

Real World Utilization of JITAIs for Risk Prevention among Youth Experiencing Homelessness: From Development to Evaluation



Jane and Robert Cizik
School of Nursing

The University of Texas
Health Science Center at Houston

DIANE SANTA MARIA, DRPH, RN, PHNA-BC, FSAHM, FAAN
Associate Professor And Dean At The Cizik School Of Nursing, University Of
Texas Health Science Center At Houston (UTHEALTH)

NIKHIL PADHYE, PHD
Professor, Biostatistician, Cizik School of Nursing At UTHEALTH

Talking Points

- ❑ Background on Youth Experiencing Homelessness
- ❑ Rationale for EMA and JITAI
- ❑ Building Predictive Models from EMA data
- ❑ Designing Interventions to Address Risk Antecedents
- ❑ MY-RID Intervention Randomized Attention Control Trial
- ❑ Methods for Examining Intervention Effects
- ❑ Intervention Trial Results
- ❑ Recommendations for Future Studies



Achieving Health for Youth
Experiencing Homelessness



1.7-2.5 million youth
1 in 10 young adults
1 in 30 adolescents





Background

YEH experience a mortality rate that's 5–10 times higher than the general population⁶

Drug overdose and suicide are leading causes of death²

Substance use rates are double that of housed youth³

86% met the DSM-IV for a substance use disorder compared to 15% in 18-25yo³

Experience extreme challenges to accessing health and mental health care.^{5,7,8}



Background

Unstable housing is a significant barrier to...

- Accessing and engaging in HIV care
- Maintaining viral suppression
- Reducing HIV transmission⁹

People experiencing homelessness have higher rates of HIV than those who are stably housed.¹⁰

One study found a self-reported HIV diagnoses rate of 4% among YEH.¹¹

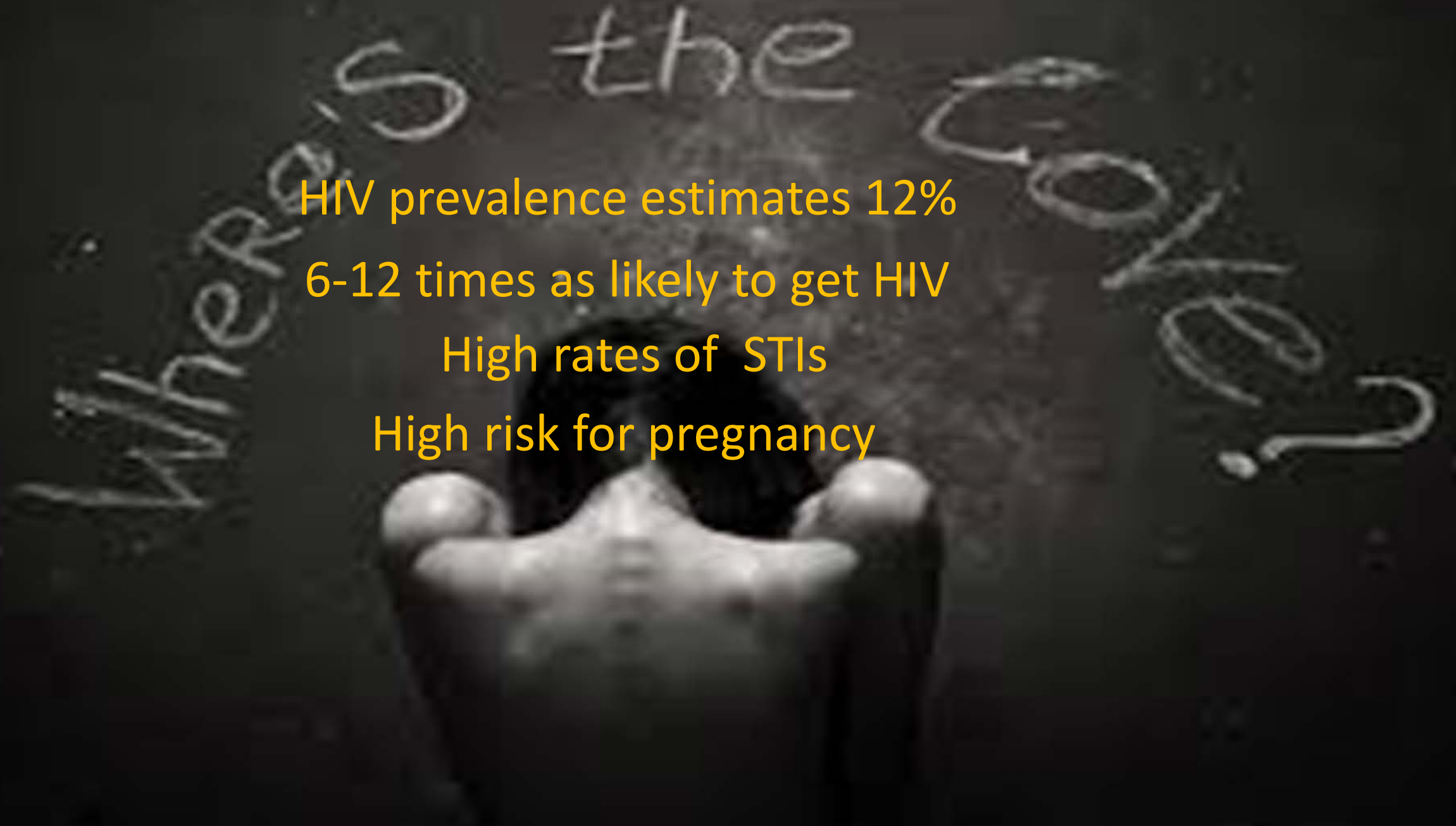


HIV prevalence estimates 12%

6-12 times as likely to get HIV

High rates of STIs

High risk for pregnancy





HIV Risk

HIV risk among all youth is correlated with sexual orientation,¹² childhood abuse,^{13,14} and histories of foster/juvenile justice involvement¹⁵⁻¹⁸

Condomless sex and substance use are correlated with real-time factors such as stress^{19,20} and depression.²¹

Modifiable factors have been found to predict HIV risk in non-YEH.

Stress, sexual urge, and substance use negatively impact sexual risk decision making thereby increasing HIV risk.



Modifiable Risk Factors and HIV Risk

So, how do modifiable risk factors contribute to HIV risk among YEH?

- Experiencing sexual urges has been found to influence YEH's decision to engage in condomless sex.²²
- Substance use is also associated with condomless sex and sexual victimization among homeless and urban youth.^{23,24,25}
- The odds of having sex on a given day were found to be highest on days when YEH experienced sexual urge and drug use, with the odds of substance use being highest on the days with high stress and drug urge.²⁶



Comparison of Sexual Risks across Populations

| | U.S. Youth | Texas Youth | Houston Youth | Homeless Youth |
|----------------------------|------------|-------------|---------------|----------------|
| First sex <13 years | 6% | 5% | 8% | 34% |
| >4 sex partners | 15% | 15% | 15% | 68% |
| Condom use last sex | 59% | 53% | 56% | 54% |
| Contraceptive use last sex | 25% | 20% | 14% | 14% |
| Substance use last sex | 22% | 24% | 25% | 35% |



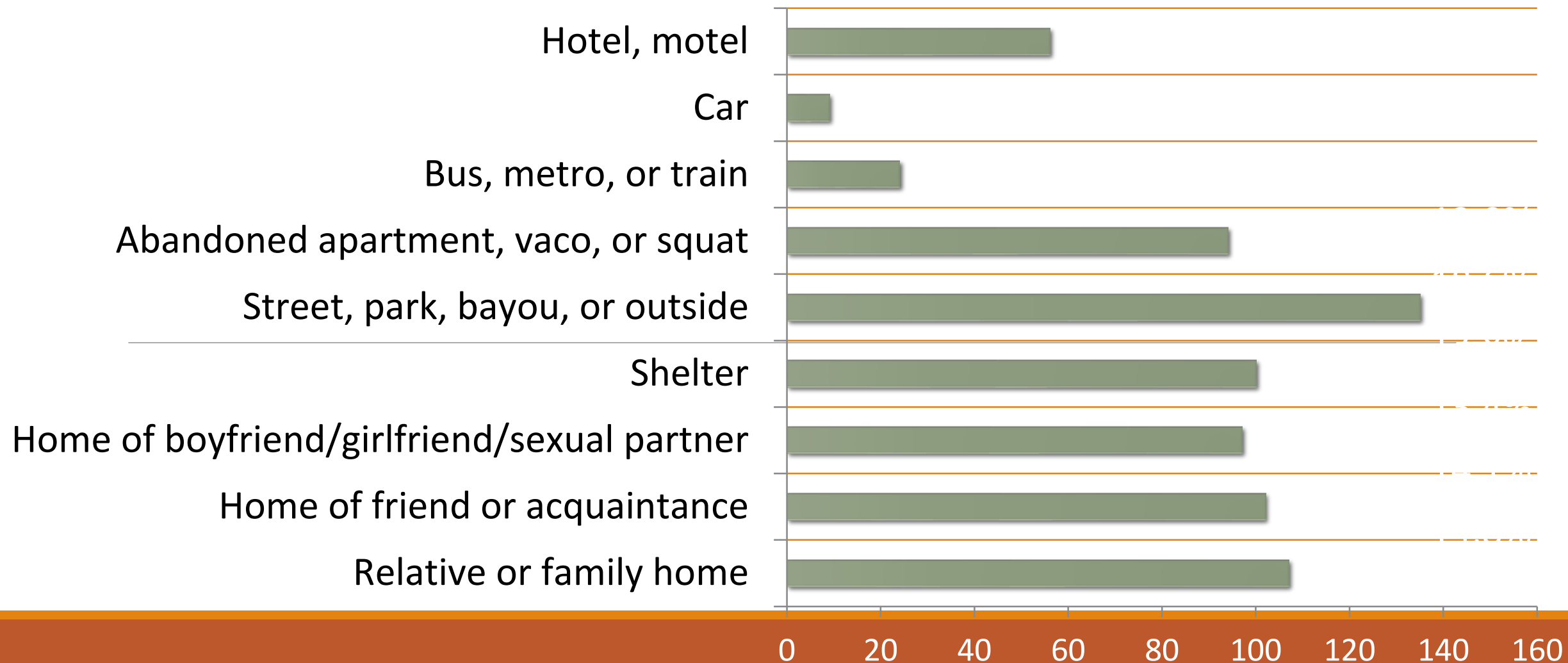
Where's the power?

Sexual Assault and Post Sexual Assault Care





Daily Sheltering Patterns





The time is now.

