

# Economics of E-cigarettes: Background, Theory, and Evidence

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Slides updated 2/23/2022 and are “free use.” Click [here for most up-to-date slides](#). Please e-mail corrections / suggestions to [mpesko@gsu.edu](mailto:mpesko@gsu.edu).

No tobacco or pharmaceutical company funding to report.

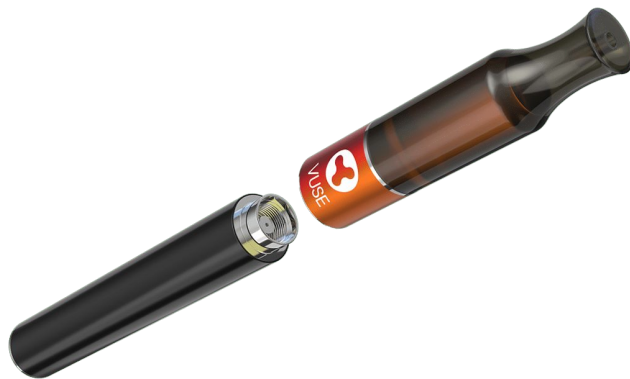
Dr. Pesko’s e-cigarette research summary available [here](#). Dr. Pesko’s research goal is to provide causal evidence on the effect of tobacco policies, with the goal of reducing tobacco-related disease and death to nearly non-existent levels.

# Combustible tobacco use is deadly and costly

- **480,000+:** Annual tobacco-related deaths in U.S.
- **\$170 billion:** Annual tobacco-related health care costs in U.S.
- **5.6 million:** U.S. kids under 18 alive today who will ultimately die from smoking (unless smoking rates decline)
- **Seven million+:** Annual tobacco-related deaths worldwide
- **\$1.4 trillion (USD):** Annual economic costs from smoking worldwide
- **One billion:** Worldwide deaths from tobacco this century unless urgent action is taken

# An alternative nicotine product

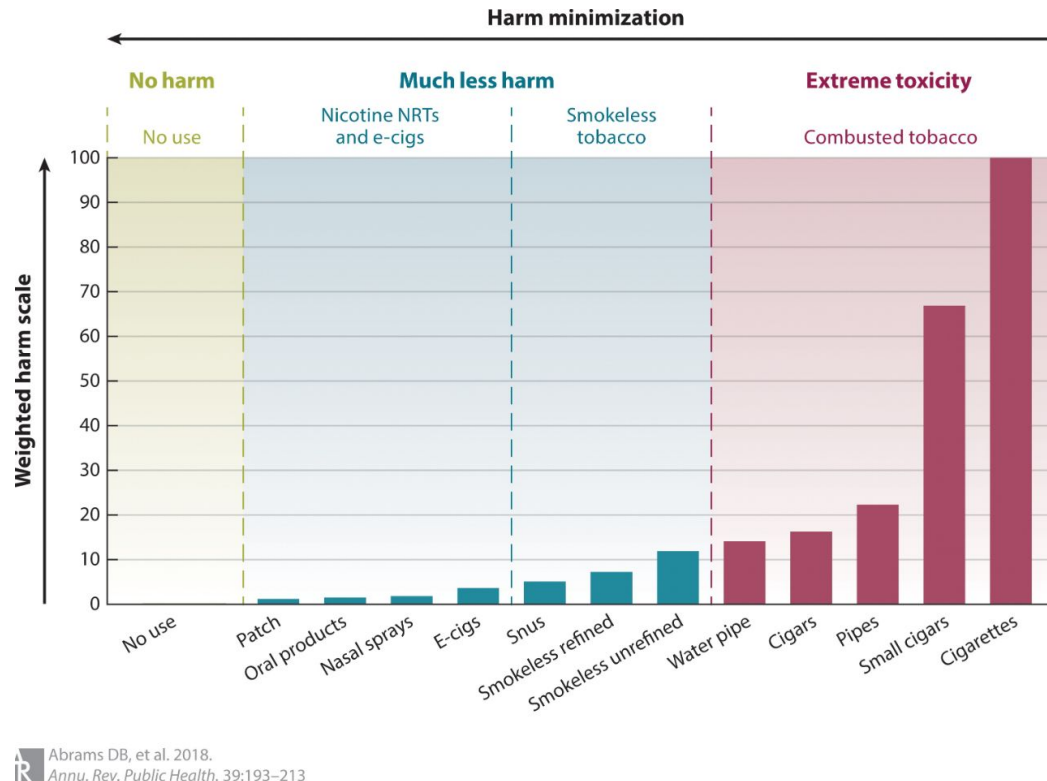
- E-cigarettes are part of a broader class of devices known as electronic nicotine delivery systems (ENDS).
  - Battery-powered devices that deliver nicotine vapor and varying levels of other chemicals and metals.



# Tobacco harm reduction?

- Harm reduction is a standard part of public health policy, though its application to e-cigarettes is controversial.
  - Seat belts for cars
  - Bicycle helmets for bicycles
  - Condoms for risky sex
  - Needle exchange programs and methadone for substance use disorder
  - E-cigarettes for nicotine addiction?

# Are e-cigarettes a safer nicotine product?



Though our understanding of e-cigarettes has improved significantly from 2014 to today, [Nutt et al. 2014](#) provides a useful starting point to think about dangers of different nicotine products (original figure modified by [Abrams et al. 2018](#)).

# Are e-cigarettes a safer nicotine product?

- Two government-commissioned systematic reviews on the question:
  - The [National Academies of Sciences, Engineering, and Medicine](#) (2018) in the United States state that e-cigarettes are not without risk, but compared to combustible tobacco cigarettes they contain fewer toxicants and are likely to be far less harmful than combustible tobacco cigarettes.
  - [Public Health England](#) (2018) finds that e-cigarettes sold in England (which are regulated to a [nicotine strength](#) of no more than [20mg/ml](#)) are substantially safer than cigarettes for non-pregnant adults.
    - E-cigarette dangers to be re-reviewed

# Are e-cigarettes a safer nicotine product?

- US government agencies offer limited statements supporting e-cigarettes being safer products.
  - The [CDC](#) states: E-cigarettes have the potential to benefit adult smokers who are not pregnant if used as a complete substitute for regular cigarettes and other smoked tobacco products.
  - The Food and Drug Administration does not believe that nicotine itself is harmful for non-pregnant adults besides causing addiction. [The FDA states](#): “nicotine is what addicts and keeps people using tobacco products, but it is not what makes tobacco use so deadly.”

# Are e-cigarettes a safer nicotine product?

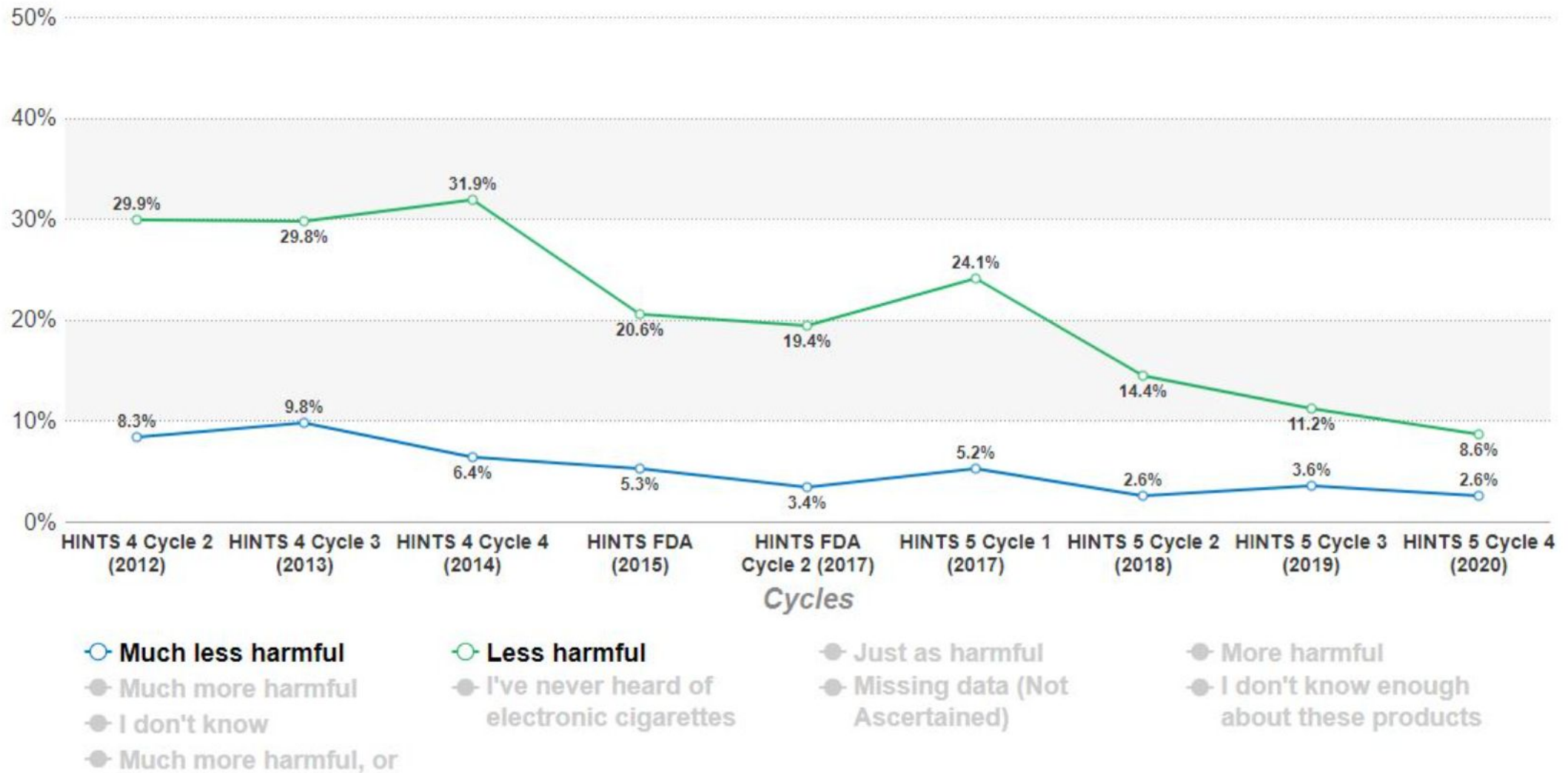
- [Surgeon General \(2016\)](#) appears to be an outlier in terms of warning of health dangers of e-cigarettes.
  - “E-cigarette aerosol is not harmless. It can contain harmful and potentially harmful constituents, including nicotine.”
  - “Nicotine exposure during adolescence can cause addiction and can harm the developing adolescent brain.”
    - Reviewed studies only document this relationship in rodents and do not show evidence for humans.
- [Surgeon General \(2018\)](#) also declared youth e-cigarette use an “epidemic,” though without evidence of observed harms.
- Surgeon General is a political appointee without a team of scientists to help with decision-making; potentially lower quality health information.

