Overview

• Session 1: Introduction to JITAIls: Just-in-Time Adaptive Interventions

• Session 2: Micro-randomized Trials for Developing mHealth JITAIls

• Session 3: Data Analytics for Developing JITAIls
Session 1: JITAIs

• Adaptive Interventions

• Just-in-Time Adaptive Interventions

• Examples
Adaptive Interventions

- Intervention design that takes advantage of systematic response heterogeneity by individualizing treatments to individuals

- Example: Adaptive drug court program for drug abusing offenders

Marlowe et al., 2008; 2009; 2012
Adaptive Drug Court Program

- Low risk:
  - As-needed court hearings + standard counseling
  - Non-compliant
  - Non-responsive

- High risk:
  - Bi-weekly court hearings + standard counseling
  - Non-compliant
  - Non-responsive

- Non-responsive:
  - As-needed court hearing + ICM
  - Non-compliant

- Non-compliant:
  - Bi-weekly court hearing + ICM
  - Non-compliant

Jeopardy contract: “zero tolerance”
Adaptive Intervention: 5 Elements

The adaptation is guided by consideration of
(1) Distal Outcome and Proximal Response

The adaptation process is composed of
(2) Tailoring Variables,
(3) Decision Rules and
(4) Treatments

The adaptation is triggered at
(5) Decision Points
Adaptive Drug Court Program

As-needed court hearings + standard counseling

Bi-weekly court hearings + standard counseling

Jeopardy contract: “zero tolerance”

Low risk

High risk

Non-responsive

Non-compliant

Non-responsive

Non-compliant

Non-compliant
First Stage Decision Rule

At point of entry into the program

If risk = low
Then, treatment = {As-needed + SC}

Else if risk = high
Then, treatment = {Bi-weekly + SC}

1. Decision Point:
A time in which treatment options should be considered based on patient information

2. Tailoring Variable:
Patient information used to make treatment decisions

3. Treatments:
Type/Dose

4. Decision rule

5. Outcomes:
Distal → Longer-term goal of intervention:
Program graduation (14 consecutive weekly negative drug urine specimens)
Proximal → Shorter-term goal of decision rules:
Adherence and abstinence in the course of intervention (mediator)

Longer-term goal of intervention:
Program graduation (14 consecutive weekly negative drug urine specimens)

Shorter-term goal of decision rules:
Adherence and abstinence in the course of intervention (mediator)
Two Types of Treatments
JITAIIs: Just-in-Time Adaptive Interventions

• A JITAI is an adaptive intervention
• That is
  o delivered when needed
  & where-ever needed

(Kaplan & Stone, 2013; Spruijt-Metz & Nilsen, 2014)
Example

Reducing Sedentary Behavior by Office Workers

- Software on the computer measures uninterrupted computer time via mouse and keyboard activity
- Smartphone delivers a message to encourage a walking activity *only* if 30 min. of uninterrupted computer activity occurs

(Dantzig et al., 2013)
Example

iCrave for weight management

- Mobile app containing a button that participants can press whenever they experience craving for unhealthy snacks
- A visualization task is provided as soon as they press the button;
- Next, the participant is prompted to make a choice between: (1) not eat at all; (2) a healthy snack; or (3) an unhealthy snack.
- A congratulating message is provided only if the participant selects (1) not eat at all.

(Hsu et al, 2014)
Commonalities?

- Both adaptive interventions and JITAIIs are time-varying and adaptive
  - Both have “Push and Pull” treatments

- However in JITAIIs technology plays a critical role
  - Information can be obtained when/where needed
  - Treatments can be delivered when/where needed
Just-in-Time Adaptive Intervention
5 Elements

The adaptation is guided by consideration of
(1) Proximal Response and Distal Outcome

The adaptation process is composed of
(2) Tailoring Variables,
(3) Decision Rules and
(4) Treatments (push)

The adaptation is triggered at
(5) Decision Points

In-the-Moment Impact

Real-Time
Distal Outcomes

The goal is to improve a longer-term, distal, outcome

• Change behavior and/or maintain behavior change
  • Substance use cessation & prevent relapse
  • Increase physical activity & maintain increased activity level
  • Improve medication adherence & maintain adherence

To improve the distal outcome, the treatments are often formulated to target proximal responses
Proximal Responses

