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These sessions are provided monthly thanks to the University of Vermont Center on Rural Addiction, the Vermont Center on Behavior and Health, and a grant from the Health Services and Resources Administration.

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Disclosures

There is nothing to disclose for this UVM CORA Community Rounds session.

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All Potential Conflicts of Interest have been resolved prior to the start of this program.

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INTERPROFESSIONAL CONTINUING EDUCATION

Smartphone-based Financial Incentives to Promote Smoking Cessation Among Pregnant Women

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Former Assistant Professor of Psychiatry

University of Vermont, Burlington, VT

Session Objectives

1. Learn about Dr. Kurti's research developing and implementing a smartphone-based financial incentives intervention for reducing smoking among pregnant women.

2. Identify key components of financial incentives interventions, and how they can be delivered via smartphone.

3. Learn how to obtain biochemical verification of abstinence in interventions for substance use that are delivered remotely.

4. Learn how smartphone-based or other remotely-delivered interventions can expand treatment access to rural-dwelling or other historically under-served populations.

Outline

- **Current Study: Smartphone Intervention for Pregnant Women**
  - Background
  - Methods
  - Results
  - Summary and Conclusions
  - Rural Implications
- **Smoking Trends Among Reproductive Age Women: Rural v. Urban Comparison**
  - Background: Rural America, Women of Reproductive Age, and Nicotine Dependence
  - Aims
  - Measures
  - Discussion

Acknowledgements

Background

- Prevalence of cigarette smoking during pregnancy has remained stable at approximately 13% over the past decade (Kurti et al., 2017; Nighbor et al., 2020)

  - Rates are orders of magnitude higher among more socioeconomically disadvantaged women (e.g., 9x higher among those with < HS versus college degree) (Higgins & Chilcoat, 2006)

- Maternal smoking = leading cause of poor birth outcomes (e.g., low birth weight, premature birth); increases risk for adverse neonatal outcomes (e.g., SIDS) and later in life health problems (e.g., metabolic disorder) (Dietz et al. 2010)

- Recent research estimates that total costs of $370 million are incurred each year in the U.S. in neonatal costs alone due to smoking, with total costs of $1.1 billion being incurred over the lifetime of infants born to mothers who smoked during pregnancy each year (Mohlman & Levy, 2016)

Existing Treatment Options

- Existing treatments produce low quit rates (< 15%) with the exception of financial incentives

- Meta-analyses: Incentive-based treatments produce the largest effect sizes of any psychosocial or pharmacological intervention for promoting smoking cessation during pregnancy (Lumley et al., 2009; Chamberlain et al., 2017): ~ 24% above controls or almost 4-fold greater odds of quitting (vs. ~ 6% for other interventions)

- Our group has conducted 4 previous RCT's examining contingent incentives versus a control (non-contingent incentives) condition (Higgins et al., 2004; Heil et al., 2008; Higgins et al., 2012)

    - Participants in incentives condition received vouchers for biochemically verified smoking abstinence;
      Start value= $6.25, + $1.25 for consecutive negative samples
    - Positive/missing samples→ reset
   - Vouchers exchangeable for bills, memberships, gift cards, etc.

Previous Trial Results

Results of previous trials showed the effectiveness of CM relative to control (non-contingent vouchers)

- Abstinence rates: 35% vs 7%

Higgins et al., 2004; Heil et al., 2008; Higgins et al., 2012

Seven Day Point Prevalence at End of Pregnancy
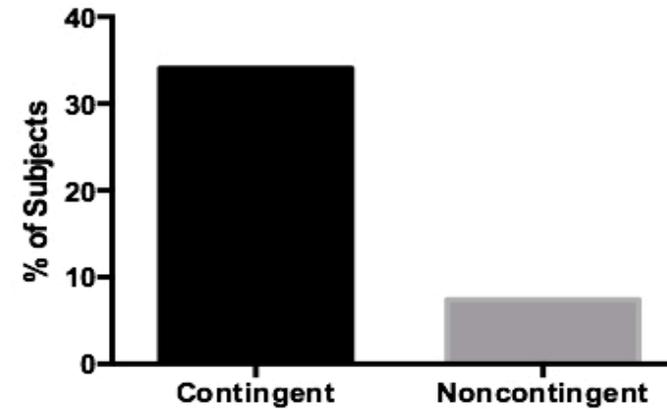

Seven Day Point Prevalence at 24 Weeks Postpartum
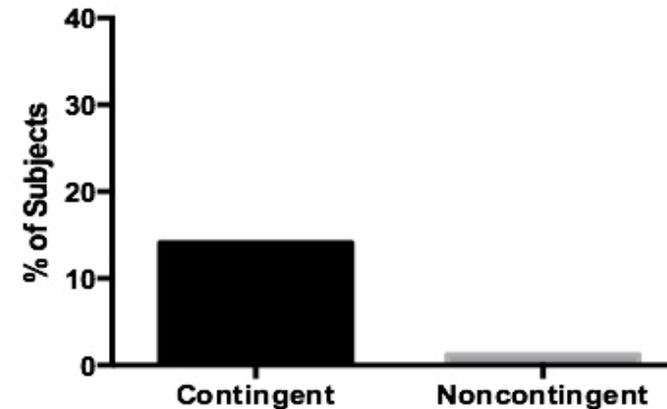
Previous Trial Results

Results of previous trials showed the effectiveness of CM relative to control (non-contingent vouchers)

- Abstinence rates: 35% vs 7%
- Improved birth outcomes
- Increased breastfeeding rates

Higgins et al., 2004; Heil et al., 2008; Higgins et al., 2012

Mean Birth Weight
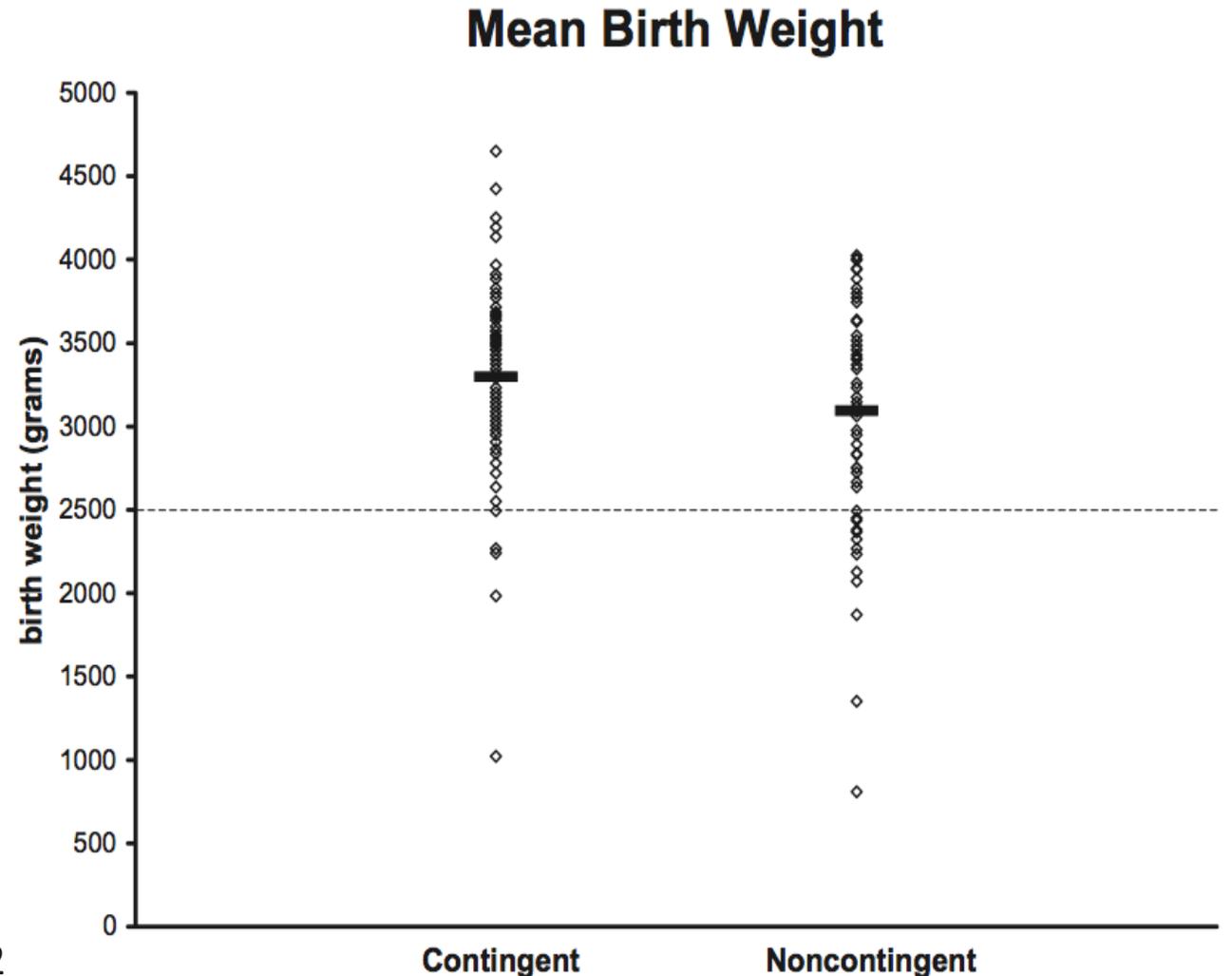
Current Study

- Although this evidence-based treatment has demonstrable capacity to reduce smoking and improve birth outcomes, scalability is constrained by frequent clinic visits necessary for biochemical verification of smoking status, which limits access to those in the immediate vicinity of clinics that can provide such care

- Capitalizing on technological advancements may surmount such access barriers, with the potential to extend financial incentives to pregnant smokers nationwide

- **Overarching Aim:** Develop an innovative, efficacious, remotely delivered financial incentives intervention to reduce smoking during pregnancy.

Methods

- Recruiting 152 pregnant women from obstetric clinics/WIC offices and online advertisements
  - $\geq$ 18 years, biochemically verified smokers, own a Smartphone

- Screening/consenting is done over the phone, after which participants are randomly assigned to incentives versus best practices
 - Usual care + quitline referral and brief counseling with study staff

The Telegraph, 2016

Smartphone Based Financial incentives

- Incentives contingent on remote submission of breath and saliva samples indicating smoking abstinence

- Videos submitted using an app designed by DynamiCare Health, Inc.
  - Testing frequency: 2x daily → 2x weekly → 1x weekly

- Incentives are delivered according to escalating schedule with reset
  - Start value = $6.25, +$1.00 for consecutive negative samples; Max earnings = $1,620 (adjusted prior/current trial maximum for inflation)
  - Incentives come in the form of money deposited onto a study debit card upon validating participant videos

DynamiCare App
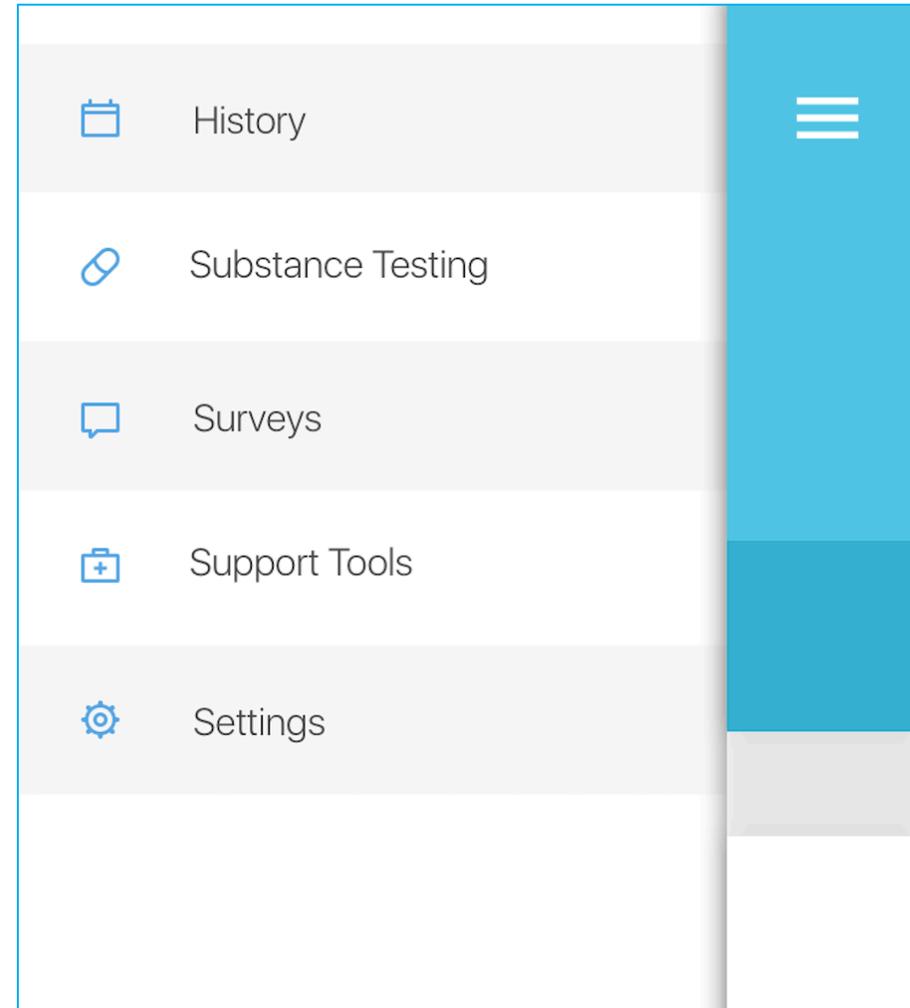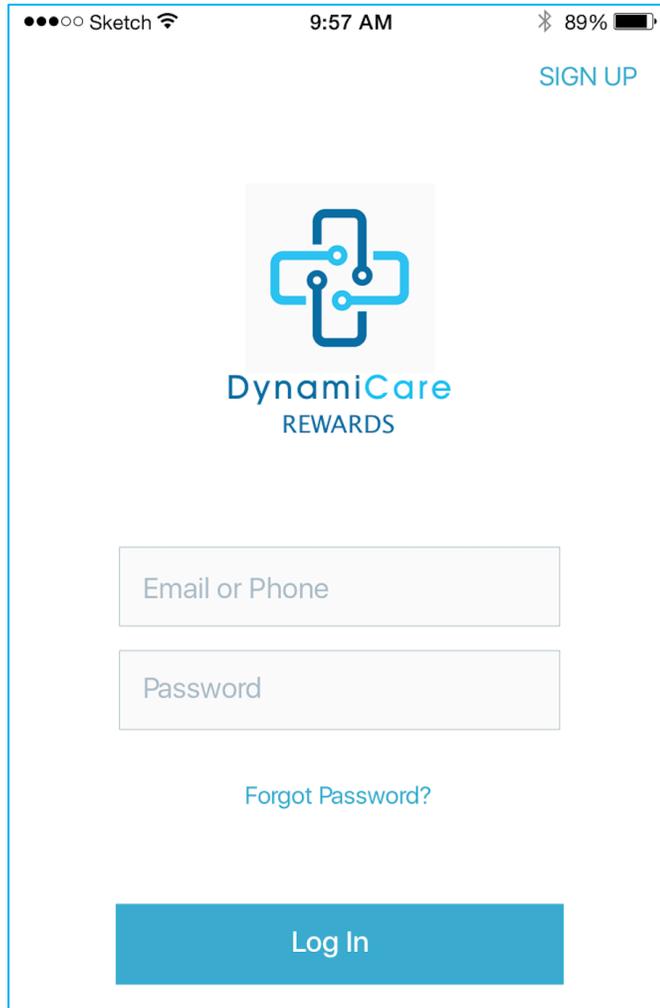
Using the App

Using the App

Step 1: Participant displays a new, unopened saliva test, and opens it in front of the camera


Step 2: Participant swabs the test in her mouth for 2-3 minutes
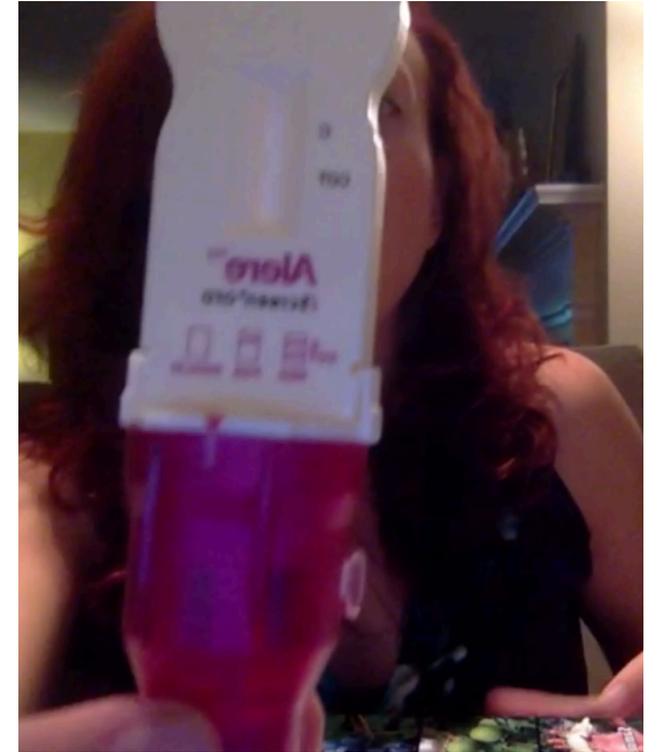
Step 3: Participant displays the test until a result appears in the results window