# Are e-cigarettes a safer nicotine product?

Concerns about e-cigarette or vaping product use-associated lung injury (EVALI).

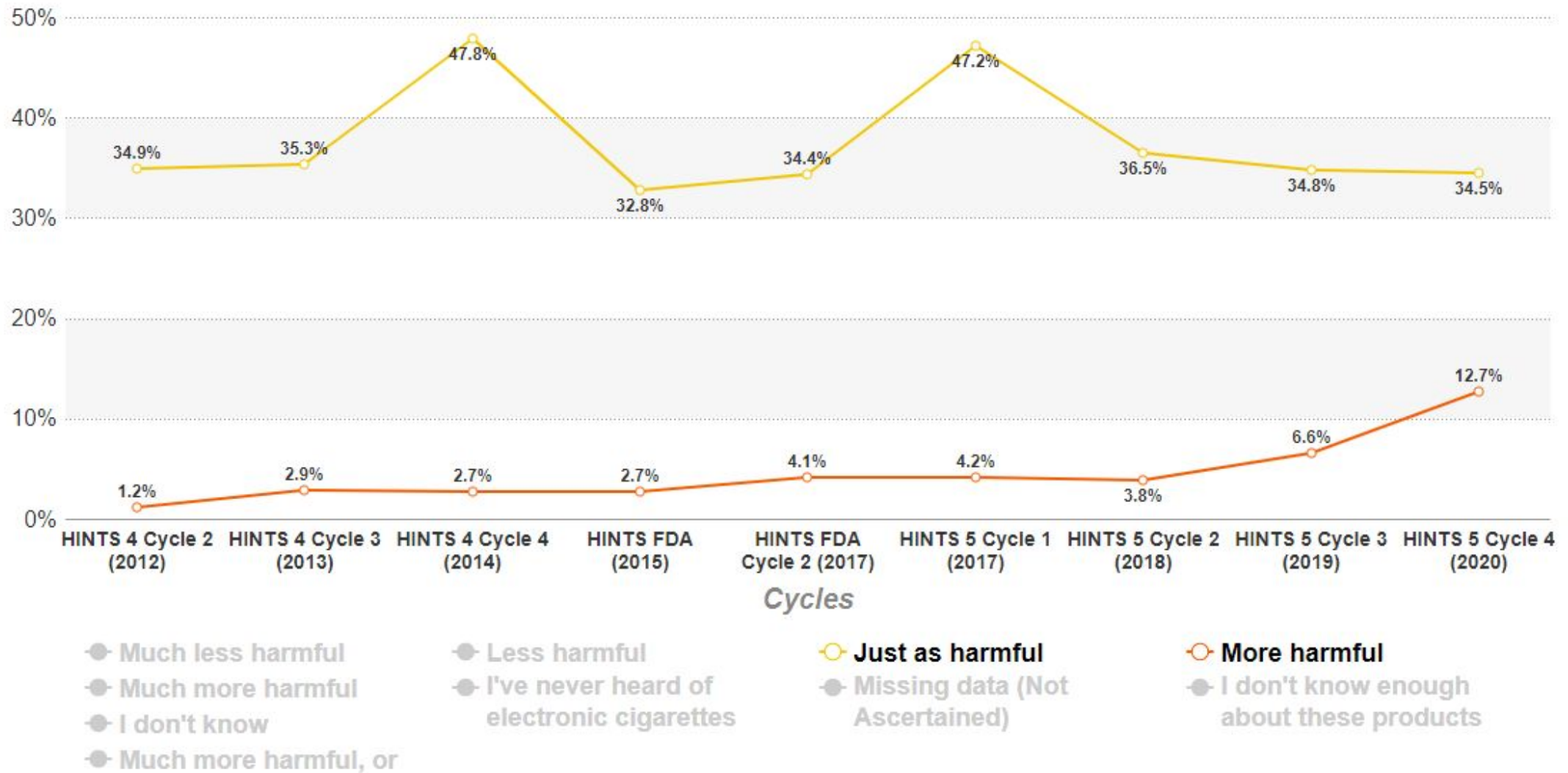
- Despite the name, [mostly linked](#) to vitamin E acetate from THC products.
- EVALI being initially wrongly attributed to e-cigarettes caused sharp increases in risk perception relative to cigarettes ([Dave et al. 2020](#)).
- Public risk perceptions of e-cigarettes are over-estimated, though not necessarily due to EVALI ([Viscusi 2020](#)).
- [75 experts](#) asked the CDC to rename EVALI to more accurately communicate the dangers of THC products to the public, and so that individuals are not unnecessarily fearful of trying to quit cigarettes with e-cigarettes.
  - As of now, the CDC [declines to change the name](#), but efforts to encourage them to do so remain ongoing.

Compared to smoking cigarettes, would you say that electronic cigarettes are...



Source: Health Information National Trends Survey

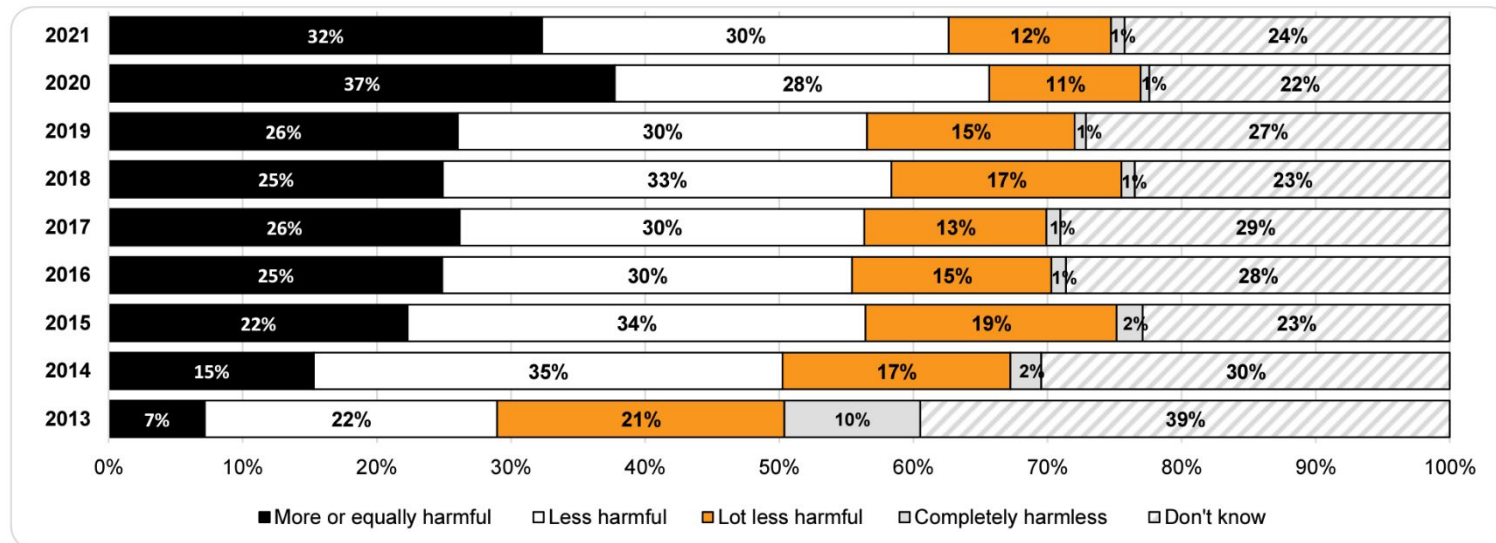
Compared to smoking cigarettes, would you say that electronic cigarettes are...



Source: Health Information National Trends Survey

# Perceptions of risk in Great Britain:

Figure 8: GB adults perception of harm from e-cigarettes (2013-2021)



Unweighted base: All GB adults who have heard of e-cigarettes: 2013, n=8936; 2014, n=11,307; 2015 n=11,340; 2016 n=11,489; 2017 n=12,101; 2018, n=12,070; 2019, n=11,634; 2020, n=11,954, 2021, n=11,429).

# Are e-cigarettes a safer nicotine product?

Unfortunately, individuals believe e-cigarettes are more harmful than they are.

