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<u>Original Paper</u>

Enabling Nurse-Patient Communication With a Mobile App: Controlled Pretest-Posttest Study With Nurses and Non–English-Speaking Patients

David Silvera-Tawil[1*], BEng, MEng, PhD; Courtney Pocock[2*], BSpPath; DanaKai Bradford[3*], BSc, PhD; Andrea Donnell[2*], BN, GradCertPH; Jill Freyne[1*], BSc, PhD; Karen Harrap[4*], BIT; Sally Brinkmann[2*], BSpPath, MHA

[1]Australian e-Health Research Centre, Commonwealth Scientific and Industrial Research Organisation, Marsfield, Australia

[2]Western Health, Melbourne, Australia

[3]Australian e-Health Research Centre, Commonwealth Scientific and Industrial Research Organisation, Pullenvale, Australia

[4]Australian e-Health Research Centre, Commonwealth Scientific and Industrial Research Organisation, Herston, Australia

[*]all authors contributed equally

Corresponding Author:
David Silvera-Tawil, BEng, MEng, PhD
Australian e-Health Research Centre
Commonwealth Scientific and Industrial Research Organisation
Cnr Vimiera and Pembroke Roads
Marsfield, 2121
Australia
Phone: 61 293724282
Email: david.silvera-tawil@csiro.au

Abstract

Background: There is growing concern regarding the implications of miscommunication in health care settings, the results of which can have serious detrimental impacts on patient safety and health outcomes. Effective communication between nurses and patients is integral in the delivery of timely, competent, and safe care. In a hospital environment where care is delivered 24 hours a day, interpreters are not always available. In 2014, we developed a communication app to support patients' interactions with allied health clinicians when interpreters are not present. In 2017, we expanded this app to meet the needs of the nursing workforce. The app contains a fixed set of phrases translated into common languages, and communication is supported by text, images, audio content, and video content.

Objective: This study aims to evaluate the efficacy of the communication app to support nursing staff during the provision of standard care to patients from non–English-speaking backgrounds when an interpreter is not available.

Methods: This study used a one-group pretest-posttest sequential explanatory mixed methods research design, with quantitative data analyzed using inferential statistics and qualitative data analyzed via thematic content analysis. A total of 134 observation sessions (82 pretest and 52 posttest) of everyday nurse-patient interactions and 396 app use sessions were recorded. In addition, a total of 134 surveys (82 pretest and 52 posttest) with nursing staff, 7 interviews with patients, and 3 focus groups with a total of 9 nursing staff participants were held between January and November 2017.

Results: In the absence of the app, baseline interactions with patients from English-speaking backgrounds were rated as more successful (t_{80}=5.69; P<.001) than interactions with patients from non–English-speaking backgrounds. When staff used the app during the live trial, interactions with patients from non–English-speaking backgrounds were rated as more successful than interactions without the app ($F_{2,119}$=8.17; P<.001; η^2=0.37). In addition, the level of staff frustration was rated lower when the app was used to communicate (t_{80}=2.71; P=.008; r=0.29). Most participants indicated that the app assisted them in communicating.

Conclusions: Through the use of the app, a number of patients from non–English-speaking backgrounds experienced better provision of standard care, similar to their English-speaking peers. Thus, the app can be seen as contributing to the delivery of equitable health care.

Introduction

Background

Good communication in clinical settings affects a number of outcomes, such as patient satisfaction and adherence and, consequently, health outcomes [1]. One of the challenging areas of health care communication is communication with culturally and linguistically diverse (CALD) patients [1,2]. In acute hospital settings, suboptimal communication appears to be the largest source of preventable medical errors [3].

In hospital settings, delays for CALD patients are common, as clinicians require interpreter services, and for a variety of reasons, this may not be immediately available [3]. Using ad hoc translators, such as family members or friends, can impact the quality of care and confidentiality, and increase distress and conflict [3]. The demand for professional interpreter services can exceed supply due to the limited number of qualified interpreters and the increasing number of patients from non–English-speaking backgrounds (NESBs). When clinical staff are unable to communicate directly with patients, their ability to adequately respond to patient needs has the potential to impact patient care and experience [4-6]. There is also a risk to patients' mental health as a result of loneliness and isolation due to their inability to communicate with either staff or other patients [7].

In 2014, we developed and evaluated a mobile app to assist with initial allied health (AH) assessments when interpreters are not present [8]. The tool is not a replacement for interpreters but instead provides a means to support initial consultations and prompt informative patient-clinician interactions when an interpreter is unavailable. Its value is in enabling patient engagement and participation in basic interactions, expediting appropriate care, improving patient experience, and reducing costs associated with delays in care provision. It comprises key phrases and accompanying images, audio, and video content to convey key concepts between an AH clinician and a patient. The phrases were translated into 10 languages.

Senior nursing staff, who had observed the AH app in practice, expressed a significant need for a nursing-based app using the same concept. Language barriers can make it difficult for nurses to provide appropriate care to patients [9]. However, unlike AH clinicians, nursing staff are required to assist patients with daily care, including tasks as simple but as essential as providing support with eating, locating and fitting reading glasses, and assessing pain. Although nursing staff may be able to access interpreters for risk assessment and to support consent and discharge, interpreting services may not be available for assisting communication during the daily care of patients. These interactions between patients and nursing staff are more frequent and of a shorter duration than interactions between patients and other health care professionals, meaning that interpreter use is not always possible or practical. Using friends, relatives, and bilingual staff to facilitate communication with patients from

NESB may at times be an option but is not an ideal alternative due to their shortage of time and lack of specific knowledge about different procedures [10].

As a response, in 2017, we worked with nursing staff to extend the original AH app by including nursing as a new module [11]. This paper reports on an evaluation of the new app with nursing staff, introduced at multiple cites of an Australian health service. This evaluation aims to quantify the value in the use of the communication app to assist nursing staff during the provision of standard care to patients from NESB when an interpreter is not available. Participants were recruited to gather use information and provide feedback to assist us in determining the impact of the use of the app and to inform any refinements required for large-scale rollout. Specifically, this project aims to determine (1) staff acceptance and satisfaction levels, (2) patient acceptance and satisfaction levels, and (3) efficacy of the app.

Related Work

The most commonly used communication methods for patients from NESB include basic English and gestures [11]. These are speculative, time consuming, inadequate to meet all communication needs, and frustrating for both patients and nurses. As a response, mobile technology has been proposed as a potential solution to interpreter availability, with web-based tools and apps available for use. Google Translate [12], for example, is a generic tool that allows people to translate text and audio in over 90 languages. Google Translate requires internet access, which can be problematic in a hospital setting. Of greater concern, however, are the varying levels of accuracy depending on language [13], with low accuracies reported for even simple medical terminology [14]. Low translation accuracy in serious health situations will, at minimum, cause distress and, at worst, could lead to patient harm [15].

In response to this drawback, a number of purpose-built medical translation apps have been introduced to facilitate communication with patients across multiple languages, including MediBabble [16], Universal Doctor Speaker [17], Xprompt, Canopy Medical Translator [18], and BabelDr [19]. Although all these apps use text and audio to communicate, previous work from cultural advocacy groups shows that communication with CALD communities can be improved by using a variety of formats, including audio-visual and pictorial resources [20]. In addition, although current purpose-built medical translation apps include questions and phrases for clinicians to communicate with patients, there is no functionality for the patients to respond. The ability to seek accurate responses from patients is a key requirement in an environment in which accuracy is relied upon.

Furthermore, BabelDr is a novel tool developed by the Geneva University Hospitals (Hôpitaux Universitaires de Genève) in response to the refugee crisis in Europe. BabelDr is a speech-enabled, fixed-phrase translator. Similar to our approach, it relies on pretranslated sentences, but it includes speech

recognition to allow doctors to search for phrases by asking questions instead of searching for them in a list. Unsurprisingly, preliminary testing showed that BabelDr is significantly more precise than Google Translate and presents higher usability than MediBabble [21]. Despite the sophisticated speech-based search, the app still requires patients to use nonverbal responses. To our knowledge, the only communication app that has been evaluated in a clinical setting is Xprompt, with participants generally supporting the introduction of mobile apps to support communication with foreign language patients, but not very enthusiastic about Xprompt's practical use as it was perceived to be too time consuming in relation to the expected benefit [22].

The CALD Assist App

The CALD Assist app is different from the abovementioned apps in a number of ways [8,11]. It is a communication tool specifically developed to support communication with patients from NESB when an interpreter is not available. It facilitates basic communication needs to provide appropriate care. The focus of the AH app was on patient screening. The articulated clinical need was the desire to conduct basic screening to ensure patient safety in areas such as safe swallowing, walking aides, and wound care.