Using the App

- Time to validate samples after submission = 1-2 hours

- Money loaded onto debit card within same day for all samples submitted by 9 pm EST

- Modification: Incentives auto-transferred to debit card upon video validation
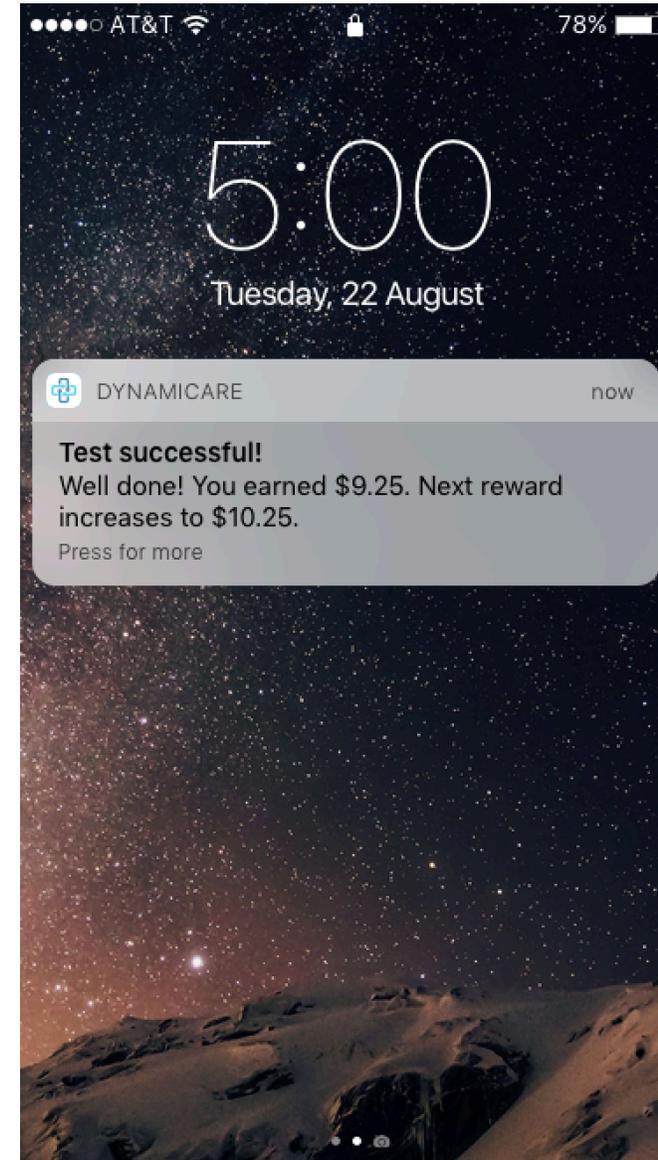
Assessment Procedures

Formal Assessments

- Include questionnaires and smoking status measures (completed remotely)
- Assessment schedule: early pregnancy (1 mo. after enrolling), late pregnancy (28-wks gestation), and at 4-, 8-, 12-, and 24-wks postpartum
- Compensation ($50) contingent on completion

Birth outcomes and associated costs (collected after delivery)

- Mean birth weight, % low birth weight deliveries (< 2500 g), mean gestational age at delivery, % premature deliveries (< 37 wks), incidence of NICU admissions, mean length of stay per NICU admission

Treatment Acceptability & Barriers/Facilitators (collected at 24-wks postpartum)

- 100-pt VAS items about whether the intervention was fair, fun, whether participants liked self-monitoring, earning incentives, etc.
- Open-ended items re: barriers/facilitators (intervention features, social/environmental variables, internal/psychological variables)

Results to Date

N = 30 Incentives,
30 Best Practices

Smartphone-based financial incentives to promote smoking cessation during pregnancy: A pilot study

Allison N. Kurti [a, b, c], Katherine Tang [a, b], Hypatia A. Bolivar [a, b], Carolyn Evemy [a, b, c], Norman Medina [a, b], Joan Skelly [d], Tyler Nighbor [a, b], Stephen T. Higgins [a, b, c]

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Recruitment

Initiated screening process (n = 1,034)

Ineligible or did not complete screening/enrollment (n = 973)
-Ineligible (n = 691)
-Eligible but did not complete screening/enrollment (n = 283)

Enrolled (n = 61)

Incentives (n = 31)

Control (n = 30)

Withdrawn (n = 1)

Withdrawn (n = 0)

Included in primary analysis (n = 30)