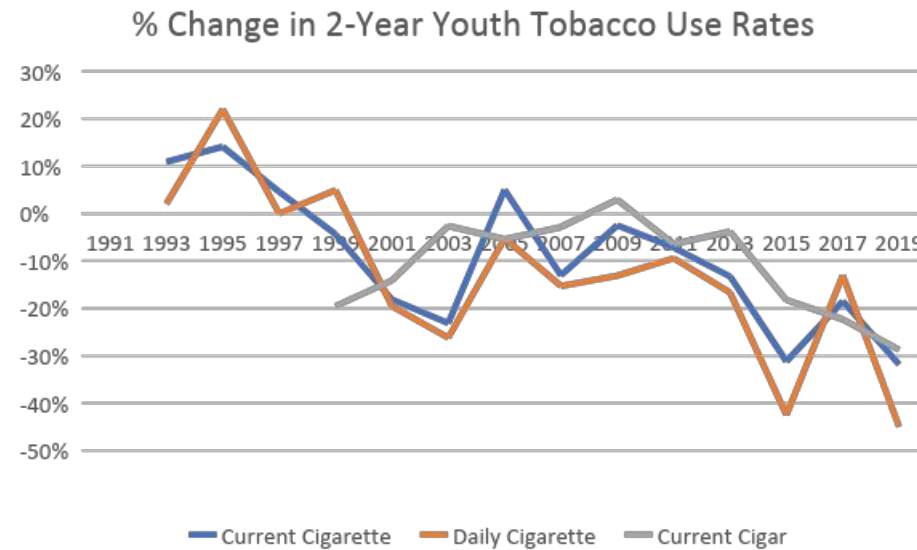
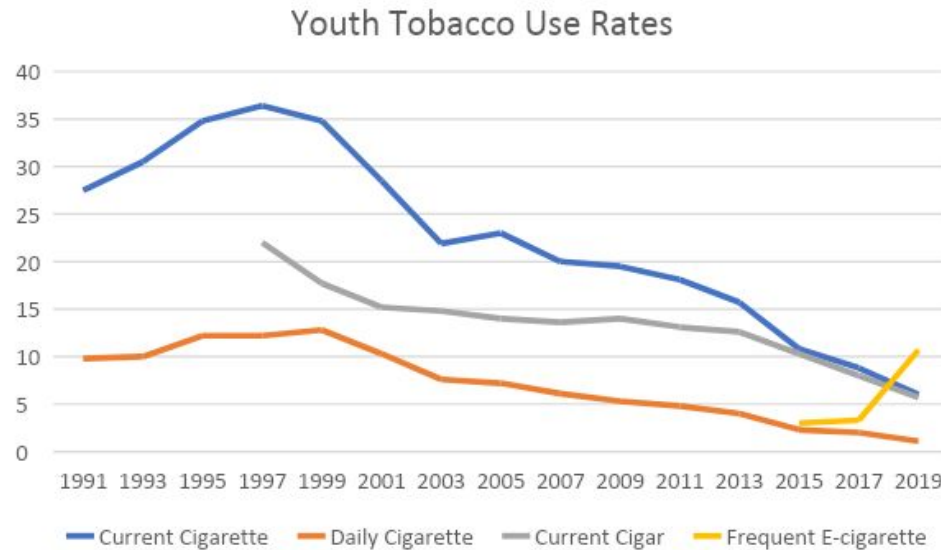
- 80% of U.S. physicians incorrectly believe that nicotine causes cancer ([Steinberg 2020](#)).
  - More physicians incorrectly believe that nicotine causes cancer than correctly believe that nicotine causes birth defects.



# Are e-cigarettes effective smoking cessation products?

- A Cochrane review of the literature found that quit rates were higher in people randomized to nicotine e-cigarettes than to other nicotine replacement therapies, translating to approximately 3 extra quitters per 100 ([Hartmann-Boyce 2021](#)).
  - Click [here](#) for a presentation of this paper at [Tobacco Online Policy Seminar](#).
- One particularly strong study: A clinical trial of 886 smokers in England found that e-cigarettes are twice as effective in smoking cessation than other forms of nicotine replacement therapy ([Hajek et al. 2019](#)).

# Prevalence

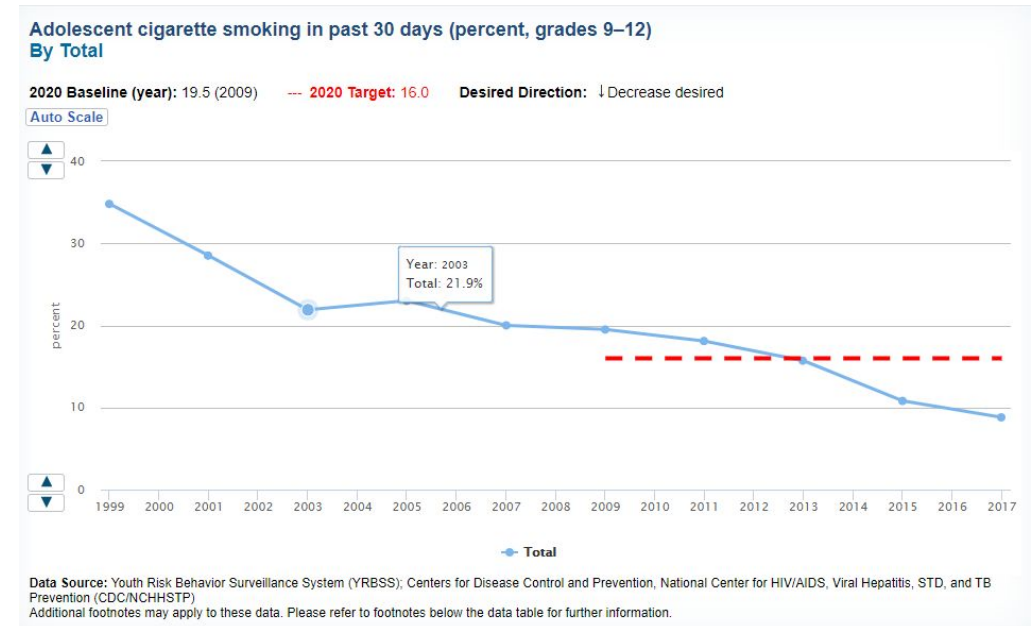


[Trends in the Prevalence of Tobacco Use National YRBS: 1991—2019 | YRBSS | Adolescent and School Health | CDC](#)

- Youth smoking rates continue declining, contrary to gateway prediction.
- In 2019, 32.9% of youth used an e-cigarette over the past 30 days, but only 10.7% used e-cigarettes frequently (20 or more days over the past 30 days).
- Particularly large declines in smoking in 2015 and 2019.
  - Daily smoking rates fell >40% in 2015 and 2019, compared to two years prior.
  - % change is a useful measure because it compensates for the hardening of smokers as levels fall.
  - E.g., It's easier to reduce smoking by 1 percentage point (pp) when the rate is at 15% than at 5%.

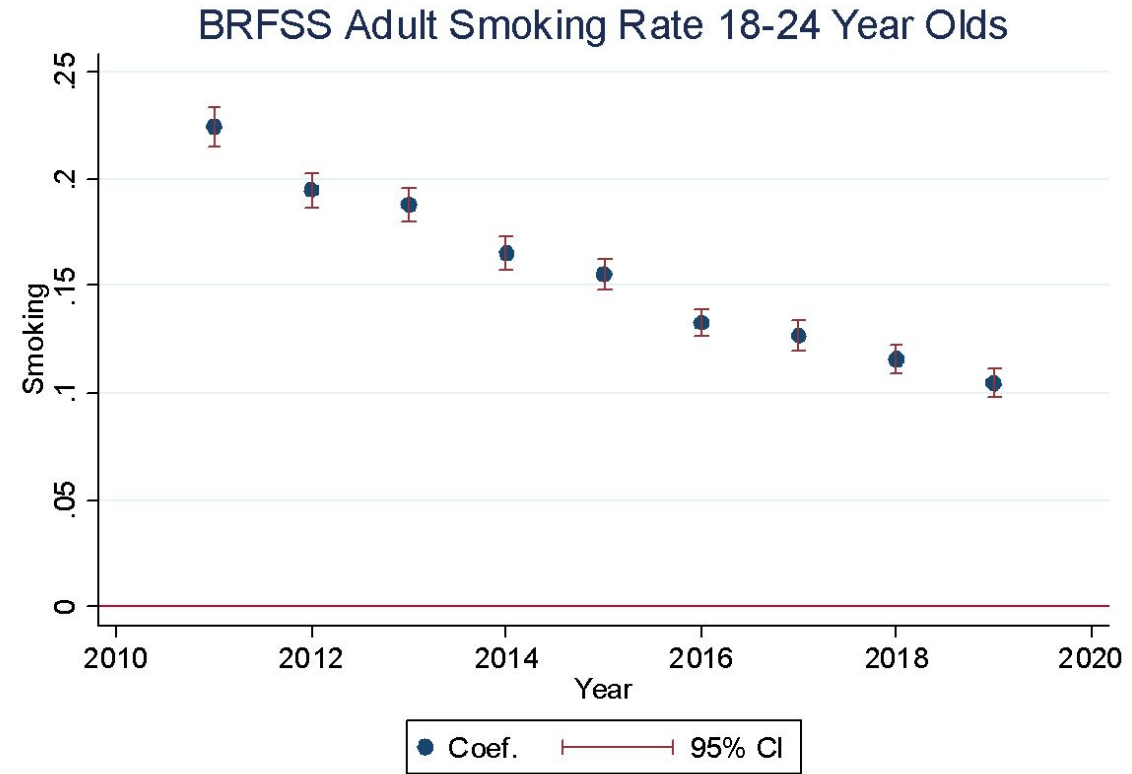
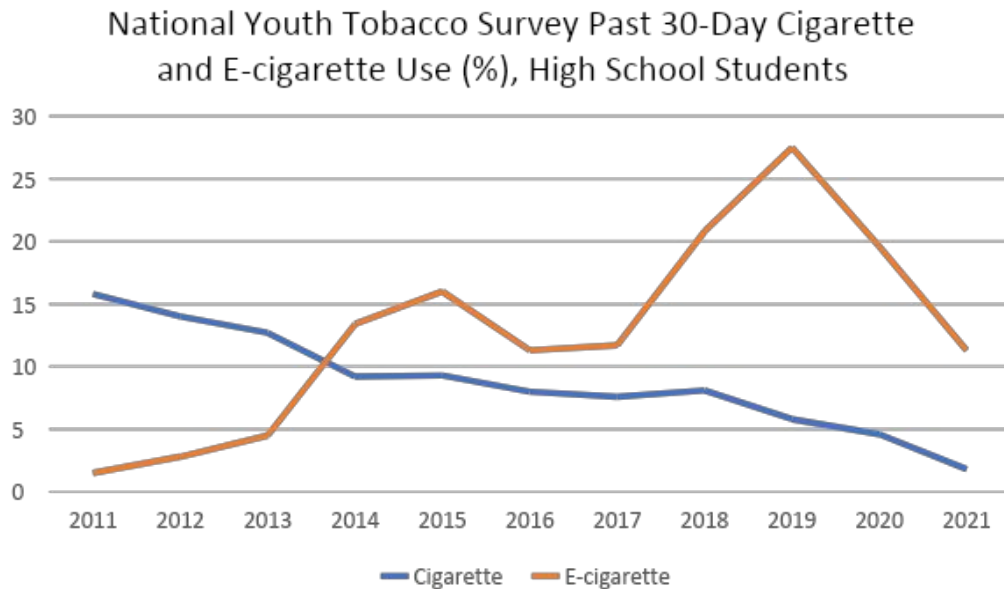
# Prevalence