Nurses unsurprisingly interact with patients in a very different manner. Nursing staff engage with patients more frequently and have information requirements around tending to the patients' day-to-day needs. Thus, the nursing module includes additional phrases relevant specific to nursing needs but also represents a different communication challenge to the previous app.

The app's content and functionality were gathered through user-centric design activities focused on two end user groups: clinicians and patients [8,11]. The app includes over 200 commonly used phrases professionally interpreted into 11 languages (including English) and grouped by discipline: dietetics, speech pathology, podiatry, physiotherapy, occupational therapy, and nursing. Languages were identified based on the interpretation of the historical demand of services. Each phrase is accompanied by answer options to facilitate two-way communication between the patient and the clinician.

The CALD patient user group is usually older, with varying literacy levels and potential audio and visual impairments. Thus, the app includes multimodal communication mediums, including text, imagery, audio, and video content, to increase its utility. The basic functionality includes the ability to select a language and discipline to communicate with a patient. Phrase groupings within disciplines follow the typical flow of a clinical interaction from introductions phases such as "Hello, I am your Podiatrist. I am here to talk to you about your feet," question or assessment phrases such as "Do you have pain in your feet?," education phrases such as "Do not get the wound wet," and phrases to close the conversation such as "I will return with an interpreter."

Selection of an individual phrase reveals the phrase in the language selected in a large font, accompanied by a smaller English font for the clinician, and appropriate images or videos relating to the phrase (Figure 1). The app also allows clinicians to play prerecorded audio of the interpreted phrase and provides patients with the ability to respond to clinicians by providing *answer options* and *follow‐up questions* (that may include text and images) for many of the questions. The ability to seek detailed information from patients through two-way, multimodal communication is a key advantage over similar apps.

The AH component of the app was trialed for 6 months in a controlled introduction in an Australian health care network [8]. The free app is now available for smartphones and tablets in the Apple App and Google Play Stores.

Figure 1. Example screenshot of the app, with Mandarin selected as the language and occupational therapy selected as the discipline.
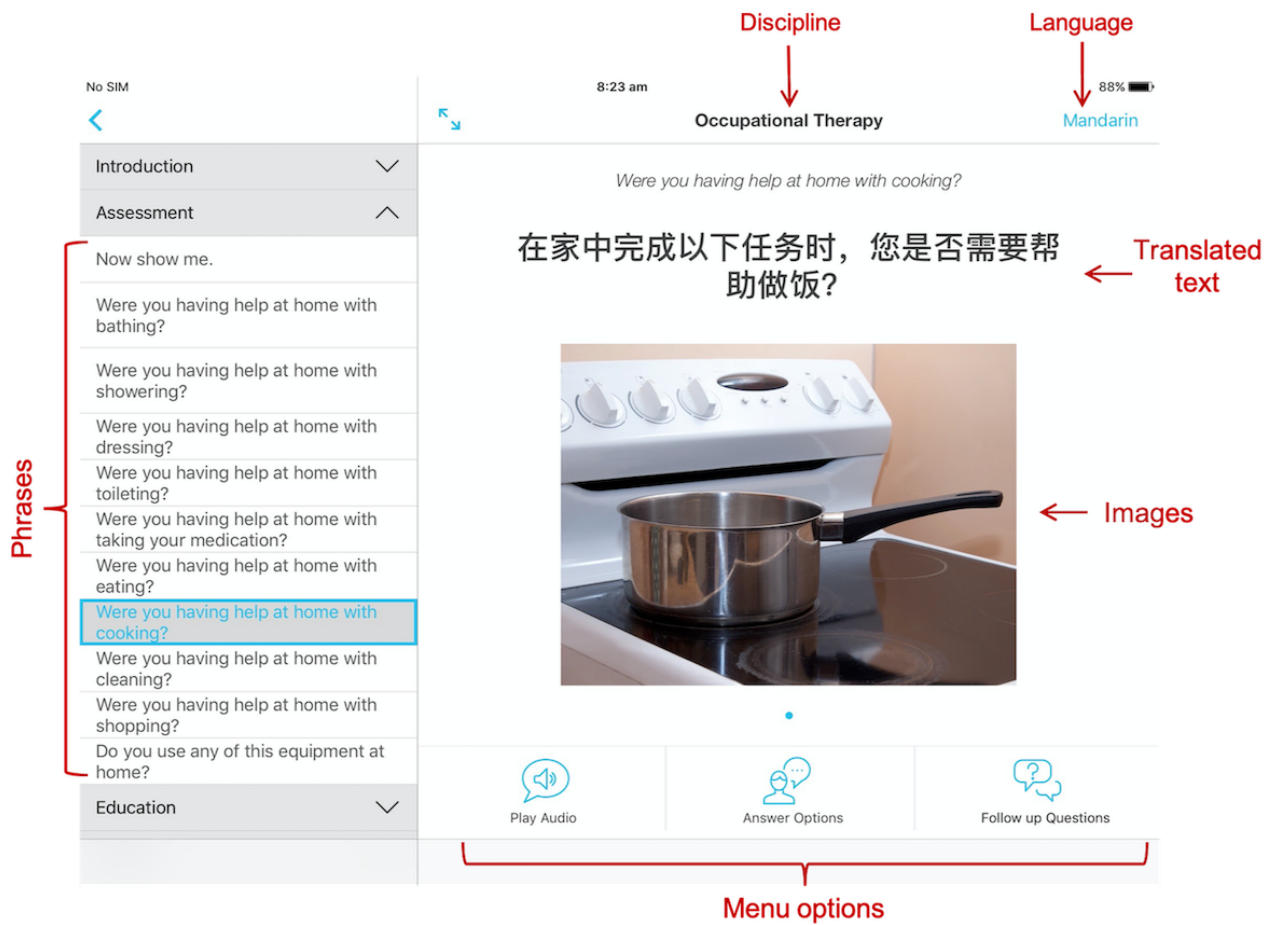

Methods

Overview

A study was conducted to evaluate the impact of the mobile app during the provision of care to patients from NESB. The study followed a pretest-posttest, sequential explanatory mixed methods research method. The evaluation was divided into three stages (Figure 2):

1. Baseline: The aim of this stage was to collect information regarding the standard of care and interactions in areas where the app was intended for use, including data regarding the number, mode, and length of interactions between nursing staff and patients and staff perspective on the quality of patient-staff interactions before the introduction of the app.

2. Live trial: This stage aimed to quantify the impact of the new app in terms of the number, mode, length, and quality of interactions between nursing staff and non–English-speaking patients during the provision of standard care when an interpreter was not available.

3. Posttrial: In this stage, feedback from the nursing staff who were exposed to the app was collected.

This study was undertaken at four medical, surgical, and subacute inpatient wards from three different campuses of an Australian health service. Low risk ethics approval was obtained from the Western Health (a hospital in Victoria, Australia) Low Risk Human Research Ethics Committee (LNR/16/WH/200) in January 2017. An information sheet was provided to all invited participants. Signed consent was obtained from all participants.

Figure 2. Study design divided by baseline data collection (February to June 2017), live trial (July to October 2017), and posttrial data collection (November 2017).
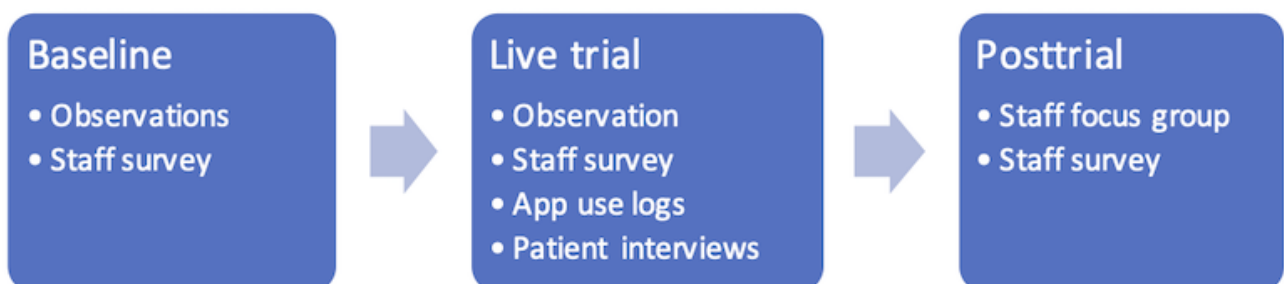
Participants

Recruitment of staff participants for the baseline and live trial was through a 10-minute presentation given to nurse unit managers (NUMs) from the same participating wards during a dedicated meeting. NUMs then identified suitable staff from each ward for potential recruitment into the study. All identified staff were invited to participate via a short (2-5 minutes) presentation delivered by a member of the project team during ward meetings. A total of 99 staff members agreed to participate.

