mHealth Apps: Designing for Patient Engagement and Behavior Change

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MassMEDIC Patient Engagement Summit
January 31, 2017
Problem:
• Growth in chronic diseases and conditions, e.g., obesity, type 2 diabetes, and aging population
• Resulting lower quality of life and higher healthcare costs

“Individuals’ daily decisions and health behaviors are the most critical factor in how they fare”

Solutions: mHealth technologies are now available to help
• Mobile Devices (Smartphones)
• Wearable, wireless health sensors and devices
• Online health information (e.g., web sites, patient portals)
• Online health communities (e.g., disease-specific support groups)
Key Design Challenges for mHealth Solutions

Discontinued use before benefits occur

- Within months, many mHealth apps are no longer used
- Many mHealth apps provide little or no user feedback, leading to discontinued use
- Effort burden (e.g., manual data entry) key in discontinued use
- Smart systems and automation can reduce burden but also reduce user control, which promotes engagement and use

**mHealth devices are often viewed as data collection devices, rather than patient engagement devices**

Lack of behavior change

- Double adoption problem: Must adopt the app or device and adopt new behaviors, both over the long-term
- Supporting healthy behaviors differs from supporting task completion, and requires voluntary usage assumption
WPI’s mHealth Research Activities

• Our goals and methods
• Overview of our Apps
Our Goals and Methods

Use mHealth technologies to design, develop and test apps that
• Engage patients in managing their health
• Motivate patients to adopt healthy behaviors
• Support self-management of chronic conditions, and wellness

Conduct research that
• Seeks to understand and generate predictions from collected health and usage data (e.g., using data mining and machine learning)
• Tests ideas, techniques, and predictive algorithms

Employ best clinical and technological practices in
• Disease management, Behavioral medicine, Wellness
• User engagement, Designing the user experience

Focus has been on
• Smartphone apps – design, develop, and test
• Patient portals – how and why patients use them
Our mHealth Ecosystem

- Technology & behavioral expertise
- HDI & its Living Lab
- UXDM Lab

Patients
WPI’s Health Apps (sample)
For chronic disease, primarily elderly

- **TJR-Decision**
  - Physician-patient decision making about Total Joint Replacement, based on pain and activity data
  - AHRQ funding
  - [http://tjrapp.wpi.edu](http://tjrapp.wpi.edu)

- **Sugar**
  - Advanced type 2 diabetes and diabetic foot ulcers (image processing)
  - NSF funding
  - [http://sugar.wpi.edu](http://sugar.wpi.edu)
WPI’s Health Apps (sample)

For weight control

**Habit**
- Weight loss
- NIH funding
  - [http://habit.wpi.edu/](http://habit.wpi.edu/)

**Relax**
- Stress-induced eating
- NIH funding

**Mom-o-meter**
- Control gestational weight gain

**SlipBuddy**
- Overeating episodes
  - NSF REU Site funding
WPI’s Health Apps (sample)
For college student health

- Socialoscope
  - Senses loneliness by analyzing smartphone activities of college students
  - At risk freshmen, seniors, internationals

- Alcogait
  - Senses intoxication levels from gait
  - Put smartphone in your pocket and it tracks as you walk

- SleepHealth
  - College student sleep health
Designing to Meet mHealth Challenges

- Minimize manual data entry
- Predict discontinued use and intervene
- Support goal setting and other behavioral medicine principles
- Follow user experience and behavior change support system design principles
Design for Minimal Manual Data Entry

**SlipBuddy** only collects data on problem episodes

**Sugar** uses Bluetooth glucometer and scale; footbox for wound image capture

**SleepHealth** will learn from data and reduce data entry over time

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Sugar provides feedback on measurement frequency and activity levels (e.g., goal of measuring weight once a week)

- Thank you for monitoring your weight last week!
- You engaged in 0 minute of exercise last week. Try to increase your exercise this week to meet your goal!

Sugar provides a summary of usage activity to care team, for purposes of human interventions

Socialoscope captures measures of smartphone usage to predict loneliness

SleepHealth will continually monitor usage and predict when usage is declining
For **Sugar**, users can set glucose, weight, and activity goals, and Sugar’s feedback is relative to those goals.

**HABIT**’s design is based on behavioral medicine principles that are highly effective for weight management.
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Follow User Experience and BCSS Design Principles

Allow some app personalization

For **Mom-o-meter**, provide pink, blue backgrounds; Display baby names

**Design Principles**

- Delight the user with an excellent user experience
- Generate smart feedback and context-appropriate interventions
  - Based on prior user input, time, location
  - SleepHealth will suggest different interventions depending on point in the educational cycle (e.g., near end of term) and location of the user
- Use Behavioral Change Support Systems (BCSS) design recommendations
  - Use system features (e.g., personalization) that aid behavioral change
  - Use system features that are persuasive and motivating
Conclusions and Next Steps

Lessons Learned
• Design for patient engagement – to attain continued use and behavior changes
• Development team needs technical, clinical, and behavioral expertise; also patient involvement

Next Steps
• Smarter feedback
• Design and test interventions
• Add more group and community level features
Questions, Comments, or Suggestions?

Funding for our research comes from the **National Science Foundation**, NSF Grants IIS-1065298 (Sugar app) and CNS-1560229 REU SITE (SlipBuddy app), **National Institutes of Health**, NIH Grants R21 DK098556-01 (Habit app) and R01 HL122302-01A1 (Relax app), and **Agency for Healthcare Research and Quality**, AHRQ Grant R21 HS024003 (TJR app).

Any opinions, findings, conclusions or recommendations expressed in this presentation are those of the authors and do not necessarily reflect the views of these funding organizations.
Apps
- Socialoscope: https://web.wpi.edu/Pubs/ETD/Available/etd-042716-222034/unrestricted/pulekar.pdf (MS thesis)
- Alcogait: https://www.bostonglobe.com/business/2016/12/19/app-make-drunk-drivers-toe-line/jTpGccVnyn7upXgKpSJD5N/story.html

Our Publications (Sample re Diabetes App):

Other Literature: