

Creating a Tailored Info App to Promote Self-Management Skills in Persons With Chronic Health Conditions

Development Strategies and User Experience

Neil Patel, Drenna Waldrop, and Raymond L. Ownby

Persons with chronic health conditions, such as heart disease, diabetes, hypertension, and others, often experience self-management problems that are not disease-specific. These include disrupted sleep, pain, memory issues, and challenges in working with healthcare providers. These patients may benefit from information



Neil Patel,
Department of Psychiatry and Behavioral
Medicine, Nova Southeastern University,
Fort Lauderdale, FL.



Drenna Waldrop,
Nell Hodgson Woodruff School of Nursing,
Emory University, Atlanta, GA.

and skill development for these problems, but simply providing them information in brief sessions during clinical appointments or in handouts or pamphlets may have little impact on their behavior. Providing information tailored to persons' needs and individual characteristics significantly impacts patients' behavior and may increase their abilities to manage their health. However, creating tailored information for each person is labor intensive, making it difficult to use in everyday clinical practice. Computer-based tailoring is an alternative, allowing automated tailoring of information presented to patients based on their interactions with a computer app. This article describes our process in developing a series of modules for chronic disease self-management for persons 40 or older with one or more chronic health conditions.

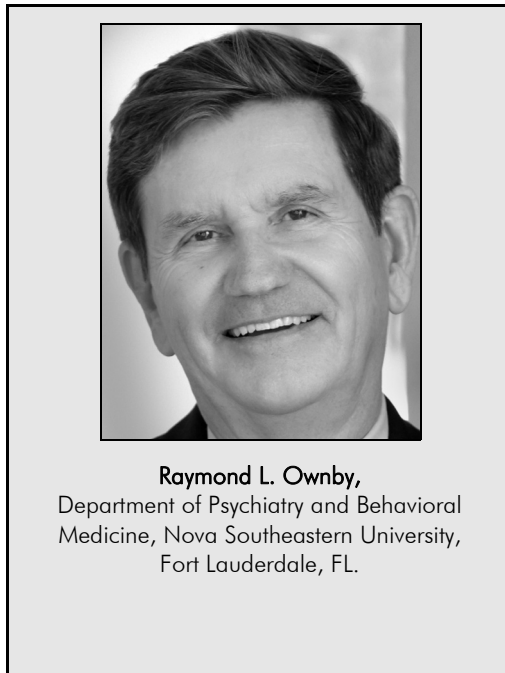
INTRODUCTION

Providing information for patients in clinical settings on self-management of their health conditions is helpful. However, traditional formats of pamphlets or handouts often need to be readied, and their recommendations need to be implemented. One strategy to increase the impact of such information on patient behavior is tailoring. Tailoring information, defined as using various methods to create individualized communications for patients, aims to reduce the

burden of self-management on health consumers by producing helpful information using computer algorithms made possible by recent technological advances.

Small studies have demonstrated the efficacy of computer-tailored health communications in increasing attention during information processing (Ruiter et al., 2006). This ability to access pertinent and personalized information drives more extensive changes in health behaviors. As previous research (Petty & Cacioppo, 1986) has studied the effects of two critical types of persuasion: (1) central route, where the thoughtful consideration of the actual merits of the information is taken into account, and (2) peripheral route, where the simple cues such as presentation and appearance influence the persuasion of the participant. Integrating both into an effective presentation module will serve an enduring effect on participant understanding and behavior (Lustria et al., 2009; Lustria et al., 2013; Noar et al., 2007; Park et al., 2009). As a result, tailored information will be more likely to be used and acted upon.

In summary, tailored health information holds the promise of helping patients acquire and act on the information and skills they need to manage their health conditions. Computer-based tailoring may allow effective automated tailoring based on patients' interactions with an application. This paper describes our project to develop a series of computer-tailored mod-



ules on chronic disease self-management information for older adults.