Recruitment of patient participants for interviews was conducted with the assistance of hospital interpreters. Patients who met the inclusion criteria (adults from NESB who used the app during the trial and were cognitively able to provide consent and feedback) were identified via a daily 5-minute discussion with NUMs and invited to participate in person by a member of the research team. The patient's cognitive ability was assessed by the NUMs based on either the patient's medical history or their own clinical judgment.

In addition, after the live trial, up to 5 staff members per ward who were exposed to the app were nominated by the NUMs as potential participants in the posttrial focus groups and invited to participate by a researcher from the project team.

Power Calculations

Power calculations for the observations and surveys were based on the ratings of patients' understanding of the interaction, using two independent groups of participants. With anticipated means of $n_1=3$ (baseline data) and $n_2=3.5$ (analysis), an SD of 0.8, $\alpha=.05$, and power=80%, we anticipated a minimum sample of 41 participants per group.

The number of focus groups was guided by theoretical saturation, whereby if no new or useful information emerged, attendance ceased. The number of patient interviews was limited by the recruitment difficulties. Recruitment of patient participants was challenging, largely due to the limited number of interpreters and the patients' inability to provide informed consent.

Baseline Data Collection

Data regarding the number, length, and mode of interactions between nursing staff and patients were collected through observation sessions of staff-patient interactions. Observation sessions were 1 hour long, once per day, 3-5 times a week between 7 AM and 7 PM from February to June 2017. Times for each observation were randomly selected. Immediately after the hour-long observations, the staff's perspective on the quality of patient-staff interaction was collected through paper-based surveys completed by staff participants who had interacted with a patient during the observation period. For each survey, nurses were asked to answer three questions regarding their experience of communicating with patients (Table 1).

Table 1. Staff surveys during the baseline and the live trials.

Survey questions	Baseline	Trial	Answer options
How successful would you rate your interactions with the patient today?	✓[a]	✓	Likert scale ranging between 1 (not successful at all) and 5 (successful)
How confident are you that the patient understood what you were saying?	✓	✓	Likert scale ranging between 1 (not confident at all) and 5 (confident)
Can you identify any phrases which would be helpful to include in the new app?	✓		Free text
Did you use the app? If not, why?		✓	(1) Unable to access, (2) time constraints, (3) did not have the phrase needed, (4) did not have the language needed, (5) not appropriate, and (6) other
How useful did you find the app when communicating with your patients?		✓	Likert scale ranging between 1 (not useful at all) and 5 (very useful)
How frustrated were you when communicating with your patient?		✓	Likert scale ranging between 1 (not frustrated at all) and 5 (very frustrated)

[a]Question present.

Live Trial

A total of 14 iPads with the preinstalled app were made available in the participating wards. Distribution of iPads was based on the number of beds in each ward as well as additional specific requests for further iPads to facilitate app use. To ensure efficient use of the app, all staff participants received training on the use of the app a week before the start of the live trial, in person, by a member of the research team at designated nursing staff meetings.

Following the same procedure as the baseline data collection stage, data regarding the number, mode, and length of interactions between staff and patients from NESB were collected through extended observations of patient-staff interactions. Observation sessions were conducted between July and October 2017, for a period of 1 hour per day, 3-5 times a week between 7 AM and 7 PM. Times for each observation were randomly selected. Immediately after the hour-long observations, paper-based surveys were completed by staff participants who had interacted with the patient during the observation period. For each survey, nurses were asked to answer five questions regarding their interaction with the patients (Table 1). The participants were also asked for additional comments about the app.

To identify patterns of app use, app logs were automatically collected by each iPad. Here, individual use sessions were defined as any use of the app with at least a single *click*. A click is represented by a single tactile interaction with the app, such as discipline selection or language selection. Considering that the average duration of patient-nurse sessions when the app is used is approximately 205 seconds (based on the observation sessions, see the *Results* section for more information), two different use sessions were differentiated when the app was not used (there were no clicks) for at least 205 seconds.

This stage was complemented with the patients' perspective of, and satisfaction with, the app through one-to-one interviews with patients who were exposed to the app. Interviews were standardized (the same questions in the same order) and performed by the research team with assistance from an interpreter. Patient interviews included demographic information (ie, patient age, gender, diagnosis, primary language, and self-reported level of English), communication challenges faced during current basic standard care interactions due to their NESB, and perceived confidence in their current understanding and staff's current understanding of their needs with and without the use of the new app. All interviews were audio recorded.

Posttrial

Staff feedback and satisfaction were collected via semistructured focus groups conducted with nursing staff who were exposed to the app during the live trial. The aim of the focus groups was to elicit information from users on the efficacy of the new app, to complement the data collected during the live trial. Aspects under discussion included the context of patient-staff interactions when the app was used, changes observed in basic standard care interactions due to the introduction of the app, and general feedback about the app. In addition, participants were asked to identify phrases and functions they found most useful; how interactions were different when the app was not available; and phrases, sections, and functions that would be useful for inclusion in the app. At least two members of the research team were present in all focus groups. The focus groups lasted approximately 60 minutes and were audio recorded.

Data Analysis

Quantitative data analysis using inferential statistics was conducted to assess potential differences between the number, length, and quality of staff-patient interactions before and after the introduction of the app. Python 3.0 (Python Software Foundation) was used for all statistical analyses.

Qualitative data from patient interviews and posttrial focus groups were transcribed verbatim and independently reviewed by 2 researchers. The data sets were brief and clear, making them easy to interpret. An inductive approach was used to determine the coding of the data, and a semantic approach was used to analyze the data by identifying explicit words. Each researcher familiarized themselves with the data and subsequently met to discuss the codes and establish agreed themes. There were no discrepancies between the reviewers, and all themes identified by both researchers were included. The final themes were then critically reviewed and discussed by the research team, with no disagreements.

Results

Baseline Data Collection

A total of 85 observations and staff surveys were conducted during this stage (Table 2). In total, 3 of the non–English-speaking patients were treated by nurses fluent in the patient's first language (Vietnamese=2 and Serbian=1) and were removed from the analysis because they do not represent the nurse-patient interactions targeted by this app. Details of the baseline data results have been reported elsewhere [11]. Here, we present only a summary of the relevant results.

Table 2. Language background of patients observed during the baseline and live trials.

Participants' language background	Total participants per stage, n (%)			
	Baseline (n=82)	Trial with app used (n=30)	Trial without app (n=22)	Trial total(n=52)
Bosnian	1 (1)	0 (0)	0 (0)	0 (0)
Cantonese	0 (0)	3 (10)	1 (5)	4 (8)
Croatian	2 (2)	6 (20)	2 (9)	8 (15)
English	42 (51)	0 (0)	0 (0)	0 (0)
Greek	4 (5)	2[a] (7)	7 (32)	9 (17)
Italian	7 (9)	4 (13)	3 (14)	7 (13)
Macedonian	6 (7)	2 (7)	1 (5)	3 (6)
Mandarin	0 (0)	1 (3)	0 (0)	1 (2)
Polish	2 (2)	0 (0)	0 (0)	0 (0)
Punjabi	0 (0)	0 (0)	2 (9)	2 (4)
Samoan	1 (1)	0 (0)	0 (0)	0 (0)
Serbian	1[b] (1)	2 (7)	1 (5)	3 (6)
Spanish	2 (2)	1 (3)	0 (0)	1 (2)
Vietnamese	14[b] (17)	9[b] (30)	5[b] (23)	14 (27)

[a]One participant removed from data analysis due to resistance to care and communication.

[b]One participant removed from data analysis because they were treated by nurses fluent in the patient's first language.