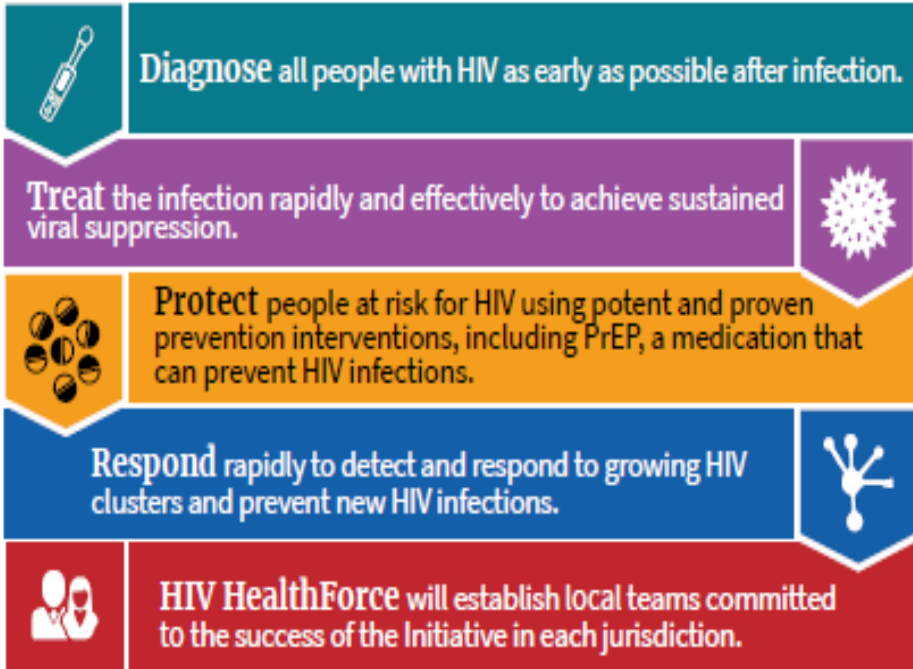
A series of colorful geometric shapes, including triangles and parallelograms in shades of blue, orange, red, and purple, arranged in a stepped pattern along the bottom of the slide.

Ending
the
HIV
Epidemic

Ending the HIV Epidemic in America

GOAL:

Our goal is ambitious and the pathway is clear – employ strategic practices in the *places* focused on the right *people* to:



75%
reduction
in new HIV
infections
in 5 years
and at least
90%
reduction
in 10 years.



More than 50% of new HIV diagnoses occurred in only 48 highest burden counties.



Addressing Modifiable Real-time Factors Among YEH

- Using real-time, personalized HIV prevention messages may provide more timely information and produce more motivation for behavioral change
- Interventions that can be delivered via smartphone at the time of heightened HIV risk may place health messages more proximally to critical behavioral decision points

Thus, these interventions may improve HIV prevention by

- Increasing motivation with personal messaging
- Targeting real-time cognitions and behaviors
- Building skills



Ecological Momentary Assessments (EMA)

The gold standard and most accurate way to measure real-time factors ^{27, 28}

In one study, 54% of youth reported condom use at last sex at baseline, yet 76% of sex acts were condomless when assessed in real-time using EMA.²⁹

Consistently high EMA completion rates have been found among youth;

- Substance use (80%) ³⁰
- Recovery (87%)³¹
- Smokers (88%)³²
- Sexual behaviors (80%)³³
- Drinking (89%)³⁴



Just-in-Time Adaptive Interventions

JITAls may be an effective delivery strategy for information and motivational messages to be sent both prior to engaging in a risk behavior at the time of heightened risk and in response to a risk behavior.

JITAls can deliver personalized HIV prevention messages that vary in content and dose depending on an individual's current sexual urges, substance use, and spikes in stress³⁵ providing the right type and dose at the optimal time.³⁶

JITAls can target the proximal, modifiable mediators that indicate the emergence of a vulnerable state (e.g., high sexual urge, substance use, or spikes in stress).



Benefits of JITAIs

Build off the willingness to disclose personal information electronically using EMA³⁷

Overcome geographic and organizational barriers to reaching the underserved³⁸

Require few agency resources, are easily accessible to youth, address personalized prevention care

Are particularly attractive to young people especially when they are developed with the target audience to enhance sustainable use.³⁹

PROJECT YEH – ECOLOGICAL MOMENTARY ASSESSMENTS



1. Santa Maria, D., Padhye, N. S., Yang, Y., Gallardo, K. G., Jung, J., Santos, G. M., Businelle, M. S. (2017). Substance use patterns and predictors among homeless youth: Results of an ecological momentary assessment. *American Journal of Drug and Alcohol Abuse*, 1-10.
2. Santa Maria, D., Padhye, N., Yang, Y., Gallardo, K. G., Businelle, M. S. (2018). Predicting Sexual Behaviors Among Homeless Young Adults: Ecological Momentary Assessment Study. *JMIR Journal of Public Health and Surveillance*, 4(2); e39
3. Suchting, R., Businelle, M. S., Hwang, S. W., Padhye, N. S., Yang, Y., Santa Maria, D. M. (2020). Predicting daily sheltering arrangements among youth experiencing homelessness using diary measurements collected by ecological momentary assessment. *International Journal of Environmental Research and Public Health*, 17(18), 6873.

Assessment 13:48

52%

Right now, I feel stressed.

☐ strongly disagree
☐ disagree
☐ neutral
☐ agree
☐ strongly agree

Next

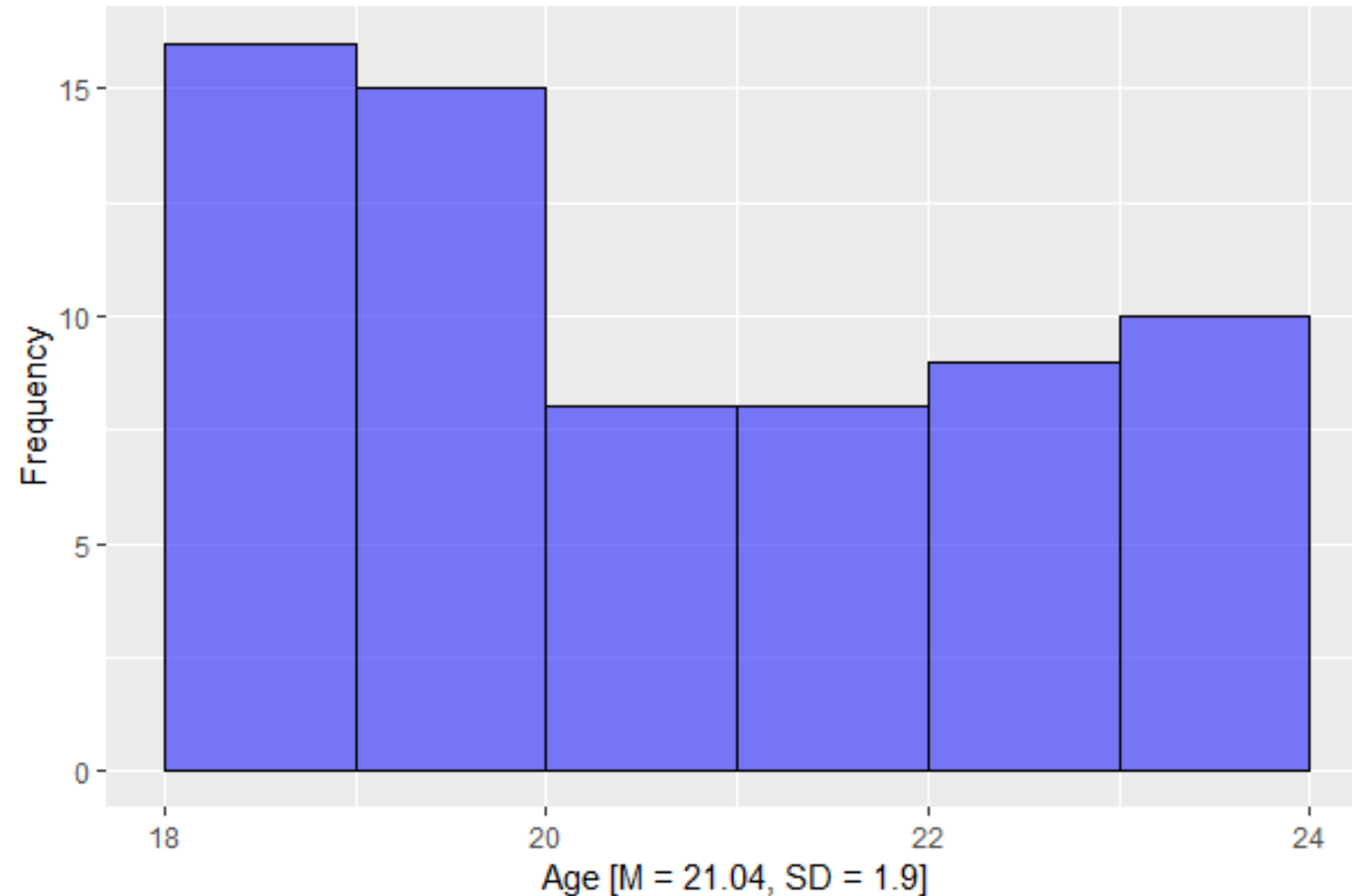
Study Methods

- Homeless youth (N= 66)
- Recruited from a large drop-in center in Houston, TX, between Sept, 2015-Mar, 2016
- Iterative field testing of EMA app
- Received a smartphone and completed up to 5 EMA daily for 3 weeks
- Tiered compensation plan
- Demographics, sexual risk, substance use, affect, and shelter measured
- Other measures = baseline survey, exit interviews, saliva-based stress & inflammation biomarkers

EMA Usage Results

| | Days of Data | Daily EMA | Random EMA | Days w Random EMA | Event EMA | Days w Event EMA | Total EMA |
|---------|--------------|-----------|------------|-------------------|-----------|------------------|-----------|
| Total | 964 | 861 | 2183 | 799 | 670 | 425 | 2230 |
| Average | 14 | 13 | 34 | 12 | 10 | 6 | 56 |

Sample Characteristics



- 62% Male
- 21% LGBTQ
- 65% Black
- 12% Hispanic
- 11% White
- 8% Other race



Prediction Model Examples

Feed-forward neural network with single hidden layer comprised of 2 units slightly outperformed GLMM on the average training set and sensitivity was higher on the average test set

- Trained on 100 random samples with 80/20 cross-validation

| | GLMM (Training set) | Neural Net (Training set) |
|-------------|------------------------|------------------------------|
| Sensitivity | 0.363 | 0.385 |
| Specificity | 0.930 | 0.959 |
| LR | 5.19 | 9.37 |

GLMM decision threshold $p=0.30$

Generalized linear mixed model (GLMM) was trained on 100 random samples with 80/20 cross-validation

Stable prediction performance on training and test sets gives more confidence in the GLMM

| | GLMM (Training set) | GLMM (Test set) |
|-------------|------------------------|--------------------|
| Sensitivity | 0.450 | 0.433 |
| Specificity | 0.913 | 0.907 |
| LR | 5.14 | 4.67 |

GLMM decision threshold $p=0.30$



Project YEH Results: Sexual Behaviors

Table 4. Generalized linear mixed models (GLMM) coefficients and odds ratios for predictors of sexual intercourse. OR: odds ratio; LGBT: lesbian, gay, bisexual, and transgender; PTSD: posttraumatic stress disorder.

| Variable | Coefficient B | SE | OR | Z | P value | 95% CI of OR |
|--|---------------|--------|-------|--------|---------|--------------|
| Fixed effects | | | | | | |
| Intercept | −2.846 | 0.576 | 0.06 | −4.944 | <.001 | 0.019-0.180 |
| Sexual orientation (LGBT) ^a | 0.8703 | 0.4061 | 2.388 | 2.143 | .03 | 1.077-5.290 |
| Race (white) ^a | −0.7501 | 0.6724 | 0.472 | −1.116 | .27 | 0.127-1.763 |
| Race (other) ^a | 0.9205 | 0.4207 | 2.511 | 2.188 | .03 | 1.101-5.733 |
| Psychosis ^a | 1.4716 | 0.6195 | 4.356 | 2.376 | .02 | 1.293-14.690 |
| PTSD ^a | −1.6613 | 0.4681 | 0.190 | −3.549 | <.001 | 0.076-0.475 |
| Drug use | 2.1748 | 0.3445 | 8.800 | 6.313 | <.001 | 4.476-17.309 |
| Sexual urge | 1.4431 | 0.4999 | 4.234 | 2.887 | .004 | 1.589-11.280 |

^aReference group is black, heterosexual youth without mental illness.