THE PROJECT

The project's goal was to create a tailored information app focused on chronic disease self-management skills in older adults with multiple health conditions. This focus was partly due to the frequency with which older persons experience more than one health condition; most Medicare beneficiaries, for example, are treated for more than one health condition (Centers for Medicare and Medicaid Services, 2012, 2018). Authors have thus argued that multimorbidity is the most common chronic condition (Tinetti et al., 2012) and that those with multimorbidity face unique challenges that are not disease-specific (Liddy et al., 2014).

Since chronic disease self-management addresses the problems and skills needed to deal with multiple issues like pain, stress, depression, fatigue, and sleep disturbance, self-management is a prime target to address the scalability issue with interventions (Zulman et al., 2015). While health conditions may require specific management skills, common issues such as treatment adherence, sleep issues, stress, fatigue, and depression cut across multiple conditions. They can be addressed in a single intervention.

HOW WE CREATED THE APP

In addition to a literature review, in the first phase of this project, we completed a qualitative study to explore the specific information needs of older adults living with chronic illnesses. This study has been more extensively reported elsewhere (Jacobs et al., 2017). We found that while most participants had a general understanding of chronic illness, they often indicated that they would like to know more about their illnesses and treatments and help manage symptoms. We thus aimed to

create interventions with this understanding of older adults with chronic illness (Lorig et al., 2012; Ory et al., 2013; Van Gerven et al., 2003; Van Gerven et al., 2002). Intervention modules were created considering multimedia learning principles (Mayer, 2009), such as coherence, segmenting, pretraining, and redundancy of information. We also took note of the principles of cognitive load theory (Paas et al., 2004; Van Merriënboer & Sweller, 2010), noting that it was essential that each content segment was within learners' ability to retain it. The structure of the modules was designed with the level of literacy data, suitability of materials, and learner characteristics in mind, specifically for patients with low literacy skills (Doak et al., 1996).

Information from the qualitative study enabled us to swiftly generate general content that addressed needs, skills, and disease-related knowledge and may be used to improve health condition-related knowledge and overall health literacy. Such content was developed from established domains of chronic disease management while adhering to the health literacy abilities-skills-knowledge model (Ownby et al., 2014; Ownby et al., 2021). Interventions and their elements were developed utilizing strategies aimed at persons with limited literacy skills (Doak et al., 1996) and while focusing on prose, document, and quantitative—the three basic literacy types delineated by the Education Testing Service (Kirsch, 2001).

MODULE TOPICS

In this project, we used Adobe Captivate, a readily available software program for creating multimedia learning apps without programming. It has expanded capacities for creating animations and allowing for individualized learning experiences (Figure 1). Individualization is possible through structured dialogues allowing the author to create specific paths through the app's screens based on user responses to ques-

Table 1. Chronic Disease Self-Management Modules

- Sleep
- Pain and/or physical discomfort
- Fatigue
- SOB
- Memory
- Depression
- Anger
- Stress
- Adherence

