15</sup>

During the selection of studies, we did not give any special preference to research of particular designs. As a result, the final sample of studies for review represented both qualitative and quantitative works. Specifically, it included four randomized control, clinical, and cluster trials<sup>16,17,18,19</sup> and nineteen qualitative articles, five of which were purely descriptive. Randomized control trials are a popular study design for testing health technologies. The key principle of this type of study—random selection of study participants—helps to reduce bias in the obtained results. Observational studies, on the other hand, provide access to larger and more diverse samples of participants, which allows for the collection of multiple perspectives. Considering benefits and drawbacks of each methodological approach, we particularly pursued the benefits of including observational studies to complement the clinical trials. Due to the applied search strategies, the final sample did not contain any quantitative studies without control groups.

## Characteristics of PHRs

The PHRs described in the studies were represented by the following naming conventions: PHRs,<sup>20,21,22,23,24,25,26,27</sup> electronic PHRs,<sup>28,29,30,31</sup> web/Internet-based PHRs,<sup>32,33,34,35,36,37</sup> personal medical records,<sup>38,39</sup> a teen-oriented PHR,<sup>40</sup> and Internet-based personally controlled health records.<sup>41,42</sup> Most PHRs were designated to be used by adults and only two by children and teenagers.<sup>43,44</sup> Some PHRs were designed to assist during the management of certain health conditions, for example, cardiovascular conditions,<sup>45,46,47</sup> chronic obstructive pulmonary disease (COPD),<sup>48</sup> special healthcare needs,<sup>49,50</sup> cancer,<sup>51,52</sup> and diabetes,<sup>53,54,55</sup> while others were not associated with support or guidance for any health condition.<sup>56,57,58,59,60</sup>

In almost all of the reviewed studies, PHRs were interoperable with EHRs/EMRs. Other examples of interoperability included integration with mobile phones,<sup>61,62,63,64,65</sup> patient portals,<sup>66,67,68</sup> and sensor and monitoring devices.<sup>69,70,71,72,73</sup> The functionality of most PHRs allowed them to send reminders or alerts to patients or their physicians and bring health-related situations to their attention. Seven PHRs sent reminders about medication intake and drug interactions,<sup>74,75,76</sup> alerts based on the readings from monitoring devices,<sup>77,78</sup> reminders about due screenings and vaccinations,<sup>79,80</sup> or messages via personal e-mails or text messages to cell phones informing patients about the need to log into their PHR and access important time-sensitive information.<sup>81,82</sup> Eight studies discussed reminders and alerts for due screenings and vaccinations<sup>83,84,85,86</sup> and personal recommendations<sup>87,88,89,90</sup> sent to patients within PHRs. Seven PHRs also sent alerts to patients' providers calling for their involvement in patient care.<sup>91,92,93,94,95,96,97</sup> In six of the reviewed studies, either the PHR did not have this functionality or the study did not mention it.<sup>98,99,100,101,102,103</sup>

## Examples of PHRs as Persuasive Tools

The reviewed articles reported on multiple examples of how PHRs functioned as persuasive tools. Eight studies described PHRs that delivered personalized information in the form of health risk assessments generated either from the readings from monitoring and sensor devices<sup>104,105,106</sup> or from the patient's answers to health risk assessment surveys.<sup>107,108,109,110,111</sup> Six studies talked about PHRs that provided recommendations, guidelines, and advice on disease management.<sup>112,113,114,115,116,117</sup> Examples of support and guidance for medication management was described in eight studies<sup>118,119,120,121,122,123,124,125</sup> and included drug intake directions and tracking, such as dosage and scheduling. Eight of the described PHRs provided the patients with links to educational resources on health and disease management.<sup>126,127,128,129,130,131,132,133</sup> Seven articles talked about PHRs that offered decision support associated with the results of health risk assessment surveys,<sup>134,135,136</sup> readings from monitoring devices,<sup>137,138,139</sup> and analysis of patient information stored in a PHR.<sup>140</sup> Most of the PHRs provided personalized information in a combination of ways, for example, health risk assessment and appropriate decision support,<sup>141</sup> personalized health risk assessment and guidelines for disease management,<sup>142</sup> or decision support and advice on disease management accompanied by links to educational resources.<sup>143</sup>

