Know thy eHealth user: Development of biopsychosocial personas from a study of older adults with heart failure

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ABSTRACT

Background: Personas are a canonical user-centered design method increasingly used in health informatics research. Personas—empirically-derived user archetypes—can be used by eHealth designers to gain a robust understanding of their target end users such as patients.

Objective: To develop biopsychosocial personas of older patients with heart failure using quantitative analysis of survey data.

Method: Data were collected using standardized surveys and medical record abstraction from 32 older adults with heart failure recently hospitalized for acute heart failure exacerbation. Hierarchical cluster analysis was performed on a final dataset of n = 30. Nonparametric analyses were used to identify differences between clusters on 30 clustering variables and seven outcome variables.

Results: Six clusters were produced, ranging in size from two to eight patients per cluster. Clusters differed significantly on these biopsychosocial domains and subdomains: demographics (age, sex); medical status (co-morbid diabetes); functional status (exhaustion, household work ability, hygiene care ability, physical ability); psychological status (depression, health literacy, numeracy); technology (Internet availability); healthcare system (visit by home healthcare, trust in providers); social context (informal caregiver support, cohabitation, marital status); and economic context (employment status). Tabular and narrative persona descriptions provide an easy reference guide for informatics designers.

Discussion: Personas development using approaches such as clustering of structured survey data is an important tool for health informatics professionals. We describe insights from our study of patients with heart failure, then recommend a generic ten-step personas development process. Methods strengths and limitations of the study and of personas development generally are discussed.

1. Introduction

User-centered design (UCD) is crucial to creating useful, usable, and satisfying health information technology (IT) applications [1,2]. The chief UCD principle is to base design on a strong understanding of the intended users, summarized by the dictum *know thy user*. Increasingly, leaders in eHealth and consumer health IT in particular have called for the application of this and other UCD principles [3,4] in parallel with further development of UCD methods to accommodate the unique nature of eHealth [5,6]. *Personas* is one UCD method worth adapting, implementing, and illustrating for the eHealth context. Personas are

fictitious user archetypes based on real (qualitative, quantitative, or mixed) data used by IT designers to imagine the kind of users to be accommodated [7]. For example, a team designing a mobile application to help older adults manage medications would examine several older adult personas to achieve a sense of typical needs, range of medications taken, and variation in technological competency. A designer might attempt to accommodate the range or else might design alternatives or add-ons to help a specific type of user (e.g., smartphone novices). Personas are also used in expert evaluation of products, for designing or recruiting for usability testing, and for marketing and education during product deployment [7].

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While personas are ubiquitous in UCD for IT design outside of healthcare, there are few published, detailed accounts of personas development for health IT. Personas are recommended as part of user-centered process for consumer health IT design and implementation, in particular, as a simple tool for communicating with the many stakeholders involved in health IT design, procurement, deployment, and management [8]. However, not only are there few examples of such work, but there are fewer studies using quantitative data for personas development [9–11]. Among those studies, none has considered the full range of biological, psychological, and social (i.e., biopsychosocial) variables that characterize actual patient users. Therefore, we report on a study in which we used a systematic approach to patient user personas development, using quantitative cluster analysis on biopsychosocial survey data from older patients with heart failure.

1.1. Personas: a user-centered design tool

The international standard on UCD, ISO Standard 9241-210, dictates that design begins with an empirical definition of users and their context [12]. There is limited guidance on achieving this empiricism, but one popular general approach is developing personas based on data collected from the intended user population [13].

In introducing personas for IT development, Cooper [14] defined a persona as a "hypothetical archetype of actual users…defined with significant rigor and precision." Personas are usually generated from the study of a population and constitute a scientific model that makes sense of volumes of chaotic information on users and their goals. The most effective personas are empirical products, though these can be supplemented with knowledge from subject matter experts (e.g., physicians, researchers) [15]. There is no single accepted way to form the archetypes and map actual participants to the archetypes, but options include using qualitative thematic analysis, affinity diagrams, or factor analysis of quantitative data [13,16]. It is often argued that personas can accelerate product design, enhance communication with customers, and contribute to post-launch interface development [7,15]. Indeed, Miaskiewicz et al. [17] identify 22 specific benefits of personas, with leading benefits including focus on specific (customer) audiences, guiding design and prioritization decisions, and challenging designers' assumptions. Not surprisingly, personas are widely recommended (e.g., by usability.gov) and used by popular software developers such as Microsoft Corporation, despite questions about the rigor of personas methodology [18].