- Large and unexpected decline in smoking over the past decade since e-cigarettes have come to market.
- In the [2012 Surgeon General report](#), DHHS Secretary Kathleen Sebelius stated that “youth and adult smoking rates that had been dropping for many years have stalled.”
- In 2009, public health leaders in the United States targeted a 16% youth current cigarette use rate as their Healthy People 2020 goal.
  - By 2019, the youth current cigarette use rate was 6%, thus surpassing the Healthy People 2020 goal by 386%.



[Data Chart | Healthy People 2020](#)

# Prevalence



- Other data sources show the same thing: no youth increase in cigarette use by 2021 despite sizable youth e-cigarette use spikes in 2014-15 and again in 2019.

# Prevalence

- E-cigarettes are not as regularly used among adults, with [adult current use](#) at 3.7% in 2020.
- The adult current smoking rate, at 14% in 2019, has declined by a more modest 27.5% between [2011](#) to [2019](#) compared to the more rapid 63.3% decline for youth current cigarette use.
  - Could higher e-cigarette use among adults translate into the larger reductions in smoking seen among youth?
- E-cigarette use may be high among pregnant women smokers: In 2014-17, pregnant smokers were approximately 3x more likely to use e-cigarettes (38.9%) than non-pregnant reproductive age women smokers ([Liu et al. 2019](#)).
  - Pregnant women appear to be using e-cigarettes in high numbers for smoking cessation.

# Gateway?

- So are e-cigarettes displacing cigarettes then?
- [Surgeon General \(2016\)](#) and [National Academies of Sciences, Engineering, and Medicine \(2018\)](#) suggest the opposite.
  - These scientific reports say e-cigarette use is strongly associated with the use of other tobacco products among youth and young adults.
    - An association should at minimum be an expression of the belief in the direction and general magnitude of the causal relationship.
  - But arguing a gateway relationship makes little sense since cigarette use has fallen to record lows.
    - Some argument that declines in smoking follow historical trends, but the continuation of these declines does not support the gateway theory.

# Gateway?

- The [Surgeon General](#) report only used studies of current e-cigarette use on future cigarette use, without using a source of experimental (or quasi-experimental) variation in current e-cigarette use.
  - Likely large omitted variable bias affecting youths' propensity to vape today and smoke tomorrow.
  - Quasi-experimental studies published at the time of writing were not included in the report. [Pesko and Warman 2021](#)
- Click [here](#) for a video discussion for how quasi-experimental methods can be used to address methodological shortcomings of prior studies suggesting a gateway effect is present.

# How might we think about optimally regulating e-cigarettes?

- *New England Journal of Medicine* perspective pieces suggest:
  - “We believe that national, state, and local policymakers should consider an approach that differentially taxes nicotine products in order to maximize incentives for tobacco users to switch from the most harmful products to the least harmful ones” ([Chaloupka, Swenor, Warner 2015](#)).
  - Concept reaffirmed in [Sindelar 2020](#) and [Balfour 2021](#).
- The [Royal College of Physicians in England 2021](#) specifically recommends a 5% tax.

Perhaps this same reasoning can be extended to non-monetary regulations as well (e.g. e-cigarette flavors sold in adult-only stores).

# How might we think about optimally regulating e-cigarettes?

- [Lillard 2020](#) provides a theoretical model in which nicotine is the primary object demanded by e-cigarette consumers, though other factors such as health and convenience are demanded as well.
- Demand considerations:
  - The shadow price of nicotine actually delivered into the bloodstream from a particular device
  - Social costs (or benefits) of using a device
  - Mental or health degradation suffered when using a device
- [Levy et al. 2021](#) provide an overview of structural aspects of the e-cigarette marketplace in the United States, particularly as it relates to Altria-JUUL deal. ([video](#) discussion)

# How might we think about optimally regulating e-cigarettes?

- Economics approach to maximizing social welfare.
  - Used by the FDA in the federal rulemaking process:

**Social benefit of e-cigarette regulation =  
reduced externalities + reduced internalities - lost consumer surplus  
- increased enforcement costs**

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**Social benefit of e-cigarette regulation =  
reduced externalities + reduced internalities - lost consumer surplus  
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- Externalities are costs imposed on others, internalities are unrealized costs imposed on oneself.
  - Positive externalities/internalities may also exist, such as if e-cigarettes reduce cigarette use and/or are safer. These would be entered into the equation as a negative number.

# How might we think about optimally regulating e-cigarettes?

- Economics approach to maximizing social welfare.
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**Social benefit of e-cigarette regulation =  
reduced externalities + reduced internalities - lost consumer surplus  
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- Consumer surplus is the price that individuals would pay for e-cigarettes beyond what they currently pay.
  - Concept: Consumer surplus monetizes “pleasure” that people receive from using e-cigarettes, which is reduced by regulation.

# How might we think about optimally regulating e-cigarettes?

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**Social benefit of e-cigarette regulation =  
reduced externalities + reduced internalities - lost consumer surplus  
- increased enforcement costs**

- Enforcement costs include youth undercover buyer sting inspection programs, tobacco surveillance activities, and tobacco tax audits.
  - These costs are generally small currently, though attempting to criminalize tobacco would likely result in exploding enforcement costs (e.g. police, jails).

# How might we think about optimally regulating e-cigarettes?

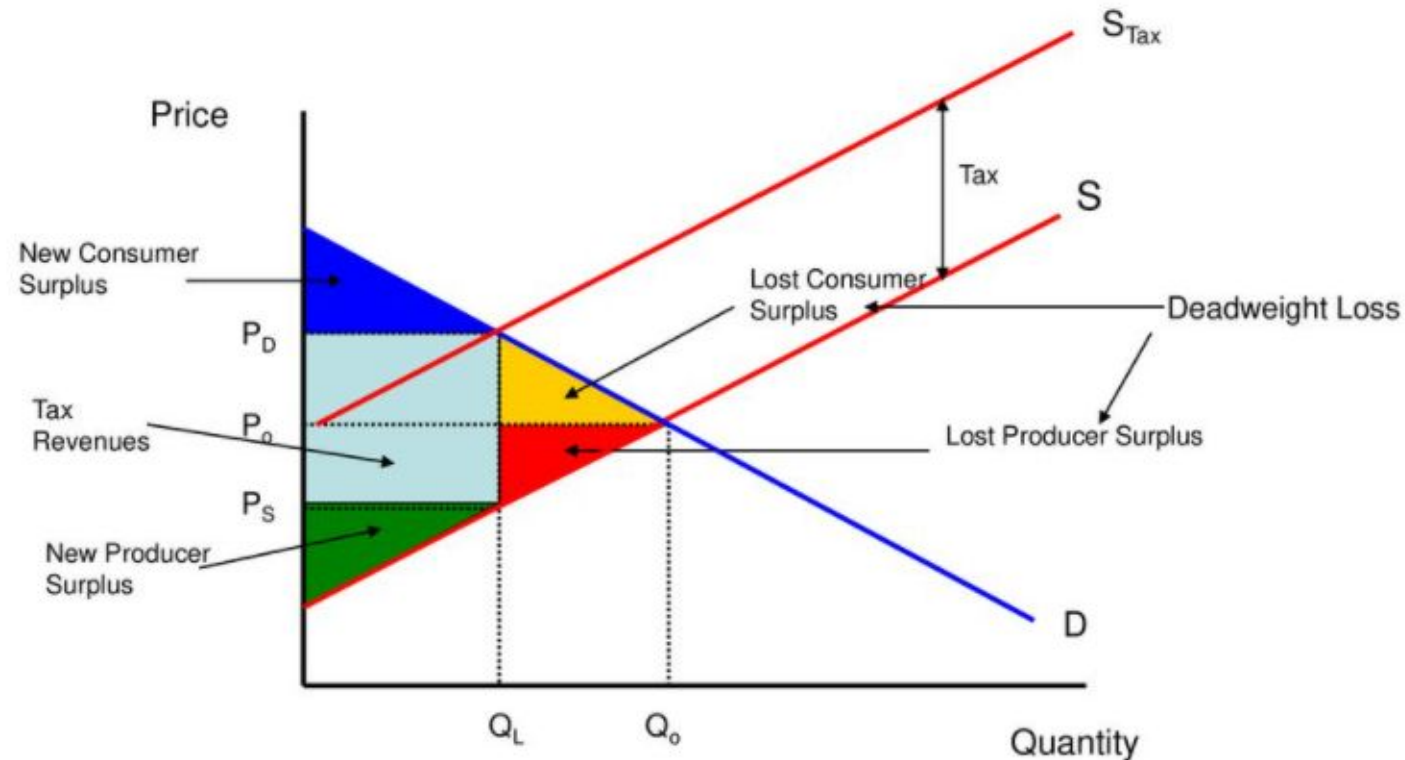
- Economics approach to maximizing social welfare.
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**Social benefit of e-cigarette regulation =  
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- If there is a negative social benefit of e-cigarette regulation, then the optimal policy is a subsidy rather than regulation.
  - Similar in concept to insurance paying for FDA-approved nicotine replacement therapy.