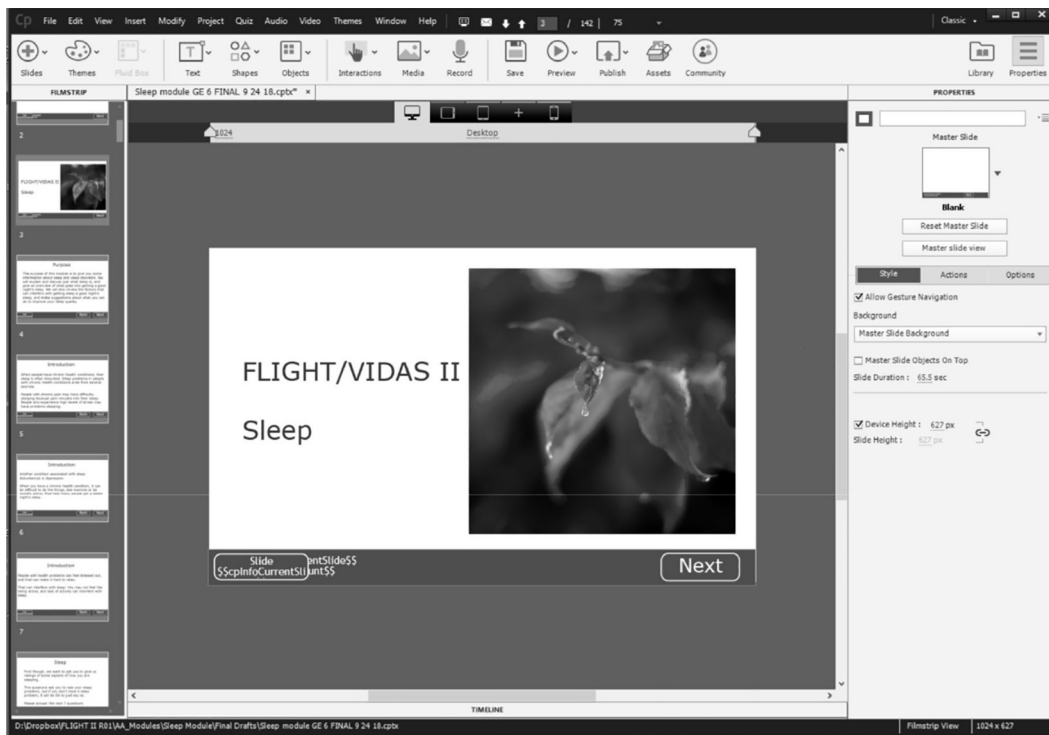


Figure 1. Adobe Creative user interface.

tions. For example, if a participant indicated they experienced a specific problem during the assessment, a variable could then be created so that in a subsequent portion of the module, that person received specific content relevant to their issue. It should be noted that other applications, both commercial (e.g., *Articulate Storyline*) and noncommercial (e.g., *Moodle*), are available and have

similar capabilities. However, we focused on Captivate because we used it in our project.

USER EXPERIENCE

Prior to further development, we tested the app's usability with an iterative procedure, asking groups of likely users to interact with prototypes and eliciting their

ongoing feedback by asking that they “think out loud” (Barnum & Dragga, 2001; Genov, 2005; Nielsen, 1989) while working through a prototype module. User comments were incorporated into subsequent versions of the interface. At the end of user testing, users rated the interface positively.

STRUCTURE OF MODULES

Each module began with a section providing a purpose statement (Table 2 & Figure 2). Participants were then asked to assess their current experience related to the module’s topic. After the assessment, participants were given a general orientation to the topic that emphasized its importance, normalizing the experience of problems in the area. Each module then presented an overview of basic information about the problem targeted to help participants understand the problem’s ori-

gin and how to apply behavioral management strategies (Figure 3). Interactivity in this section was ensured by providing a self-check about the material presented. Questions branched to positive reinforcement for correct answers, additional feedback for incorrect responses, and the opportunity to review the material relevant to an incorrectly answered question.

Modules then provided feedback on the participant’s responses, with links from the initial assessment to information and skill building later in the module (Figure 4). A final section provided a recap of the activity (Figure 5; this is only the first page of the summary). All participants were asked to provide ratings of each module on the Success in Tailoring scale, an eight-item measure assessing the extent to which participants viewed the material as relevant and valuable to them.