## Efficiency of PHRs as Persuasive Tools

Findings from the reviewed studies on the efficiency of PHRs as persuasive tools were mixed. Qualitative studies reported positive patient feedback about the ease of use and usefulness of PHRs. Through focus groups and questionnaires, patients expressed their preferences for access to personalized over general health information,<sup>144,145</sup> and the need for timely feedback about their health conditions accompanied by guidance on what to do.<sup>146</sup> Patients reported that PHRs were making them act on the coming information, which increased their sense of empowerment,<sup>147,148,149</sup> increased their motivation,<sup>150,151,152</sup> and promoted positive behavior change.<sup>153</sup> In cases where the primary users of PHRs were children and teenagers, their feedback about PHRs functioning as persuasive tools was also positive. Slagle et al. reported that children took more responsibility for medication administration upon receiving a call to action in the form of a message.<sup>154</sup> Chira et al. reported that teenagers were interested in better understanding their overall health state by referring to information generated in a PHR and delivered via mobile phones.<sup>155</sup> PHR interoperability with external devices and systems was strongly complimented by patients. The value of PHRs' integration with monitoring devices was seen as a feature that helped to save lives and significantly assisted in prehospitalization triage.<sup>156</sup> Patients were supportive of the fact that providers could obtain timely access to patients' health information thanks to reminders and notifications and could engage in different levels of care delivery.<sup>157</sup>

Only a few qualitative studies reported the lack of PHRs' efficiency. In the study by Wiljer et al., although patients found a PHR easy to use, they did not demonstrate any changes in their self-efficacy scores.<sup>158</sup> Hess et al. found that despite the fact that a PHR provided patients with the sense of empowerment by offering access to health self-management tools, the actual number of patient visits to the clinic or the number of phone calls did not change.<sup>159</sup> Additionally, user testing of PHRs revealed the need for usability improvements regarding some of the PHRs' features and functionality.<sup>160</sup>

Studies in which PHRs were evaluated through randomized controlled trials revealed their low efficiency as persuasive tools. Sequist et al. found that electronic outreach via a PHR produced an initial increase in colorectal cancer screening rates among patients but that the increase was not sustained.<sup>161</sup> Bourgeois et al. found that the use of a PHR did not have a statistically significant effect on patients' knowledge, beliefs, and behaviors associated with influenza prevention.<sup>162</sup> Grant et al. found that the use of a PHR specific to diabetes mellitus might have improved the process of diabetes mellitus care; however, low rates of account registration limited the effect of the intervention.<sup>163</sup> Wright et al. found that efficiency of reminders sent via a PHR was fragmented but potentially helpful to improve patient self-efficacy.<sup>164</sup> The summary of findings is included in [Table 1](#).

**Table 1**  
**Summary of Findings**

References	Examples of PHRs' Capability to Persuade, Motivate, and Influence				Feedback Delivery	PHRs' Efficiency	
	<i>Health risk assessments</i>	<i>Recommendations/ guidelines on disease/ medication management</i>	<i>Links to educational resources</i>	<i>Decision support</i>	<i>Reminders/ alerts/ notifications</i>	<i>Found efficient</i>	<i>Found inefficient</i>
Chronaki et al. (2010)	+			+	+	n/a	n/a
Yang et al. (2010)	+	+			+	n/a	n/a
Rubel et al. (2005)	+				+	+	
Tuil et al. (2006)		+	+			+	
Wang et al. (2009)		+			+	n/a	n/a
Helmer et al. (2010)		+		+	+	n/a	n/a
Wiljer et al. (2010)		+	+				+
Chira et al. (2010)		+	+			+	
Slagle et al. (2010)		+			+	+	

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Sequist et al. (2011)					+		+
Mandl et al. (2007)		+		+	+	+	
“New-Age PHR Comes with Decision-Support, Multiple Opportunities for DM”	+	+		+	+	+	
Bourgeois et al. (2008)	+	+		+	+		+
Luo et al. (2011)	+	+			+	n/a	n/a
Fonda et al. (2010)		+	+	+	+	+	
Sands and Halamka (2004)		+	+			+	
Zeng et al. (2008)		+	+			+	
Grant et al. (2008)		+		+	+		+
Tang and Lansky (2005)			+			+	
Hess et al. (2007)			+		+		+
McInnes et al. (2011)					+	+	
Wright et al. (2012)					+		+