# How might we think about optimally regulating e-cigarettes?

## Loss in Efficiency Taxation



# History of E-cigarette Regulations in the USA

- August 2006: E-cigarettes first enter the United States market.
- June 2009: Food and Drug Administration's Center for Tobacco Products (FDA-CTP) established by Congress, with broad authority to regulate nicotine products "derived from tobacco."
- March 2010: New Jersey implements the first e-cigarette minimum legal sale age (MLSA) and comprehensive e-cigarette indoor use ban (workplaces, restaurants, bars).
- August 2010: Administrative ruling in Minnesota results in the first e-cigarette tax in the nation.

# History of E-cigarette Regulations in the USA

- April 2014: The FDA proposes new regulations to “deem” e-cigarettes and other tobacco products as subject to regulations by the FDA-CTP.
- June 2015: The Juul e-cigarette first introduced.
- May 2016: FDA-CTP issues a final rule that among other things requires e-cigarettes to carry a warning label and implements a national e-cigarette MLSA of 18.
- August 2016: E-cigarettes on the market are eligible to submit a Pre-Market Tobacco Product Application (PMTA) by 2019 to become legally sold (later extended to 9/2020). These e-cigarettes must demonstrate “appropriateness for the protection of public health.” Enforcement discretion allows them to remain on the market until the PMTA application process is resolved.
- Sept. 2018: Juul reaches market share of 72% of all e-cigarette sales, coinciding with a sharp increase in youth e-cigarette use.

# History of E-cigarette Regulations in the USA

- Nov. 2018: The FDA requests that e-cigarette manufacturers not sell e-cigarettes online without strict age verification, limit bulk purchases of e-cigarettes, and remove flavored e-cigarettes from stores that minors can access. The FDA threatens to revoke enforcement discretion if e-cigarette companies are not compliant.
- 2019: Under further scrutiny from the FDA and press, Juul voluntarily ceases selling flavors besides tobacco or menthol.
- Oct. 2019: The CDC introduces the term “E-cigarette, or vaping, product use-associated lung injury” (EVALI) in response to lung injuries primarily affecting THC vaping.
- Dec. 2019: Tobacco-21 law (covering all tobacco products including e-cigarettes) implemented nationally (though not currently enforced federally).

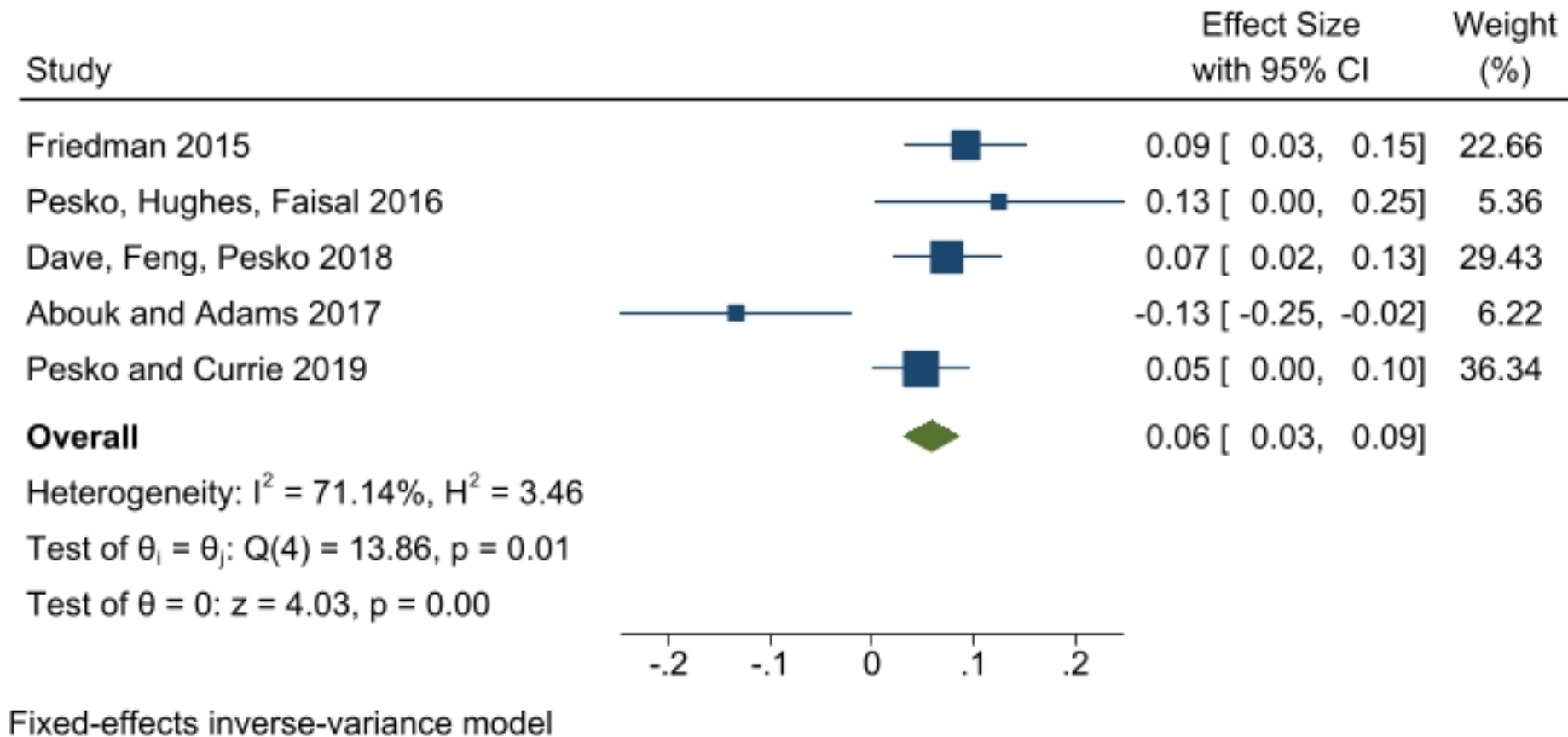
# History of E-cigarette Regulations in the USA

- Feb. 2020: FDA bans flavored, cartridge-based e-cigarette products (other than tobacco- or menthol-flavored products).
- July 2020: FDA orders Puff Bar and other disposable closed-system e-cigarette products off the market because they were not complying with FDA requests on flavors and were used in high numbers by youth.
- Sept. 2020: PMTA applications due that demonstrate appropriateness of e-cigarettes for public health.
- Feb. 2021: Puff Bar returns to the market with a synthetic “tobacco free nicotine” closed system product that puts them outside the regulatory authority of the FDA-CTP.
- Oct. 2021: FDA grants marketing orders for three e-cigarette products, marking the first time e-cigarettes are legally sold in the United States.
- March 2022: The Consolidated Appropriations Act amended the Federal Food, Drug, and Cosmetic Act to now include specific language that the FDA can regulate synthetic nicotine.

# Literature on Minimum Legal Sale Ages

- Three studies use difference-in-differences models and have found that e-cigarette minimum legal sale age (MLSA) laws increase teen smoking by approximately 0.8 to 1.0 percentage points (pp) ([Friedman 2015](#); [Pesko et al. 2016](#); [Dave et al. 2019](#)).
  - Friedman uses the National Survey on Drug Use and Health
  - Other studies use Youth Risk Behavior Surveillance System
- A fourth study also uses a difference-in-differences model and Monitoring the Future data to find that e-cigarette MLSAs decrease high school senior smoking participation by 2.0 pp ([Abouk and Adams 2017](#)).
- One study finds that e-cigarette MLSA laws reduce smoking cessation during pregnancy by 0.6 pp among rural, underage pregnant teenagers ([Pesko and Currie 2019](#)).

