

# National Cancer Institute TUS-CPS Data User Webinar

County Level Analyses on TUS-CPS  
Using Small Area Estimation Techniques

*Welcome and thank you for joining. The webinar will begin shortly.*

# Welcome

## **QUESTIONS & TECHNICAL SUPPORT**

Participants are on mute.

Use the **Chat Box** to ask questions or request support.

Questions will be addressed during designated Q&A periods.

---

## **CLOSED CAPTIONING SERVICE**

Closed captioning is available.

A link to the service will be provided in the Chat Box.

---

## **WEBINAR RECORDING & MATERIALS**

The webinar is being recorded.

Materials will be posted online in approximately three weeks.

Email notification will be sent.

# Speakers



**Anne Hartman, MS, MA**

*Biostatistician, Program Director*

National Cancer Institute

Tobacco Control Research Branch

[hartmana@mail.nih.gov](mailto:hartmana@mail.nih.gov), 240-276-6704



**Benmei Liu, PhD, MS**

*Survey Statistician, Program Director*

National Cancer Institute

Statistical Research and Applications Branch

[liub2@mail.nih.gov](mailto:liub2@mail.nih.gov), (240) 276-6718

# Small Area Estimation for the TUS-CPS: *Specific Policy Example & General Considerations*

Anne Hartman & Benmei Liu, DCCPS, NCI, NIH  
*TUS-CPS 2021 Webinar series*

# Disclaimer

The views and opinions expressed are the presenters' and do not necessarily represent the views, official policy, or position of the U.S. Government, U.S. Department of Health and Human Services or any of its affiliated institutions or agencies.

# OUTLINE

- TUS-CPS **Features**
- **Why** we need Small Area Estimates (**SAE**)?
- General Goals & **Rationale** for 2 **Policy** Items
- **Overview of** SAE Methods & **How** Applied to 2 Policy Items?
- **Results** for 2 Policy Items
- **Dissemination** & Website Info
- **Future** TUS SAE Plans (e.g., add e-cigarette & menthol use)
- **Discussion**: Statistical & Policy Implications

# TUS-CPS Features

- TUS Key source of U.S. national, state, & some sub-state level data on tobacco use and tobacco control policy
- Supplement to the BLS' Current Population Survey (CPS) conducted by the Census Bureau
  - national complex probability address-based household sample
  - conducted monthly, uses panel design (sampling efficiency)
  - detailed stats on demography, labor force & unemployment
- NCI sponsored survey (FDA co-sponsored since 2014)
  - TUS fielded about every 2-4 years since 1992
  - 150,000+ self reports\* of civilian pop. aged 18+(< 2007,15+)
  - interviews: 35% in-person visit & 65% by phone; also in Spanish

# Why Small Area Estimation (SAE)?

- TUS-CPS design allows **reliable** national and state level estimates
- Policy makers, cancer control planners and researchers often need tobacco related **county level data** to evaluate tobacco control programs, monitor progress, and conduct research
- TUS standard **direct estimation (design-based)** methods cannot provide reliable **county level** estimates due to small (or zero) sample
- **Model-based** methods that combine information from multiple related sources are needed to increase **precision**



# Research Goals

- Produce ***model-based, county level*** estimates for key measures (2014-2015 TUS, age 18+):
  1. % population currently smoking
  2. % population that has ever smoked
  3. % population that has quit for 24+ hrs, among those who have smoked within PAST 12 mos.
  4. % working population reporting a “***smoke-free (SF) workplace policy***” (**NEVER** allowed in **ANY** work areas & **ANY** public/common spaces)
  5. % population reporting a “***smoke-free (SF) home rule***” (where **NO ONE** is allowed to smoke anywhere inside the home at ANY TIME)
- ✓ Through collaboration between NCI and the **Census Bureau (Dompereh, I)**
- ✓ This talk will focus on the **two SF policy** outcomes

# Why Smoke-free Home & Workplace Policy?

- **SHS Exposure** causally linked to many chronic diseases in adults who do not smoke, as well as to serious illness in children
- **SHS Major Settings**: private workplaces, public places such as bars, restaurants and recreational settings, and homes
  - *Salient sources*: workplaces for adults in general & homes for children, the unemployed, and retired persons
  - Thus, workplace & homes are important settings for implementing **evidence-based** strategies to reduce **SHS exposure**.

# Workplace Policy: Benefits & How Established?

- **Benefits:**

- protects workers from SHS adverse health effects,
- **< active smoking** behaviors (prevalence & intensity), &
- yields safer & more efficient work environments

- **Establishing SF workplace policies:**

- by state or local legislation
- adopted voluntarily by employers or building owners
- ↑ **local jurisdictions** (*especially states without strong state SF laws*) enacted **SF** environments-mainly in work areas & public places

# SF Home Rules: Benefits & How Established?

- **Benefits:** prevents youth/young adult smoking **initiation**; ↑ **cessation** among adults; & protects individuals from SHS **harm**
- Home SHS restrictions are **rarely** covered by SF legislation; **generally established** by adult home residents
  - **multi-unit** housing- imposed by voluntary action -landlords, building owners, or individual tenants
  - several CA localities, limited legislation covering some multi-unit housing
- In 2017, **U.S. Department of Housing and Urban Development (HUD)** **required ALL public multi-unit** housing be 100% **SF** by mid-2018
  - HUD policy covers ONLY ~ 2 million of >300 million US residents

# Why SF Home & Workplace Policy SAEs?

- Few publications have provided detailed geospatial variation in indoor **SF workplace policies** or **home rules** coverage
- Babb et al. studied variation in SF workplace policies across states, but **NOT** at smaller geographic levels
- Comprehensive ordinance lists compiled by **American Nonsmokers' Rights Foundation** (ANRF) provide info on presence/absence of an ordinance, but **NOT** its implementation / enforcement
  - **ANRF** % pop. covered by 3 categories of laws: **non-hospitality workplaces, restaurants, & free-standing bars**



# Overview of the Model-based SAE Techniques

- ***Borrowing strength*** from relevant sources (Census/ Administrative information, related surveys)
- Borrowed strength comes from covariates, and from other counties with similar characteristics
- Methods of combining Information
  - Choose good small area model
  - Use good statistical methodology
- Mixed models (fixed effects + random effects) at area level or unit level have been popularly used in the small area estimation literature (Rao & Molina 2015).
- Among the many models developed in the SAE literature, the most prominent approach is the ***Fay-Herriot*** area- level model, originally developed to estimate per-capita income for U.S. areas with populations of less than 1,000.

# Fundamental Area-level Model

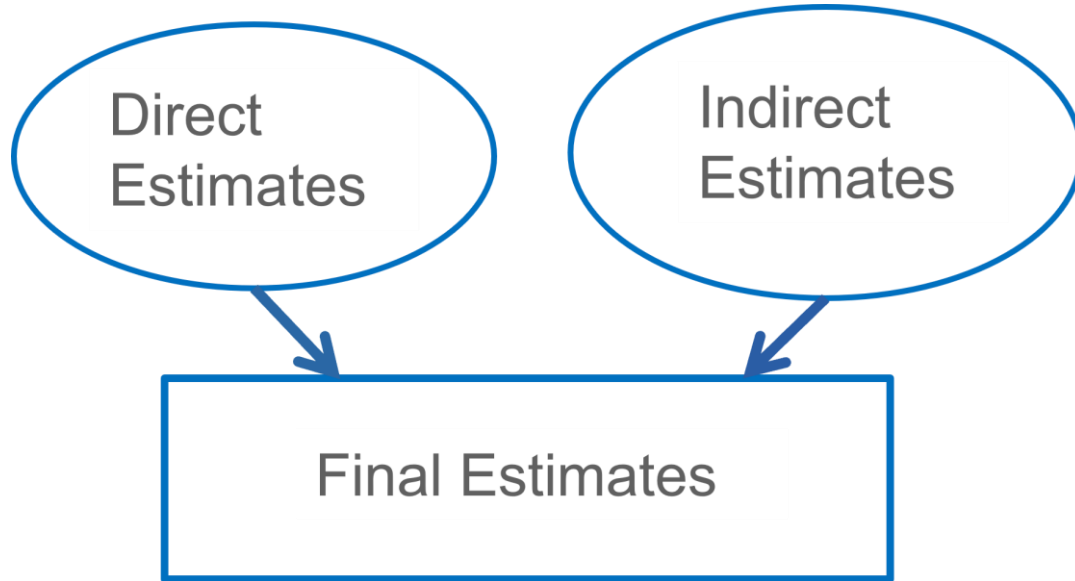
The well-known Fay-Herriot model (Fay & Herriot 1979):

- Sampling model:  $D_i | \theta_i \sim N(\theta_i, \varphi_i)$ ;
- Linking model:  $\theta_i = X_i' \beta + v_i$ ; where  $v_i \sim N(0, A)$ ;
  - $\theta_i$  is the parameter to be estimated;
  - $D_i$  is the direct estimate of  $\theta_i$ ;
  - $\varphi_i$  is the sampling variance of  $D_i$
  - $X_i$  is the auxiliary variable matrix
  - $A$  is the modeling variance



# Statistical Inferences Using Mixed Models

- The final estimates are combinations of the direct estimates with the synthetic estimates.



Fully Bayesian approach or empirical best prediction approach (analytic formulas) can be used for the estimation.

# TUS-CPS SAE: Models and Auxiliary Variables

- After comparison of several potential models, the Fay-Herriot class of model with arcsin square root transformation are applied
- The pool of auxiliary variables include:
  - 30+ **county-level** demographic & socio-economic variables obtained from ACS 2011-2015, Census 2000 & 2010, and other administrative records;
  - 5 **state level** tobacco policy data (cigarette taxes, clean air laws, tobacco control funding, Medicaid Coverage for Tobacco-Related Treatment, year in which Quitline service was established)
- Classical model selection procedures are applied to reduce the number of auxiliary variables for each outcome

# Statistical Inference and Model Diagnosis

- Hierarchical Bayesian approach through Markov Chain Monte Carlo (MCMC) methods were used to estimate the parameters of the statistical models.
- Extensive model selection and model diagnosis procedures are used to select the final models and assess the goodness of fit for each model.
- Modeled estimates were compared to the available direct estimates. The ratio of the two is expected to converge to 1 as the sample size gets larger.

# Model evaluation

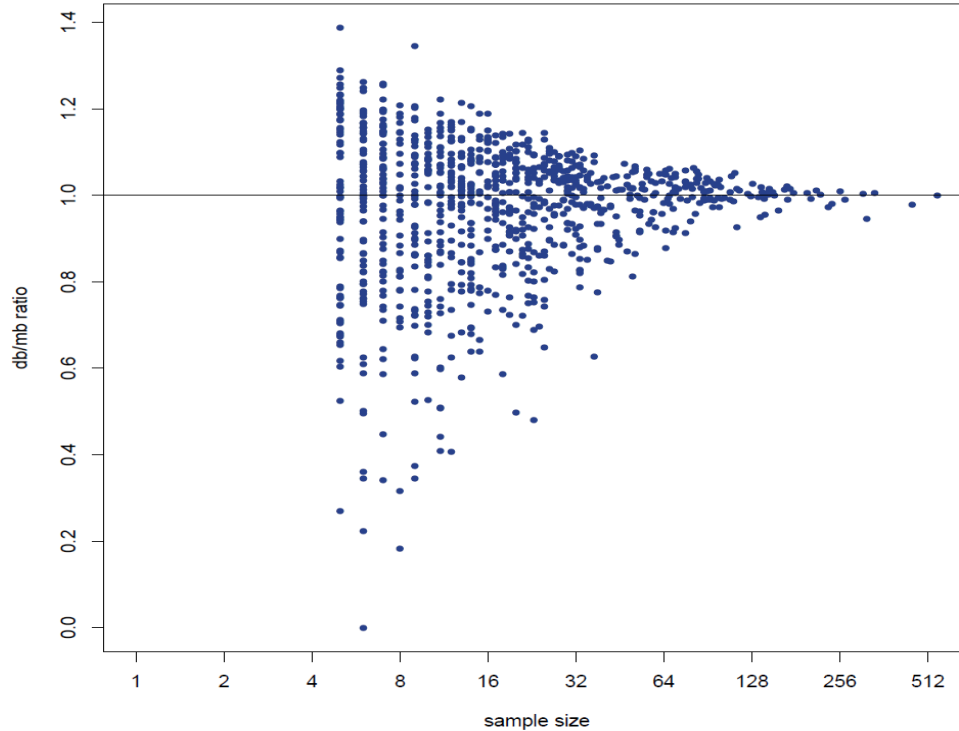


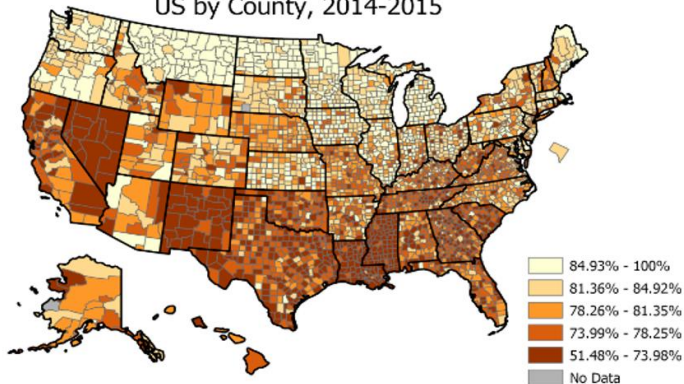
Figure 1: Ratio of the direct over modeled estimates for the proportion of workers covered by smoke-free workplace polices against sample size – TUS-CPS 2014/2015

# Final Results:

## Model-based Estimates for Percent of Population Governed by a Smoke-free Workplace Policy\* Among Age 18+: TUS-CPS 2014-15

### Individual Self-Reported

Percent Coverage of Smoke-Free Workplace Policy (aged 18+)  
US by County, 2014-2015



\*Workplace has an official smoking policy:  
Smoking Not allowed in ANY public areas  
and work areas

<https://sae.cancer.gov/tus-cps/>

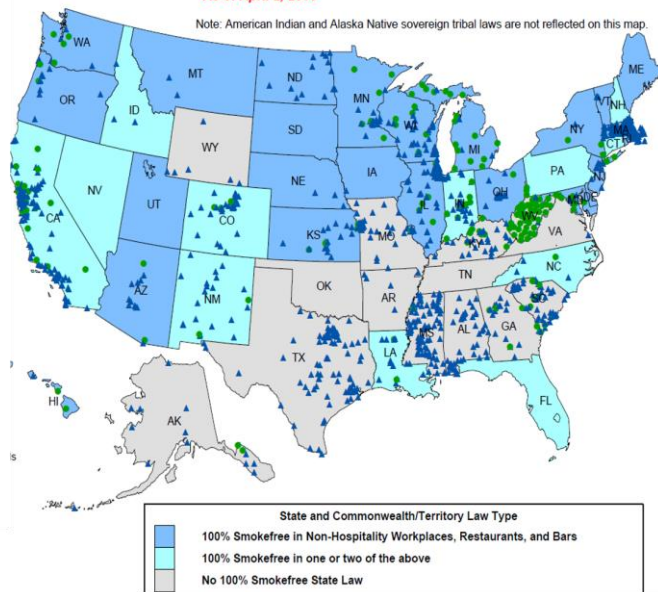
### Law Legislations

#### United States 100% Smokefree Air Laws

American Nonsmokers' Rights Foundation

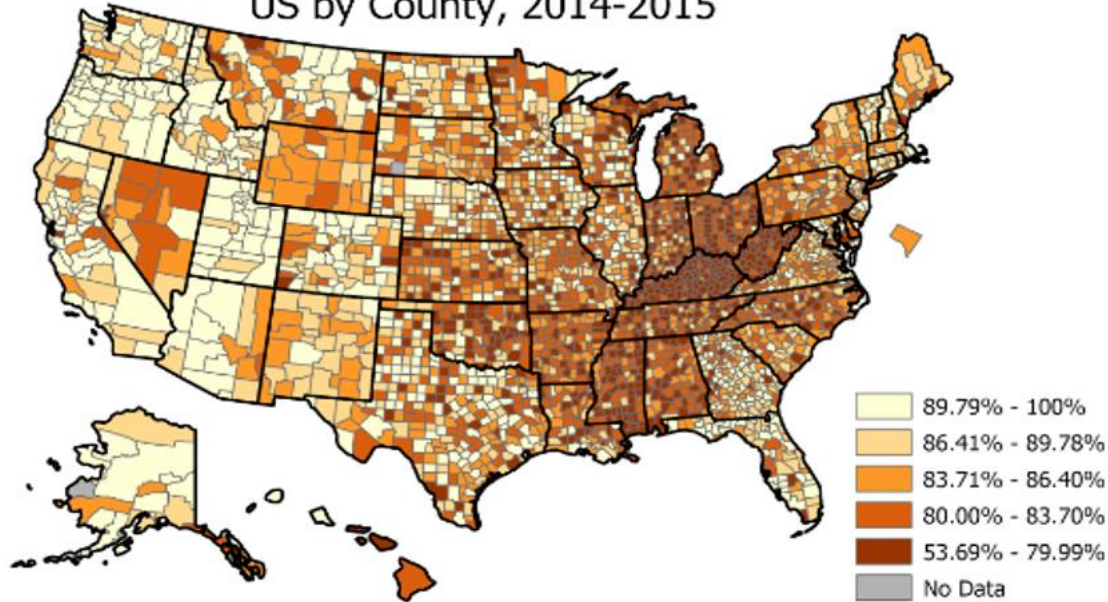
As of April 2, 2015

Note: American Indian and Alaska Native sovereign tribal laws are not reflected on this map.



# Model-based Estimates for Percent of Population Living in Smoke-free Homes Among Age 18+: TUS-CPS 2014-15

Percent Coverage of Smoke-Free Home (aged 18+)  
US by County, 2014-2015



# Data accessibility: The SAE Website

Model-based Estimates at the State and County Levels

Home About **Measures** Resources

Search Search

## Tobacco Use and Policies

### Introduction

Methodology

Data Sources

Available Estimates

Residence - No Smoking

Workplace - No Smoking

Smokers Who Quit 24+ Hours

Limitations and Uses

Publications and Contributors

Citation Format

## Small Area Estimates for Tobacco Use and Policies \*

Model-based small area estimates are created by combining information from [TUS/CPS](#) and auxiliary variables obtained from relevant sources (Census and American Community Survey) through statistical models.

- Outcomes included smoke-free home rule, smoke-free workplace policy, and smoking cessation
- Estimates are for counties and [health service areas](#)
- Estimates are for three time periods 2006/2007, 2010/2011, and 2014/2015

### Explore Further

#### Methodology

Discover more about the proposed statistical models.

#### Data Sources

Get in-depth information about TUS-CPS.

#### Available Estimates

View all the available small area estimates for this topic.

\* Modeled estimates for current and ever smoking prevalence are also derived from this project. They are not released in this website to avoid overlap with estimates derived from combining NHIS/BRFSS under the topic of Cancer Risk Factors and Screening Behaviors. For those who are specially interested in the estimates of smoking prevalence derived from TUS/CPS, please [contact us](#).

[Return to top](#)



This website is a service of the Surveillance Research Program, in NCI's Division of Cancer Control and Population Sciences.

Home  
About  
Measures  
Resources

Contact  
Privacy Policy  
Accessibility  
FOIA

# Future Considerations for TUS-CPS SAE

- Estimation using the TUS-CPS 2018/19 data is underway.
- In addition to the 5 outcomes considered in the past, we are adding new outcomes including **menthol use** and **e-cigarette use**.
- We will evaluate the current approach and consider improved modeling approach if needed.



## Discussion- Statistical

- Generated county-level model-based estimates for prevalence of 5 smoking/*SF* related outcomes for **3,134** US counties/equivalents
- Applying hierarchical Bayesian models, allowed borrowing strength from covariates & other counties with similar profiles.
- Extensive model selection & diagnostics applied to choose the best SAE model for each outcome among several candidate models
- For all the outcomes, the modeled estimates showed consistency with direct estimates in the aggregate, and reduced variance for each county in a general sense.
- Our results demonstrate SAE-positive feature of “borrowing-of-strength” from areas with similar characteristics for small areas with large variation to yield relatively stable estimates.