Project YEH Results

Table 4. GLMM coefficients and odds ratios for predictors of drug use.

| Fixed Effects | B | SE | Exp(B) | z | p |
|------------------|--------|-------|--------|--------|--------|
| Intercept | −2.446 | 0.393 | 0.087 | −6.231 | <0.001 |
| Discrimination | 1.327 | 0.609 | 3.769 | 2.178 | 0.029 |
| Pornography Use | 1.855 | 0.435 | 6.390 | 4.264 | <0.001 |
| Alcohol Use | 1.531 | 0.440 | 4.621 | 3.480 | 0.001 |
| Drug Use Urge | 3.855 | 0.616 | 47.248 | 6.256 | <0.001 |
| Alcohol Use Urge | 1.647 | 0.871 | 5.193 | 1.892 | 0.058 |
| Urge to Steal | 4.027 | 1.026 | 56.109 | 3.927 | <0.001 |

*Includes observations from 59 subjects over 630 days and 222 days of drug use

Adaptation to the risk of sex and drugs

Probability of
sex/drug-use

$$\pi = \frac{\exp(b_0 + b_1x_1 + \dots + b_kx_k)}{1 + \exp(b_0 + b_1x_1 + \dots + b_kx_k)}$$

Predictors (x's) and
parameters (b's)
were estimated in a
prior study

Messaging was adapted based on the real-time assessment of the risk of engaging in sex or in drug use.

- Sex: predicted by *drug use*, PTSD, psychosis, *sexual urge*, sexual orientation, and race
- Drug use: predicted by *theft urge*, *drug urge*, *porn viewing*, *alcohol urge*, *alcohol use*, *experienced discrimination*

Red font indicates
real-time predictors

Adaptation examples

Sex

Messages to resist sex were triggered whenever $\pi > 0.2$

- If sexual urge and psychosis were present, $\pi = 0.52$. This triggered a message to resist sex.
- If drug use was present without any other risk factors, $\pi = 0.34$. This triggered a message to resist sex.
- If drug use and PTSD were present, $\pi = 0.09$, and it did NOT trigger a message to resist sex.

Drug Use

Messages to resist drug use were triggered whenever $\pi > 0.33$

- If drug urge was present, $\pi = 0.80$. This triggered a message to resist drug use.
- If alcohol use was present, $\pi = 0.29$, and it did NOT trigger a message to resist drug use.
- However, if alcohol use was present along with experience of discrimination, $\pi = 0.60$. This triggered a message to resist drug use.



Rationale for JITAIs

- Use mobile health (mHealth) technology that can respond to Ecological Momentary Assessments (EMAs) in real-time to deliver personalized messaging and behavioral feedback.^{23,24}
- Used the Information-Motivation-Behavioral Skills model to develop the intervention
- Built in Motivational Interviewing (MI)^{15,16} and Shared Decision Making^{25,26} approaches
- YEH received personalized mobile messages that address their current risk
- We conducted a randomized waitlist-controlled trial of MY-RIDE to assess intervention effects



MY-RID (Motivating Youth to Reduce Infection and
Disconnection)



Methods:

Aim 1

Develop and
field test
prevention
messages that
address real-
time predictors
of HIV risk
behaviors

Message Development

- Used Information, Motivation, and Skills Model
- Study team developed 404 messages
- Conducted youth working groups (N=5, 10 YEH)
- After YWG revisions, there were 333 messages

Software Programming

- Study app was developed at the University of Oklahoma Health Science Center mHealth Core

Software Testing

- Research team conducted beta testing to confirm app functionality and correct any issues

Youth Working Group

- ❖ Total of 29 youth participated in at least one of four sessions
 - ❖ Approximately 60% male, 35% female, 5% transgender
 - ❖ Predominantly African American
- ❖ Sessions #1 & 2: Reworded messages and created new messages
- ❖ Sessions #3 & 4: Ranked messages

Message development

Research team developed and categorized intervention messages guided by IMB

Total messages = 187

YWG rewrote original messages and created new messages

Total messages = 307

Research staff edited youth messages and added messages based on youth feedback

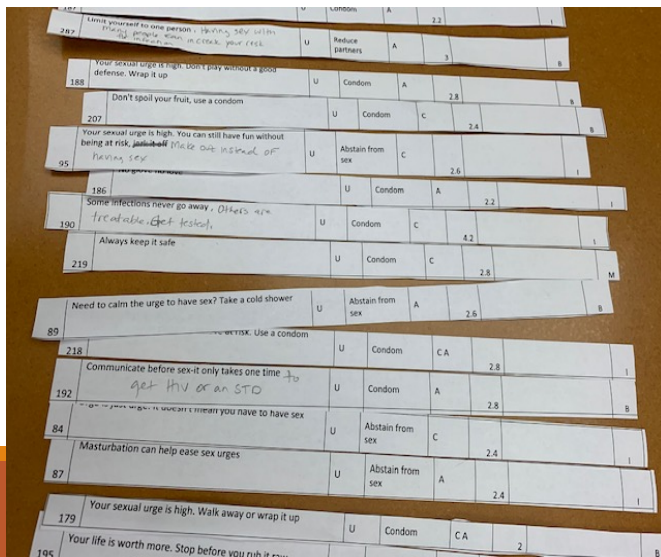
Total messages = 331

YWG scored edited messages (1=great to 5=terrible) and mean scores were ranked

Message finalization:
-Omitted low-ranking messages
-Broke down longer messages
-Added sexual assault messages
-Check to assure final messages reflected IMB model

Final messages were programed into app

Total messages = 386



| Topic | # messages | Message examples |
|---------------------|------------|---|
| Sex urge | 94 | <ul style="list-style-type: none"> <i>Your sexual urge is high. Don't play without a good defense. Wrap it up.</i> <i>Using condoms helps avoid STDs. Stay healthy and use a condom every time.</i> |
| Drug & alcohol urge | 100 | <ul style="list-style-type: none"> <i>Staying sober can help you stay alert & aware of danger.</i> <i>Only you control your drug use, don't let drugs control you.</i> |
| Stress | 27 | <ul style="list-style-type: none"> <i>Did someone upset you? Take some time, then talk through it when you are calm.</i> <i>Things seem very stressful. Use your existing social support network to help resolve stressful situations.</i> |
| Drug use | 37 | <ul style="list-style-type: none"> <i>Be on top of your game, don't have sex while high.</i> <i>Going to a clinic can help when you are ready to stop using.</i> |
| Had sex | 51 | <ul style="list-style-type: none"> <i>Go get free HIV testing at Legacy Community Health - Montrose Clinic, you will have a peace of mind and know your options.</i> <i>HIV testing is an important step to keeping you and your sexual partners healthy.</i> |
| Sexual assault | 8 | <ul style="list-style-type: none"> <i>If you have been raped, involving law enforcement is YOUR CHOICE. But you need medical care within 72 hours to prevent STIs, pregnancy, and HIV. Call 281-306-6893 or go to Houston Area Women's Center or The Bridge Over Troubled Waters.</i> <i>If you have been sexually assaulted, the Center of Forensic Excellence can provide care. It is important to arrive within 72 hours to obtain medication to prevent HIV, STIs, and pregnancy. Call 281-306-6893 for services.</i> |
| No urge or risk | 69 | <ul style="list-style-type: none"> <i>Fear of failure can be strong, but you are stronger. Do what you are afraid of, and you are capable of anything.</i> <i>What you do today determines your tomorrow. Think about your future before you act.</i> |
| Control | 86 | <ul style="list-style-type: none"> <i>You need water to regulate your body temperature and help you stay cool on hot days.</i> <i>Fun fact: Vitamin C is important for your immune system and is found in many fruits and vegetables.</i> |

Study Methods: Aim 2

Evaluate intervention
feasibility,
acceptability, and
initial intervention
efficacy on HIV risk
behaviors

Conducted a randomized attention
control trial with 100 YEH

- Ages 18-25-years-old
- Houston, Texas
- May to July 2019



Methods: Aim 2

Evaluate
intervention
feasibility,
acceptability, and
initial intervention
efficacy on HIV
risk behaviors

Design:

- The study used a 1:1 randomized attention control design with 96 YEH

Recruitment

- Took place at a drop-in centers and shelter during one week in May 2019

Eligibility criteria

- YEH ages 18-25, HIV risk, and the ability to read and speak English

Measures

- The baseline survey assessed demographics, substance use, sexual behavior, housing, stress, depression, and social support
- Daily EMAs assessed real-time stress, risk behaviors, and sexual urge

Randomized Attention Control Trial

- ❖ Recruitment took place at a drop-in centers and shelter
- ❖ Eligibility criteria include increased HIV risk and the ability to read and speak English
- ❖ The baseline survey assesses demographics, substance use, sexual behavior, housing, stress, depression, and social support
- ❖ Additionally, daily Ecological Momentary Assessments (EMAs) assess real-time stress, risk behaviors, and urge

INTERVENTION

❖ Chose a goal related to increase HIV prevention:

- ✓ Use condoms
- ✓ Reduce sex partners
- ✓ Take PrEP daily
- ✓ HIV testing
- ✓ Reduce drug & alcohol use
- ✓ Avoid injection

❖ Received multiple daily EMAs

❖ Received intervention messages tailored to reported behavior & urge

❖ Behavioral interface kept track of goal progression

CONTROL

❖ Chose a goal related to increase health behaviors:

- ✓ Increase sleep
- ✓ Daily exercise
- ✓ Eat 5 servings of fruits and vegetables daily
- ✓ Avoid tobacco use

❖ Received multiple daily EMAs

❖ Received control messages regardless of reported behavior & urge

❖ Behavioral interface kept track of goal progression

Message Algorithm

Intervention arm

Control arm

EMA Assessment:

Weeks 1 & 2: 1 daily, 3 random

Weeks 3 & 4: 1 daily, 2 random

Weeks 5 & 6: 1 daily, 1 random

State variables
(Primary prevention)

Reactionary Variables
(secondary prevention)

Indicated
sex
urge*

Indicated
drug
urge*

Indicated
high
stress

Indicated
drug use

Indicated
sexual
activity

Indicated
sexual
assault

No risk
indicated

Resist sex
urge
messages

Resist drug
urge messages

Stress
management
messages

Harm
reduction for
drug use

Harm
reduction for
sexual activity

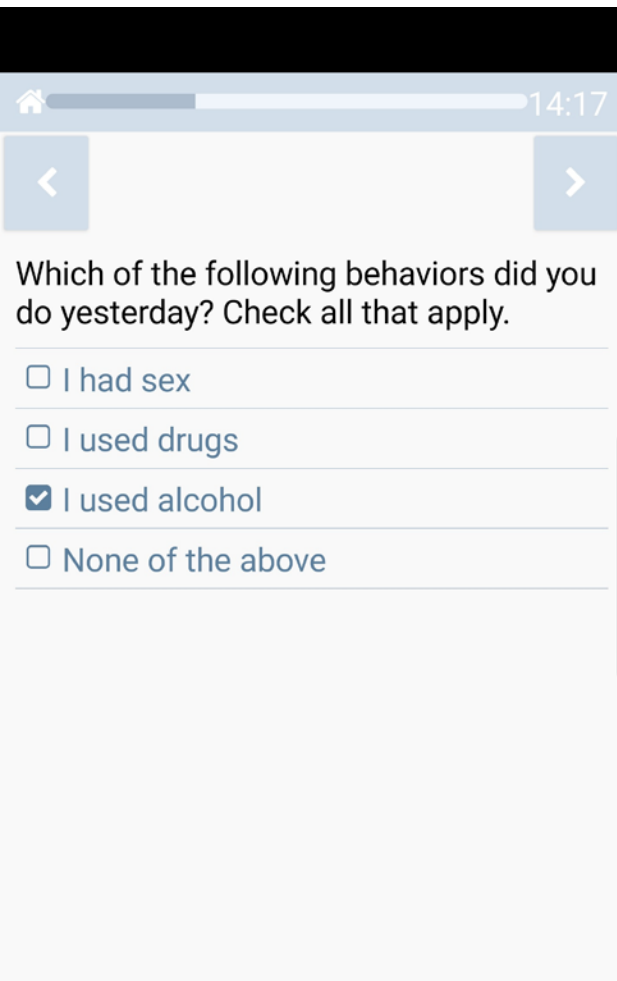
Harm
reduction for
sexual assault

General health
and motivational
messages

Control
messages

*Determined by probability formula plus urge

EMA , Messages, and Behavioral Interface

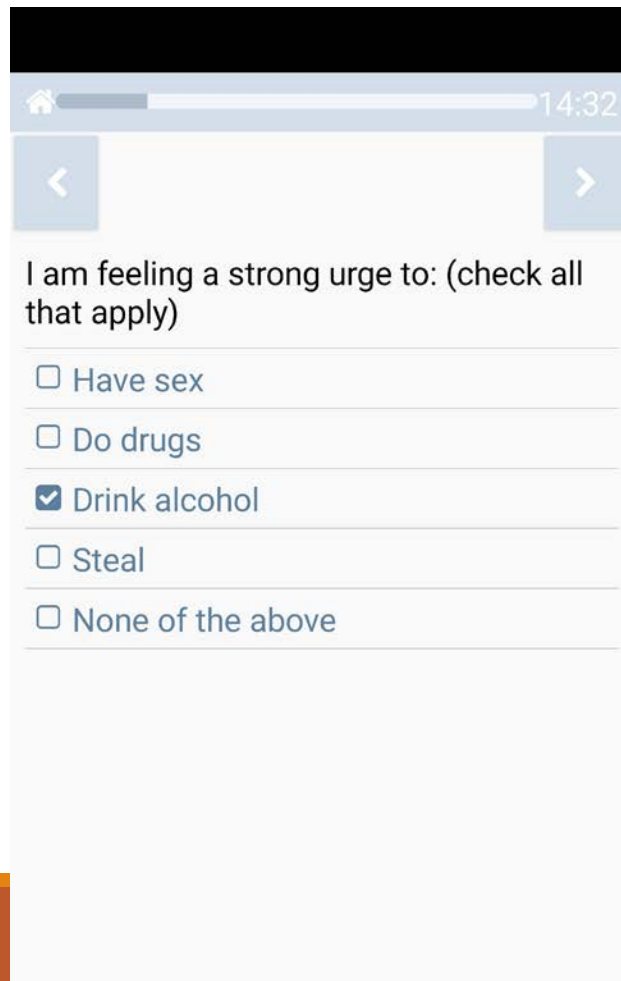


14:17

< >

Which of the following behaviors did you do yesterday? Check all that apply.

- ☐ I had sex
- ☐ I used drugs
- ☒ I used alcohol
- ☐ None of the above

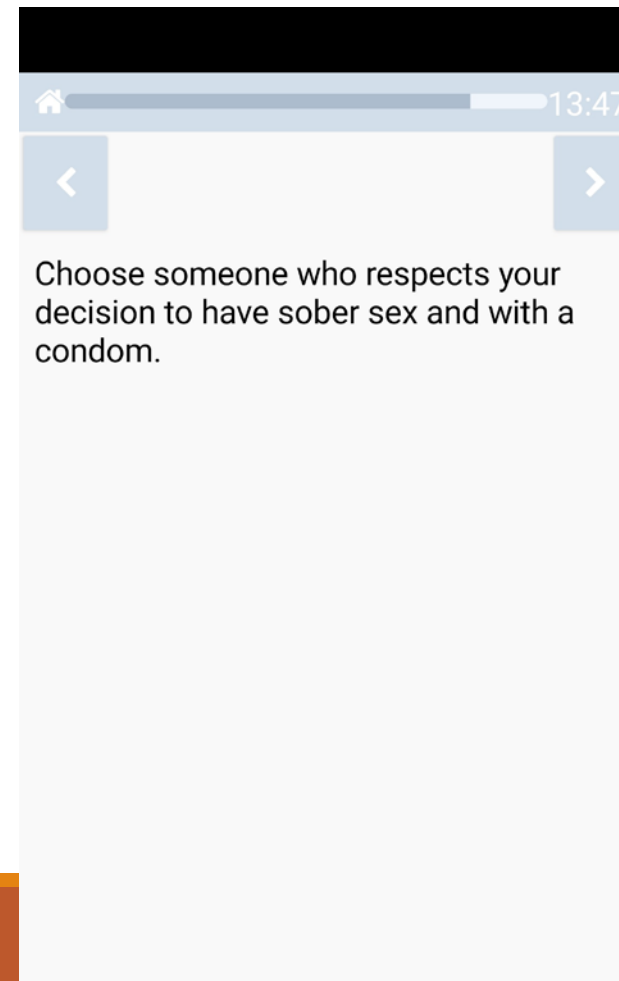


14:32

< >

I am feeling a strong urge to: (check all that apply)

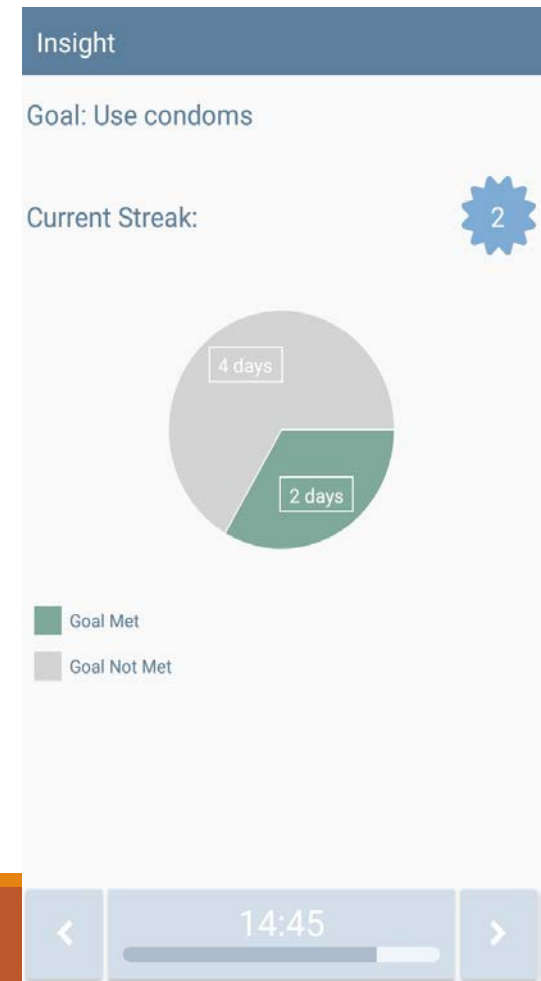
- ☐ Have sex
- ☐ Do drugs
- ☒ Drink alcohol
- ☐ Steal
- ☐ None of the above



13:47

< >

Choose someone who respects your decision to have sober sex and with a condom.



Participant retention

- ❖ Provided incentives based on percentage completion every 2 weeks
 - ❖ 90-100% = \$40
 - ❖ 75-89% = \$35
 - ❖ 50-74% = \$30
 - ❖ 25-49% = \$20
 - ❖ 0-24% = \$15

Participant retention

❖ Tracked EMA completion in Content Management System (CMS)

❖ Texted and/or called participants when no survey activity was detected

The screenshot displays the 'Insight™ PARTNERS' interface for study E118. The top navigation bar includes tabs for Study, Groups, Participants (selected), Payments, Notifications, Questions, Assessments, Events, Reports, and Permissions. The left sidebar contains icons for Activity, Information, Contact, Appointments, Stages, Schedule, Settings, and Payments. The main content area shows the participant's setup code (WGMT2P) and a list of activity logs. The logs table includes columns for Date, Stage, Type, Name, Snoozed minutes, Scheduled, Notified, Started, Completed, and Responses. The data shows a mix of 'Data sync complete' and 'Intervention Random' events, with the latter having associated scheduled and completed times and response counts.

| Date | Stage | Type | Name | Snoozed minutes | Scheduled | Notified | Started | Completed | Responses |
|-----------------------------------|----------|--------------------|---------------------|-----------------|-----------|----------|---------|-----------|-----------|
| 245 logs | | | | | | | | | |
| 07/17/19 20:44 | | Data sync complete | | | | | | | |
| 07/17/19 16:12 | Week 5-6 | Random | Intervention Random | | 16:12 | 16:12 | 16:12 | 16:14 | 43 |
| 07/17/19 14:41 Data sync complete | | | | | | | | | |
| 07/17/19 09:30 | Week 5-6 | Fixed | Daily Tues-Sun | | 09:30 | 09:34 | 09:37 | 09:40 | 58 |
| 07/17/19 07:04 Data sync complete | | | | | | | | | |
| 07/17/19 03:05 Data sync complete | | | | | | | | | |
| 07/16/19 22:09 Data sync complete | | | | | | | | | |
| 07/16/19 16:12 | Week 5-6 | Random | Intervention Random | | 16:12 | 16:14 | 16:15 | 16:17 | 44 |
| 07/16/19 14:39 Data sync complete | | | | | | | | | |
| 07/16/19 09:30 | Week 5-6 | Fixed | Daily Tues-Sun | | 09:30 | 09:35 | 09:36 | 09:38 | 59 |



Analyses:

Intervention Effects and Time Effects

Baseline frequency data were compared between the study groups with t-tests and chi-squared tests.

