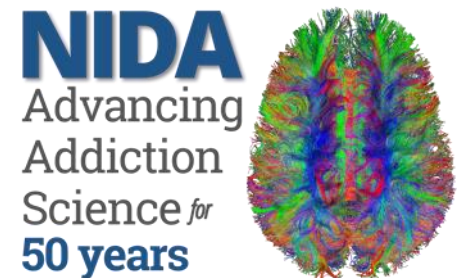


# The effects of state-level flavored electronic cigarette restrictions on adult tobacco use using multilevel modeling: Findings from the PATH Study Waves 5 & 7 (2018-2023)

John H. Kingsbury, PhD

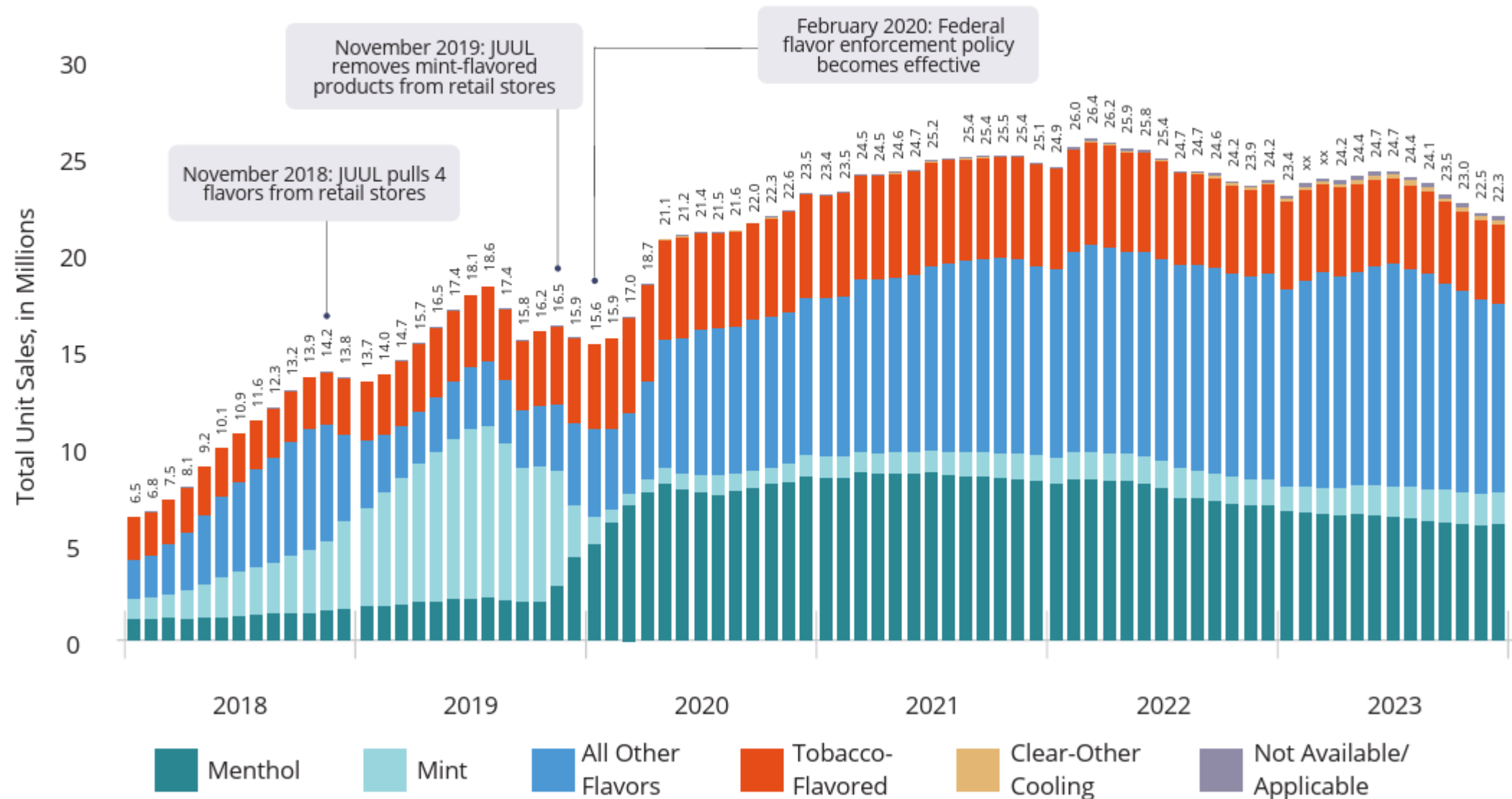
[John.Kingsbury@nih.gov](mailto:John.Kingsbury@nih.gov)

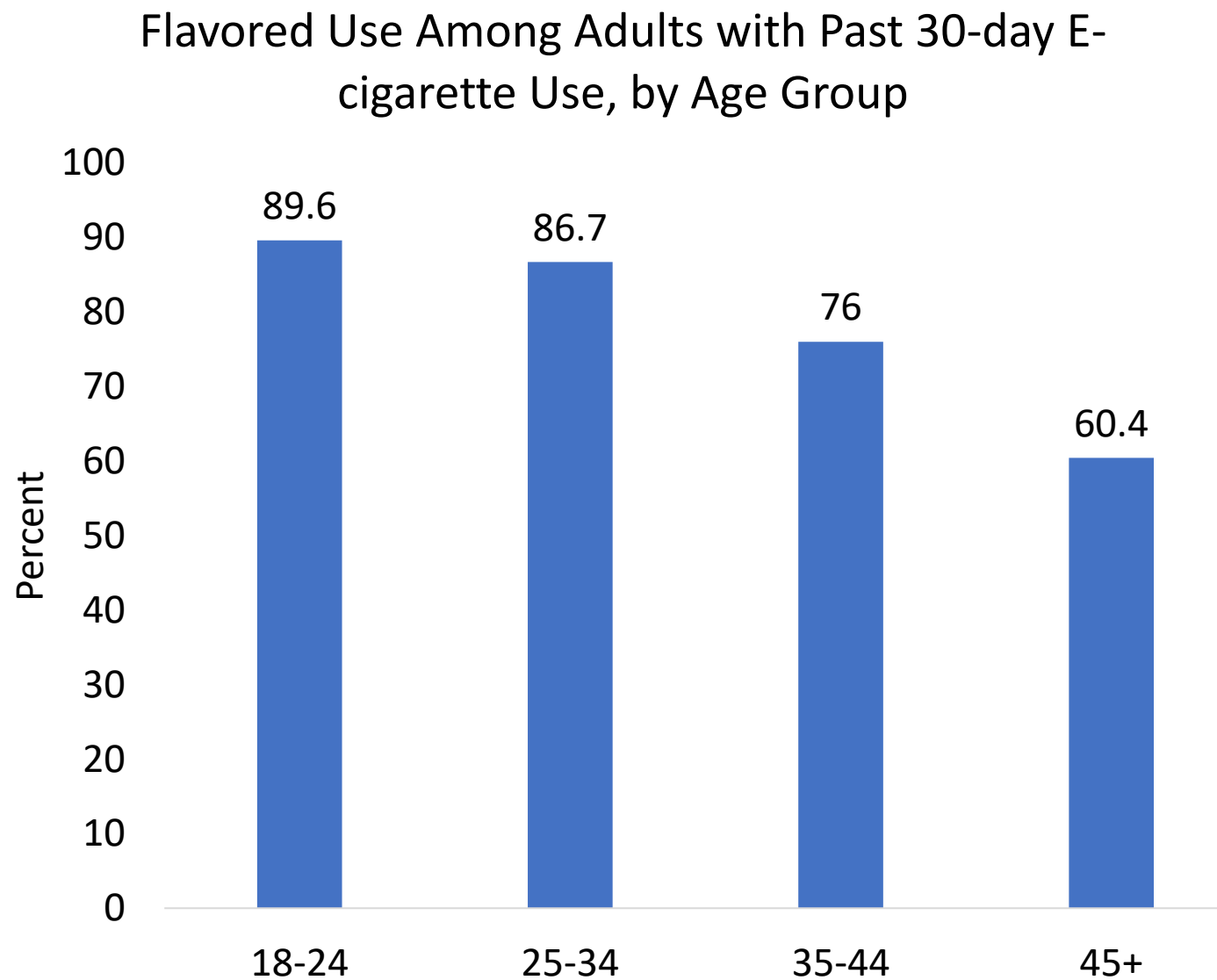
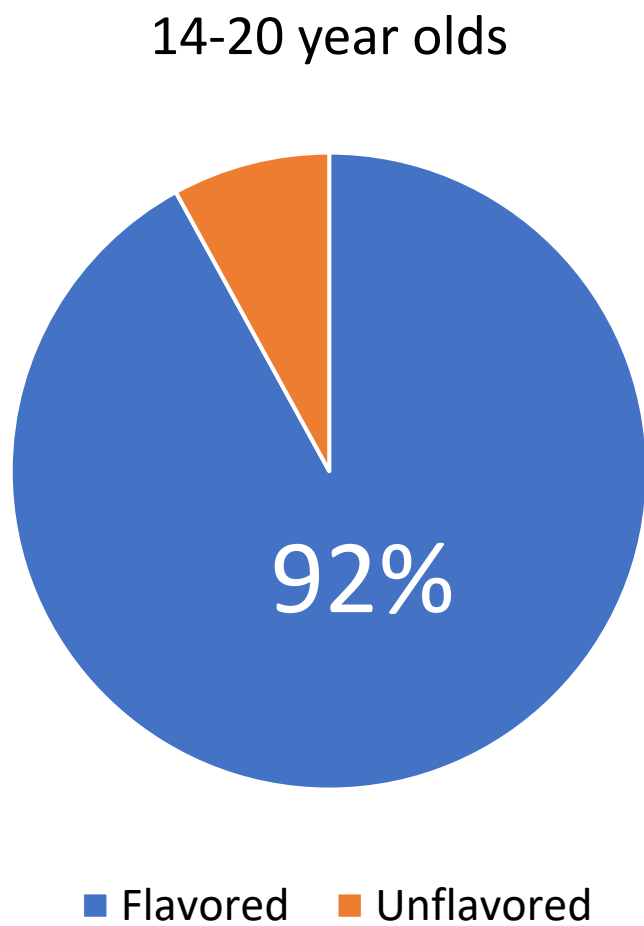


# Disclosures

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- Declarations of interest:
  - Dr. Kingsbury has not received any tobacco-related funding over the last 10 years for any research.
  - Dr. Compton reports long-term stock holdings in General Electric Company, 3M Company, and Pfizer Incorporated, unrelated to this work. The other authors have no conflicts of interest.
- Disclaimer: The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the U.S. Department of Health and Human Services or any of its affiliated institutions or agencies.

Figure 7. National E-Cigarette Unit Sales by Flavor, 4 Week Estimates 2018-2023





# Reasons for use differ by age

## Adolescents and young adults

- Stronger preference for fruit and candy flavors
- More likely to try e-cigarettes out of curiosity
- Perceive sweet and candy-flavored e-cigarettes as less harmful than tobacco-flavored e-cigarettes

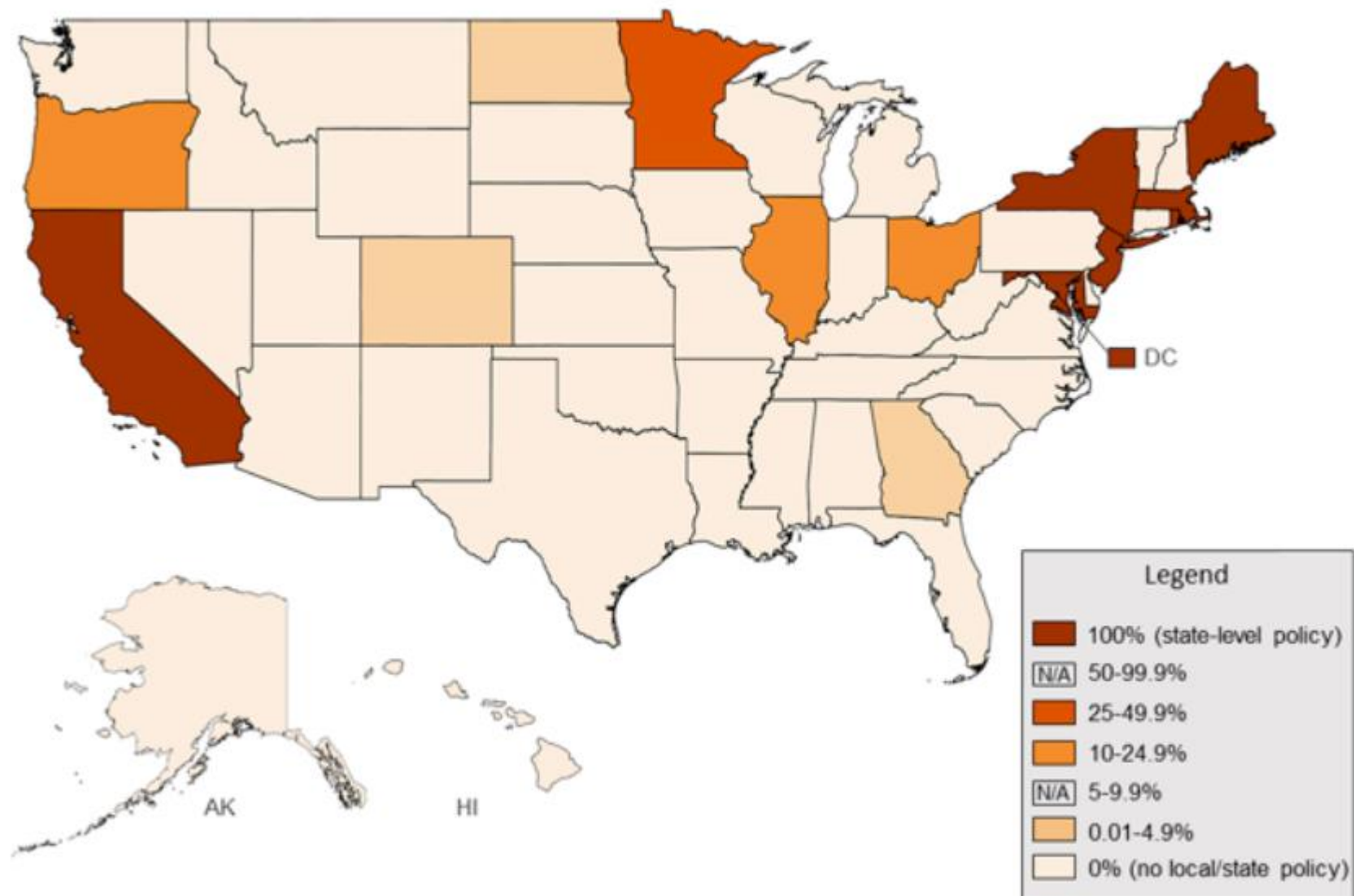
## Older young adults (aged 25+)

- Stronger preference for tobacco and mint/menthol flavors
- Commonly use tobacco or menthol flavored e-cigarettes to quit combustible cigarettes

# Poll question

- Which of the following is NOT an e-cigarette/e-juice flavor?
  - A. Bacon
  - B. Bubba's pig sap
  - C. Roast chicken
  - D. Thanksgiving stuffing
  - E. Beetlejuice
  - F. Tuna
  - G. Unicorn vomit

Percent of state population covered by a flavored tobacco sales restriction  
As of December 31, 2024



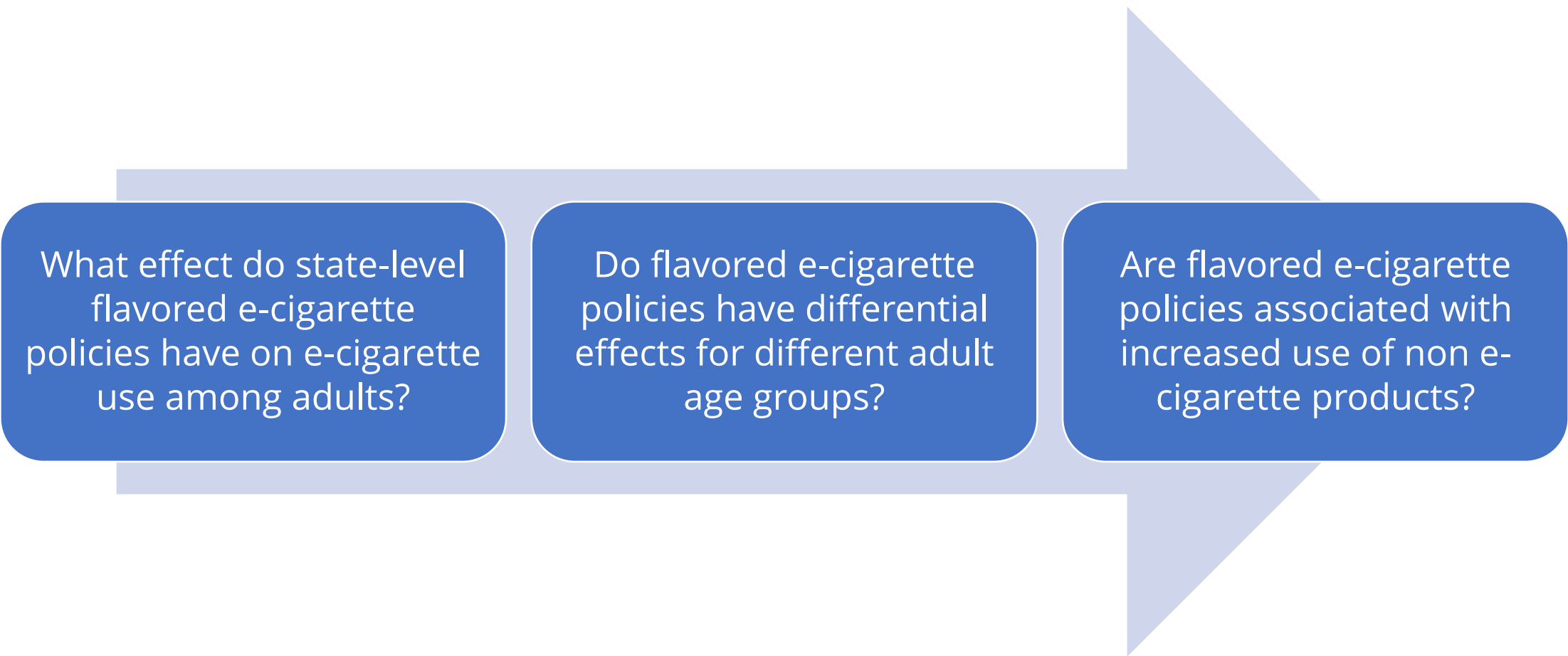
# Are there unintended consequences of flavored e-cigarette policies?

Flavored policies can influence post-implementation behavior

- Purchasing online or from unaffected locales
- Switching to a combustible product

Conversely, there is evidence that using e-cigarettes to successfully quit smoking is unrelated to preference for flavored e-cigarettes





What effect do state-level flavored e-cigarette policies have on e-cigarette use among adults?