# Discussion- Policy Implications

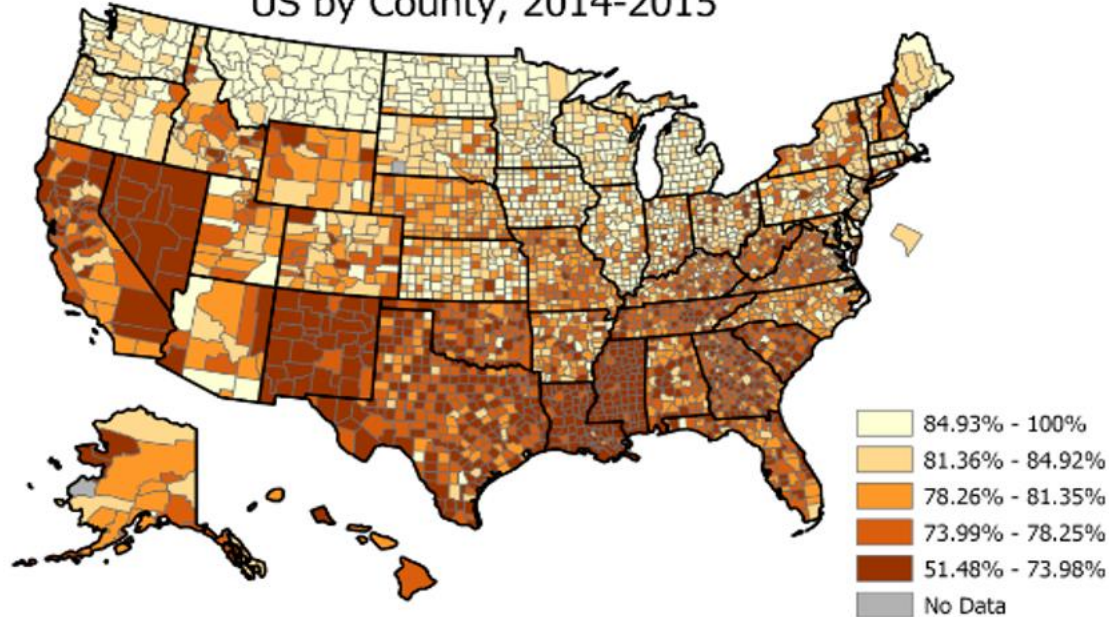
- **1<sup>st</sup> study** of **SF** home rules/workplace policies **county-level** estimates from *self-reported national survey data*
- **Self-reports measure Workplace Policy** effect indirectly from:
  - ordinances/laws & those applied voluntarily by employers or building owners
- **TUS-CPS** - ALL types work-places, in hospitality sector (restaurants, bars, casinos), non-hospitality sector, as well as those in government
- **~80%** of US workers (18+ yrs in 2014-15) reported **SF** workplace policy coverage; yet **NO** state achieved **>90% SF** workplace coverage
  - suggests even in states with comprehensive state-wide SF laws, some workers remain unprotected
- **>85%** of US adults reported coverage by **SF** home rules

# Discussion- Policy Implications

- **Lowest** % for **SF** workplace policies & often **lowest** % **SF** home rules in states with **highest** % smoking, mainly US south & eastern central parts.
  - consistent with past research

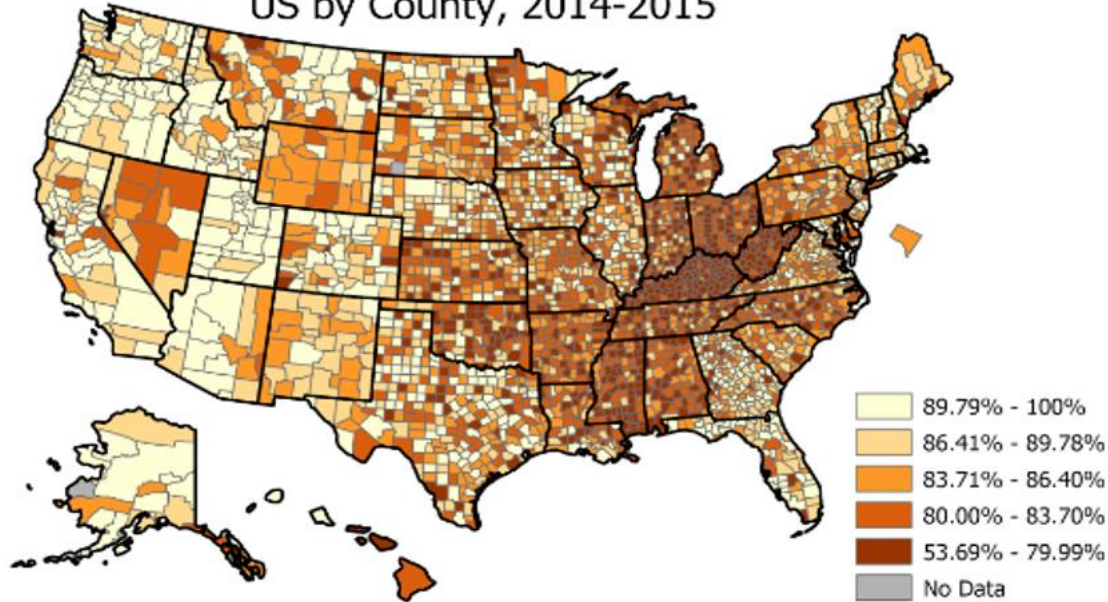
# Model-based Estimates for TUS-CPS 2014-15

Percent Coverage of Smoke-Free Workplace Policy (aged 18+)  
US by County, 2014-2015