Overall, a total of 370 interactions with a mean duration of 101 seconds (SD 141) per interaction were observed between nursing staff and patients, 164 (44.3%) of those interactions with patients from NESB, and the rest with English-speaking patients. No significant differences were observed in either the number, length, or purpose of the nurse-patient interactions between the English-speaking patients and patients from NESB. However, a significant difference was observed in both the staff's confidence in the patient's level of understanding (t_{80}=7.49; P<.001) and the success of the interaction (t_{80}=5.69; P<.001) depending on whether the patient was from an English-speaking background or NESB. That is, interactions with patients from an English-speaking background were rated by staff as more successful (mean 4.81, SD 0.45) and with higher confidence (mean 4.81, SD 0.40) of the patient's understanding than interactions with patients from NESB (mean 3.59, SD 1.30; mean 3.14, SD 1.28). The observation sessions also revealed that although patients from English-speaking backgrounds communicate in English, patients from NESB communicate in

a combination of basic English and gestures. Patients from NESB also communicate using interpreters, bilingual nurses, and family members.

Live Trial

Observations and Staff Surveys

A total of 55 observations and staff surveys were conducted during the live trial (Table 2). Similar to the baseline data collection stage, 2 of the patients were treated by nurses fluent in the patient's first language (Vietnamese) and were removed from the analysis. Data from 1 Greek patient who was resistant to care and communication were also removed.

Overall, 208 interactions with a mean duration of 135 seconds per interaction were observed between nursing staff and patients from NESB. Of these, the app was used in 71 interactions with 30 patients. The app was not used at all with the remaining 22 patients. A summary of the reasons given by staff for not using the app is presented in Table 3; note that each staff member could have mentioned more than one reason.

Table 3. Reasons why the app was not used by 22 patients when asked "Did you use the app? If not, why?"

Reason	Times mentioned, n
App not needed; patient knew enough English	10
Family was present to help	9
Time constraints	4
Missing phrases	3
Forgot to use it	3
Missing language	2
Patient was reluctant to engage with staff	2
My (staff's) inability to use technology	1
Patient cognitive impairment	1

To assess the differences that may exist between the number, length, success, and quality of interactions between patients from NESB before and after the introduction of the app, a total of four one-way analyses of variance were conducted, with the length, number, confidence, and success of interactions (as reported by staff in Table 1) as the dependent variable and the following groups as the independent variables: (1) patients from NESB before the introduction of the app; (2) patients from NESB after the introduction of the app, when the app was not used; and (3) patients from NESB after the introduction of the app, when the app was used.

No significant differences were found in the number of interactions ($F_{2,89}=2.87$; $P=.06$; $\eta^2=0.061$) per observation

session. Significant effects were found for the length of interactions ($F_{2,369}=11.26$; $P<.001$; $\eta^2=0.058$] as well as the confidence ($F_{2,119}=13.50$; $P<.001$; $\eta^2=0.185$) and success ($F_{2,119}=8.17$; $P<.001$; $\eta^2=0.121$) of the interactions. Post hoc comparisons using the Tukey honestly significant difference test indicated that the ratings of confidence and success of interactions with patients from NESB when the app was used were significantly higher than the ratings when the app was not used either before or after the introduction of the app. Interactions when the app was in use were also of a longer duration (Table 4).

Table 4. Number of samples, mean, and SD of observation variables for patients from non–English-speaking backgrounds before (during baseline) and after the introduction of the app (live trial).

Category	Before		After (with app)		After (without app)		P value
	Sample	Value, mean (SD)	Sample	Value, mean (SD)	Sample	Value, mean (SD)	
Observations							
Number of interactions per participant	40	4.10 (2.10)	30[a]	4.67 (2.99)	22	3.09 (1.66)	.06
Length of each interaction (seconds)	164	110.95 (148.77)	71	205.56 (185.35)	137	100.10 (156.78)	<.001
Surveys							
Confidence of the interaction	40	3.24 (1.28)	30	4.23 (1.07)	52	2.77 (1.29)	<.001
Success of the interaction	40	3.59 (1.30)	30	4.30 (0.99)	52	3.21 (1.18)	<.001
Staff frustration	0	__[b]	30	1.5 (0.94)	52	2.23 (1.29)	.008

[a]These participants used the CALD Assist app at least once during the observation period.

[b]This question was not asked during the baseline stage.

In addition, an independent samples two-tailed *t* test was conducted to compare the reported level of staff frustration during interactions with patients from NESB when the app was used and when the app was not used. The results suggest that a significant difference exists in the reported levels of frustration ($t_{80}=2.71$; $P=.008$; $r=0.29$), with lower frustration when the app was used (Table 4).

When asked about the usefulness of the app to nursing staff, 93% (28/30) of staff participants agreed that the app was useful for communicating with patients from NESB (very useful=18 and somewhat useful=10). When asked for additional comments about the app, staff participants suggested new languages, phrases, and images and a new feature that allowed any phrase to be typed and translated by the app. They also mentioned that although the iPad size is appropriate, the audio should be louder. They acknowledge that it takes some time to get used to the

app, but they expect that the more they use it, the easier it will get. They also highlighted that to make the app more accessible, the iPads should be at the patient's bedside or on equipment trolleys:

> *[I] need to get used to it. Once I'm more familiar with it, it will make it easier to use.* [Nurse 24]

> *They need to be more accessible, for example, bedside – have it already there with the patient; handover – put on the handover that they have an iPad already there to use.* [Nurse 25]

The observation sessions and surveys also revealed that, similar to the baseline data, patients from NESB communicate with staff using basic English, gestures, family members, and bilingual nurses (in addition to using the iPads). During these observations, the use of interpreters was not common. No significant differences in the purpose of interactions were found between the observations before and after the introduction of the app.

Patient Interviews

Recruitment of patient participants who used the app was more challenging than anticipated, largely due to the limited number of interpreters available and, thus, the patients' inability to provide informed consent. A total of 7 patients (male=4 and female=3) from three language backgrounds (Vietnamese=5, Greek=1, and Croatian=1) were interviewed across three of the four trial wards. Patients were aged between 48 and 90 years. All patients identified that their level of spoken English was *a little,* with their level of English understood ranging from *a little* to *a lot*.

In total, 86% (6/7) of patient participants reported that it was not easy to communicate with their nurse, and at times, they did not understand their nurse and could not communicate their needs: "Sometimes the nurses tells me something but I didn't understand" [Patient 2]. All patients used the app and could recall the app being used by their nurse to communicate, with 86% (6/7) indicating that it was useful, it assisted them in understanding their nurse, and it assisted their nurse in understanding their needs:

> *If I have an iPad it's easier for me to communicate with them.* [Patient 2]

> *I understand and then I can answer the questions.* [Patient 3]

Patients mentioned additional phrases that would be helpful for inclusion, including "I need your help," "I'm hungry," "I'm thirsty," "I need to go to the toilet," and "I'm cold." They also requested additional phrases for them to explain where the pain is and how to describe it.

Log Data Analysis of App Use

A total of 396 sessions were identified across all wards between July 1 and October 13, 2017. We could not distinguish between familiarity sessions and use in standard care. Sessions averaged a total of 25.6 clicks over a period of 150 seconds. The most frequently used language was Vietnamese (Table 5).

There were 1000 clicks across all categories. Of the categories selected, the most popular was pain-related phrases, which was selected 14.1% (141/1000) of the time (Table 6). We also examined the use of the individual functions of the app. Playing the audio was the most popular feature (Table 6).

Table 5. Number of sessions per language (N=396).

Language	Sessions, n (%)
Vietnamese	117 (29.5)
Croatian	52 (13.1)
Cantonese	48 (12.1)
Italian	39 (9.8)
Macedonian	37 (9.3)
Greek	32 (8.1)
Spanish	24 (6.1)
Serbian	22 (5.6)
Mandarin	11 (2.8)
Arabic	9 (2.3)
English	5 (1.3)

Table 6. Top 10 most used phrase categories and functions.

Variable	Total clicks, n (%)
Phrase category (n=1000)	
Pain	141 (14.1)
General	94 (9.4)
Continence	74 (7.4)
Hygiene	73 (7.3)
Observations	69 (6.9)
Introduction	68 (6.8)
Mobility	65 (6.5)
Procedures	64 (6.4)
Use of the app	59 (5.9)
Nutrition	55 (5.5)
Function (n=5080)	
Play audio	1279 (25.2)
Choose phrase by selecting a discipline	1073 (21.1)
Choose category	1000 (19.7)
Choose discipline	683 (13.4)
Choose language	328 (6.5)
Swipe image	199 (3.9)
Phrase image selected	193 (3.8)
Show answer options	141 (2.8)
Choose phrase by browsing or searching	105 (2.1)
Searching started	76 (1.5)

Posttrial Focus Groups

Overview

Three focus groups were conducted at the same three campuses of the Australian health service. The focus groups brought together 1 NUM and 8 nurses from the participating wards, including: (1) respiratory and infectious disease; (2) upper gastro-intestinal surgery; (3) ear, nose, and throat surgery; (4) plastics and thoracic surgery; (5) geriatric evaluation and management and rehabilitation; and (6) oncology, gastroenterology, hematology, renal, and endocrinology. Qualitative analysis focused on four practical themes of app deployment: app use, context of use, content and functionality, and accessibility.