# Literature on Minimum Legal Sale Ages



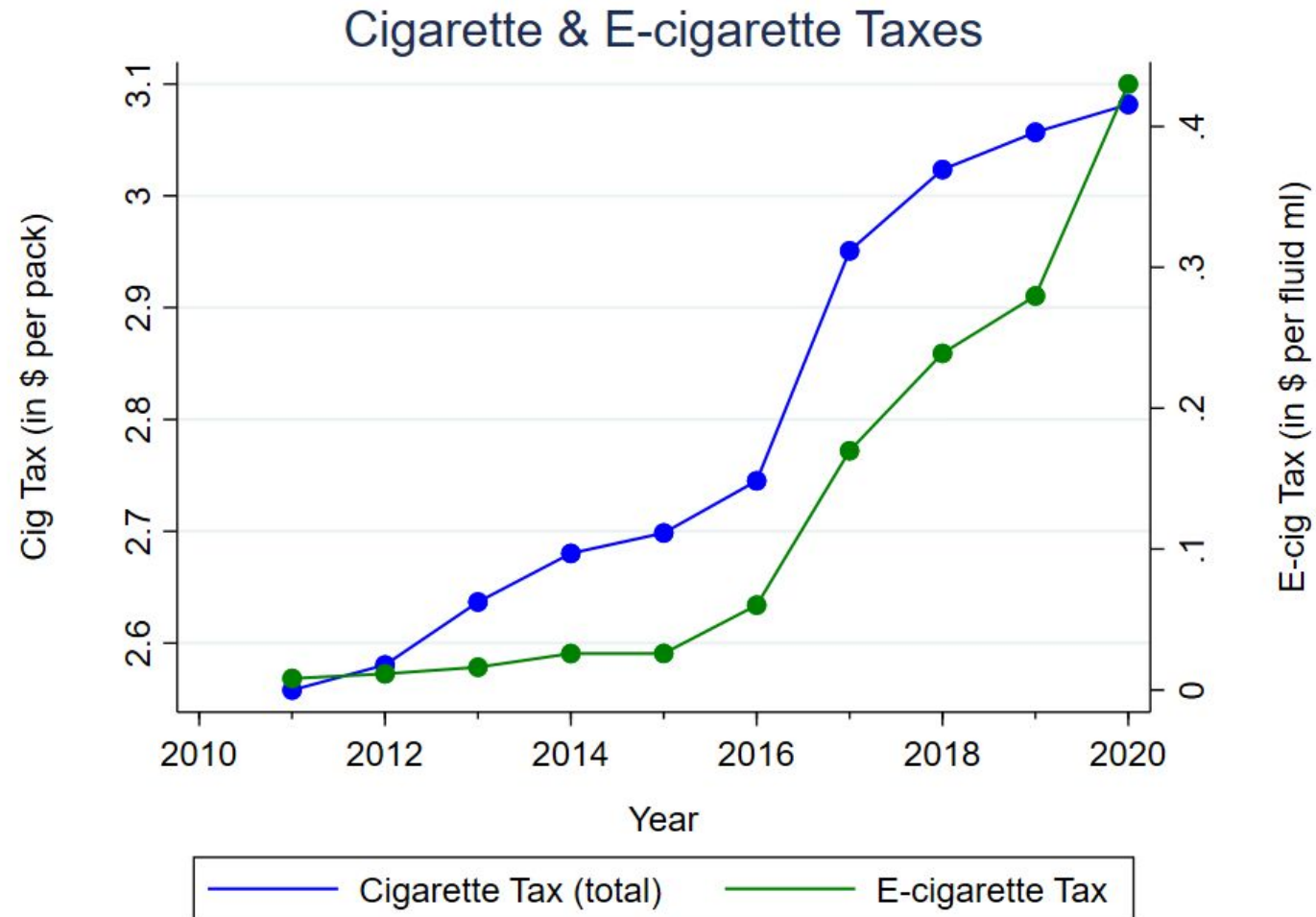
# Literature on Minimum Legal Sale Ages

- One study ([Nguyen 2020](#)) uses Canadian data on youth e-cigarette use from 2013-17 to study province-level e-cigarette MLSAs.
- Difference-in-differences models suggest MLSAs:
  - Reduce e-cigarette use among youth by 4.3 pp (more than halving the increase that would otherwise occur).
  - Reduce belief that regular e-cigarette use poses no harm by 2.6 pp.
  - Increase self-reported greater difficulty in obtaining e-cigarettes by 6.2 pp.

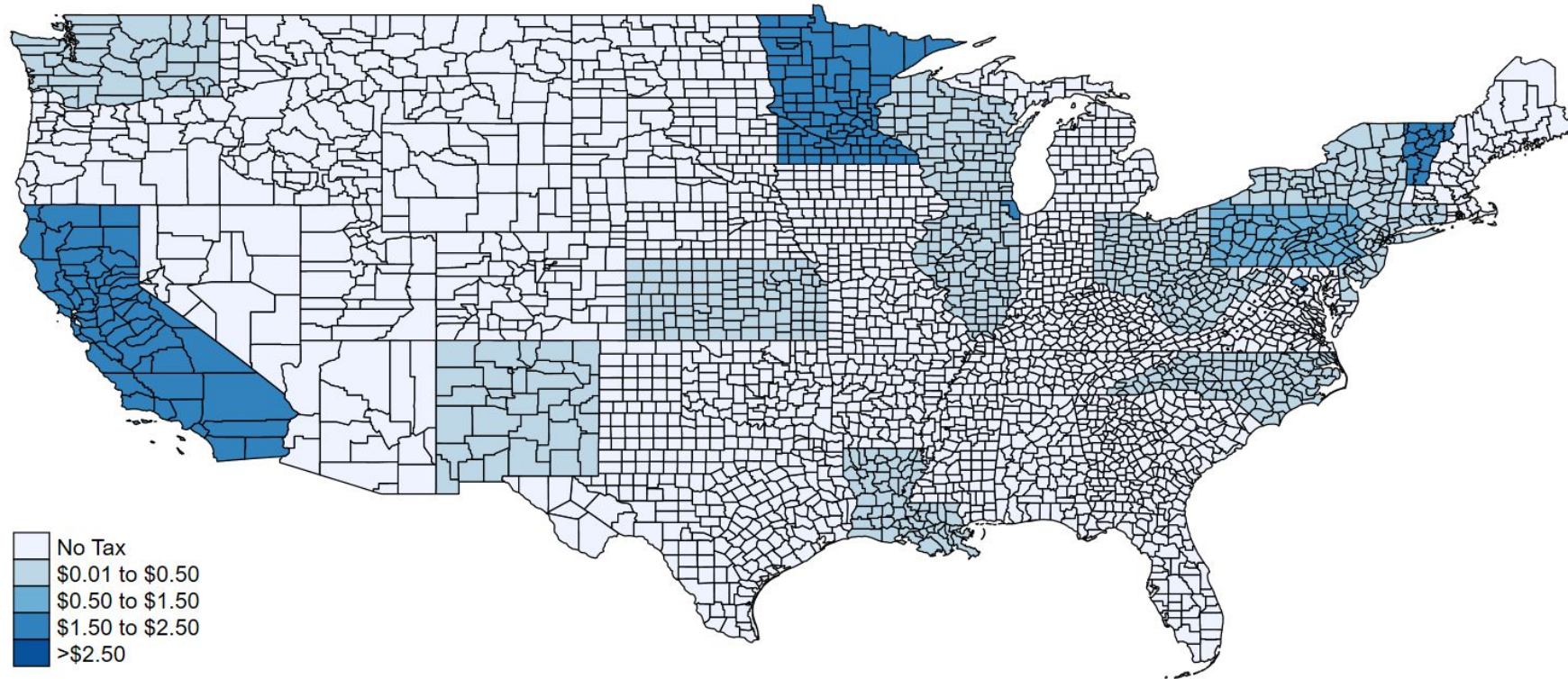
# Literature on E-cigarette Taxes

- Prices could be endogenous because of omitted variables affecting market-level e-cigarette demand and individual-level e-cigarette use.
- Solution is to use an exogenous source of variation in e-cigarette prices.
- One approach is to use a discrete choice experiment with experimental variation in e-cigarette prices ([Pesko et al. 2016](#); [Kenkel et al. 2020](#); [Marti et al. 2019](#); [Shang et al. 2020](#)).
- Alternatively, explore the effect of e-cigarette taxes as a plausibly exogenous source of variation for prices.
  - One challenge is that e-cigarette taxes are levied differently across states: unit excise, ad valorem, sales, and two-tier.
  - New paper provides a methodology and database of standardized taxes ([Cotti et al. 2021](#)).