Included in primary analysis (n = 30)
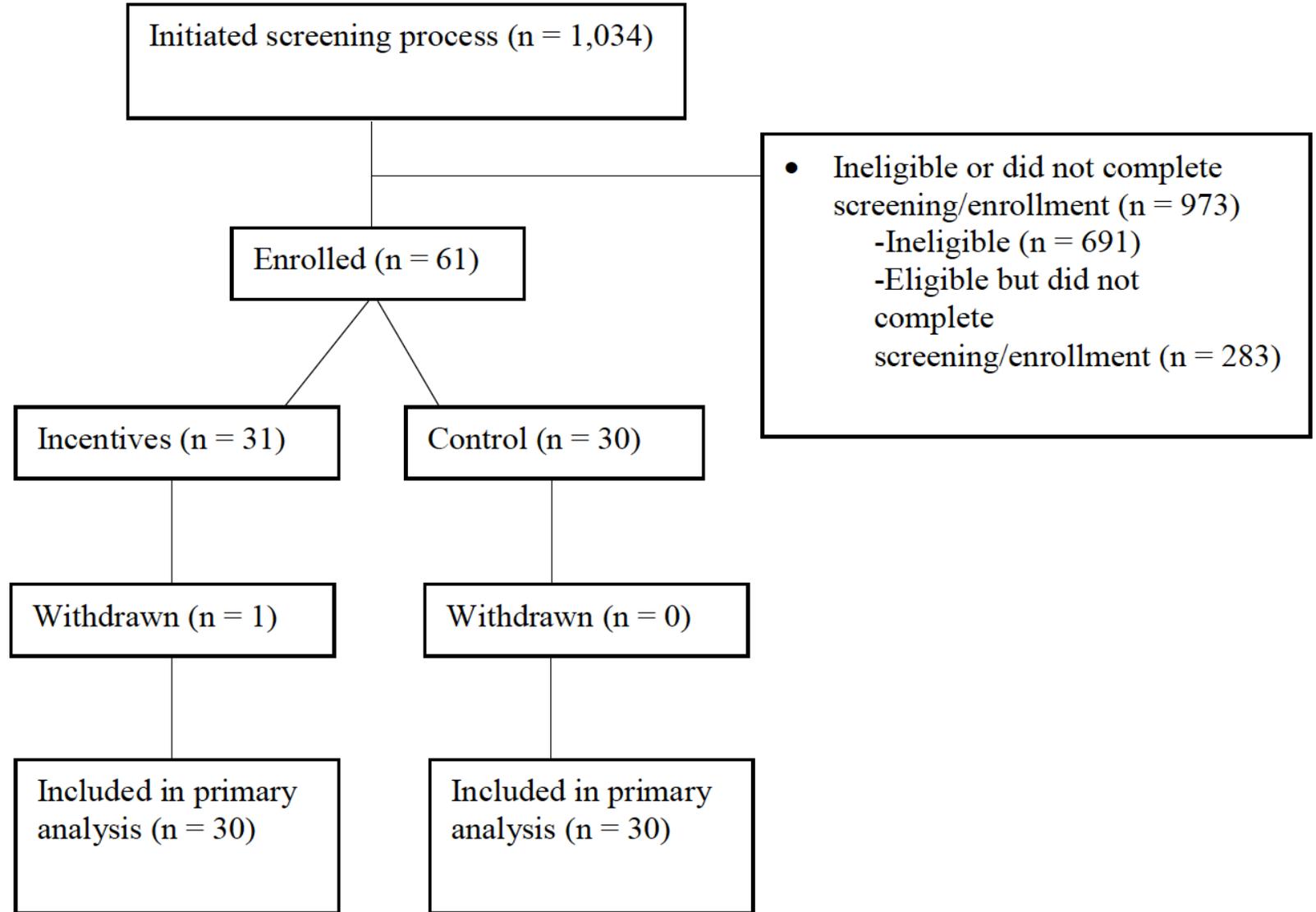
Intervention Reach
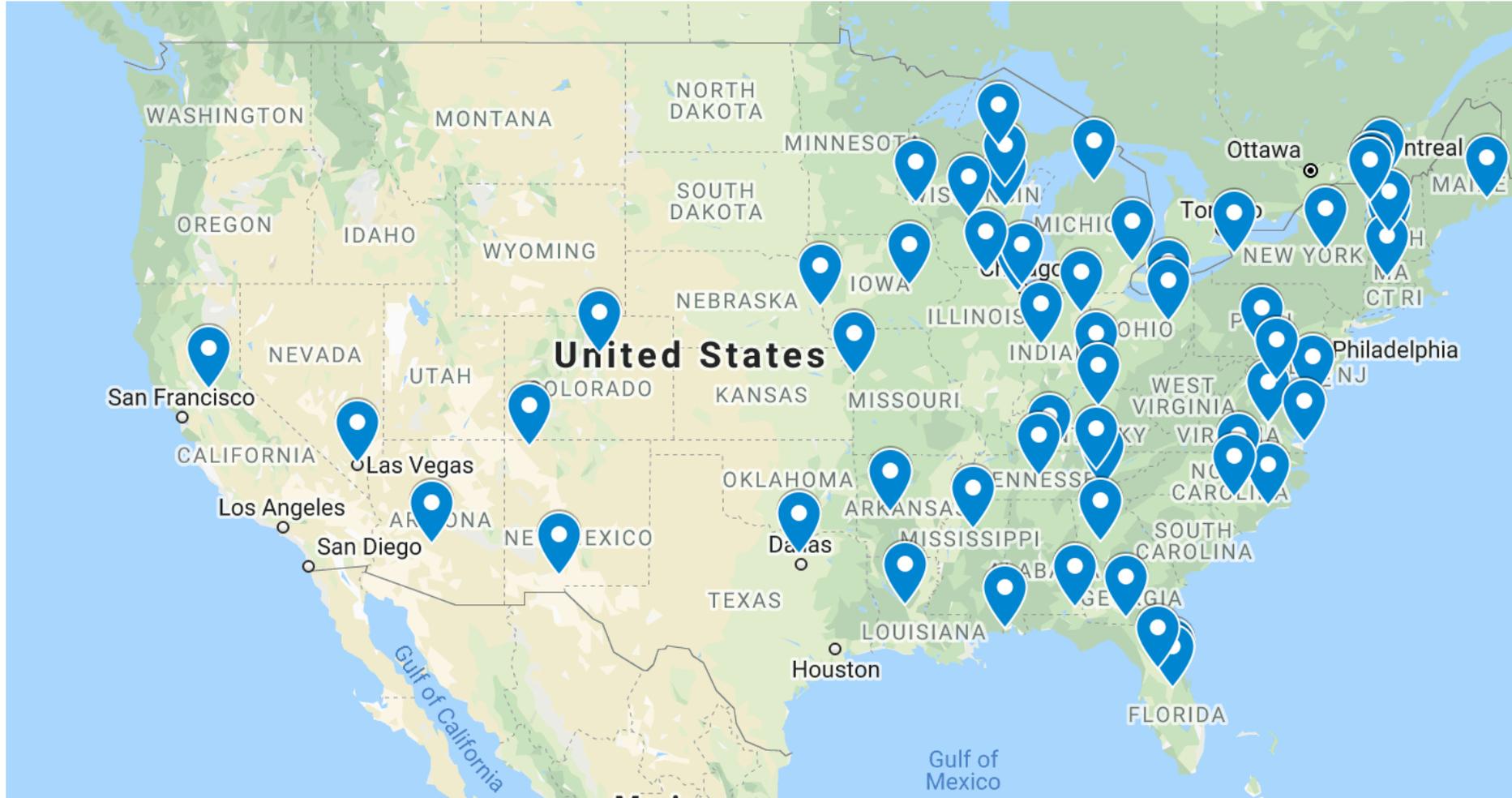
Sample Characteristics

Characteristic	Overall (*N* = 60)	Incentives (*N* = 30)	Best Practices (N = 30)	p-value
Demographics				
Age (years)	30.4 (5.2)	30.8 (5.0)	30.0 (5.4)	.54
Race/Ethnicity				
% White	72	67	77	.39
Education				
% < 12 years of education	7	3	10	.10
% = 12 years of education	53	67	40	
% > 12 years of education	40	30	50	
% Participating in WIC	47	53	40	.30
% Working for pay outside of home	40	27	53	.03
Smoking Characteristics				
Cigarettes per day pre-pregnancy	18.6 (5.2)	19.0 (4.8)	18.2 (5.5)	.56
Cigarettes per day at intake	10.6 (6.2)	11.4 (6.0)	9.9 (6.5)	.36
Age first started smoking cigarettes	15.5 (3.1)	15.4 (3.3)	15.6 (3.0)	.82
% Living with another smoker	72	73	70	.77
% With no smoking allowed in home	73	70	77	.56
Cigarette Type				
% Ultralight	0	0	0	.07
% Light	13	3	23	
% Medium	17	17	17	
% Full Flavor	70	80	60	
% Contains Menthol	58	63	53	.43
% Tried quitting pre-pregnancy	69	72	67	.63
% Tried quitting during pregnancy	54	52	57	.70
Pregnancy Characteristics				
Gestational age (weeks)	14.4 (4.6)	14.9 (4.9)	13.9 (4.3)	.41
Pregnancy Intention				
% Sooner	8	17	0	.13
% Now	13	17	10	
% Later	40	30	50	
% Never	23	23	23	
% Don't know	15	13	17	