Do flavored e-cigarette policies have differential effects for different adult age groups?

Are flavored e-cigarette policies associated with increased use of non e-cigarette products?



The Population Assessment of Tobacco and Health (PATH) Study is an ongoing nationally representative longitudinal cohort study of tobacco use and health in the United States. A collaboration between the National Institute of Health (NIH) National Institute on Drug Abuse (NIDA), and the U.S. Food and Drug Administration (FDA) Center for Tobacco Products, the study was launched in 2011. There were over 40,000 respondents aged 12 and older in the last full wave of data collection.

To learn more:



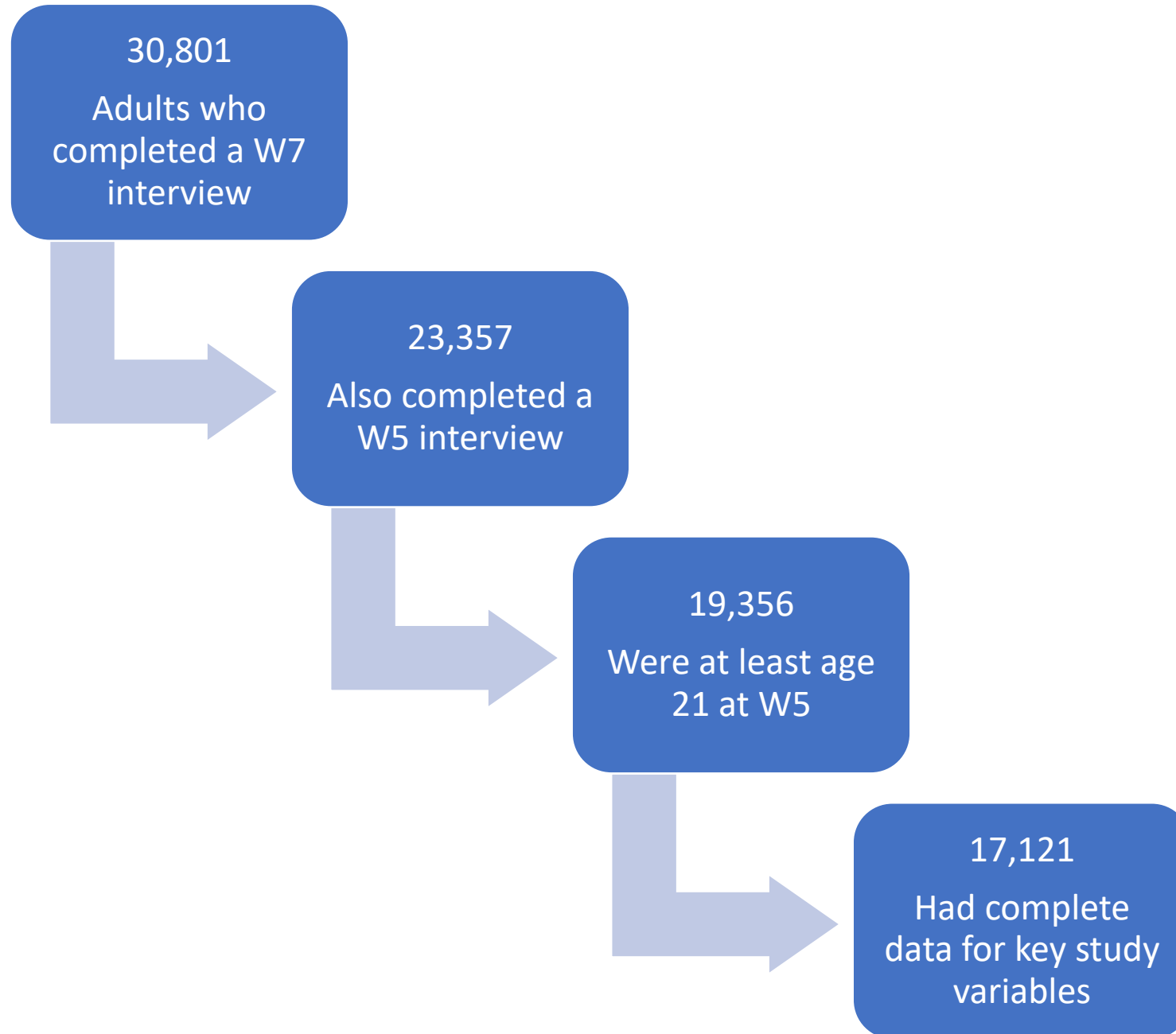
Nationally representative  
sample of adults (21+)

Pre-/post-test non-  
equivalent groups design

W5: 12/2018 – 11/2019

W7: 1/2022 – 4/2023





## Outcomes

- **W7 E-cigarette use**
  - Past 30-day (P30D)
  - Current established use: Ever used the e-cigarettes “fairly regularly” AND currently using some days or every day
- **P30D Tobacco use other than e-cigarettes**