Nurses' Description of App Use

Participants believed that the CALD Assist app facilitated basic communication needs with patients from NESB, and helped them deliver the care the patients needed. They mentioned that with the app, there was less need to seek assistance from family members or bilingual colleagues. They reported that they would use the app as the first resource but go to interpreters or family members if they needed additional help.

There were no reports of resistance to using the app by either patients or family members. Nurses believed that patients felt more included using the app, and family members appreciated it. It was highlighted, however, that patients with cognitive impairment had difficulty understanding long sentences. One participant reported *embarrassment* due to her inability to find the phrases she needed in front of a patient. This sense of embarrassment prevented her from using the app more often:

> *...you will be using your iPad in front of the patient and trying to find it and then is embarrassing that you couldn't find the one that is suitable to communicate...[then] I didn't really used it for a while.* [Nurse 1]

Participants also highlighted two stories that demonstrated the impact of the app. In one story, they described how the app was used to facilitate a pain medication dosage change in a patient, whereas in the other story, the app was used to help nurses find out that a patient had chest pain. According to participants, without the app, these exchanges would have been more difficult:

> *...we wanted to know if the pain lessened or higher [sic]. They [doctors] use the iPad because they want to change that [the dosage].* [Nurse 2]
>
> *We had a lady who was...saying that she had pain and I was trying to determine if it was chest pain. We used the pain questions even though it's not "Do you*

have chest pain or abdominal pain?" while pointing.
[Nurse 3]

Context of Use

It was mentioned that the app was particularly useful for older patients from NESB who tended to speak and understand less English than younger generations. Participants also believed that the app could be useful in communicating with patients with hearing impairment, as long as they were able to read. Participants highlighted that the app allowed them to do more for patients because communication was easier, quicker, and more accurate:

…you're more sure of what she wants and it's quicker...because you don't have to guess? [Nurse 4]

Content and Functionality

Participants were very positive about the phrases, sections, and functionality of the app. According to them, the app is easy to use, the text is large enough for patients to read, and the pictures are useful and appropriate. The audio is good but can be louder. The spoken phrases are appropriate for most patients but too fast for some of them, and participants suggested a function to slow down the audio when needed. Participants also suggested additional functionalities such as voice activated functions, the ability to translate spoken text into or from the patient's language (similar to Google Translate), and a calendar and time function to tell patients the time or date of a procedure.

Most participants noted that the more the app was used, the more comfortable they felt using it. They mentioned that the browsing option to go through phrases was used more than the search functionality. Participants who used the search function, however, believed that it was a better and faster way to find phrases: "...the more you use it, the more you know exactly what's on there" [Nurse 7].

Accessibility

In two of the wards, the iPads were stored at either the nursing stations or the drug room. As a result, nurses often forgot to use them or had no time to go and get them from those locations. In the rest of the wards, the iPads were placed next to the bed of a patient that may need the CALD Assist app to communicate:

...because out of sight is out of mind for a lot of things. It's there, make use of it, and just to encourage them [my staff]. [Nurse 5]

Although there were concerns that the iPads could have been damaged or stolen (none were during the trial), this approach improved access and visibility.

Discussion

Overview

Effective communication in clinical settings is essential. The inability of hospital staff to communicate effectively with patients from NESB can impact patient care and experience. This paper reports the results of an impact evaluation of the CALD Assist app in a controlled rollout on medical, surgical, and subacute inpatient wards at three different campuses of an Australian health service. This evaluation aimed to quantify the value of the app during the provision of standard care to patients from NESB when an interpreter is not available.

This is the first study to investigate the value of using mobile health tools to support communication with patients from NESB in clinical settings. Previous studies have focused only on accuracy and technology acceptance. Thus, a key contribution is the demonstration that a multimodal app can affectively assist communication between nurses and patients from NESB in the absence of interpreters; reducing care inequities between patients from English-speaking backgrounds and NESBs, increasing staff confidence, and reducing staff frustration.

Principal Findings

Baseline observations and surveys confirmed that significant differences were observed in nurse-patient interactions depending on whether the patient identified as English speaking or from a NESB. Nurses treating patients from NESB scored lower in both their perception of the patient's level of understanding and the success of the patient-nurse interaction. This reinforced the need for a tool to support communication access with patients from NESB. Interestingly, no significant differences were observed in the type, length, or number of interactions between staff and English-speaking patients or patients from NESB.

The observed interactions and the postobservation surveys also confirm that the main purpose of interactions was consistent with those reported during the design and development stages of the app [11], including pain management, mobility, hygiene, and nutrition.

During the live trial, the app was used by nursing staff in 396 sessions to provide standard care to patients. Although we do not know the exact number of staff-patient interactions during the same period, during the observations, from a total of 208 interactions with 58% (30/52) of the patients, the app was used in 71 (34.1%) interactions. Given that the app was new and only available on four wards, the number of sessions conducted was encouraging. It is expected that the app will be used more regularly, as nurses become more familiar with it.

In addition, 93% (28/30) of staff participants believed that the app was useful to communicate with patients from NESB when an interpreter was not present, and 86% (6/7) of patients indicated that the app assisted them in communicating with their nurse. Through the use of the app, a number of patients from NESB experienced better provision of standard care, similar to their English-speaking peers. That is, interactions with patients from NESB were rated as more successful, and staff report of *confidence* in patients' understanding increased (to levels similar to their English-speaking peers) when the app was used, independent of the availability of the app. In addition to the app, participants communicate with patients using gestures, family members, and interpreters.

Speaking a second language is also a real benefit for staff, as they can communicate with patients more easily than by using any of the other approaches. Although bilingual nurses were excluded from the study, it was noted that the three interactions recorded between patients from NESB and staff members fluent in the patient's first language were rated as the highest score on

the 5-point Likert scale in all cases for the level of understanding and success of the interactions. Although the data are limited, this result supports previous findings that suggest that bilingual staff can assist in improving the quality of care for patients from NESB [9].

Staff and patients were all positive about the app and its content and functionality. We note the high utilization of pain, general, continence, and hygiene phrases that allow nurses to provide basic care to patients. This distribution of categories selected was expected, given the priorities mentioned by staff members during the user needs stage of the project [11]. In fact, the creation of phrase groupings aimed to facilitate flow in typical scenarios of use. It is possible that using these groupings might have facilitated the interaction between participants and, therefore, influenced the app evaluation. We also note high use of the language, phrase, and category selection and low use of the search capability. We expect that through increased familiarity, we will see increased use of this function.

Challenges and Limitations

The introduction of the app was not without any challenges. The introduction of new clinician‐focused technology in a hospital environment is complex, as experienced clinicians find it challenging to change established behaviors or practices. As a result, they may follow current practices without considering the new app as a tool to facilitate standard practice. Training and familiarity with the app and the phrases played a significant role in the participants' use and experience. Following our evaluation, an education and promotion stage was introduced to further embed the use of the new app into current practice.

Finding the ideal location that provided visibility and accessibility to the iPad, while ensuring the security of the device, was essential. Positioning the iPads close to the patient's bed proved to be ideal.

Although the app was reported to be effective when used to assist patients with mild cognitive impairment, it was not specifically designed for this population. In this trial, cognitive impairment was reported by participating nurses in 6 participants, and the app was reported to be useful in 4 (67%) of those cases.

Finally, although the impact of the app on staff-patient interactions was evaluated via observations and a short survey, validated scales to measure the usability and acceptability of the app were not used (eg, the system usability scale or the technology acceptance model) to reduce the participation load on nursing staff who lack time. Future research should further evaluate the usability and acceptability of the app.

App Refinements

Our results suggest that the app was used particularly by older patients. The current version of the app, however, appears to be limited for patients with cognitive impairment, and additional material based on keywords and short phrases (eg, "Toilet?" with answer options yes or no) is recommended for this population.

Although both male and female voices were suggested during the design stage of the app to address potential cultural and life experience concerns (eg, female patients with a history of sexual assault might be uncomfortable with a male voice) [11], the current version includes only a single voice per language.