# Model-based Estimates for Percent of Population Living in Smoke-free Homes Among Age 18+: TUS-CPS 2014-15

Percent Coverage of Smoke-Free Home (aged 18+)  
US by County, 2014-2015

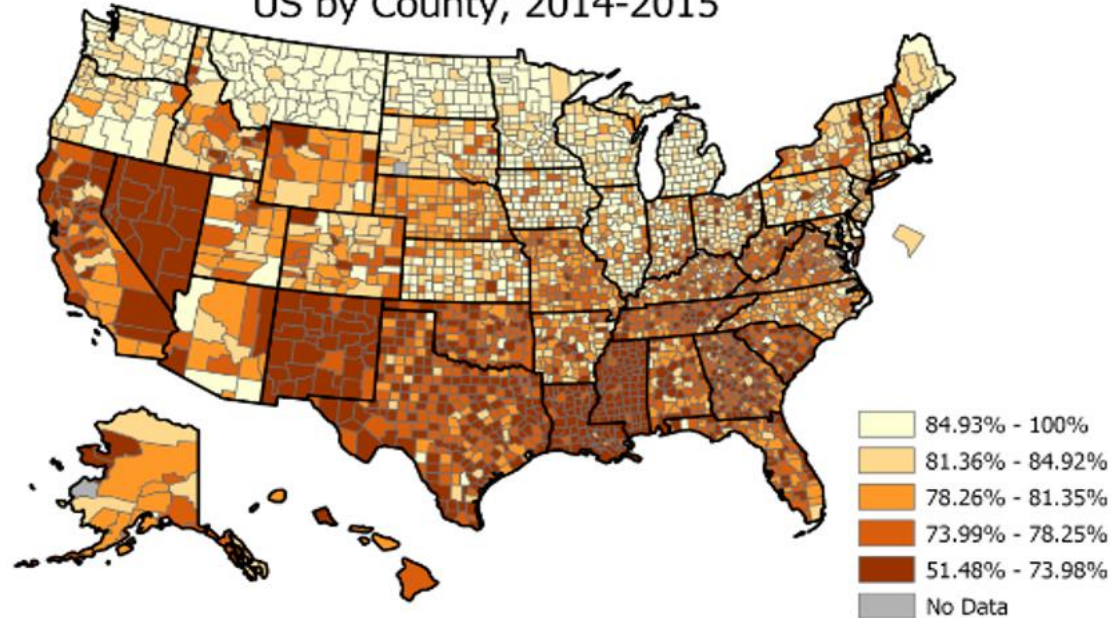


# Discussion- Policy Implications, Continued

- States with minimal within-state variation are largely those with strong state-level tobacco control policies, compensating for counties that do not have their own laws
- Large within-state variation in **CA** partly explained by CA 's early adoption of comprehensive tobacco control state-wide law, at a time when exemptions were common, in effect “**penalizing**” CA.

# Model-based Estimates for TUS-CPS 2014-15

Percent Coverage of Smoke-Free Workplace Policy (aged 18+)  
US by County, 2014-2015