*Mediators* that may be critical to achieving the long-term goal

1) Short term targeted behavior
   - Substance use over x hours
   - Physical activity over x minutes
   - Adherence over next hour

2) Short term risk
   - Current craving, current stress

3) Engagement with mobile app and intervention burden
Treatments

• In-the-moment push treatments:
  • Behavioral strategies, cognitive strategies, self-monitoring, social linkages, motivational,…
  • Reminder to use supportive apps or reminder to self-monitor
  • How to deliver a treatment
  • “Provide nothing” option

• Theoretically/scientifically driven (Klein et al., 2011)
Tailoring variables

Tailoring variables are moderators that inform which treatment is best when, where and for whom.

- Often past proximal responses: stress, activity
- Risk & protective factors: busyness of calendar, current mood or craving, location, social context
- Adherence & burden
Decision Points

Typical decision points in JITAIIs:
  - Intervals in time (every x seconds, every x minutes, every x hours)
  - When user requests help (presses “help” button)

Frequency is guided by the dynamics of the tailoring variables and “in-the-moment nature” of the treatment effect.
Decision Rules

Link individual information to treatments at decision points

• A decision rule is implemented at each decision point
• A JITAI often includes many different decision rules
• Development of decision rules is guided by an integration of empirical evidence, theory and clinical experience.
What to do when composite risk assessment at random prompt indicates risk

At self-report assessment

If composite substance abuse risk $\geq R_0$

Then, Tx = \{reminder to access intervention\}

Else if composite substance abuse risk < $R_0$

Then, Tx = \{do nothing\}
What to do when composite risk assessment indicate risk + user does not access intervention

At M minutes following a self-report assessment:

*If* composite risk $\geq R_0$

*and* intervention access in past M minutes = NO

*Then*, Tx = {message encouraging intervention use}

*Else if* risk < $R_0$ or intervention access in past M minutes = YES

*Then*, Tx = {do nothing}
At 1 minute intervals

If current accumulated computer activity > $P_0$

Then, $Tx = \{\text{recommend movement}\}$

Else if current accumulated computer activity ≤ $P_0$

Then, $Tx = \{\text{do nothing}\}$
Summary of JITAI elements

1. Outcomes
   - Distal (scientific/clinical goal) & Proximal Response (guided by mediational theories pinpointing the necessary processes needed to achieve the distal outcome)

2. Treatments
   - Guided by the proximal responses

3. Tailoring variables
   - Guided by theory concerning moderation.

4. Decision points
   - Guided by the dynamics of the tailoring variable and in-the-moment nature of the effect of the treatment.

5. Decision rules
Example

MD2K Sense2Stop

- Wearable bands measure activity, stress, cigarette smoking; smartphone sensors provide location, ……

- In which contexts should the wrist band provide supportive stress-reduction “cue” and smartphone activate to highlight associated stress-regulation exercises?
Sense2Stop

- Goal: Develop a Just-in-Time Adaptive Intervention for Delaying Time to Relapse to Smoking
Sense2Stop

Distal Outcome:
Time to Relapse.

Proximal Response:
Fraction of time stressed over next x minutes.
Sense2Stop

Treatments:
Whether to provide a reminder to practice stress regulation exercises? Yes/No

Decision points:
Approximately every minute of a 10 hour day
Reminder to use stress-regulation exercise

No Message

OR

MS band vibrates and displays reminder; Stress-regulation app opens on phone
Potential Tailoring Variables:
availability, current stress, location, volatility in stress over prior x hours, craving (self-report)
Every minute
   IF available,
      Then,
         If passively sensed stress = Yes,
            Then Tx= prompt stress-regulation
         Else if passively sensed stress = No
            Then Tx= ‘do nothing’
      Else If not available,
         Then Tx= ‘do nothing’
Practice forming your own JITAI!

1. Problem Behavior & Population?
2. Outcomes?
   - Distal (scientific/clinical goal) & Proximal Response
     (guided by mediational theories pinpointing the necessary
     processes needed to achieve the distal outcome)
3. Treatments?
   - Guided by the proximal responses
4. Tailoring variables?
   - Guided by theory concerning moderation.
5. Decision points?
   - Guided by the dynamics of the tailoring variable and in-
     the-moment nature of the effect of the treatments.
6. Decision rules?
Collaborators