Conclusions

This study guides the impact evaluation of a communication app to directly improve the provision of care to patients from NESB. Using the proposed app, nursing staff delivered safer, higher quality care to a potentially at-risk and vulnerable population, reducing inequity in health care delivery and providing a timelier and more positive patient experience to patients.

Conflicts of Interest

None declared.

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Abbreviations

AH: allied health
CALD: culturally and linguistically diverse
NESB: non–English-speaking background
NUM: nurse unit manager

<u>Original Paper</u>

Experiences of Using a Self-management Mobile App Among Individuals With Heart Failure: Qualitative Study

Myra Schmaderer[1*], PhD; Jennifer N Miller[1*], APRN-NP, PhD; Elizabeth Mollard[1*], APRN, PhD

College of Nursing, University of Nebraska Medical Center, Lincoln, NE, United States

[*]all authors contributed equally

Corresponding Author:
Myra Schmaderer, PhD
College of Nursing
University of Nebraska Medical Center
550 N 19th HCCN
PO Box 880220
Lincoln, NE, 68588
United States
Phone: 1 402 472 7335
Fax: 1 402 472 7345
Email: mschmade@unmc.edu

Abstract

Background: Interventions that focus on the self-management of heart failure are vital to promoting health in patients with heart failure. Mobile health (mHealth) apps are becoming more integrated into practice to promote self-management strategies for chronic diseases, optimize care delivery, and reduce health disparities.

Objective: The purpose of this study was to explore the experience of using a self-management mHealth intervention in individuals with heart failure to inform a future mHealth intervention study.

Methods: This study used a qualitative descriptive design. Participants were enrolled in the intervention groups of a larger parent study using a mobile app related to self-management of heart failure. The purposive, convenient, criterion-based sample for this qualitative analysis comprised 10 patients who responded to phone calls and were willing to be interviewed. Inclusion criteria for the parent study were adults who were hospitalized at Nebraska Medical Center with a primary diagnosis and an episode of acute decompensated heart failure; discharged to home without services such as home health care; had access to a mobile phone; and were able to speak, hear, and understand English.

Results: Study participants were middle-aged (mean age 55.8, SD 12 years; range 36-73 years). They had completed a mean of 13.5 (SD 2.2) years (range 11-17 years) of education. Of the 10 participants, 6 (60%) were male. Half of them (5/10, 50%) were New York Heart Association Classification Class III patients and the other half were Class IV patients. The intervention revealed four self-management themes, including (1) I didn't realize, and now I know; (2) It feels good to focus on my health; (3) I am the leader of my health care team; and (4) My health is improving.

Conclusions: Participants who used a self-management mHealth app intervention for heart failure reported an overall positive experience. Their statements were organized into four major themes. The education provided during the study increased self-awareness and promoted self-management of their heart failure. The mHealth app supported patient empowerment, resulting in better heart failure management and improved quality of life. Participants advocated for themselves by becoming the leader of their health, especially when communicating with their health care team. Finally, the mHealth app was used by the participants as a self-management tool to assist in symptom management and improve their overall health. Future research should study symptom evaluation, medication tracking, and possibly serve as a health provider communication platform to empower individuals to be leaders in their chronic disease management.

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Introduction

The prevalence of heart failure in adult Americans continues to increase with over 6 million diagnosed with heart failure [1]. Heart failure continues to be one of the leading causes of mortality and morbidity [2]. Self-management interventions have improved patient outcomes, such as individual's knowledge, quality of life, and hospitalizations due to heart failure [3]. However, less is known about patients' experiences with self-management mobile health (mHealth) interventions to assist in the management of chronic heart failure.

The study of self-management techniques in chronic disease management has led to the research of patient activation and the role that an individual's knowledge, skills, abilities, and willingness to manage chronic health conditions play in multimorbid disease processes. There is growing evidence that supports patient activation to guide interventions and assist in implementing strategies to activate individuals for self-management [4,5]. Previous studies have linked patient activation with positive health outcomes, such as decreased health care utilization [6,7], reducing symptoms [8,9], and improving quality of life [10].

Interventions that focus on the nonpharmacologic management of heart failure are vital to promoting chronic disease management in patients with heart failure. Heart failure practice guidelines recommend self-management through daily symptom and weight monitoring [11]. However, slight changes in health status can be challenging to identify. The complex nature of heart failure makes early symptom intervention vital to reducing health care utilization, hospital readmissions, and improving quality of life. Furthermore, empowering individuals to focus on their health and developing self-management routines has been shown to reduce heart failure disease burden.

Mobile phones and other portable technologies are increasingly more affordable. mHealth apps are becoming more integrated into practice to promote chronic disease self-management strategies [12], optimize care delivery, and provide potential health benefits with use [13]. Studies have shown that mHealth apps engage individuals in their health care and increase empowerment [14]. mHealth interventions have shown to promote chronic disease self-management in persons with heart failure [15,16] and patients with other chronic diseases [13,17-20].

A recent review found that mHealth apps focusing on heart failure self-management are cost-effective solutions to symptom monitoring and promoting engagement [21]. The study participants using mHealth apps showed an improvement in their quality of life, medication adherence, and reduced readmissions [21]. In other studies, participants have found the apps to be more convenient for self-management of fluid intake than traditional means because of smartphone portability and ease of data input [16]. Despite the positive outcomes of using mHealth apps among individuals with heart failure, there remain challenges to their use and uptake. Barriers to the use of mHealth apps include the lack of patient's integration of technology in everyday life [16] and difficulties in using mobile apps [15]. In the elderly population, health problems such as cognitive changes related to aging, disability, and lack of confidence are reasons for not using digital technology [22,23]. Further research is needed to evaluate patient experiences with apps, and the benefits gained as a result.

A recent review identified few high-quality commercially available mHealth apps for managing heart failure and a paucity of peer-reviewed literature assessing the experiences, functionality, and efficacy of apps [12]. However, with more interventions using mHealth as a medium for intervention delivery, its acceptability and usability have been reported [16,24,25]. Although many heart failure apps are currently available, a systematic search [26] found that several apps need further redesign or development to engage users in self-management behaviors. It is important to measure patient experiences and perceived benefits of mHealth apps to ensure uptake and usability of future apps. The purpose of this qualitative study was to further understand and explore the experience of using a self-management mHealth app among patients with heart failure to inform a future planned mHealth intervention study.

Methods

Study Design

This study used a qualitative descriptive design. Qualitative descriptive research creates a close description of participants' subjective experience [27,28]. Participants were recruited from the intervention groups of a larger parent study using a mobile app related to heart failure self-management [29]. The parent study was a three-group repeated measures randomized controlled pilot study. Institutional review board approval was obtained at a major academic institution, and all participants provided written informed consent for both the larger parent study and this qualitative study.

Intervention Description

A brief description of the intervention will be provided in this manuscript, as a full description of the sample and study is under review in another paper [29]. The 12-week intervention promoted self-management using mHealth as a platform. Participants in all three groups (ie, enhanced usual care, mHealth, and mHealth Plus) received an mHealth app (Play-It Health) customized for the study. The app was downloaded to a mobile device (phone or tablet) with a Bluetooth incorporated weighing scale. Screenshots of the app are presented in Figure 1.