## Predictor

- Living in a state that had implemented a flavored e-cigarette policy between W5 and W7

## Covariates

- Age
- Sex
- Race/ethnicity
- Education
- Living in a state with an e-cigarette tax
- Living in a state with comprehensive clean indoor air laws

## Hierarchical logistic regression models

```
graph TD; A[Hierarchical logistic regression models] --> B[Overall: Time X Policy]; A --> C[Stratified by age: 21-24, 25-29, 30-39, 40+]; A --> D[Non-ecig use: Time X Policy X Tobacco use other than e-cigarettes]
```

Overall: Time X  
Policy

Stratified by age: 21-  
24, 25-29, 30-39, 40+

Non-ecig use: Time X  
Policy X Tobacco use  
other than e-cigarettes

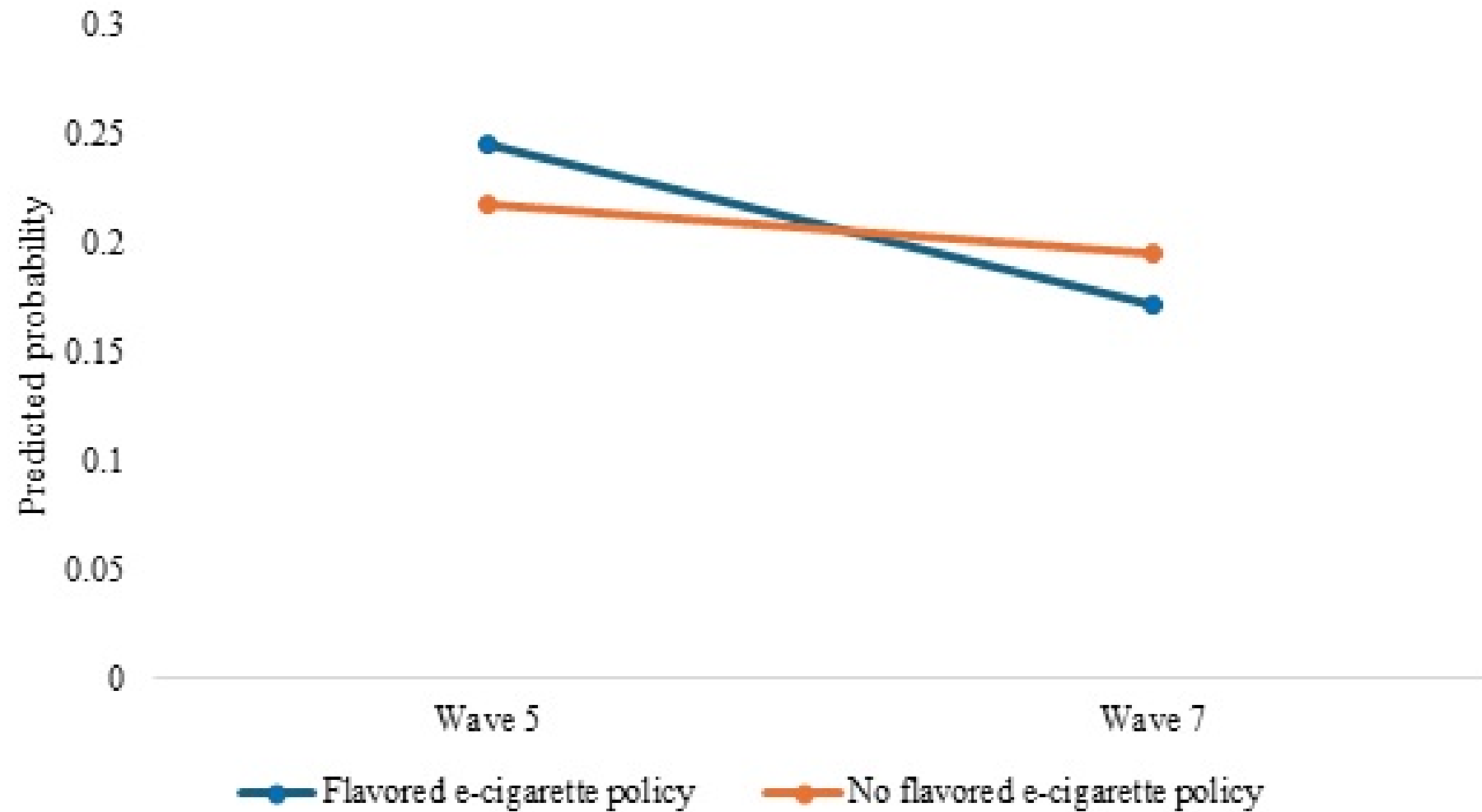
Characteristic	Frequency	%	95% CI
<b>W5 Age (<i>M</i>)</b>	48.4	--	(48.3, 48.6)
<b>State clean indoor air</b>			
Yes	9876	57.6%	(54.7, 60.5)
No	7245	42.4%	(39.5, 45.3)
<b>State e-cigarette tax</b>			
Yes	8090	49.5%	(45.4, 55.5)
No	9031	50.5%	(44.5, 54.6)
<b>State flavored e-cigarette policy</b>			
Yes	1720	11.6%	(9.0, 14.8)
No	15401	88.4%	(85.2, 91.0)
<b>W5 P30D e-cigarette use</b>			
Yes	2354	8.0%	(7.6, 8.4)
No	14767	92.0%	(91.6, 92.4)
<b>W7 P30D e-cigarette use</b>			
Yes	2081	7.1%	(6.7, 7.5)
No	15040	92.9%	(92.5, 93.3)
<b>W5 Established e-cigarette use</b>			
Yes	1229	4.3%	(4.0, 4.6)
No	15892	95.7%	(95.4, 96.0)
<b>W7 Established e-cigarette use</b>			
Yes	1422	4.7%	(4.5, 5.0)
No	15699	95.3%	(95.0, 95.5)
<b>W5 P30D tobacco use other than e-cigarettes</b>			
Yes	6516	24.6%	(23.9, 25.2)
No	10599	75.4%	(74.8, 76.1)
<b>W7 P30D tobacco use other than e-cigarettes</b>			
Yes	5563	20.7%	(20.2, 21.4)
No	11553	79.3%	(78.6, 79.8)