Table 2. Examples From Sleep Module

Statement of purpose	This module aims to give you some information about sleep and sleep disorders. We will explain and discuss just what sleep is and give an overview of what goes into getting a good night’s sleep. We will also review the factors that can interfere with getting a good night’s sleep and suggest what you can do to improve your sleep quality.
Assessment	Insomnia Severity Index is a measure that asks the participant about problems getting to sleep, staying asleep, and waking up too early. The measure also asks about general satisfaction with sleep (Morin et al., 2011).
Additional assessment	As part of the initial assessment, participants completed the Center for Epidemiological Studies-Depression measure, or CES-D (Radloff, 1977).
Overview of basic information	(1) Sleep stages, (2) hypnogram, (3) sleep hygiene, and how to use a (4) sleep diary, including animations supported by illustrations for each sleep stage.
Self-check questions	What is another word to describe the daily rhythm that makes you awake or sleepy? (Correct answer: circadian)
Tailored information based on assessment	Feedback on level of depression and its possible impact on sleep; techniques and skill building for sleep hygiene practices (e.g., no caffeine in the evening; no napping).
Conclusion/Recap	In this module, we have gone over some important concepts about sleep. We discussed how sleep relates to your immune system and mood and reviewed how sleep is an active process in which you move through stages.
Assessment of relevance (success in tailoring scale)	The information in this module would be helpful to someone like me.
After completing all modules	Questionnaire-based on the Technology Acceptance Model (Venkatesh, 2000) provided participant ratings of their perception of the intervention’s overall usefulness, ease of use, and self-reported intent to use the intervention again.

Purpose

The purpose of this module is to give you some information about sleep and sleep disorders. We will explain and discuss just what sleep is, and give an overview of what goes into getting a good night's sleep. We will also review the factors that can interfere with getting sleep a good night's sleep, and make suggestions about what you can do to improve your sleep quality.



Figure 2. Sleep module statement of purpose.

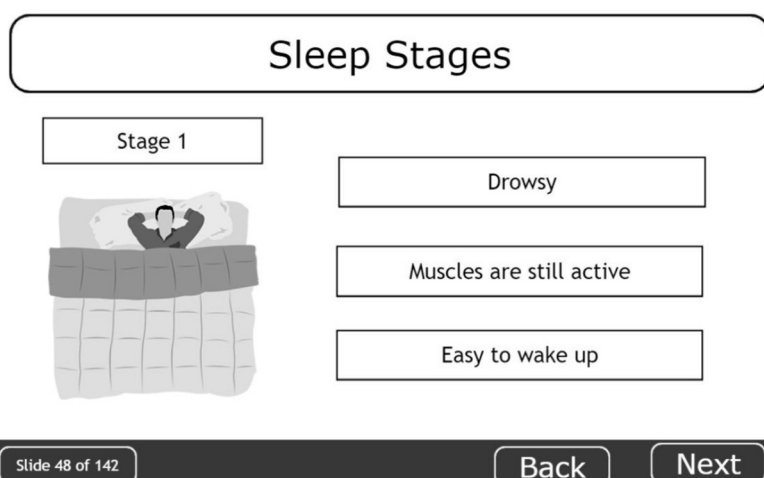


Figure 3. Basic information about Sleep Stage 1.

HOW WE EVALUATED THE MODULES

We recruited individuals who would be potential users of the app, with inclusion criteria including low levels of health literacy based on a screening procedure described in greater detail elsewhere (Ownby et al., 2017). All participants were 40 or older and had at least one chronic health condition for which they were treated. After completing a baseline visit to assess current health and physical status,

measures of cognitive and academic skills, and self-report of mood, stress, and health-related quality of life, participants completed each self-management module in research offices over 2 to 3 weeks. They then completed a follow-up assessment, part of which were questions about the participants' views of the app using a questionnaire based on the Technology Acceptance Model (Venkatesh, 2000) and the Success in Tailoring Scale developed for

Sleep

If you have difficulties getting to sleep because you worry about things whether you'll get to sleep you should do a relaxation exercise.

Don't watch the clock, and remember that few people get a perfect night of sleep every night. Most of us can still function the next day, even if we aren't in perfect form.

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Figure 4. Sleep module tailored feedback to the user.

Conclusion

In this module, we've gone over some important concepts about sleep.

We talked about how sleep is related to your immune system and your mood.

We went over how sleep is an active process in which you move through stages.

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Figure 5. Conclusion.

this study. We then asked participants to complete a semistructured interview to assess their responses to the app, its contents, and its usability. In a second follow-up visit 3 months later, we completed assessments and the interview again.