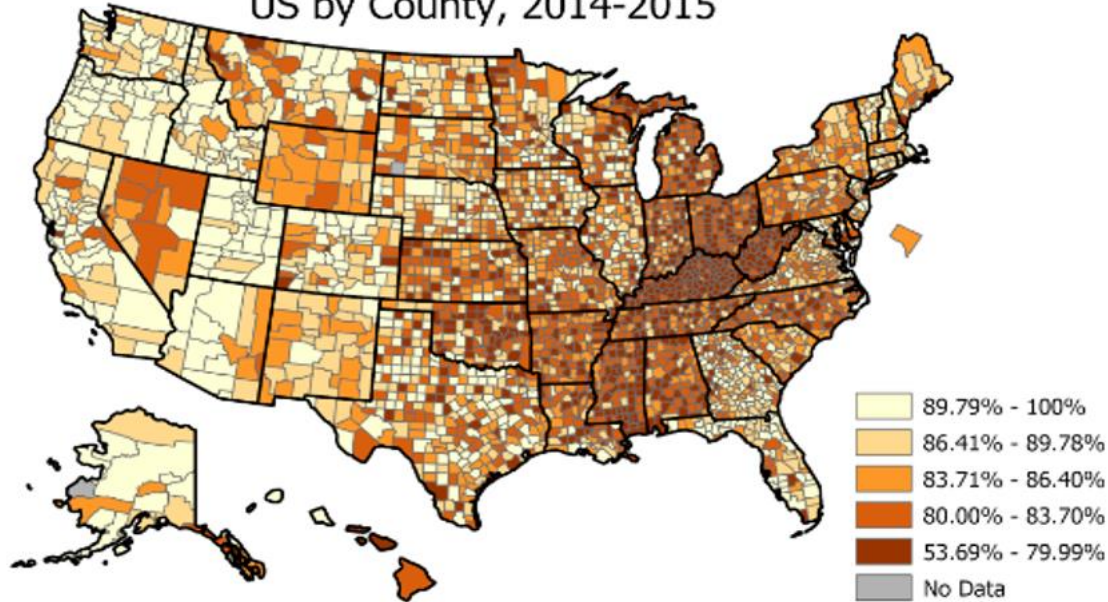


# Discussion- Policy Implications, Continued

- In contrast, **CA** has a high **SF** home rule % & minimal variation between counties likely as a result of its program ALWAYS emphasizing social norms

# Model-based Estimates for Percent of Population Living in Smoke-free Homes Among Age 18+: TUS-CPS 2014-15

Percent Coverage of Smoke-Free Home (aged 18+)  
US by County, 2014-2015



# Broader Implications of Results

- Recent study correlated TUS-CPS **SF** workplace policy & ANRF constructed scores
  - some *consistency* between *two measures* in terms of **observed impact** on smoking **cessation** & **cigarettes smoked per day**
- Self-report advantageous -includes **perception**, as well as **knowledge**, *reflecting enforcement* strength
- Detailed **SF** county & state-level *workplace* policies & *home* rules can help **identify coverage disparities** & **differential impact**
- **Framework** useful for modeling **different** *tobacco control* variables & applied to, e.g., **other** *behavioral*, *policy*, or *health* topics

## Selected References

- Liu B, Dompok I, and Hartman A.M. Small area estimation of smoke-free workplace policies and home rules in U.S. counties. *Nicotine & Tobacco Research*, 2021. ntab015, <https://doi.org/10.1093/ntr/ntab015>
- Rao JNK, Molina I. *Small Area Estimation*. 2nd ed. Hoboken, NJ John Wiley & Sons, Inc; 2015
- Fay R and Herriot R. Estimation of income from small places: An application of James-Stein procedures to Census data. *Journal of the American Statistical Association* 1979; 74: 269-277.

## Contact:

- [liub2@mail.nih.gov](mailto:liub2@mail.nih.gov)
- [hartmana@mail.nih.gov](mailto:hartmana@mail.nih.gov)

Thank you!



**NATIONAL  
CANCER  
INSTITUTE**

[www.cancer.gov](http://www.cancer.gov)

[www.cancer.gov/espanol](http://www.cancer.gov/espanol)

**RAISE YOUR HAND** if you wish to be unmuted and ask any final questions.

The screenshot shows a Cisco Webex Events window. The main area displays a video of Nalini Corcy, Host. On the right, the 'Participants' panel is open, showing a search bar, a list of participants (Nalini Corcy, Host and Nel C, Me), and a hand icon for raising the hand. The bottom control bar includes buttons for Unmute, Share, a menu, a close button, a 'Participants' button (highlighted with a red box), and a Chat button.

Ensure the Participants Panel is open.

Raise your hand by clicking on the hand icon.

Lower your hand by clicking on the hand icon again.

# THANK YOU FOR YOUR PARTICIPATION

## WE VALUE YOUR FEEDBACK!

Please share your feedback via a brief survey.  
The survey link will be shared via the Chat Box and email.

### FOR MORE INFORMATION & HELPFUL RESOURCES

TUS-CPS Website

[cancercontrol.cancer.gov/tus-cps](https://cancercontrol.cancer.gov/tus-cps)

TUS-CPS Email Subscription

[cancercontrol.cancer.gov/brp/tcrb/tus-cps#is-newsletter-subscription](https://cancercontrol.cancer.gov/brp/tcrb/tus-cps#is-newsletter-subscription)

TUS-CPS Team Contact

[ncidccpsbrpadvances@mail.nih.gov](mailto:ncidccpsbrpadvances@mail.nih.gov)





**NATIONAL  
CANCER  
INSTITUTE**

[www.cancer.gov](http://www.cancer.gov)

[www.cancer.gov/espanol](http://www.cancer.gov/espanol)