# Literature on E-cigarette Taxes



# E-cigarette Taxes through end of 2019



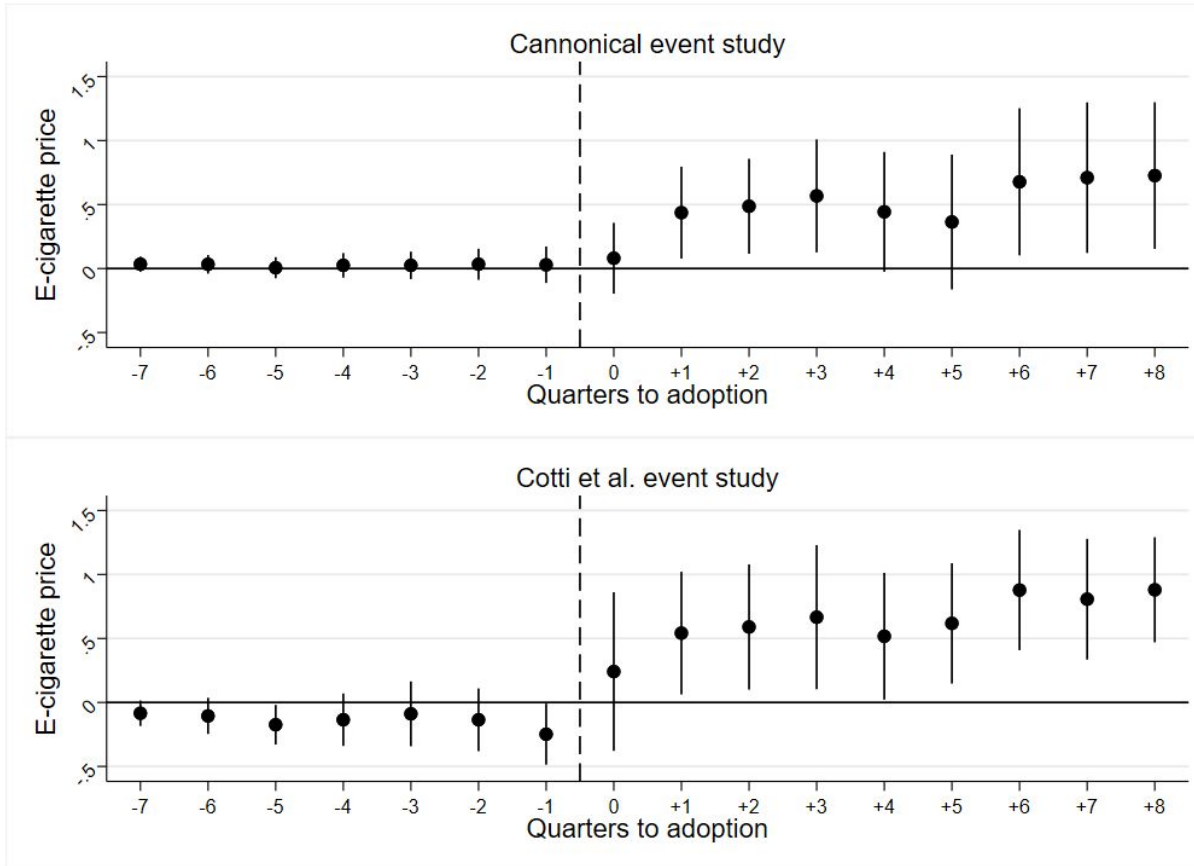
# Estimating the Effect of E-cigarette Taxes Using Sales Data

- Study uses Nielsen retail sales data for 27,817 stores participating each year from 2013 to 2019 to estimate cigarette and e-cigarette price and tax responsiveness.
  - Uses standardized tax values from [Cotti et al. 2021](#).
  - Click [here](#) for a presentation of this paper at [Tobacco Online Policy Seminar](#).

# Almost full pass-through of e-cigarette prices to taxes

Outcome:	E-cigarette prices		
E-cigarette tax (\$):			
Beta	1.157***	1.106***	0.913***
(SE)	(0.080)	(0.073)	(0.113)
Cigarette tax (\$):			
Beta	0.056	0.060	0.047
(SE)	(0.080)	(0.084)	(0.090)
Locality fixed effects	Y	Y	n/a
Period (quarter-by-year) fixed effects	Y	Y	Y
Time-varying controls	N	Y	Y
UPC-by-locality fixed effects	N	N	Y
Observations	118,279	118,279	118,279
Mean: E-cigarette price in e-cigarette tax adopting localities, year prior to the tax (\$)	4.717	4.717	4.717

# Effect of E-cigarette Tax Adoption on Prices



- The canonical event study creates an event study variable that equals 0 for non-adopters, and “centers” the adoption date for adopters at 0 for when the policy comes into place.
- The regression model then includes indicators for each time period (negative = policy leads; positive = policy lags), fixed effects for time and place (over which the policies vary), and any other model covariates.
- Ideally policy lead coefficients are small in magnitude and statistically insignificant, suggesting parallel trends.
- Policy lag coefficients show heterogeneity in the post period.
- For more practical DD advice, check [out this Twitter post](#).

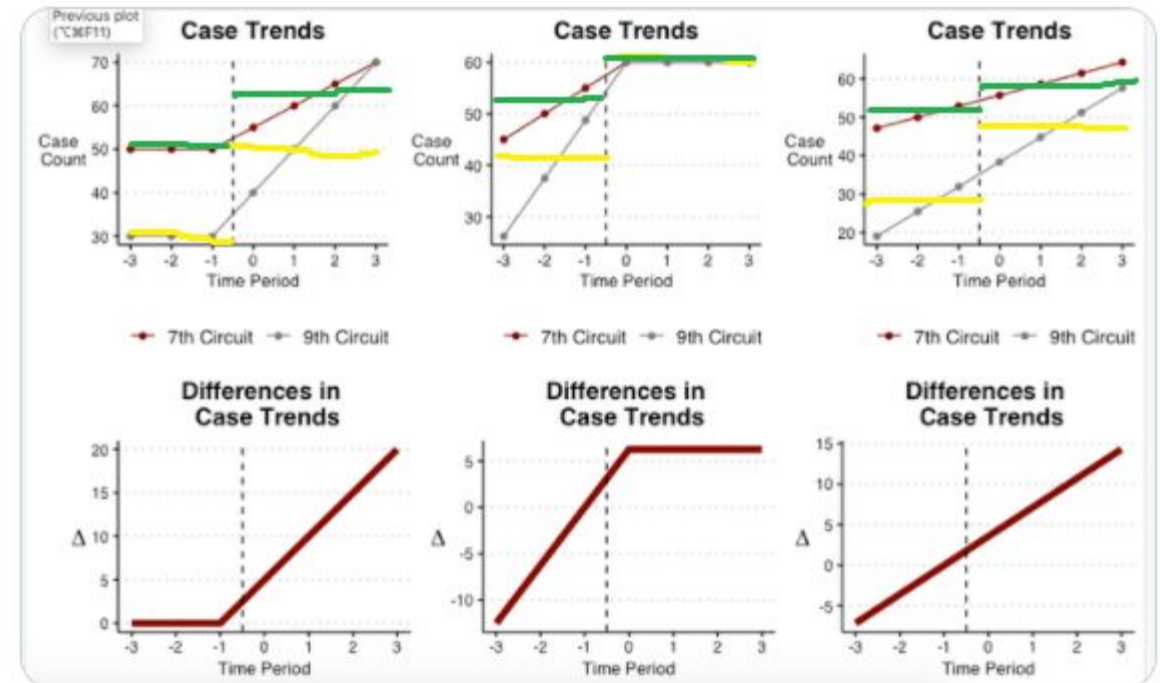
# Why Explore the Parallel Trends Assumption?

- This event study figure shows that adopting locations had no changes in e-cigarette taxes *prior* to the adoption, which would otherwise violate the parallel trends assumption and cause a biased difference-in-differences estimate.
- Trends could be non-parallel due to endogenous policy adoption—e.g. e-cigarette taxes were enacted because of falling e-cigarette prices, for example.
- Example on right:  
Diff-in-diff =  $\Delta$  yellow -  $\Delta$  green
- Trends are parallel only on left



Andrew Charles Baker  
@Andrew\_\_Baker

All of these have the same TWFE DiD estimate and this is why you must always run your analysis as an event study



8:35 PM · Jan 19, 2021 · Twitter Web App

**A \$1 rise in e-cigarette prices leads to a 47% decline in e-cigarette sales. Own-price elasticity = -2.1.**

<b>Sales outcome:</b>	<b>E-cigarettes</b>	<b>Cigarettes</b>
Instrumented E-cigarette price (\$)		
Beta	-782***	4,653**
(SE)	(274)	(2,091)
Instrumented Cigarette price (\$)		
Beta	275	-4,447**
(SE)	(222)	(1,840)
Observations	1,428	1,428
<i>Mean: E-cigarette tax adopting localities, year prior to the tax</i>	1,663	47,956
<i>Mean: Cigarette tax adopting localities, year prior to the first cigarette tax increase</i>	1,451	65,637

The same \$1 e-cigarette price rise increases cigarette pack sales by 10%. Cross-price elasticity = 0.34.

Sales outcome:	E-cigarettes	Cigarettes
Instrumented E-cigarette price (\$)		
Beta	-782***	4,653**
(SE)	(274)	(2,091)
Instrumented Cigarette price (\$)		
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<i>Mean: Cigarette tax adopting localities, year prior to the first cigarette tax increase</i>	1,451	65,637

**A \$1 rise in cigarette price reduces cigarette sales by approximately 7%. Own-price elasticity = -0.46.**

<b>Sales outcome:</b>	<b>E-cigarettes</b>	<b>Cigarettes</b>
Instrumented E-cigarette price (\$)		
Beta	-782***	4,653**
(SE)	(274)	(2,091)
Instrumented Cigarette price (\$)		
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**The same \$1 rise in cigarette price increases e-cigarette sales by approximately 19%. Cross-price elasticity = 1.07.**

<b>Sales outcome:</b>	<b>E-cigarettes</b>	<b>Cigarettes</b>
Instrumented E-cigarette price (\$)		
Beta	-782***	4,653**
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**Neither tax appears to affect sales for cigars, chewing tobacco, or loose tobacco.**

<b>Tobacco product:</b>	<b>Cigars</b>	<b>Chewing tobacco</b>	<b>Loose tobacco</b>
E-cigarette tax (\$)			
Beta	-2,303	126	27
(SE)	(2,391)	(253)	(125)
Cigarette tax (\$)			
Beta	2,557	-178	88
(SE)	(1,906)	(189)	(100)
Observations	1,428	1,428	1,428
Mean: Sales in E-cigarette tax adopting localities, year prior to the tax	16,641	3,389	897
Mean: Sales in Cigarette tax adopting localities, year prior to the first cigarette tax increase	17,355	3,513	631

A \$1 rise in e-cigarette price reduces flavored e-cigarette sales by nearly 72%, and a more modest 23-30% for non-flavored or menthol/mint-flavored e-cigarettes.

