R3: Telerehabilitation Enhanced Wellness Program for Spina Bifida

Presenters:
Brad E. Dicianno, MD and
Andrea D. Fairman, PhD, MOT, OTR/L, CPRP

Respondent:
Clayton Lewis, PhD, University of Colorado

Brief Overview

• The iMHere (Interactive Mobile Health and rehabilitation) System, developed to remotely support self-care activities of persons with spina bifida
• Secure clinician portal which interfaces in real time with a suite of specially designed smartphone apps.
• 3 Phases
  – Phase I: Development & Usability Testing
  – Phase II: Clinical Efficacy Studies
  – Phase III: Follow-up Semi-Structured Interviews
The Problem

- ½ Americans have ≥ 1 chronic illness
- 5% of Americans with chronic conditions account for ½ health care expenditures

Problem: Secondary Conditions in people with Spinal Cord Conditions

<table>
<thead>
<tr>
<th>Preventable</th>
<th>Expensive</th>
</tr>
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<tbody>
<tr>
<td>1/3 of hospitalizations due to preventable conditions</td>
<td>Nationally</td>
</tr>
<tr>
<td>Skin and Bladder infections most prominent</td>
<td>Expenditures 3-6x higher than general population</td>
</tr>
<tr>
<td>1% of these hospitalizations lead to death</td>
<td>Each hospitalization $30K</td>
</tr>
<tr>
<td>30 day readmission rates high</td>
<td>~4 hospitalizations/yr/person</td>
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</tbody>
</table>


Locally (Pittsburgh, PA)
- UPMC >$2M for all preventable conditions in '09
The Solution

- Mobile Technology
  - PDAs now out of favor
  - The ubiquitous smartphones
    Use at home, work, play

Versatile features and functions:
- Telephone
- Camera
- GPS
- Text Messaging
- Picture / Video Messaging
- Internet Access to e-mail, social networking sites

and the ability to download and utilize 1,000's of "apps"

The Current Market

- Over 5,800 health, medical, and fitness phone apps within Apple's AppStore, of which:
  - 73% targeted to consumers or patient-end users, and
  - 23% targeted to healthcare professionals
- Few provide for patients and clinicians interaction (telehealth)
Telerehab Approach

Dynamic two-way communication:

- **Patient**
  - Reminders
  - Educational Tools
  - Reporting Tools

- **Wellness Coordinator**
  - Quick triage/monitoring
  - Interventions

- **Smartphone Applications**
  - Cueing for performance of self-care tasks

- **Remote Care Coordination**
  - Continuity of Services
  - By Health Care Professional(s)

**Wellness Program**
- Client-Centered Goals
- Remote Support & Education

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Interactive Mobile Health & Rehabilitation (iMHere)

- Designed to empower spina bifida patients to do preventative self-care, with the guidance and oversight of clinicians.
- It accomplishes this through a set of patient operated smartphone apps working in sync with a web-based clinician portal.

Smart Phone Applications

1. Skin ✓: Wound Tracking
2. MoodTracker: Identification & Monitoring Depression
3. TeleCath: Self-Catheterization
4. BMQ: Bowel Management Program
5. MyMeds: Medication Management
Accessibility of Apps—Physical Dexterity, Perception & Cognition

- Visual interfaces and application structure for enhancing ease of operation and effective and motivating interaction.

- Auditory and tactile interfaces including operability itself effect in usability by use with visual interface.

- Automatic tailoring, context awareness and self-configuration of the user interface depending on user’s cognitive level, functional abilities severity and preferences.

Usability Testing of Apps

Data gathered includes:
- Audio: “Think Aloud”
- Video: Screencast Software
- Number of Errors
- PSSUQ – Adapted Survey  
  - Qualitative (narrative)
  - Quantitative (Likert scale)
IBM Post-Study Usability Questionnaire

- n=8
- Likert scale 1-7
- Lower scores indicate higher satisfaction
- 2 Phases
  - Scrolling
  - Bundling of alerts
  - Font and color
  - Reliability with spotty Wi-Fi

IBM Post-Study Usability Questionnaire (Modified)

<table>
<thead>
<tr>
<th>Apps Tested</th>
<th>Range of Average PSSUQ</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Round 1</td>
</tr>
<tr>
<td>MyMeds</td>
<td>2.0-4.3</td>
</tr>
<tr>
<td>TeleCath</td>
<td>1.0-2.3</td>
</tr>
<tr>
<td>BMQ's</td>
<td>1.0-2.7</td>
</tr>
<tr>
<td>MyMood</td>
<td>2.3-3.0</td>
</tr>
<tr>
<td>SkinChec</td>
<td>1.3-3.0</td>
</tr>
</tbody>
</table>
Icons allow the clinician to easily and quickly scan the portal for problems.

- No problem
- Needs Attention
- Needs Immediate Attention

Two-way communication allows the clinician to provide secure messaging and/or revise the information remotely.

iMHere © 2012, University of Pittsburgh.
Technology Usage Outcomes

- Usage – how often are they using each of the apps
- Pictures sent of wounds
- Reports of incontinence
- Problems reported when performing self-catheterization
- Score reported on Mood app (range 0-10)
  - Lower score is better
- Incidence of technical problems encountered (this would come from messaging)
Clinical Phase -- and unexpected problems

- Mood app - suicidal ideation reports
- "Technical Malingering"
- quality of pictures due to lighting
- frequency of alarms

Future Directions

- Other populations (ages, diagnosis)
- Integration with clinical workflow (EMR systems?)
- Usability testing by clinicians
- Gamification as motivator for sustained engagement