Technology-Based Intervention
HeartMapp: A Mobile Phone app for Telemonitoring Support to improve Heart Failure Outcomes

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Disclaimer

HeartMapp: A mobile App for Heart Failure

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Heart Failure Symptoms

- HF: Complex syndrome
- 5.1 million people in US (Go et al., 2014)
- Symptom clusters varies individually (Moser et al., 2014)
Heart Failure Self Care

Heart failure patients are expected to:

• Remember complex information
• Practice Daily self-care
  • Daily weight
  • Follow complex medication regimen
  • Follow low salt diet
  • Understand and manage heart failure symptoms
  • Exercise regularly
• Manage other diseases (Yancy et al., 2013)
Why is Self-care Important?

Heart Failure Management and Self-care are aimed to:

• Prevent remodeling: Prevent heart failure from getting worse

• Increase lifespan

• Improve quality of life

• Thereby reduce costly readmissions
  
  (Mann & Bristow, 2005)
Current Strategies to Improve Outcomes

• Get with guidelines (Go et al., 2014)
• Improve performance measures (Heidenreich et al., 2013)
  • Focused on best practice models
  • Follow Pathways and algorithms
  • Have discharge order set
• Biobehavioral interventions: i.e., transition care, education, telemonitoring
• However: no sustained benefit in reducing readmission rate
  • 25% in 30-days; 50% within 6-months (Go et al., 2014)
Aims for Developing HeartMapp

• To fill the gap, what is needed is a constant companion like a health coach or health buddy

• Mobile technology is carried on by individuals all the time

• Available in real-time and all settings for information

• thus engages individuals over a long-period, may be for their life time
Technology Use by Older Adults

- 79% of Internet users accessed the internet through their mobile phone in 2014
- 98% of text messages are read, compared to 22% of emails on the computer
- Text messages are usually read within the first five seconds of being received
- Once older adults >65 years join the online world, digital technology often becomes an integral part of their daily lives
- Mobile technology is defined as devices (Mobile phones and tablets) that are intended to be always be on and carried by the person throughout the day for the purpose of communication during normal daily activities.
We developed a Mobile Phone Application to Improve Self-care and HF Outcomes
A Heart Mobile Phone Application
HeartMapp

HeartMapp was developed in collaboration with Dr. Miguel Labrador, Professor, Department of Computer Engineering
Goal of HeartMapp

- HeartMapp encourages persistent involvement and engagement of patients’ daily self-care activities to potentially improve HF outcomes.

- HeartMapp acts as constant companion and is like a health coach or buddy
Conceptual Framework for HeartMapp (mHealth)

- Information, Motivation, and Behavior (IMB) model, the theoretical underpinning (Fisher et al., 2002).
- One who is well informed and motivated is thought to develop and enact the knowledge and skills necessary to ratify the focused behavior and is likely to reap greater health benefits.
- Carman’s multidimensional framework engagement, expands the IMB model of the behavior change (Carmen et al., 2013).
IMB & Engagement Model

**Information**
- Self-care
- Medication
- Diet
- Physical Activity

**Motivation**
- Personal Motivation with increased knowledge and Social Support

**Engagement with HeartMapp**
- Persistent daily Self-care practice
- Medication, Diet, Physical activity

**Behavior Change**
- Adherence to Self-care practice
- Medication, Diet, Physical activity

**Health Outcome**
- Improved Self-care practice, Adherence to Medication, Diet, Physical activity

**Figure 1: Conceptual Framework**
Method/Design Used

• Patient-centered approach was utilized

• Patients were involved in the initial design of the prototype

• Alpha and beta testing was done during the development phase with feedback from patient in redesigning the prototype

• Based on feedback from patients and providers - refinements were added to the HeartMapp
Alpha and Beta Testing of HeartMapp

• Beta testing (N=10): mean age of 63 years
  • 60% were 65 years of age or older.
  • All ten of the participants were employed full time
  • All 100% owned a mobile phone, 50% smartphones
  • 50% used text messaging
  • 60% reported using mobile phone very well and 40% fairly well.

• Refinements made
  • Interactive educational modules, audio enabled
  • Feedback for physical activity based on distance walked in 6-min
  • Summary statistics to enable tracking trends and communication
  • Audio enabled for feedback messages
  • Finger tapping and Zoom enabled for easy navigation
HeartMapp Architecture
Features of HeartMapp

- HeartMapp is Copyrighted
- Patient accept the disclaimer
- Register to use the HeartMapp
- Once registered, patients will have access to all features of HeartMapp
Features of HeartMapp

1. Assessment
   - Memory
   - Heart failure symptoms
2. Exercises/physical activity
   - Walking
   - Breathing
3. Vital Sign Monitoring
   - Heart rate
   - Respiratory rate
   - Heart rate variability
4. CHF educational information
   - 10 modules
   - that are audio enabled
Clinical Features of HeartMapp

- **Patient engagement** tool including audio/video enabled HF information to enhance knowledge
- **Automation of clinical protocol**
  - HF symptom assessment utilizing the NYHA Classification to determine severity of HF and feedback using colored zones
  - Feedback on physical activity utilizing distance walked in six minutes based on age, gender, and BMI
- **Remote physiological monitoring** of heart rate, respiratory rate, and heart rate variability utilizing Bluetooth sensors
- **Clinical support decisions** by offering feedback to patients as well as providers based on real time data.
Assessment: Memory Testing

• Test of memory/exercise

• Presents picture of the Day
  Three pictures
  Occur randomly
  Different ones each day

• HeartMapp Includes a Library of pictures over 50
Assessment: Weight and BP

• Check weight and Blood pressure and record it

• Bluetooth enabled devises will transfer data automatically and offer feedback
## HF Symptom Assessment