1.2. Personas for eHealth

Despite widespread use in other industries, personas are rarely reported in healthcare, clinical health IT, or consumer health IT literature [9]. One recent example is the "Voices of Veterans" project at the Veterans Affairs (VA) Center for Innovation, whose Human-Centered Design methodologies produced seven personas varying in demographics, education, occupation, needs, attitudes, medical benefits used, and personal background [19]. The project describes how designers could use the personas as well as future directions in personas development, such as personas evolution and refinement. To account for the dynamics of patient experience, as opposed to creating static patient profiles, Hall et al. [20] developed journey maps of cancer patients to guide design. In a study of older Chinese adults with diabetes, LeRouge et al. [9] performed data collection (focus groups, observations, interviews) and qualitative analysis to create a number of participant profiles. The authors presented two illustrative personas, a rural 68 year-old married Chinese woman and an urban 63 year-old married Chinese woman, and described ways personas could be used for UCD projects on eHealth. Of interest, LeRouge et al.'s patient profiles and personas deliberately included variables such as social support network and attitudes towards providers in order to supplement traditional demographic and cognitive factors such as education, computer skills, and learning style. Valdez

et al. [6] recently argued the importance of taking this broader, *contextual* or *biopsychosocial* approach to understanding current or prospective consumer health IT users. The authors introduced a hypothetical persona based on an amalgam of patients from prior studies, "Brenda," a 48-year-old woman with diabetes, and the physiological, social-behavioral, and contextual (e.g., social, organizational, and environmental) factors shaping her everyday activity and technology use. While both LeRouge et al. and Valdez et al. urged attending to biopsychosocial factors during consumer health IT design, neither quantitatively assessed these factors. Other limitations of existing literature include inadequate description of the personas development method [21] or the actual personas yielded [22].

2. Biopsychosocial personas development for older patients with heart failure

In the present study, we used quantitative methods to develop personas inclusive of a range of biopsychosocial variables relevant for eHealth design. We chose heart failure (also known as chronic heart failure and congestive heart failure) as the illustrative patient user domain and used data from a survey of older patients with heart failure. Heart failure is a chronic, terminal illness especially common in older adults, with 4.6 million cases estimated among Americans aged ≥ 65. Similar population prevalence rates are found across North America, Europe, Asia, and Australia [23]. Heart failure is a common reason for hospitalization and rehospitalization [24], and a major target for disease management and readmission reduction efforts. It imposes both symptoms and self-care requirements that affect quality of life. Studies report several meaningful differences among patients with heart failure, including differing levels of knowledge and expertise, motivation and engagement, cognitive function, social and instrumental support, and living arrangements [6,11,25]. These and other factors can be combined to form individual patient profiles or archetypes of patients (i.e., personas), to be used by designers of eHealth and other interventions. Our present research objective was to develop biopsychosocial personas of older patients with heart failure using quantitative analysis of survey data.

3. Method

The study was a secondary analysis of survey data collected on a sample of 32 older adults with chronic heart failure who were recently hospitalized for acute heart failure or heart failure and myocardial infarction at an academic medical center in the Southeast US. The primary dataset for this analysis was collected through the Vanderbilt Inpatient Cohort Study (VICS), described in detail elsewhere [26]. The VICS survey was a standardized questionnaire administered by a researcher during hospitalization, and at approximately two, 30, and 90 days post-discharge. Additional data were collected through the Caring Hearts Study (see [27]) using semi-structured interviews and standardized self-administered surveys a mean of 57.5 days (SD = 19.5) post-discharge. Lastly, electronic medical records were abstracted for diagnoses, heart failure functional status and left ventricular ejection fraction (LVEF), medications, laboratory test results, hospitalizations, and death, some of which were used in the analyses. Participants were patients aged 65 or older living within a 300-mile radius covering multiple regions of two states.

3.1. Procedure

The VICS survey [26] and Caring Hearts Study instruments [27] had over 500 items combined spanning multiple domains from biological and physiological, to psychological and behavioral, to social and economic. Variables from these instruments were selected for inclusion in personas development to cover the range of biopsychosocial domains deemed useful for eHealth design. The domains were selected in