Figure 1. Screenshots of the mHealth app used in this study.
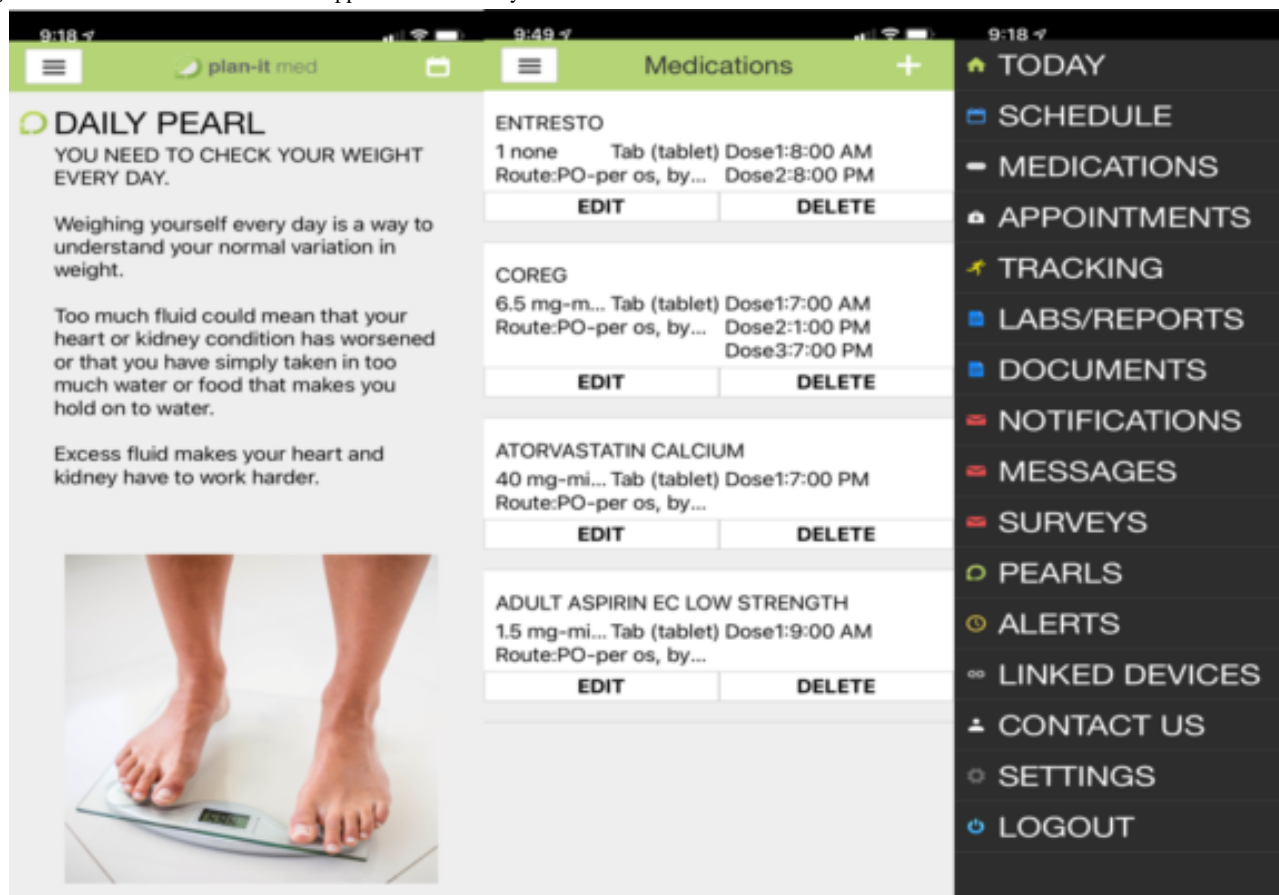
The enhanced usual care group received the app to report medications and body weights without any reminders. The mHealth group received the app and weighing scale with reminders daily to weigh in and answer educational tips (ie, "pearls") related to heart failure. *Pearls* were evidence-based and promoted self-management behaviors for chronic disease. Additionally, reminders were sent to individuals prior to scheduled medications. The mHealth Plus group received the aforementioned components plus virtual visits with a cardiac nurse practitioner and community health worker over 8 weeks to promote self-management, symptom management, and decision-making. Virtual visits were not evaluated in this qualitative study. The intervention's theoretical underpinnings were based on Hibbard's conceptualization of patient activation (ie, knowledge, skill, and confidence) [30].

Sample

For this qualitative study, participants were enrolled from the intervention arms (mobile app) of the parent study. This purposive, convenient, criterion-based sample selected for this qualitative study consisted of the first 10 patients who responded to phone calls requesting their feedback on their experience with the mHealth app.

Inclusion criteria for the parent study were adults who were hospitalized at Nebraska Medical Center with a primary diagnosis and an episode of acute decompensated heart failure; discharged to home without services such as home health care; had access to a mobile phone or iPad; and were able to speak, hear, and understand English. Participants were excluded if they had documented dementia or a life expectancy of fewer than 6 months.

Procedures

One researcher interviewed all 10 participants individually in approximately 30- to 60-minute-long qualitative interviews. The interview method followed a semistructured interview guide that allowed for both formal and informal interaction between the interviewer and participant, guided by participant response.

Analysis

We conducted a qualitative analysis of the transcribed interview transcripts by using thematic content analysis techniques as described by Miles and Huberman [31], organized using NVivo qualitative data analysis software (version 12, 2018; QSR International Pty Ltd.). Our analysis started with individual open coding by two reviewers (including EM who had conducted the interviews), comparing and contrasting, recoding after collaborative discussion, and finally clustering of relevant codes into common themes. Themes were then discussed and reviewed with an additional peer reviewer principal investigator, MS). Saturation was determined when information obtained from participants became redundant, and no further thematic observations could be determined [32,33], Saturation was determined after analyzing 7 participants' data, but because of previously scheduled interviews, 3 additional participants were included in the sample.

Results

Overview

Demographic and clinical characteristics are represented in Table 1. Participants of this subsample were generally middle aged (mean age 55.8, SD 12 years), in the age range of 36 to 73 years. The mean years of education was 13.5 (SD 2.2) with a range 11 to 17 years. Of the 10 participants, 6 (60%) were male; 4 (40%) were White, 4 (40%) were Black, and 1 (10%) was American Indian, whereas 1 self-reported more than one race. Half of the participants (5/10, 50%) were uninsured, 3

(30%) had private insurance, and 2 (20%) were enrolled in Medicare. Regarding acuity, half were New York Heart Association Classification Class III patients, and the other half were Class IV patients (5/10, 50% each). According to American College of Cardiology Foundation/American Heart Association Heart Failure Staging System, most (7/10, 70%) were Stage C patients, whereas 2 (20%) were Stage B patients and 1 (10%) was a Stage D patient. The majority were patients with heart failure (9/10, 90%), with reduced ejection fraction whereas the remaining 1 (10%) had preserved ejection fraction. This subsample had demographic characteristics typical of the parent study.

Table 1. Demographic and clinical characteristics of the study sample (N=10).

Characteristic	Value
Age in years, mean (SD); range	55.8 (12); 36-73
Educational level in years, mean (SD); range	13.5 (2.2); 11-17
Gender, n (%)	
Female	4 (40)
Male	6 (60)
Race, n (%)	
Caucasian	4 (40)
Black	4 (40)
American Indian or Pacific Islander	1 (10)
More than one race	1 (10)
Employment, n (%)	
Yes	3 (30)
No	5 (50)
Retired	2 (20)
Marital status, n (%)	
Married or cohabitating	4 (40)
Single or separated	5 (50)
Divorced	1 (10)
Insurance, n (%)	
Uninsured	5 (50)
Medicare	2 (20)
Private insurance	3 (30)
New York Heart Association classification, n (%)	
Class III	5 (50)
Class IV	5 (50)
American College of Cardiology Foundation/American Heart Association Heart Failure Stage classification	
Stage B	2 (20)
Stage C	7 (70)
Stage D	1 (10)
Ejection fraction, n (%)	
<50%	9 (90)
≥50%	1(10)

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Study Themes

Four final themes emerged, characterizing the experiences of individuals using the mHealth app. The intervention provoked four self-management themes, focusing on their chronic illness: (1) I didn't realize, and now I know; (2) It feels good to focus on my health; (3) I am the leader of my health care team; and (4) My health is improving ([Figure 2](#)).

Figure 2. Self-management themes emerged from participants' experience with the mHealth app.

I Didn't Realize, and Now I Know

Participants noted that by using the self-management intervention, they became in tune with their health. Through frequent monitoring of medication administration, body weight, and vital signs, participants began to realize that changes to their health were occurring daily. The app inspired self-monitoring—a critical element of self-management. One younger participant (aged 39 years) noted that he was inspired to begin monitoring because of the app, "It made me pay more attention to myself and want to check myself again, 'cause I don't want the same thing happen again, you know." [Participant 29]. Another participant noted that by using the app to monitor all elements of her health, including self-managing behaviors combined with the specific education from *pearls*, she felt a new awareness and comfort.

> *With that medication reminder and then weighing myself every day to see if I was retaining water, it helped me a lot because I was really scared at first. But now that I've taken my meds the same time and took everything more seriously and learned everything that I got - everything that I know about heart failure and heart disease, I learned it from that app because of those little questionnaires you got.* [Participant 78]

Another participant spoke about how the regular self-monitoring could be related back to his behaviors and tell him more information about what may trigger changes to his health:

> *It's been interesting for one reason. I seem to have a weight gain when I go goose hunting...So, I think that's an interesting part of this, is that I can go back and see well, what was I three or four or five days and ago...So, it's very interesting to me how I can peak and then I had come back down during the week and then I might go up again and, so.* [Participant 71]

It Feels Good to Focus on My Health

After participants began the regular practice of monitoring their health status through the mobile app, they began to feel hopeful and empowered to be focusing on their health.