Point Prevalence Smoking Abstinence
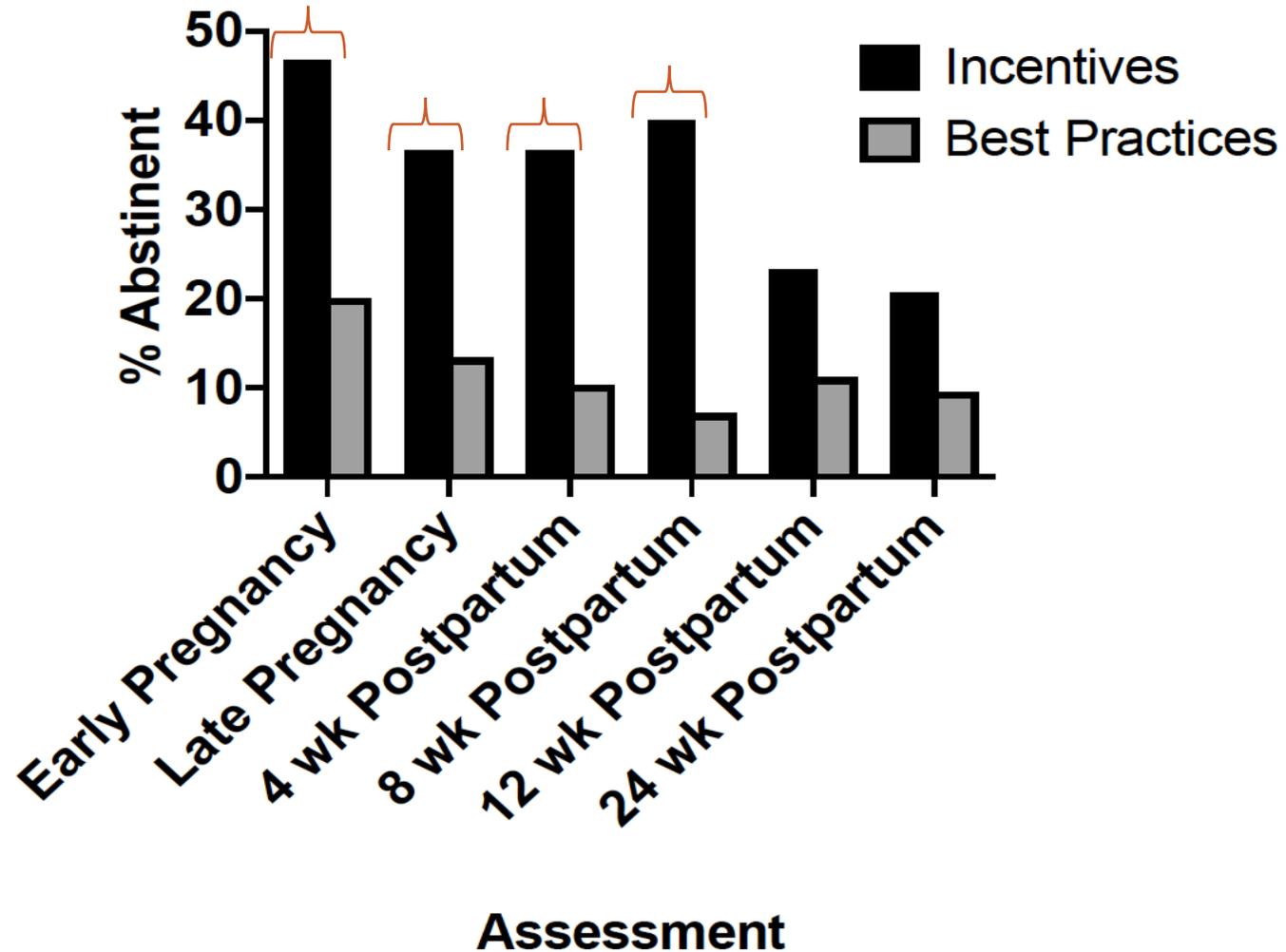
Treatment Acceptability
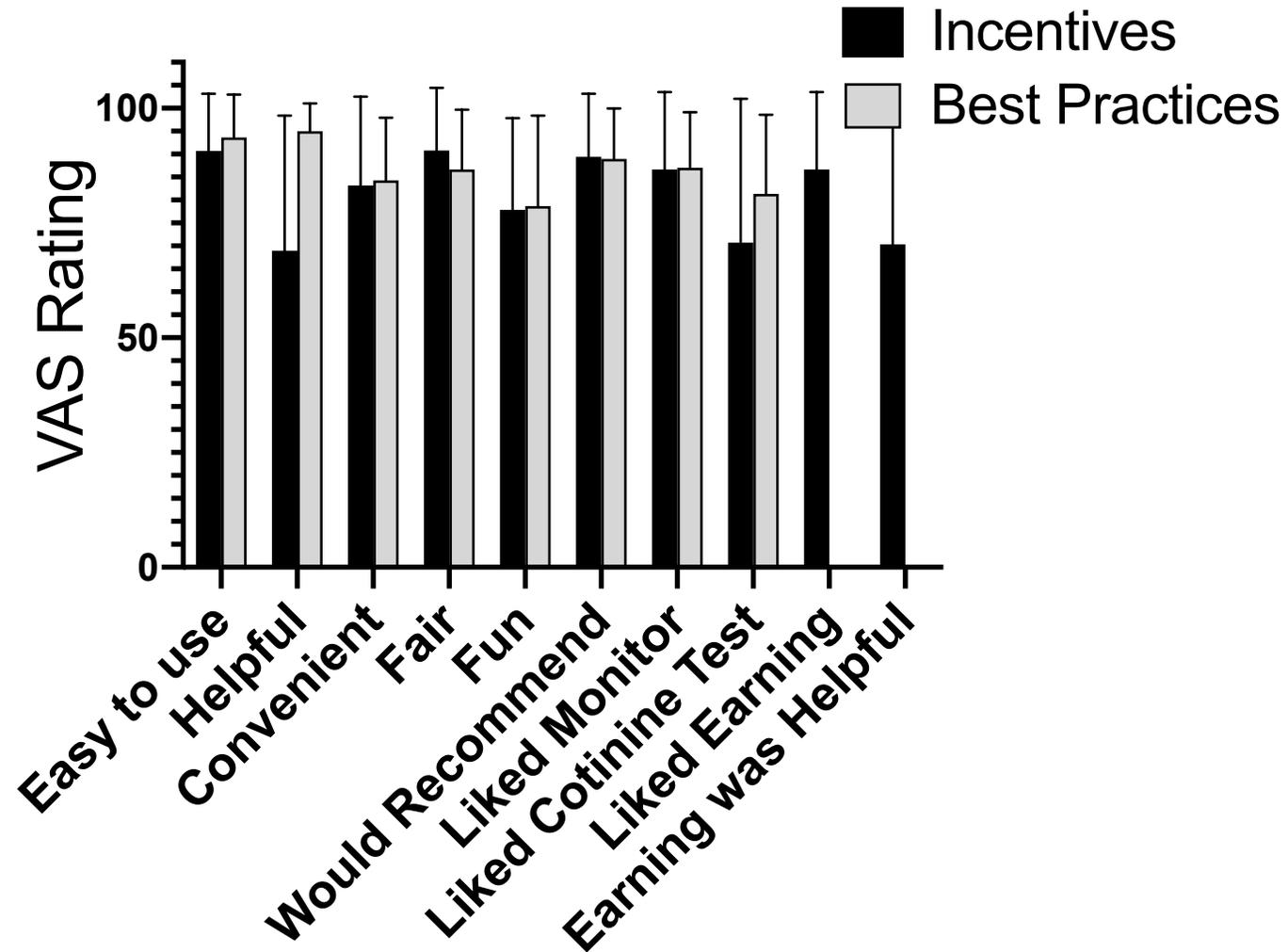
Treatment Acceptability

"The new smartphone testing makes this so **convenient** because as long as it's in the testing timeframe I can do it at my convenience instead of scheduling an appointment to do urine samples like it used to be. The **support and positive reinforcement** through not only the **debit card** but the **staff** has been wonderful. They have been super encouraging!"
– 88040

"I feel like this whole study has helped me not only quit smoking, but become healthier which is the goal for any mom to be…I think the app through the smartphone is great because **smartphones are something we have on us most of the day**. We just record a video of ourselves completing the saliva test, upload it, then wait. It makes the process so much **easier**. I feel that I have benefited from this study the best I can with help from everyone involved and I **couldn't be more thankful to have the opportunity to participate and better myself**!" – 88017

"Pros: The **compensation, easy testing, fast results, easy access to customer service, constant support and encouragement**.
Cons: Payment process delay in surveys, using gift card requires paying for shipping so you don't have your full compensation, managing the camera while doing the testing for saliva" – 88032

Summary and Conclusions

- Data to date are promising

- Ultimate goal of this research is to develop a broadly applicable and sustainable remotely delivered treatment targeting pregnant smokers

- The proposed intervention stands poised to make a substantial public health impact in terms of improving maternal and infant health outcomes and reducing health disparities
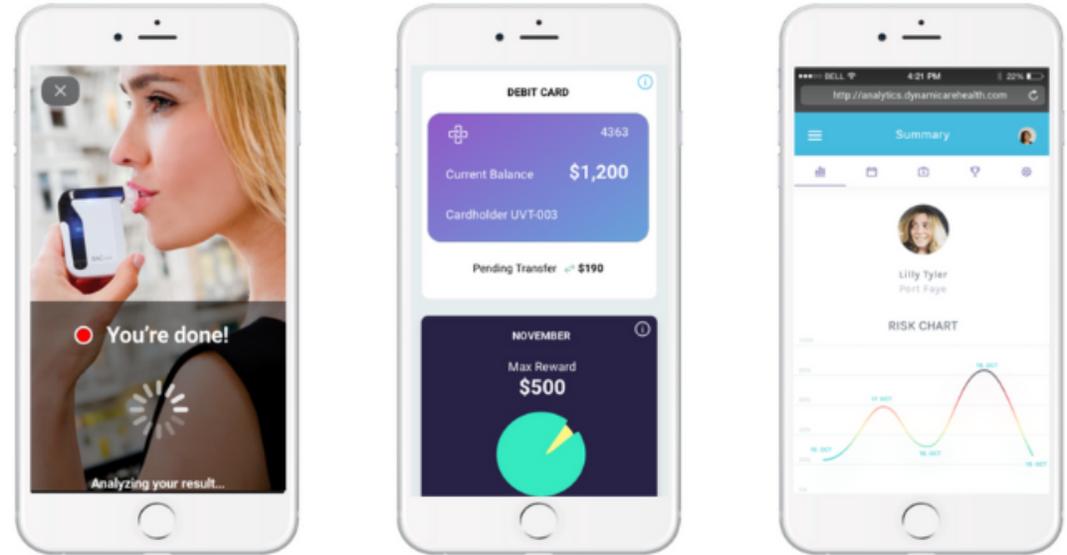
DynamiCare, 2020

Rural Implications

- Smartphone-based interventions can reach rural populations that may otherwise be hard to reach and/or difficult to treat.

- Detrimental health behaviors are disproportionately high in certain populations (e.g., cigarette smoking in rural women, obesity in rural America).

- Special populations increasingly use technology (e.g., economically disadvantaged, rural; [ITU, Reuters, Smith, 2013; PEW Research Center, 2018]).