Participant retention was studied to assess the feasibility of future studies.

Counts of participants who engaged at least once in sexual and substance use behavior were compared between study groups. Likewise for urges and stress.

Bayesian hierarchical regression models were used to assess the time and intervention effects on sex, drug use, alcohol use, their corresponding urges, and reported level of stress.

Methods: Longitudinal Models

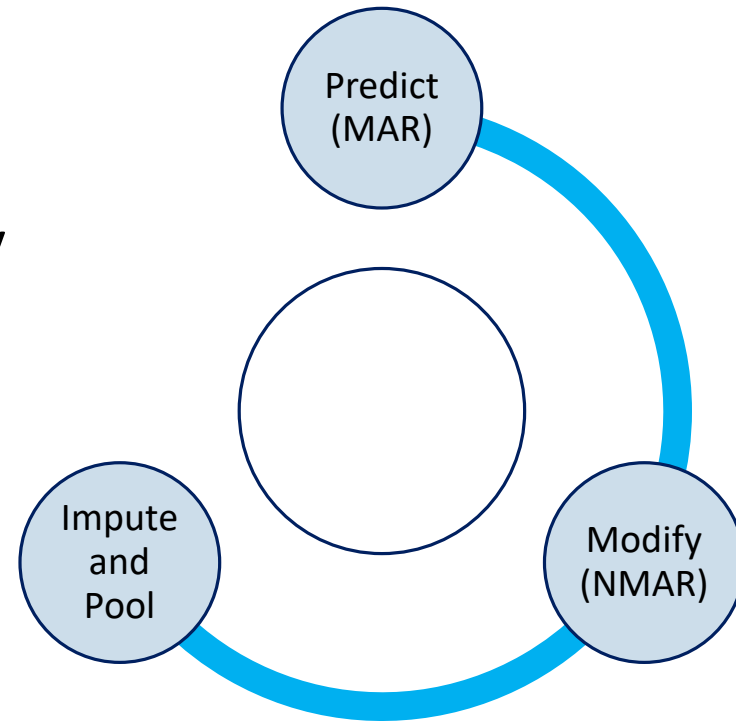
Time and intervention effects were modeled with Bayesian hierarchical logistic regression

- The main outcomes were repeated binary measurements of engagement in sex, drug use, and alcohol use
- Log-odds were assumed to have linear dependence on log-days, intervention group, and its interaction with log-days
- Random intercept and slope allowed each participant to have departures from the overall level and in the time-dependence of the odds of risky behavior
- Bayesian models were implemented with *RStan* using vague normal priors for means and improper uniform priors for variances. Four chains with 4000 iterations were used.

Sensitivity Analysis (NMAR)

Tipping-point approach was used to evaluate robustness to (1) time-independent under-reporting of risky behavior and (2) underestimation of time-dependent probability of risky behavior when response was missing

- Predict (MAR):
 - $P(y) = \text{invlogit}(\beta_f X_f + \beta_r X_r)$
- Modify $P(y)$ to reflect NMAR mechanism
- Multiple Imputation ($m=200$)
- Apply GLMM and pool results with Rubin's rules

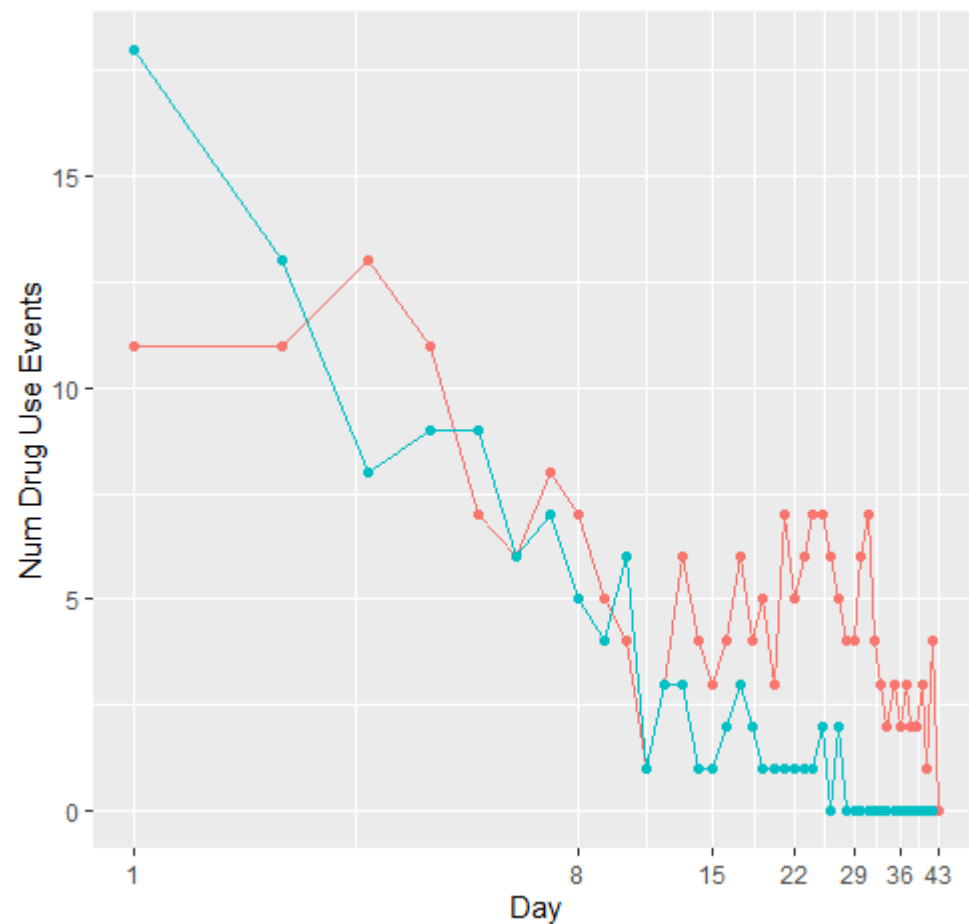


Results: Main Outcomes

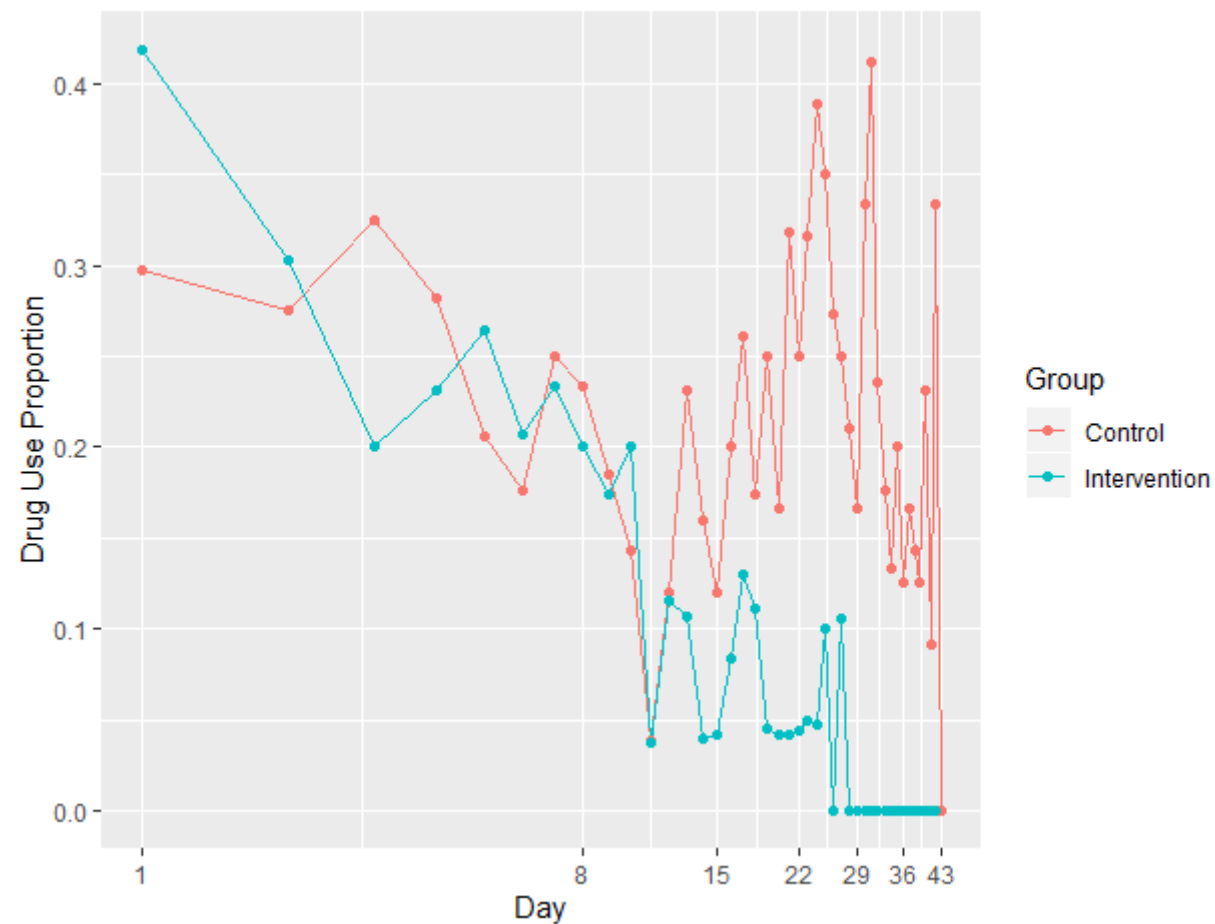
- Intervention effect for drug use
 - Control group: over 6 weeks, the odds of drug use decreased by a factor of 25.1 (95% CI: 4.96 to 187)
 - Intervention group: over 6 weeks, the odds of drug use reduced by an additional factor of 13.8 (95% CI: 1.17 to 170) relative to the control group
- Sexual intercourse and alcohol use reduced over time in both groups
 - Sex: odds reduced by a factor of 25.6 (95% CI: 7.57 to 108) over 6 weeks
 - Alcohol use: odds reduced by a factor of 20.9 (95% CI: 3.45 to 156) over 6 weeks



Daily Drug Use Data: Counts (left) and Proportions (right)