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Discussion

A scoping review of research on PHRs’ efficiency as persuasive tools was conducted in accordance with the theoretical framework of captology and the York framework methodology and identified a diversity of studies and research approaches. Through the charting process, we created a detailed description of the literature that could be useful for future research on studying the motivational and design characteristics of PHRs. This review also contributes to the methodology of scoping reviews by offering a description of our approach to critically appraising the relevant literature.

Findings from the reviewed articles provided evidence that PHRs, as computer-based tools, are capable of motivating and persuading patients to adopt target health behaviors associated with disease and medication management. Motivation and persuasion was achieved through tailored health-related information and personalized recommendations, guidance, and decision support delivered within or with the assistance of PHRs. Effects of such influence, however, were not consistent throughout the reviewed studies. Findings from almost all qualitative studies demonstrated patients’ overall positive attitudes related to the efficiency and usefulness of PHRs. Randomized controlled trial studies, on the other hand, provided evidence that PHRs did not have a significant impact on patients’ health behaviors or did not result in increases in patients’ self-efficacy. Despite their inconsistency, we consider findings from each methodological approach equally valuable to the research questions as they provide different perspectives on the phenomena under investigation. If anything, this review demonstrated that a more balanced sample of studies for review is needed to provide a full scope of the existing evidence of PHRs’ efficiency as persuasive tools.

All but six of the reviewed articles described instances in which alerts, notifications, or reminders were generated with the assistance of or within PHRs and were used as a means of communicating health-related information to patients or their healthcare providers. Some of these alerts were delivered internally via PHRs, and some were delivered externally via mobile phones or personal e-mail. In half of the studies in which PHRs were not found to significantly change patients’ target health behaviors, health-related reminders were delivered within PHRs. We hypothesize that when health-related reminders and alerts are delivered internally within PHRs, they could be easily overlooked by patients, especially if the patients opt not to log into PHRs for a certain amount of time. Therefore, in order to bring patients’ attention to time-sensitive information generated within or with the assistance of PHRs, the information should be delivered outside of the system, for example, in the form of alerts or reminders sent to mobile devices or e-mail accounts.

This finding contributes to the idea that the efficiency of PHRs as a persuasive tool depends on their level of interoperability. When PHRs are interoperable with other systems or devices, they become a powerful tool; when PHRs function as standalone accounts, they have limited value. Interoperability with mobile devices that enables a PHR to send alerts, reminders, or notifications to patients even when they are not using the PHR could trigger necessary actions associated with disease or medication management. Interoperability of PHRs with electronic health systems could allow for easier information exchange between patients and providers, and interoperability with monitoring and tracking devices could significantly improve critical healthcare by allowing patients or healthcare providers to foresee and prevent serious health incidents.

Limitations and Future Research

Findings of this scoping review should be interpreted with a number of limitations taken into account. First, the final sample of the reviewed research was lacking non-control-group quantitative studies that addressed PHRs’ efficiency as persuasive tools.



Adding studies of this type would balance the body of available evidence and avoid the possibility of dealing with conflicting findings. Other factors that could have limited the value of the findings were that (1) only one database was searched, and only certain search strategies were applied; (2) this scoping review provided a glimpse of the literature at only a single moment in time; (3) this review did not include follow-up findings from the studies that described PHR prototypes; therefore, information about the efficiency of the final products was not included; and (4) articles published only in the English language were reviewed.

One of the main reasons that could have contributed to the mixed findings is the breadth of the theoretical framework of captology that was used in this study. Even though we applied only one aspect of this framework, namely, computers as persuasive tools, it still was too broad since included multiple characteristics of PHRs. For that reason, focusing on separate, smaller elements of this framework, for example, the role of reminders within PHRs or the role of personalized guidance in conforming to the treatment plan, would be a more appropriate approach to the analysis of PHRs as persuasive tools. In order to evaluate the consistency of the impact of PHRs as persuasive tools on changes in patients' health, reviews of longitudinal studies are also needed.

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