Variables	Overall		Age 21-24		Age 25-29		Age 30-39		Age 40+	
	AOR	95% C.I.	AOR	95% C.I.	AOR	95% C.I.	AOR	95% C.I.	AOR	95% C.I.
<i>Past 30-day e-cigarette use</i>										
Time (W7 vs W5)	0.83***	(0.75, 0.91)	0.79*	(0.64, 0.97)	1.05	(0.86, 1.30)	1.00	(0.81, 1.23)	0.62***	(0.51, 0.76)
Flavored policy (vs. no policy)	0.96	(0.64, 1.46)	1.30	(0.57, 2.94)	1.31	(0.65, 2.64)	0.88	(0.41, 1.88)	0.60	(0.30, 1.20)
Time*Flavored policy	0.76	(0.53, 1.11)	0.59*	(0.36, 0.97)	0.64	(0.32, 1.29)	0.90	(0.42, 1.93)	0.89	(0.36, 2.22)

Notes. N = 17,121. \*\*\* p<.001; \*\*p<.01; \*p<.05. AOR = Adjusted odds ratio. C.I. = Confidence interval. All models adjusted for education, race/ethnicity, sex, state e-cigarette tax, and state clean indoor air policy, and the overall model additionally adjusted for age.



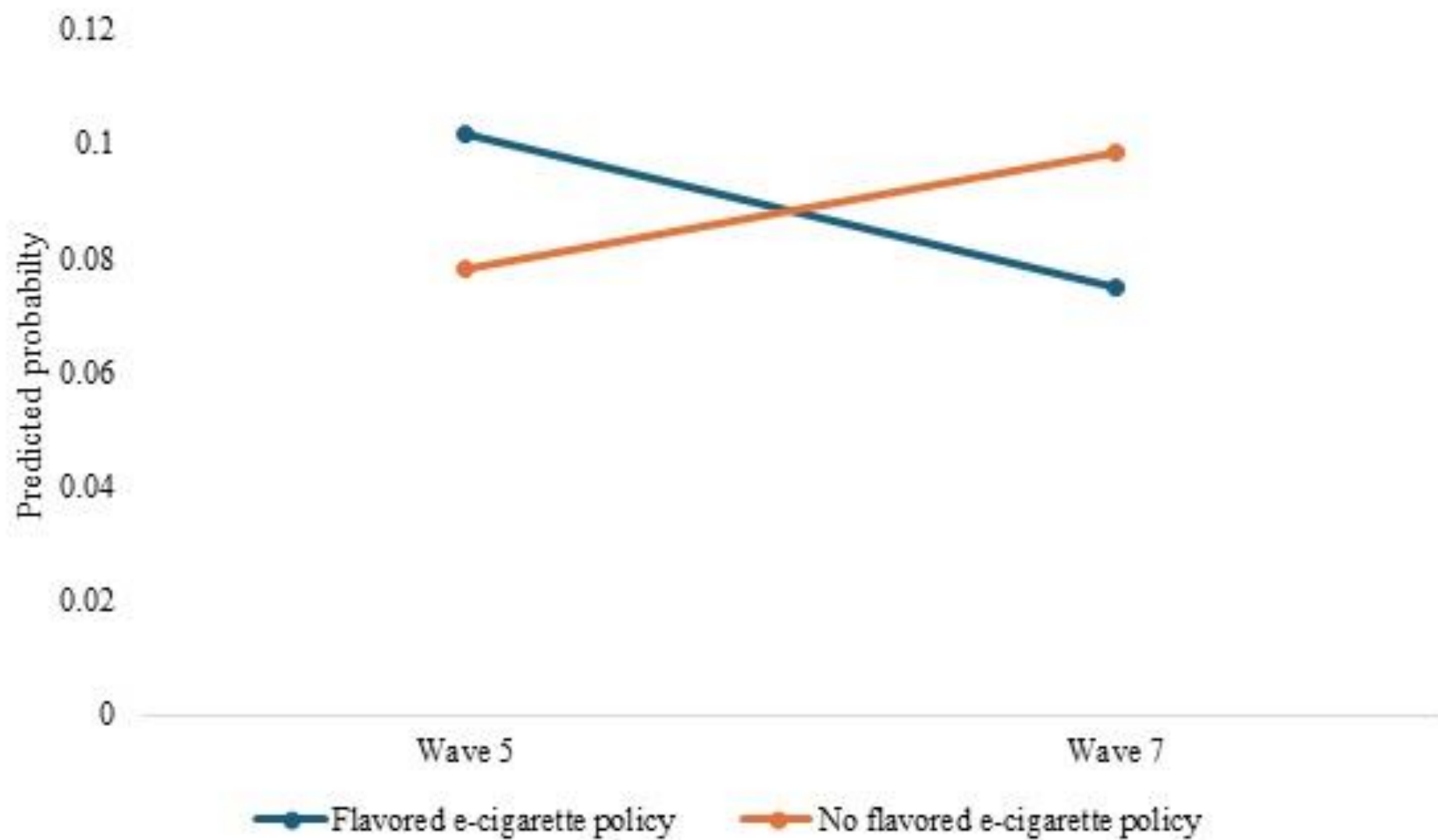
### Past 30-day e-cigarette use, ages 21-24