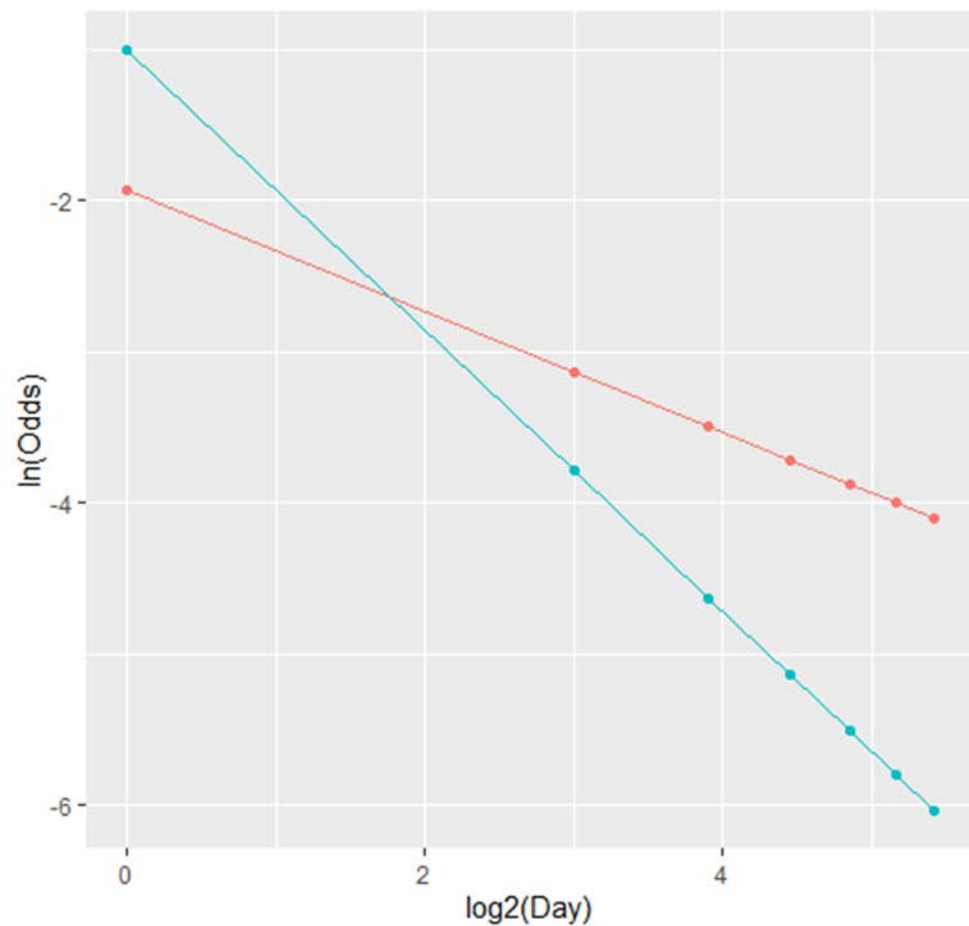
(log scale, base 2)



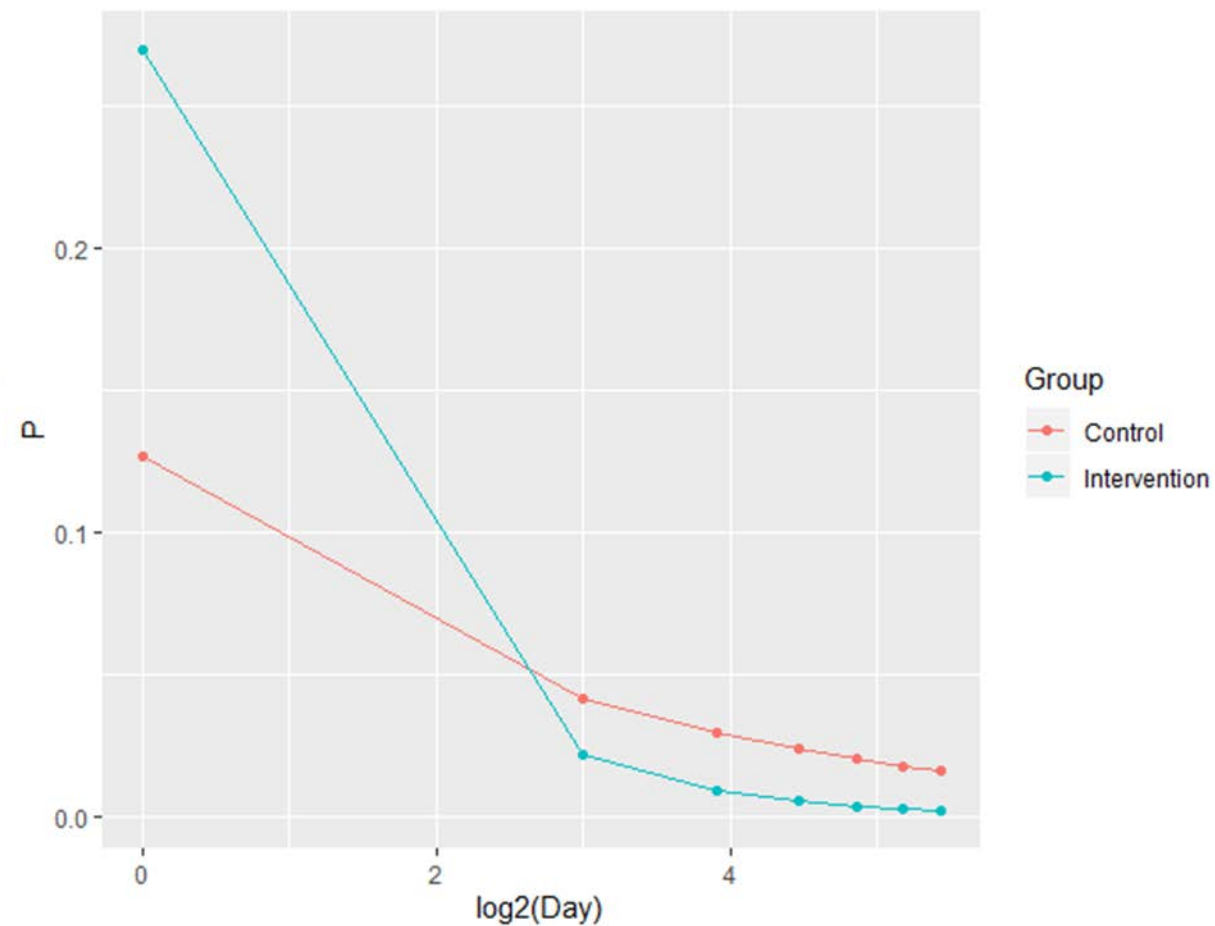
(log scale, base 2)



Drug Use Model: Estimated Odds (left) and Probability (right)



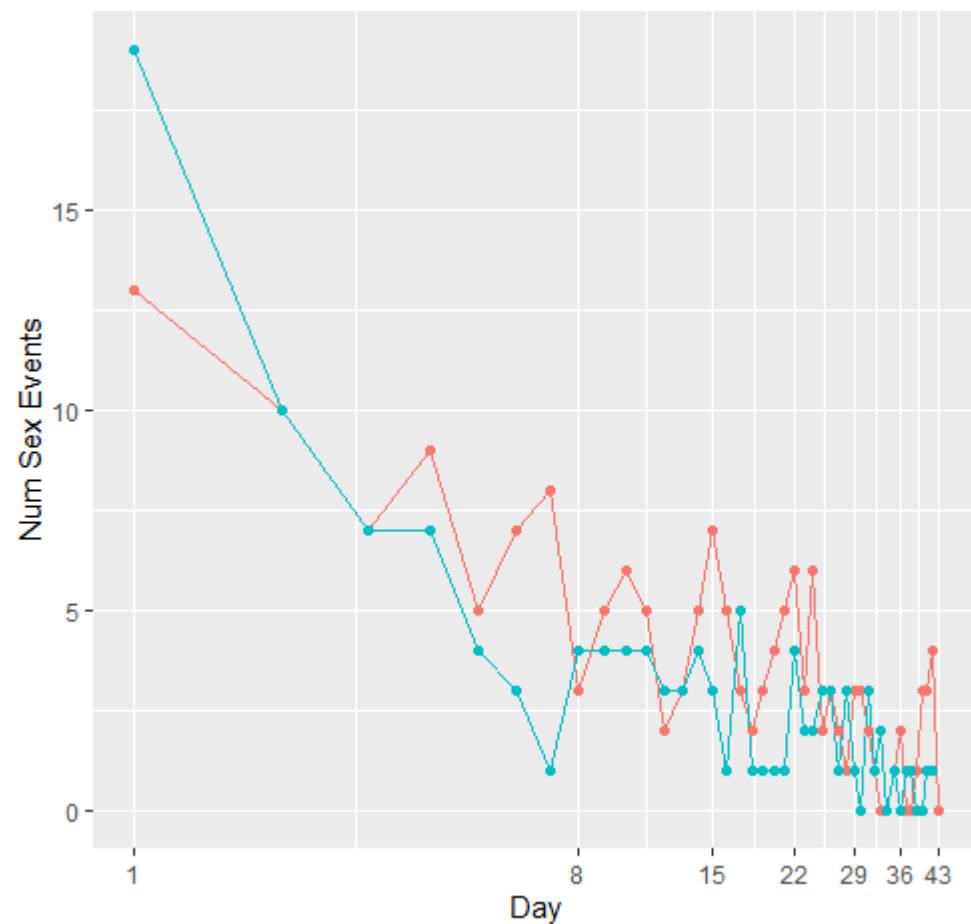
(log scale, base 2)