Smoking prevalence and trends among a U.S. national sample of women of reproductive age in rural versus urban settings

Tyler D. Nighbor, Nathan J. Doogan, Megan E. Roberts, Antonio Cepeda-Benito, Allison N. Kurti, Jeff S. Priest, Harley K. Johnson, Alexa A. Lopez , Cassandra A. Stanton, Diann E. Gaalema, Ryan. Redner, Maria A. Parker, Diana R. Keith, Amanda J. Quisenberry, & Stephen T. Higgins

Rural America

- Characterized by socioeconomic and health disparities

- Highest cigarette smoking rates in the country

- Poorer cessation-related outcomes

- Higher mortality rates

Photo by Tim Harris for The New York Times

Previous Research

Doogan et al. (2017)
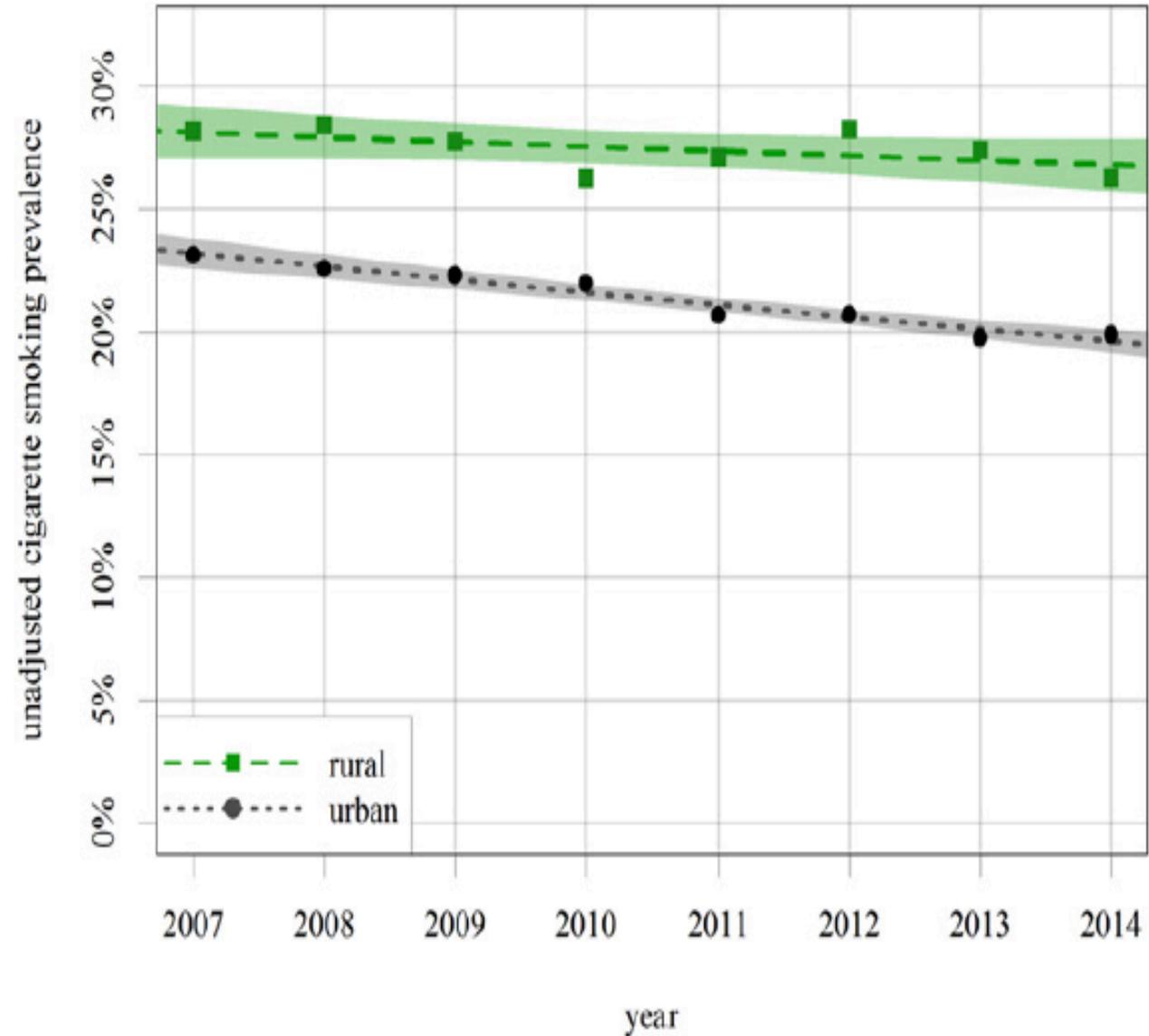
Previous Research

Cepeda-Benito et al. (2018)
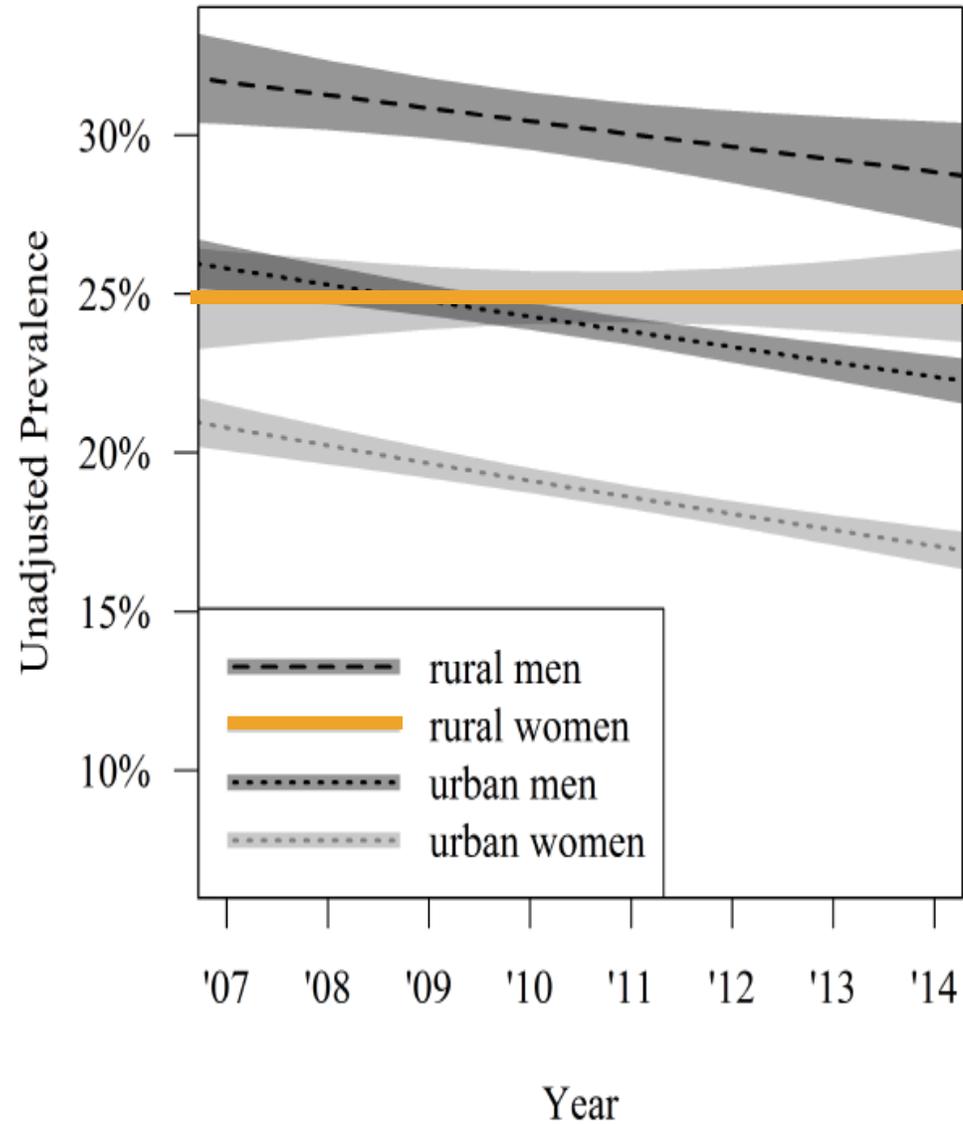
Women of Reproductive Age