OUTCOMES

Participants in this study were 304 individuals (mean age 57.57 years; mean education 11.85 years; 144 men and 157 women;

40 Whites and 261 non-Whites). Participants reported from one to 16 health conditions, averaging 6.3 conditions ($SD = 2.7$). The most common conditions reported included arthritis ($n = 171$), hypertension ($n = 201$), elevated cholesterol levels ($n = 145$), gastroesophageal reflux ($n = 91$), depression ($n = 163$), and diabetes ($n = 73$). Results of ratings and interviews from the first follow-up (immediately after completing the app) are reported here; results from the 3-month follow-up were similar.

TAM RATINGS

Participants rated the apps on a 0 to 6 scale, with higher values indicating more positive evaluations. The mean rating on the Usefulness subscale was 4.8, and 5.1 on the Usability subscale. The mean rating on the Behavioral Intent subscale (indicating a willingness to use the app again in the future) was 4.8.

SIT RATINGS

Participants rated the app's relevance and usefulness on the Success in Tailoring Scale, from 1 to 5, with a lower rating indicating greater agreement with statements such as "The information in this app would work for someone like me." Their average rating on the eight items was 1.8, indicating moderate to strong agreement that the information in the app was relevant and useful to them. One item on the SIT asked the participants how strongly they agreed or disagreed with the statement, "I want to try out some of the things I learned in the modules." Participants' average rating on this item was 1.8, again suggesting a substantial willingness to act on the information they learned during interactions with the app.

INTERVIEW RESULTS

The first 136 follow-up interviews were coded according to participants' reports of using techniques described in each module and the technique used. The most commonly cited module was stress (32%), with numerous participants indicating they had tried techniques such as relaxation and deep breathing to cope with the stress related to their daily lives and their health. The next most often cited module was adherence (18%), which included topics such as strategies for treatment adherence and working with providers. The most often cited techniques from this module were remembering to ask providers questions about treatment, especially medica-

tions, and making a list of issues to discuss with participants.

An important interview finding was the participants' surprise that they could question providers about the reasons for prescribed treatment and how to understand its effects. Participants' comments on the contents of the adherence module suggest that it helped them feel they could become more active partners in their health care. They may have asked questions about their treatment to understand better its purpose, how to judge whether it was effective, and how to cope with any adverse effects that might arise. Finally, a less-frequently cited module was sleep. Approximately 10% of participants cited trying some techniques, and several participants asked for paper copies of a sleep log to record their sleep habits. They indicated they would take the logs to their providers to discuss their sleep issues and seek further assistance.

CONCLUSION

This report demonstrates that while computer-based tailoring of healthcare information may require substantial effort on the front end (development, programming, and deployment), the impact on an individual's health may be significant. In another project, we showed that a tailored information application promoting medication adherence could be cost-effective, with reduced cost of care (doctor visits, hospitalizations) more than offsetting increased costs for app development and deployment (Ownby et al., 2013). Results of our current study suggest that our chronic disease self-management app is helpful, as long-term use might offset initial development and deployment expenses.

Limitations of our approach are essential to recognize. Most important, developing app content that is reliable and likely to be helpful requires that content experts are available to assist. In addition, while cur-

rently available software for app development does not require sophisticated programming skills, applications require some familiarity. Further, the simplicity of the software must be balanced with its limitations: apps can be developed but are less sophisticated and less complex than those that require more extensive programming skills. A final advantage of app development software, however, is the ability to revise and update content without the intervention of expert programmers.

This report explained how currently available off-the-shelf software can be used to develop apps that provide patients with individually tailored information about managing their chronic health conditions. While this development process requires resources, including computer and software support, multiple resources are available from the software publisher and other online resources, such as YouTube. Given the potential power of helping those in need better understand how to manage their healthcare, this report will inspire others to develop tailored information apps in other areas of need.

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