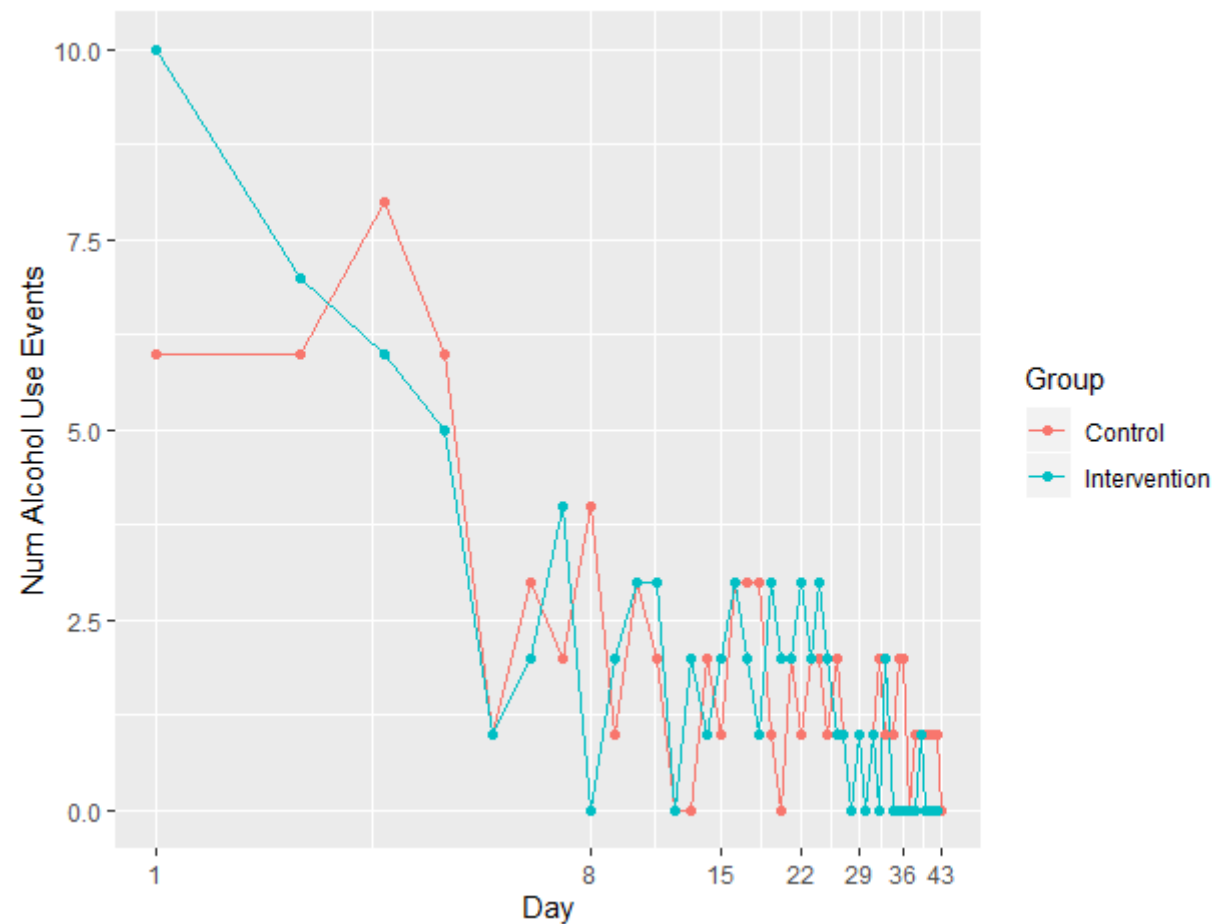
(log scale, base 2)



Daily Counts of Sex (left) and Alcohol Use (right)



(log scale, base 2)



(log scale, base 2)



Results: Urges

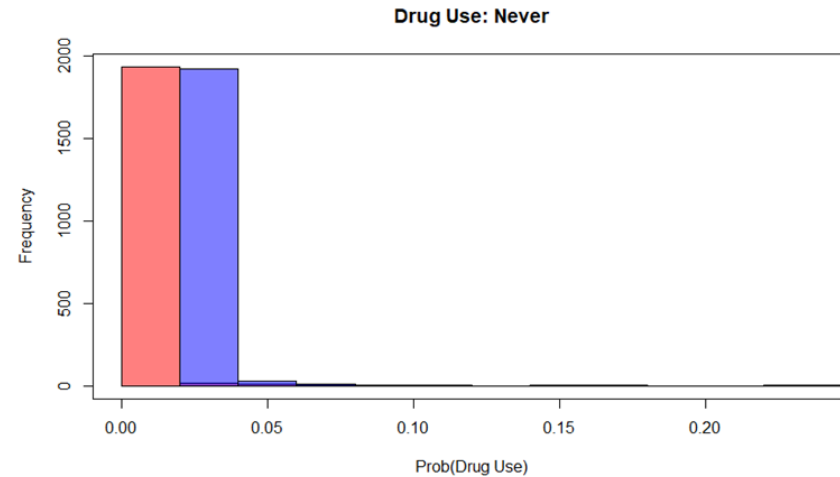
- Urges for sex, drugs, and alcohol reduced in both groups
 - Sex urge: lower by a factor of 77.8 (95% CI: 17.8 to 376) over 6 weeks
 - Drug urge: lower by a factor of 18.2 (95% CI: 3.35 to 122) over 6 weeks
 - Alcohol urge: lower by a factor of 62.8 (95% CI: 8.07 to 697) over 6 weeks
- Intervention effect for sex urge
 - Odds of the urge for sex were lower by a factor of 6.33 (95% CI: 1.60 to 26.3) in the intervention group



Results: Stress

- Stress experienced now and yesterday also reduced over time in both groups
 - Over 6 weeks, odds were lower by factors of 60.7 and 6.24, respectively.
- Intervention effect for stress (aggregate effect)
 - Proportions of participants who reported feeling stressed yesterday were lower in the intervention group (41.7%) compared to the control group (63.3%)

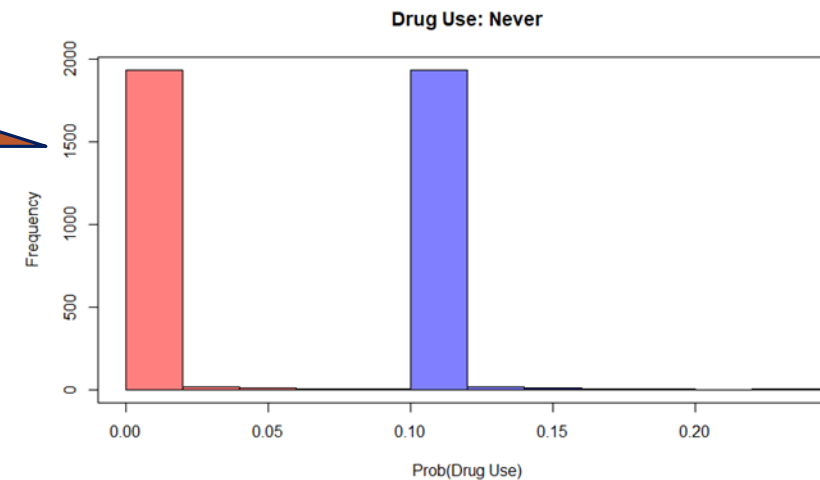
Adjustment (NMAR) for uniform under-reporting of drug use



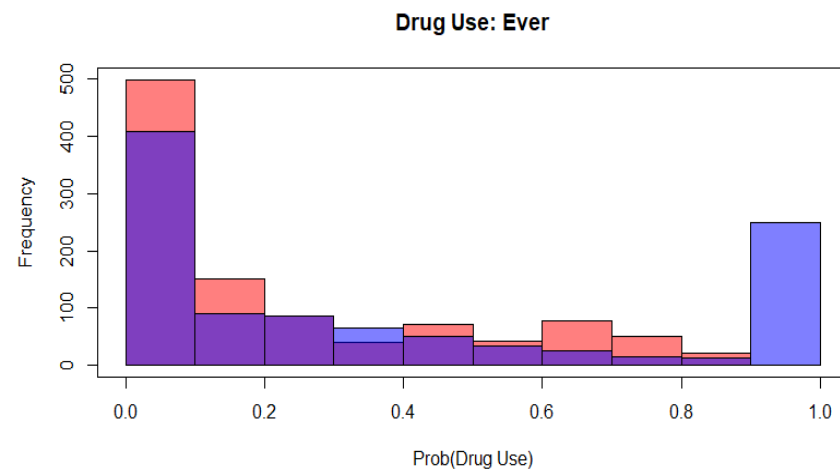
$$.025 + P_{\text{MAR}}(y)$$

$$.10 + P_{\text{MAR}}(y)$$

Translations of .025, .05, .075, .10 result in approximately 1, 2, 3, and 4 unreported drug use events per participant, respectively.