Mother and infant health should these women become pregnant

Second-hand smoke exposure
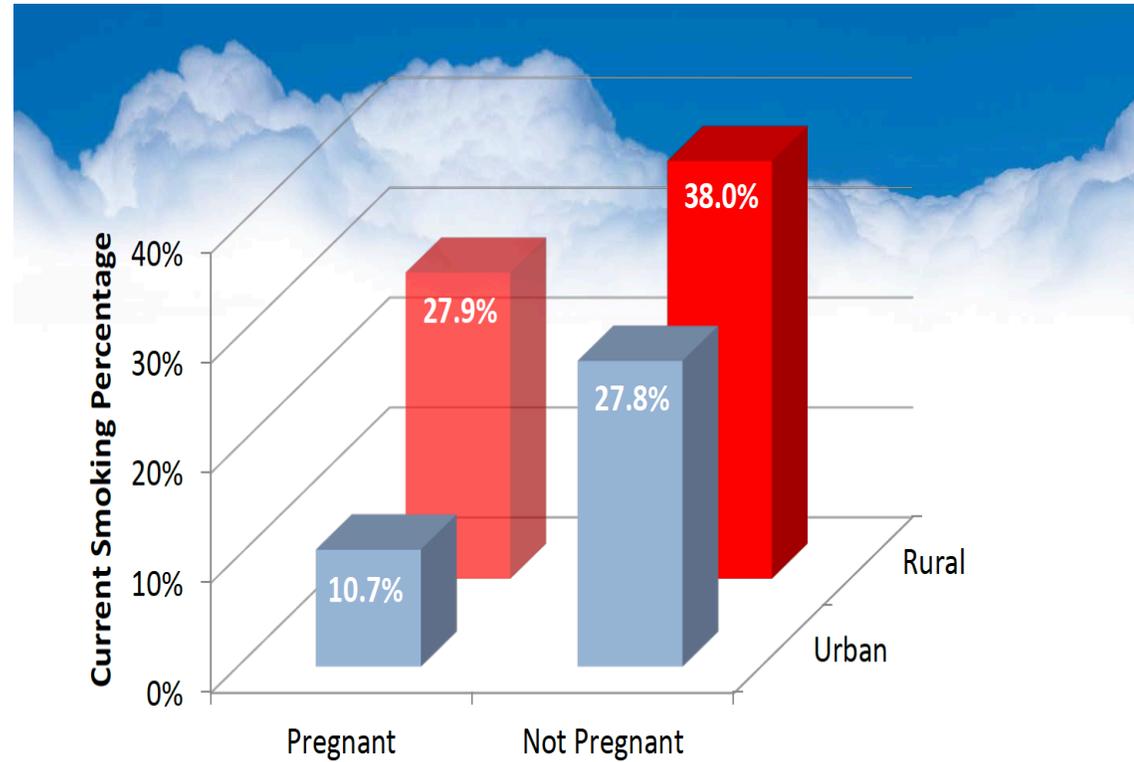
Crude Smoking Rate Among Women by Geography and Pregnant Status

- Rural pregnant not different from urban or rural not-pregnant

Nicotine Dependence

- No known data on if nicotine dependence differs between rural versus urban smokers

- Nicotine dependence is a major contributor to the emergence and persistence of chronic smoking and robust predictor of difficulties in quitting cigarette smoking

Aims

- Examine rural versus urban differences in smoking prevalence among women of reproductive age and whether rural women may be more likely to continue smoking during pregnancy

- Comparing levels of nicotine dependence between rural versus urban women of reproductive age who smoke

Data Source

Most recent ten years (2007-2016) of data from
National Survey on Drug Use and Health (NSDUH)

Measures

Predictors
- Urban versus Rural setting
- Pregnancy Status
- Interaction of Setting x Pregnancy Status