> *I love the scale. I love weighing myself every morning. That's a good thing. I don't ever want to go through that build-up of fluids in my body again. That was kind of miserable. You know and I get on the scale every morning.* [Participant 76]

Many participants noted the transformation from feeling afraid and powerless after receiving their diagnosis or being hospitalized to the change toward empowerment and feeling more in charge once they began using the app:

I was actually thinking I was going to die. But, now that I know a little bit more and how I can improve my health and my heart, I have a lot of hope and when the doctor told me that, you know, I'm good, I'm okay now, you know, like with everything I'm doing, I'm doing everything right. [Participant 78]

I Am the Leader of My Health Care Team

Participants noted that their experience with their health care providers also improved, as they were more empowered with knowledge and information about their health. This allowed them to speak up more with their health care providers and provide essential health information. One participant noted:

It really helped enabling me to make me feel like I was actually more a part of the process of the treatment. [Participant 18]

Another participant noted that having information about her body weight improved her experience at her appointment and allowed her to weigh carefully at home:

I have a lot of doctor's appointments and, you know, I have several issues and when I go to my appointments, I'm in a wheelchair and it's kind of painful to stand up. So, I can show them in my phone a record of my actual weight for the morning...I like being able to, like, go into the doctor's appointment, show exactly what my weight was and it really made me aware of keeping up with my weight, my ups and downs and how much I've gained. [Participant 39]

Participants also noted that the organization of the app improved the interactions with their health care team, likely improving the care they received. One participant noted how the app had improved her health care interaction as opposed to pen and paper:

Sometimes I take off to the doctor and I forget it [weight records on paper]. Well now I can click on my phone and go to that app that you know from you guys and boom they're all listed right there on my phone so I can show them to my doctor. You know how the nurse always checks your pills before you go in, and I just show them that and they see everything that I've got on. [Participant 76]

My Health is Improving

Many individuals with chronic illness, specifically heart failure or multimorbid conditions do not believe that their health can improve. Although participants began to monitor their health, feel good about managing it, and interact in clearer ways with their health care team, they also began to notice that these behaviors were also correlated with an improvement in their health. One participant noted:

I was able to, like, you know, better myself. My heart was only working at a 25% when I first started the app and now...my heart is improved to a 45% strength then. [Participant 78]

Other participants noted that while their health was improving, it became even clearer to themselves that the self-management behaviors they had learned through the mobile app were critical to their health maintenance and improvement going forward.

It really did help and my condition got really this bad because it just really got this bad as a result of me being neglectful and it was a good thing it was caught in time because it took a while for me to really come to the conclusion of what was actually going on and so I'm really grateful for that. [Participant 18]

Discussion

Principal Findings

Participant experience using the mHealth interventions were overall positive and enhanced their self-management of heart failure symptoms. Statements received by participants were organized into four major themes: First, education provided during the study increased self-awareness and promoted self-management through a better understanding of heart failure. Second, the mHealth app supported participant empowerment, resulting in better self-management of their condition of heart failure and, in turn, increasing quality of life. Third, the participants felt activated to take responsibility for their health by advocating for themselves and communicating with their health care team. Finally, participants felt the mHealth app provided them with a tool to self-manage their symptoms and, therefore, improve their health. These specific themes support previous research findings that mHealth apps can be an empowering and engaging platform for participants to better manage chronic illnesses [14,21].

Studies have shown that education focusing on symptom awareness enhances self-management, thus enhancing the ability to recognize subtle health changes. It is important for future mHealth interventions to incorporate a chronic illness education component to emphasize disease management and monitoring of symptoms. Moreover, technological literacy, patient activation, and cognition should also be considered [34-36]. In relationship to the theme *I didn't realize, now I know*, the mHealth intervention incorporated an educational component within the app consisting of a daily educational tip (*pearl*) related to heart failure. Education is a common component of mHealth and self-management research in mobile health [21,24]. This theme deepened the understanding of how education can be incorporated into apps and interventions. The app offered a small daily *pearl* related to heart failure, followed by a question for the users to answer about the content shared on the given day. Participants received positive encouragement when the question was answered correctly. Educational content tailored to the participant's knowledge level enhances self-management and the ability to recognize subtle health changes [35]. The mHealth app in this study offered a different and unique strategy to present educational content that may be less overwhelming to the participants than large amounts of content presented at once. Effective strategies to deliver education within such apps warrants further study.

The theme *It feels good to focus on my health* supports the empowerment of patients and likely enhances their ability to manage their heart failure symptoms. Empowering and activating patients to manage their chronic disease can increase

the quality of life and reduce health care utilization [18,37]. Likewise, persons with low activation levels may be at greater risk of poor health outcomes and unplanned hospital readmissions in persons with chronic disease [7,38]. A study completed in rural heart failure patients found a decreased understanding of their health made the self-management of chronic illness sometimes impossible because of decreased knowledge around illness-related symptoms [34]. Consistent with a recent review on mobile apps for individuals with chronic diseases [14], this study identified that participants were engaged and empowered when using the app. An increase in the activation levels may encourage health-related behaviors, such as increasing physical activity, dietary behaviors, and medication adherence [39,40], as well as support closer monitoring of their disease symptoms [18].

The theme *I am the leader of my health care team* was supported by participant reports that the mHealth app empowered them to lead conversations with their health care team. Participants were able to advocate for themselves by communicating with their providers. Having health information readily available on their phone was convenient and less cumbersome than having paper and pencil records. mHealth apps should be used as a complement to health care with a provider [14], as they may offer a direct communication pathway via technology or can be accessed on a mobile device during face-to-face visits. Apps can promote the education needed for individuals to know how to manage their disease process at home and when to communicate with their health care team for more support [13,18,41]. These mHealth interventions aim to test ways to reduce the impact of chronic illness by preventing exacerbations, empowerment self-management skills, and encouraging communication with the health care team when appropriate.

Some participants reported the theme *My health is improving* in the realization that self-monitoring with the app correlated with improving their health and managing their heart failure. Findings from this study were consistent with other reported research [17], identifying that apps are often a useful platform to record daily biomarkers such as weights. The ability to visualize the trend of stable or decreasing weight offers a strategy to see health changes. Other apps also incorporate identifying symptoms, such as breathing, daytime sleepiness, or fatigue [12,42]. Built-in medication reconciliation tools may help participants communicate with their health care team, promoting up-to-date recording keeping and accurate reporting that is consistent with other mHealth apps [12,17,19,43]. Enhancements to this app could include the ability to notify a health care provider when biomarkers or symptoms change from day-to-day, as previously reported [10].

Limitations

Future research with a larger sample size is needed to control for potential bias. This sample was purposive and convenient. Participants were telephoned at various times of the day and the first 10 individuals were interviewed. It is important to learn from those less engaged and seek strategies to improve the app and intervention; likewise, it is imperative to know how the mHealth app benefits some individuals. It is timely to study mHealth interventions limiting face-to-face contact, considering the recent COVID-19 pandemic.

Future Research

In the future, we plan to include participants in the development of the intervention to assess their needs and desires to enhance engagement. These results combined with the parent study's results on usability and acceptability of the intervention will inform a larger, fully powered study.

Future research should focus on the components of mHealth interventions that improve outcomes. One possible approach is to incorporate food logs or daily symptom evaluation to further enhance the mHealth intervention. It is also essential to evaluate notification fatigue; for example, how many notifications should be sent and how often they should be sent. Research has shown that a patient-centered approach with app tailoring options allows for personalization options and will guide the frequency and timing of notification in future studies [14].

Conclusions

The use of mHealth can enhance the promotion of self-management techniques in patients with heart failure. Enhancing patient engagement is directly affected by patients' usability of an mHealth intervention and potential benefits from its tailored content. This study showed that participants who were interviewed about the self-management mHealth app intervention for heart failure reported an overall positive experience. The education provided during the study increased their self-awareness and promoted self-management of their heart failure. Future mHealth apps need to support patient empowerment, resulting in better heart failure management and improved quality of life. Participant activation to take responsibility for their health through advocating for themselves when communicating with their health care team is vital to long-term self-management of chronic diseases. The mHealth app we evaluated could also be used in future studies to assist in symptom management and, therefore, improve individual's overall health. Future research will further support symptom evaluation, medication tracking, and possibly serve as a health provider communication platform to empower individuals to be leaders in their chronic disease management.

Conflicts of Interest

None declared.

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Abbreviations

mHealth: mobile health

XSL•FO
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