Variables	Overall		Age 21-24		Age 25-29		Age 30-39		Age 40+	
	AOR	95% C.I.	AOR	95% C.I.	AOR	95% C.I.	AOR	95% C.I.	AOR	95% C.I.
<i>Established e-cigarette use</i>										
Time (W7 vs W5)	1.31***	(1.14, 1.50)	1.39*	(1.01, 1.91)	1.62	(1.16, 2.27)	1.46*	(1.08, 1.96)	1.00	(0.77, 1.30)
Flavored policy (vs. no policy)	0.97	(0.54, 1.76)	1.26	(0.56, 2.84)	1.74	(0.54, 5.65)	0.51	(0.48, 1.76)	0.22*	(0.07, 0.72)
Time*Flavored policy	0.65	(0.37, 1.13)	0.73	(0.34, 1.54)	0.32**	(0.14, 0.76)	1.11	(0.41, 3.02)	0.57	(0.15, 2.21)

Notes. N = 17,121. \*\*\* p<.001; \*\*p<.01; \*p<.05. AOR = Adjusted odds ratio. C.I. = Confidence interval. All models adjusted for education, race/ethnicity, sex, state e-cigarette tax, and state clean indoor air policy, and the overall model additionally adjusted for age.

### Established e-cigarette use, ages 25-29



Variables	Overall		Age 21-24		Age 25-29		Age 30-39		Age 40+	
	AOR	95% C.I.	AOR	95% C.I.	AOR	95% C.I.	AOR	95% C.I.	AOR	95% C.I.
<i>Tobacco use other than e-cigarettes</i>										
Time (W7 vs W5)	0.44***	(0.39, 0.50)	0.45***	(0.37, 0.56)	0.45***	(0.37, 0.56)	0.38** *	(0.30, 0.49)	0.45***	(0.37, 0.56)
Flavored policy (vs. no policy)	0.56	(0.24, 1.34)	0.78	(0.36, 1.69)	1.95	(0.68, 5.65)	0.46	(0.11, 1.99)	0.78	(0.36, 1.69)
Time*Flavored policy	0.95	(0.67, 1.36)	1.06	(0.59, 1.89)	0.89	(0.44, 1.82)	1.61	(0.72, 3.60)	1.05	(0.59, 1.89)

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# Key takeaways

Flavored e-cigarette policies were associated with:

- Less P30D e-cigarette use among young adults (21-24)
- Less established e-cigarette use among older young adults (25-29)
- No change in e-cigarette use among older adults (30+)

# Implications

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Among adults, flavored e-cigarette policies have strongest effect among younger adults (21-29)

Additional strategies may be needed to reduce use among those 30+

Reduced concerns about use of other products

Additional research is needed to explore equity implications

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*For more information on the PATH Study:*



John H. Kingsbury, PhD

[John.Kingsbury@nih.gov](mailto:John.Kingsbury@nih.gov)

National Institute on Drug Abuse, Kelly Government Solutions