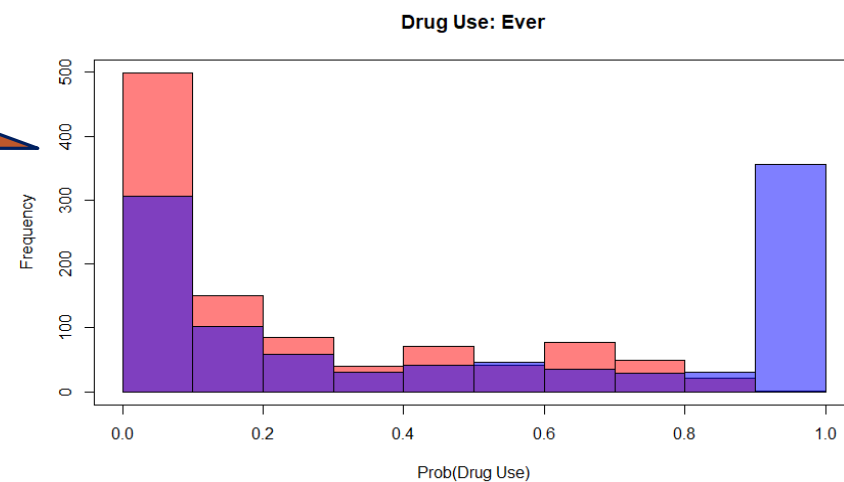


Adjusted (NMAR) Probability for Drug Use

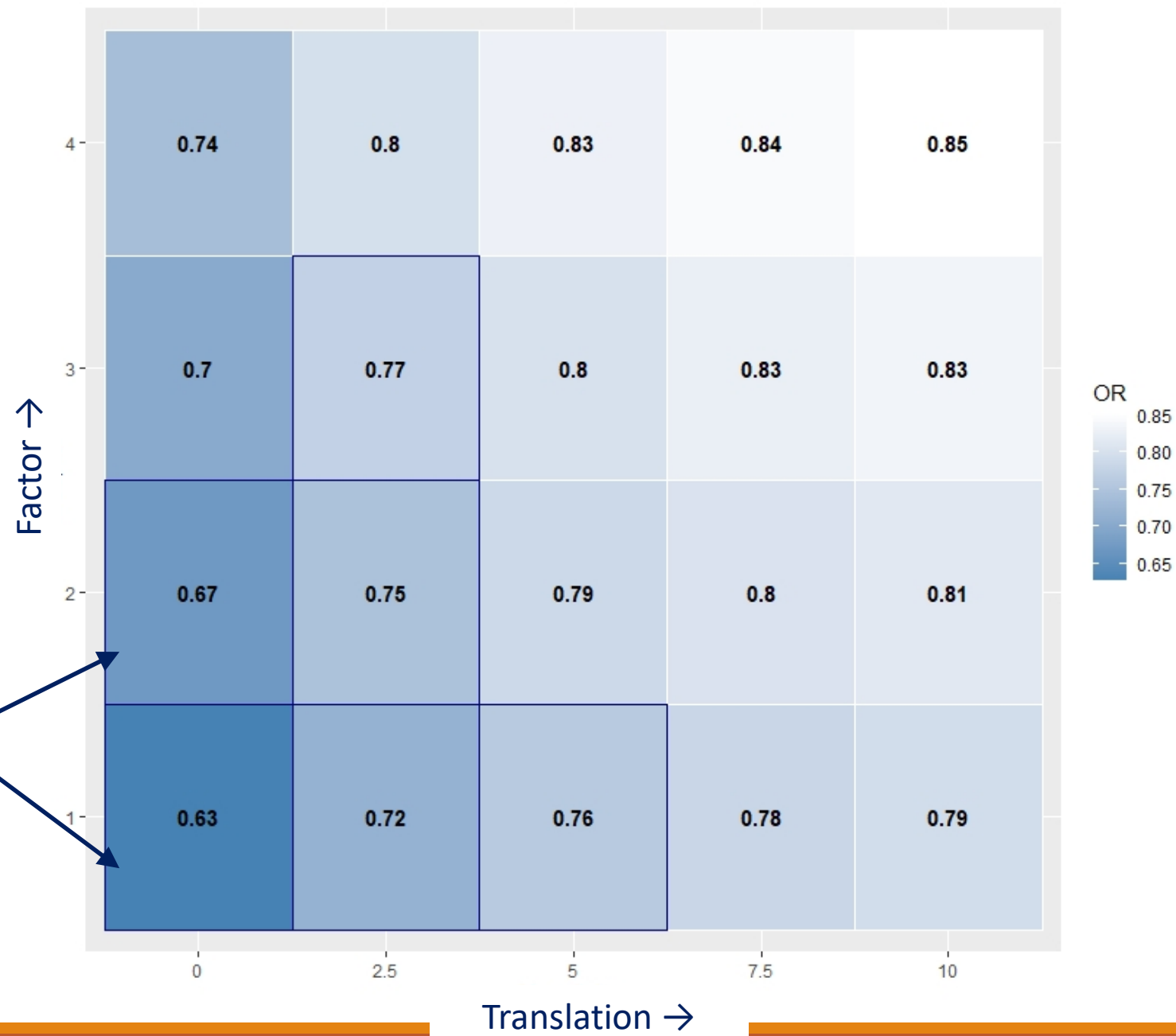


$$2 \times P_{\text{MAR}}(y)$$

$$4 \times P_{\text{MAR}}(y)$$



Multipliers range from 1x to 4x



Cells with blue outline exhibit treatment effect with confidence > 95%



Discussion

- This intervention was effective at
 - 1) reducing the odds of substance use
 - 2) reducing the urge for sex
 - 3) reducing stress among YEH

Delivering intervention messages proximal to the time of heightened symptoms, may improve stress management and reduce behaviors such as substance use and risky sexual activity.

Intervention effects were also found for reducing urges for sex among YEH.

Limitations

1. This was a small, pilot feasibility study with a convenience sample which only allowed for preliminary analyses of the intervention effects
2. The control condition received generic motivational messages which may have positively impacted stress management strategies thereby reducing the signal of additional impact from the intervention.

Strengths

1. Diverse gender identity, sexual orientation, and race/ethnicity of the sample



Conclusions

- The findings from this study suggest a positive effect of a highly scalable mobile intervention that increases access to a HIV prevention intervention for a hard-to-reach population.
- These findings also suggest promising intervention effects that should be further explored in a larger randomized trial to determine if there are reductions in HIV risk behaviors that are sustained over time.

Special Thanks

- PARTNERS
- YARC and Covenant House staff
- Youth Working Group
- Center for Nursing Research (CNR) research support staff

References

- Morton MH, Dworsky A, Matjasko JL, et al. Prevalence and correlates of youth homelessness in the United States. *Journal of Adolescent Health*. 2017.
- Bassuk E, Murphy C, Coupe N, Kenney R, Beach C. America's youngest outcasts 2014: State report card on child homelessness. *Retrieved November*. 2014;24:2014.
- Bassuk E, Murphy C, Coupe N, Kenney R, Beach C. America's Youngest Outcasts 2010. In: Needham, MA: The National Center on Family Homelessness; 2011.
- Bassuk EL. Ending child homelessness in America. *American Journal of Orthopsychiatry*. 2010;80(4):496-504.
- Edidin JP, Ganim Z, Hunter SJ, Karnik NS. The mental and physical health of homeless youth: a literature review. *Child Psychiatry & Human Development*. 2012;43(3):354-375.
- Baggett TP, Hwang SW, O'Connell JJ, et al. Mortality among homeless adults in Boston: shifts in causes of death over a 15-year period. *JAMA internal medicine*. 2013;173(3):189-195.
- Kulik DM, Gaetz S, Crowe C, Ford-Jones EL. Homeless youth's overwhelming health burden: A review of the literature. *Paediatrics & child health*. 2011;16(6):e43.
- Hwang SW, Ueng JJ, Chiu S, et al. Universal health insurance and health care access for homeless persons. *American journal of public health*. 2010;100(8):1454-1461.
- Aidala A, Cross JE, Stall R, Harre D, Sumartojo E. Housing status and HIV risk behaviors: Implications for prevention and policy. *AIDS and Behavior*. 2005;9(3):251-265.
- Beijer U, Wolf A, Fazel S. Prevalence of tuberculosis, hepatitis C virus, and HIV in homeless people: a systematic review and meta-analysis. *The Lancet Infectious Diseases*. 2012;12(11):859-870.
- Santa Maria D, Flash CA, Narendorf S, et al. Knowledge and Attitudes about Pre-Exposure Prophylaxis among Young Adults Experiencing Homelessness in Seven US Cities. *Journal of Adolescent Health*. 2018. Noell JW, Ochs LM. Relationship of sexual orientation to substance use, suicidal ideation, suicide attempts, and other factors in a population of homeless adolescents. *Journal of adolescent health*. 2001;29(1):31-36.
- Noell JW, Ochs LM. Relationship of sexual orientation to substance use, suicidal ideation, suicide attempts, and other factors in a population of homeless adolescents. *Journal of adolescent health*. 2001;29(1):31-36.
- Melander LA, Tyler KA. The effect of early maltreatment, victimization, and partner violence on HIV risk behavior among homeless young adults. *Journal of Adolescent Health*. 2010;47(6):575-581.
- Tyler KA, Hoyt DR, Whitbeck LB. The effects of early sexual abuse on later sexual victimization among female homeless and runaway adolescents. *Journal of interpersonal violence*. 2000;15(3):235-250.
- Thompson RG, Hasin DS. Cigarette, marijuana, and alcohol use and prior drug treatment among newly homeless young adults in New York City: relationship to a history of foster care. *Drug and alcohol dependence*. 2011;117(1):66-69.
- Fowler PJ, Toro PA, Miles BW. Pathways to and from homelessness and associated psychosocial outcomes among adolescents leaving the foster care system. *American Journal of Public Health*. 2009;99(8):1453.
- Combs KM, Begun S, Rinehart DJ, Taussig H. Pregnancy and childbearing among young adults who experienced foster care. *Child maltreatment*. 2017:1077559517733816.
- Zlotnick C. What research tells us about the intersecting streams of homelessness and foster care. *American Journal of Orthopsychiatry*. 2009;79(3):319.
- Hill TD, Ross CE, Angel RJ. Neighborhood disorder, psychophysiological distress, and health. *Journal of Health and Social Behavior*. 2005;46(2):170-186.
- Cutrona CE, Wallace G, Wesner KA. Neighborhood characteristics and depression an examination of stress processes. *Current directions in psychological science*. 2006;15(4):188-192.
- Diez Roux AV, Mair C. Neighborhoods and health. *Annals of the New York Academy of Sciences*. 2010;1186(1):125-145.
- Kennedy DP, Brown RA, Morrison P, Vie L, Ryan GW, Tucker JS. Risk evaluations and condom use decisions of homeless youth: a multi-level qualitative investigation. *BMC public health*. 2015;15(1):62.
- Heerde JA, Hemphill SA. Sexual Risk Behaviors, Sexual Offenses, and Sexual Victimization Among Homeless Youth A Systematic Review of Associations With Substance Use. *Trauma, Violence, & Abuse*. 2015:1524838015584371.
- Elkington KS, Bauermeister JA, Zimmerman MA. Psychological distress, substance use, and HIV/STI risk behaviors among youth. *Journal of Youth and Adolescence*. 2010;39(5):514-527.
- Tucker JS, Ryan GW, Golinelli D, et al. Substance use and other risk factors for unprotected sex: Results from an event-based study of homeless youth. *AIDS and Behavior*. 2012;16(6):1699-1707.
- Santa Maria D, Padhye N, Yang Y, Gallardo K, Businelle M. Predicting Sexual Behaviors Among Homeless Young Adults: Ecological Momentary Assessment Study. *JMIR public health and surveillance*. 2018;4(2):e39.
- Stone A, Shiffman S, Atienza A, Nebeling L. The science of real-time data capture: Self-reports in health research. Oxford University Press; 2007.
- Stone AA, Shiffman S. Capturing momentary, self-report data: A proposal for reporting guidelines. *Annals of Behavioral Medicine*. 2002;24(3):236-243.
- Santa Maria DP, Nikhil; Gallardo, Kathryn; Johnson Baker, Kimerly; Swain, Honora; Tortolero Emery, Susan; Businelle, Michael. Using EMA to Assess the Relation between Stress and Sexual Risk Behaviors among Homeless Youth. Council on the Advancement of Nursing Science: State of the Science Conference; September, 2016, 2016; Washington, D.C.
- Comulada WS, Lightfoot M, Swendeman D, Grella C, Wu N. Compliance to Cell Phone-Based EMA Among Latino Youth in Outpatient Treatment. *Journal of ethnicity in substance abuse*. 2015(ahead-of-print):1-19.
- Dennis ML, Scott CK, Funk RR, Nicholson L. A pilot study to examine the feasibility and potential effectiveness of using smartphones to provide recovery support for adolescents. *Substance Abuse*. 2014(just-accepted):00-00.
- Hoepfner BB, Kahler CW, Gwaltney CJ. Relationship between momentary affect states and self-efficacy in adolescent smokers. *Health Psychology*. 2014;33(12):1507.
- Shrier LA, Feldman HA, Black SK, et al. Momentary affective states surrounding sexual intercourse in depressed adolescents and young adults. *Archives of sexual behavior*. 2012;41(5):1161-1171.
- Wright CJ, Dietze PM, Crockett B, Lim MS. Participatory development of MIDY (Mobile Intervention for Drinking in Young people). *BMC public health*. 2016;16(1):1.
- Spruijt-Metz D, Hekler E, Saranummi N, et al. Building new computational models to support health behavior change and maintenance: new opportunities in behavioral research. *Translational behavioral medicine*. 2015;5(3):335-346.
- Nahum-Shani I, Smith SN, Spring BJ, et al. Just-in-Time Adaptive Interventions (JITAIs) in Mobile Health: Key Components and Design Principles for Ongoing Health Behavior Support. *Annals of Behavioral Medicine*. 2016:1-17.
- Serrano KJ, Yu M, Riley WT, et al. Willingness to exchange health information via mobile devices: findings from a population-based survey. *The Annals of Family Medicine*. 2016;14(1):34-40.
- Silva BM, Rodrigues JJ, de la Torre Díez I, López-Coronado M, Saleem K. Mobile-health: a review of current state in 2015. *Journal of biomedical informatics*. 2015;56:265-272.
- Akter S, Ray P. mHealth-an ultimate platform to serve the unserved. *Yearb Med Inform*. 2010;2010:94-100.