Dependent Variables
- Current Smoking
- Nicotine Dependence

Covariates
- Five categorical variables (age, race, education, marital status, and income)
- Four dichotomous variables (employment status, past year major depressive episode, health insurance (any type), and past year substance abuse)
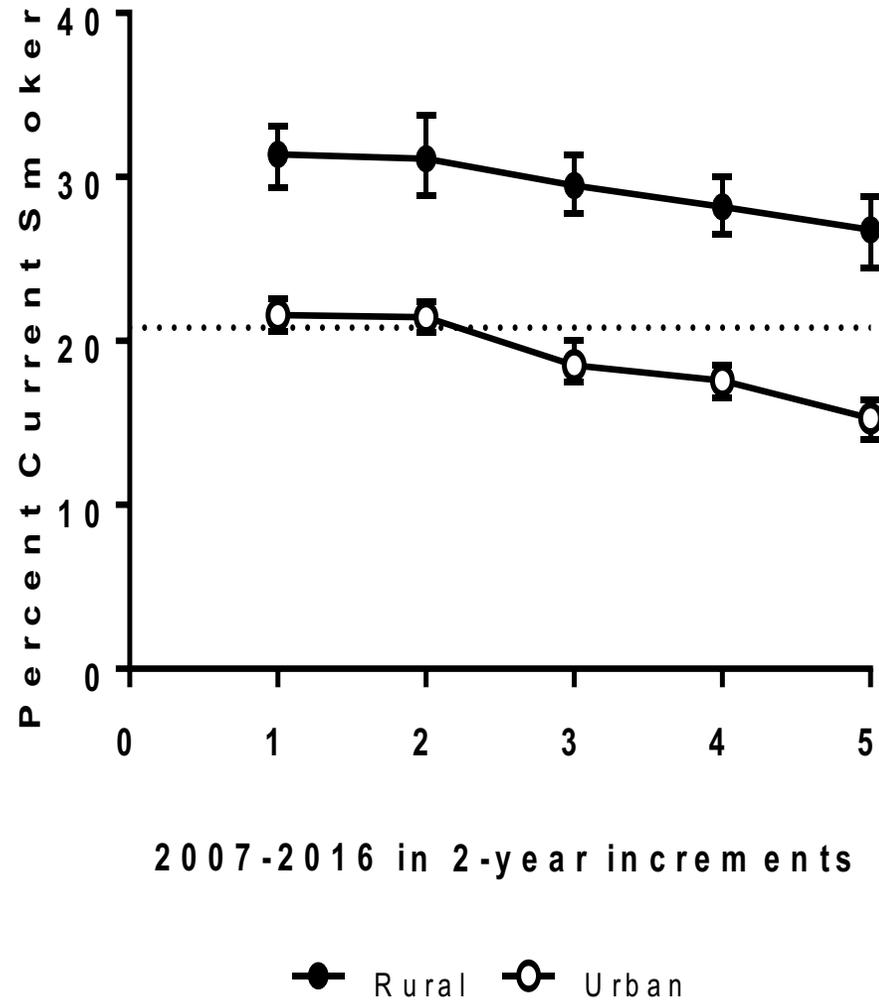
Figure 1
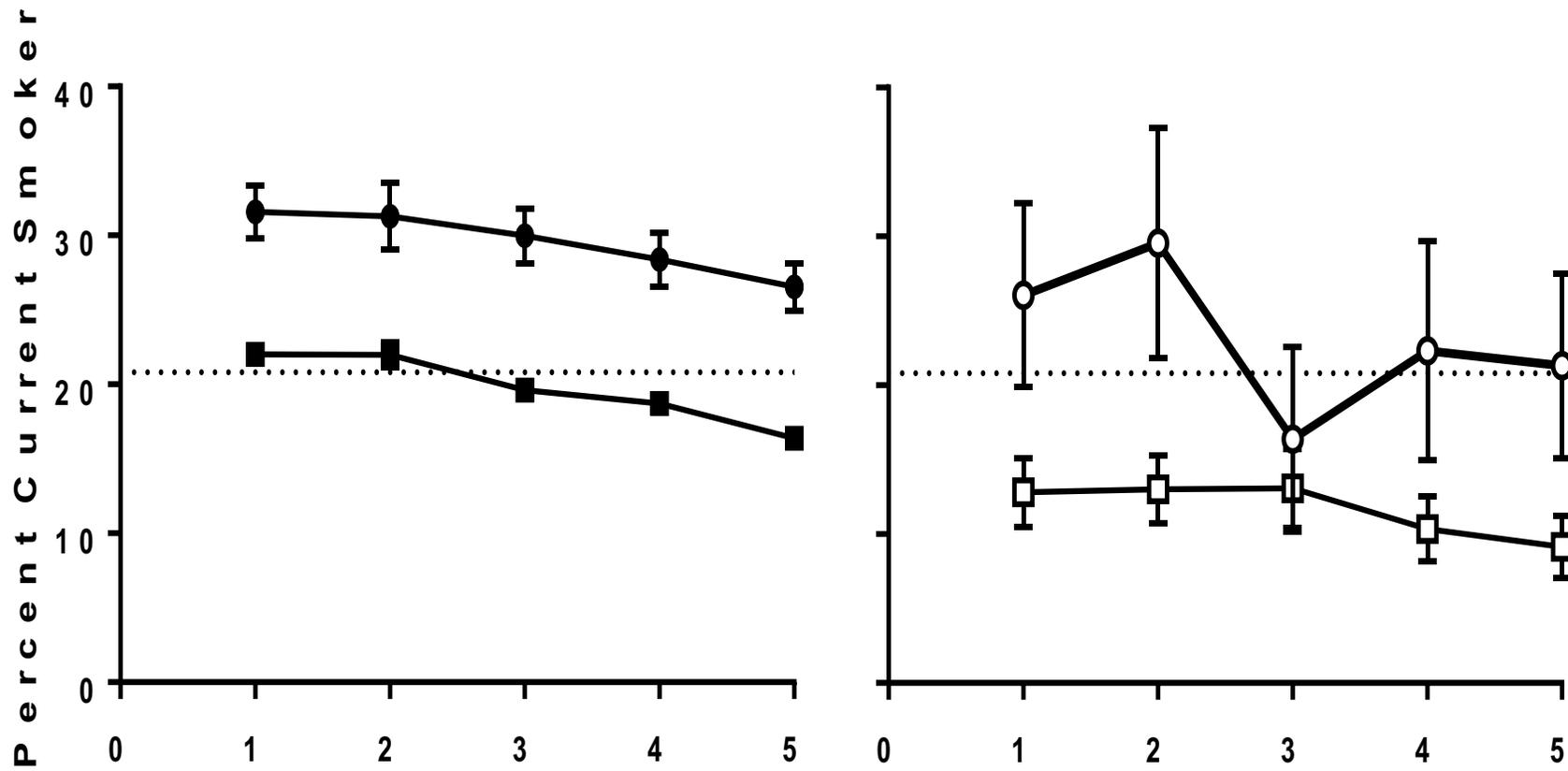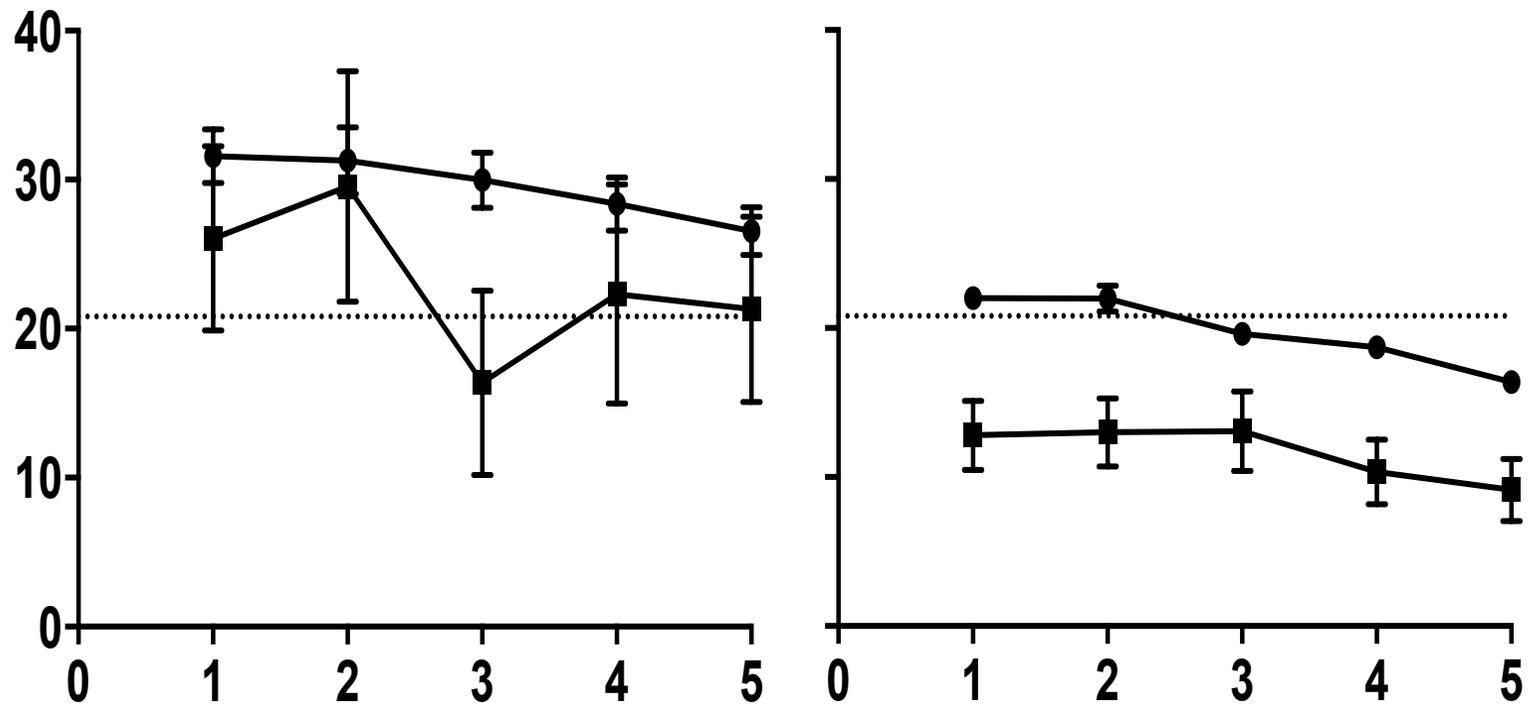
Figure 2

Figure 2 *(re-graphed by Rural/Urban setting)*

Table 2. Adjusted odds ratios (and 95% confidence intervals) from models of current smoking in the US between the years 2007–2016.

	Adjusted Model (No Interaction)				Adjusted Model (1 Interaction)			
	OR	95% CI		p	OR	95% CI		p
Rural Residence								
Yes	1.10	1.06	1.15	< .0001	—	—	—	
No	Ref							
Pregnancy Status								
Yes	.61	.56	.67	< .0001	—	—	—	
No	Ref							**~17%**
Rurality by Pregnancy Status								
Rural, Pregnant vs. Non-Pregnant	—	—	—		.75	.62	.92	.005
Urban, Pregnant vs. Non-Pregnant	—	—	—		.58	.53	.63	< .0001
Non-Pregnant, Urban vs. Rural	—	—	—		.80	.77	.85	< .0001
Pregnant, Urban vs. Rural	—	—	—		.62	.50	.76	< .0001

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Nicotine Dependence

- Overall nicotine dependence across the ten-year period was higher among rural than urban women

- Higher at each timepoint for rural v urban women

- Decreased over time for both groups, but greater decrease for urban women
  - Similar trends based on pregnancy status, but no significant interaction between rurality and pregnancy status
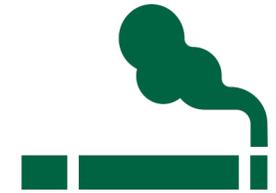
Table 3. Adjusted multivariable logistic regression coefficients for a model of nicotine dependence (in current smokers only) in the US between the years 2007–2016.

	Adjusted Model			
	AOR	95% CI		p
Rural Residence				
No	Ref			
Yes	1.26	1.19	1.34	< .001
Pregnancy Status				
No	Ref			
Yes	1.25	1.07	1.46	.005

Discussion

- Replicated earlier findings showing differences in cigarette smoking between urban and rural individuals

- Extended to women of reproductive age overall, and among non-pregnant and pregnant women examined separately

- Larger nonpregnant-to-pregnant reductions in odds of smoking (~17%) in urban compared to rural women

- This potentially suggests a disparity in pregnancy-related smoking cessation

Discussion Continued

- Greater nicotine dependence among rural than urban smoking women of reproductive age overall, and among rural non-pregnant and rural pregnant women examined separately

- All differences remained significant even after adjusting for common psychosocial, socioeconomic, and demographic smoking risk factors

- Results add to accumulating evidence underscoring rural residence as an independent smoking vulnerability

Questions?

akurti@uvm.edu or cora@uvm.edu
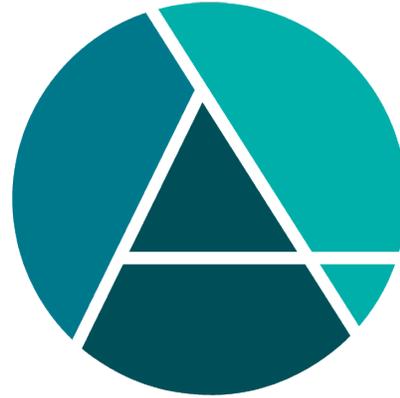
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