Personalized, Precision mHealth!

Susan A Murphy

BariFit

HeartSteps

Sense Stop

15 min.
15 slides
Using Data to optimize mHealth Interventions

Use data to address:

• mHealth “pulls:” When users access the app, what is the best way to provide treatment?
  – Should this differ by the user’s current context?

• mHealth “pushes:” When should the mobile device or wearable initiate contact with the user to provide treatment?
  – Should the treatment, or whether to provide treatment, depend on the user’s current context?

what problems are you trying to solve?
**Pull:** When the user accesses the app to track his/her exercise, should the app provide a tailored message focused on making the future more salient OR provide a tailored message focused on the user’s realized outcomes?
- Should the type of message differ by how well the user is currently doing?

**Push:** When should the app remind the user to utilize stress management exercises?
- Should these reminders occur when the user is currently experiencing physiological stress?

how are you uniquely solving them w/ data science? Brief case studies
Optimizing mHealth Engagement

Pull: When the user opens the app, should the user interface provide engagement rewards via a growing aquarium or via a growing tree?

- Should the user interface differ by baseline user characteristics?

Push: Should the app notify the user to provide an inspirational message?

- Should these messages appear when the user is more or less engaged?

how are you uniquely solving them w/ data science? Brief case studies
Experimentation to Improve mHealth Intervention and Engagement

Developing principles and methods for

- Learning Experiments
- After experiment data analysis
- Real-time personalization of mHealth app
The Substance Abuse Research Assistance (SARA) is an app for gathering data about substance use in high-risk populations. App developers are using an MRT to improve engagement with completion of the self-report data collection measures. At the time this summary was written, this MRT is unique in that it has an engagement component, but not a treatment one. 30 days

**PIs:** Maureen Walton, Susan Murphy, and Mashfiqui Rabbi Shuvo

**Location:** University of Michigan

**Funding:** Michigan Institute for Data Science (PI S. Murphy), University of Michigan Injury Center (PI M. Walton), NIDA P50 DA039838 (PI Linda Collins), NIAAA R01 AA023187 (PI S. Murphy), CDC R49 CE002099 (PI: M. Walton)

https://clinicaltrials.gov/ct2/show/NCT03255317

And

https://osf.io/whgfp/
This project tests the feasibility of conducting an MRT aiming to investigate whether real-time sensor-based assessments of stress are useful in optimizing the provision of just-in-time prompts to support stress-management in chronic smokers attempting to quit. The resulting data will be used to inform the development of a JITAI for smoking cessation. 10 days postquit, 4 days prequit.

**PI:** Santosh Kumar, Center of Excellence for Mobile Sensor Data-to-Knowledge (MD2K, [https://md2k.org](https://md2k.org))

**Location:** Northwestern University, Bonnie Spring, (site P.I.)

**Funding:** NIBIB through funds provided by the trans-NIH Big Data to Knowledge initiative ([www.bd2k.nih.gov](http://www.bd2k.nih.gov)). U54EB020404

MD2K smoking cessation study
[https://www.clinicaltrials.gov/ct2/show/study/NCT03184389?recrs=a&lead=Northwestern+University&entry1=NA%3AUS&state1=NA%3AUS%3AUS&draw=1](https://www.clinicaltrials.gov/ct2/show/study/NCT03184389?recrs=a&lead=Northwestern+University&entry1=NA%3AUS&state1=NA%3AUS%3AUS&draw=1)
This project tests the feasibility and effectiveness of providing, via a smartphone, just-in-time tailored physical activity suggestions as well as evening prompts to plan the following day's physical activity so as to help sedentary individuals increase their activity. The resulting data will be used to inform the development of a JITAI for increasing physical activity.

**PI:** Predrag Klasnja  
**Location:** University of Michigan  
**Funding:** NHLBI/NIA R01HL125440

heartsteps MRT
HeartSteps Results

The data indicates that contextually tailored activity suggestions improve step count in the succeeding 30 minutes.

- This effect is primarily due to the walking activity suggestions as opposed to anti-sedentary suggestions.
- The walking activity suggestion initially increases step count over succeeding 30 minutes by $\approx 271$ steps but by day 21 this increase has dissipated.

what outcomes are you realizing? How do you quantify?
Goal in Optimizing mHealth Interventions

Use data to address:

- Might the best treatment pull or treatment push, for a given context, vary by user?

- Could it be that, as time proceeds, the best treatment pull or push for a given context, change?

- Incorporate continual learning and optimization in the rollout of a mHealth application.

- what do you see as future challenges?
Collaborators!