### How is your shortness of breath today?

<table>
<thead>
<tr>
<th>Severe, even present at rest</th>
<th>Moderate, present after walking or during house hold works</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild, only with exigent activities</td>
<td>Stable</td>
</tr>
</tbody>
</table>

### Do you have a cough or wheezing?

<table>
<thead>
<tr>
<th>Worse with lots of phlegm</th>
<th>Slight cough with no phlegm</th>
</tr>
</thead>
<tbody>
<tr>
<td>No cough or wheezing</td>
<td>Moderate with small amount of phlegm</td>
</tr>
</tbody>
</table>

### Are you fatigued?

<table>
<thead>
<tr>
<th>The fatigue is mild</th>
<th>The fatigue is severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>No fatigue or same as before</td>
<td>The fatigue is moderate</td>
</tr>
</tbody>
</table>

Heart failure symptom questions; audio enabled; answers appear randomly
### HF Symptom Assessment

**Do you have any swelling in your leg?**

<table>
<thead>
<tr>
<th>Worse and present up to thigh and hips</th>
<th>No swelling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moderate and present in ankles and legs</td>
<td>Slight swelling or present in ankles only</td>
</tr>
</tbody>
</table>

**Do you feel bloated?**

<table>
<thead>
<tr>
<th>The bloating is severe</th>
<th>The bloating is mild</th>
</tr>
</thead>
<tbody>
<tr>
<td>The bloating is moderate</td>
<td>No bloating or feel the same</td>
</tr>
</tbody>
</table>

**Were you able to lay down and sleep as usual?**

<table>
<thead>
<tr>
<th>I had to sit up in a recliner to sleep</th>
<th>I used one extra pillow to sleep</th>
</tr>
</thead>
<tbody>
<tr>
<td>I slept normal</td>
<td>I used 2 or more extra pillows to sleep</td>
</tr>
</tbody>
</table>

Heart failure symptom questions; audio enabled; answers appear randomly
Assessment: Memory Testing

- Nine pictures appear randomly from the library of 50 pictures
- If heart function is normal, they may be able to remember all
Feedback on Symptom Assessment

Colored Zones are classified utilizing New York Heart Association classification

- **Green Zone**: Your Symptoms are under control. You are in the Green Zone
  - Continue taking your medications as ordered
  - Continue checking your weight daily
  - Follow a low salt diet
  - Keep your doctor’s appointment as scheduled

- **Yellow Zone**: Your Symptoms are getting slightly worse. Still Safe and you are in the Yellow Zone
  - Take an extra dose of water pill
  - Call your doctor’s office for additional instruction
  - Physician's name:

- **Orange Zone**: Your Symptoms are Worse. You are in the Orange Zone
  - Call your doctor’s office for additional instruction
  - Physician’s name:

- **Red Zone**: You are in the RED ZONE
  - CALL 9-1-1 IMMEDIATELY!!
HeartMapp: Exercises Module

Breathing Exercise
Biofeedback with 6 breath/min
It aims to reset the autonomic system

Measures Predicted distance walked in 6 minutes- based on the Algorithm of Age, Gender, BMI
HeartMapp: Vital Sign Monitoring

BioPatch and BioHarness Strap with Bluetooth Sensor to transmit vitals

**Monitors**

- Heart Rate
- Resp. rate
- HRV
- Posture
- Coughing
- Activity
What is Heart Failure?

Heart failure simply means that the heart muscle is weak. The heart cannot contract normally. This affects the ability of the heart to pump the blood to the body. Thus the body does not get the blood it needs. Blood backs up into the blood vessels around the lungs and causes congestion of fluid into the lungs. This fluid in the lungs causes congestion and makes it hard to breathe. Blood backs into blood vessels causes abdomen, legs and feet swelling. This is why heart failure is known as congestive heart failure or CHF.

The heart has four chambers. The two upper chambers are called atria and the two lower chambers are called ventricles. The left ventricle is the chamber of the heart that pumps the blood out into the body.

A normal heart is “pear shaped”. When a person has heart failure, the heart changes from a pear shape to an apple shape, which results in a decrease in function. Heart failure drugs can stop this process and sometimes even reverse it.

The heart begins to change shape and becomes enlarged.

from a pear shape to an apple shape

Heart failure usually occurs when another problem makes the heart weak or stiff so it does not pump or fill normally. Understanding the reasons for your heart failure can help you ways to improve.
Usability Study (N=25)
Cross sectional Pilot Study

- 92% owned a mobile phone (one person lost his phone recently),
- 72% were smart phones or iPhones,
- 52% used mobile phone to obtain health information.
- 32% African Americans reported solely using smartphones to access internet for health information compared to 16% of Caucasians.
- High self-confident in using the HeartMapp (26.60±12).
- 22% of patients reported not confident in using the Bluetooth strap
- All participants completed the task of navigating the HeartMapp with Little or no help with mean score of 28.84±3.65.
Usability Study (N=12)

- Physicians (n=4) all of whom had over 15 years of experience,
- Nurse Practitioners (n=4) had <10 years of experience
- Nurses (n=3) had over 15 years of experience
- Pharmacist (n=1) also had over 15 years of
- Confidence in recommending HeartMapp (4.58±0.67)
- Utilize the data from HeartMapp for clinical decision making (4.50±0.67)
- Concerned on patients ability to use Smartphone
Research Goal and Clinical Implication

• Currently HeartMapp is being refined
  ** Wrist worn devise

• Pilot testing HeartMapp in a clinical trial to compare with existing Telemonitoring service
  • explore safety and efficacy of HeartMapp
  • Develop Prediction model using machine learning algorithms form real time data
References


Thank You!