<u>Cigarette type:</u>	<u>E-cigarettes</u>			<u>Cigarettes</u>	
<u>Outcome:</u>	<u>Non-flavored</u>	<u>Menthol /mint</u>	<u>Flavored</u>	<u>Non-flavored</u>	<u>Menthol</u>
Instrumented E-cigarette price (\$)					
Beta	-175***	-81**	-526***	3,855***	798
(SE)	(60)	(38)	(203)	(1,455)	(727)
Instrumented Cigarette price (\$)					
Beta	85*	38	152	-3,121**	-1,326**
(SE)	(50)	(33)	(174)	(1,414)	(569)
Observations	1,428	1,428	1,428	1,428	1,428
Mean: E-cigarette tax adopting localities, year prior to the tax	572	360	730	34,936	13,020
Mean: Cigarette tax adopting localities, year prior to the first cigarette tax increase	598	347	504	49,274	16,363

# Literature on E-cigarette Taxes

- Uses National Health Interview Survey (NHIS) and Behavioral Risk Factor Surveillance System (BRFSS) data from 2013-18 to find:
  - Evidence that higher e-cigarette tax rates reduce adult e-cigarette use and increase adult cigarette use (i.e. economic substitution), especially for young adults <40 years of age.
  - Symmetrical effects using cigarette tax rates.
  - Results suggest that a proposed national e-cigarette tax of \$1.65 per milliliter of vaping liquid would raise the proportion of adults who smoke cigarettes daily by approximately one pp, or 2.5 million extra adult daily smokers.

# Literature on E-cigarette Taxes

- In a working paper, Abouk et al. (2021) examine the effect of e-cigarette tax rate changes in 10 states using Monitoring the Future (MTF) and Youth Risk Behavior Surveillance System (YRBSS) data through 2019.
  - Youth e-cigarette tax elasticities of -0.06 to -0.21
  - Sizable positive cigarette cross-tax elasticities.
  - E-cigarette taxes cause youth to substitute from retail based purchasing of e-cigarettes to social sourcing of e-cigarettes.
  - E-cigarette taxes increase perception of the risk of e-cigarettes.

# Literature on E-cigarette Taxes

- Uses national birth record data from 2013-18 to find that a \$1 increase in the standardized e-cigarette tax:
  - Increases pre-pregnancy and prenatal smoking by  $\approx 0.4$  pp (7.5% of the mean)
  - Reduces smoking cessation during pregnancy using a panel data model
  - No effect on birth outcomes
- Uses Pregnancy Risk Assessment Monitoring System data from 2016-18 to find that a \$1 increase in the standardized e-cigarette tax:
  - Reduces pre-pregnancy vaping by 1.3 pp (31.7%)
  - Reduces 3<sup>rd</sup> trimester vaping by 0.9 pp (81.8%).
- Approximately 1 in 3 pregnant women that stops using e-cigarettes due to an e-cigarette tax smokes cigarettes instead (through less smoking cessation).
- Click [here](#) for a presentation of this paper at [Tobacco Online Policy Seminar](#).

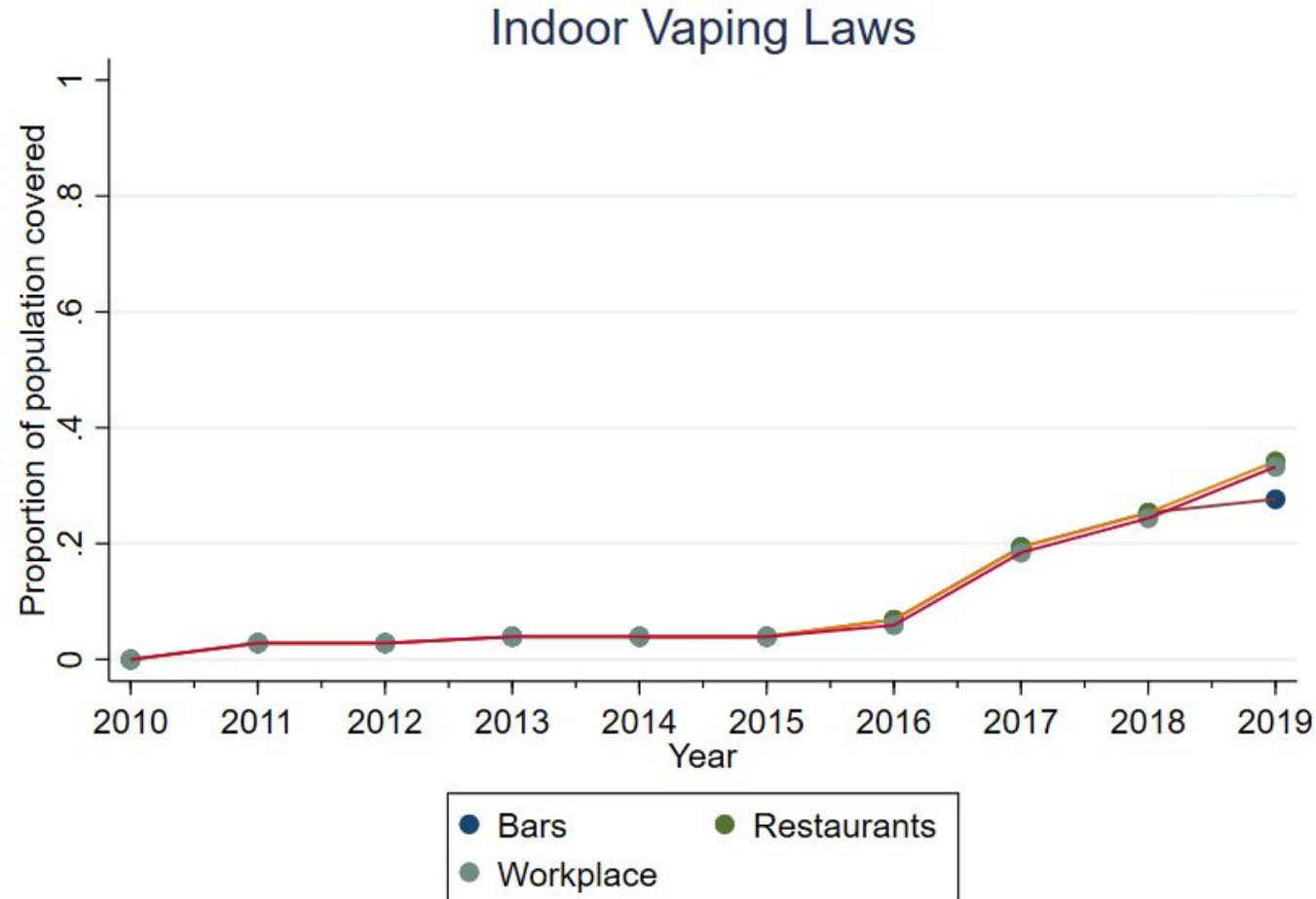
# Literature on E-cigarette Taxes

- [Saffer et al. 2020](#) study the effect of e-cigarette taxes in Minnesota using synthetic controls, finding that e-cigarette taxes increase adult smoking and reduce smoking cessation.
- [Allcott and Rafkin 2021](#) use the pre-2013 smoking propensities for 800 adult demographic cells and 56 youth demographic cells to implement a shift-share strategy to examine the impact of wide use of e-cigarettes starting in the year 2013 on smoking rates.
  - As a component of their paper, they also find mixed evidence of substitution using the Nielsen retail data, depending on specification.
  - Click [here](#) for a presentation of this paper at [Tobacco Online Policy Seminar](#).

# Literature on E-cigarette Taxes

- [Pesko and Warman 2021](#) use price and tax variation to find evidence of economic substitution among youth through 2015.
- [Anand and Kadiyali 2020](#) explore the effect of e-cigarette taxes on youth social media postings.
  - 388,593 user-posted images on social media from Jan 2016 to Dec 2018 measure the impact of greater taxes on underage posting behavior.
  - Synthetic control group methods.
  - Large e-cigarette taxes in California and Pennsylvania decreased underage postings, but not small e-cigarette taxes in Kansas and West Virginia.

# Literature on E-cigarette Indoor Vaping Restrictions



# Literature on E-cigarette Indoor Vaping Restrictions

- [Cooper and Pesko 2017](#) use national birth record data from 2010-15 to find that indoor vaping bans:
  - Increase any prenatal smoking by 0.9 pp using a cross-sectional model
  - Increase smoking in a given trimester by 2.0 pp using a panel data model
  - No effect on immediate birth outcomes
  - In a follow-up paper, indoor vaping bans increased infant mortality ([Cooper and Pesko 2020](#)).
- [Nguyen and Bornstein 2020](#) use Canadian data and find:
  - No statistically significant change in e-cigarette use or cigarette use for adults.

# Literature on E-cigarette Indoor Vaping Restrictions

- [Friedman, Oliver, Busch 2021](#) find no added effect of indoor vaping restrictions on adult e-cigarette use, cigarette use, or smoking cessation beyond that explained by indoor smoking restrictions using NHIS data from 2014-2018.
- [Cotti, Nesson, Tefft 2018](#) find no evidence of e-cigarette indoor vaping restrictions affecting household purchases of e-cigarettes or cigarettes.

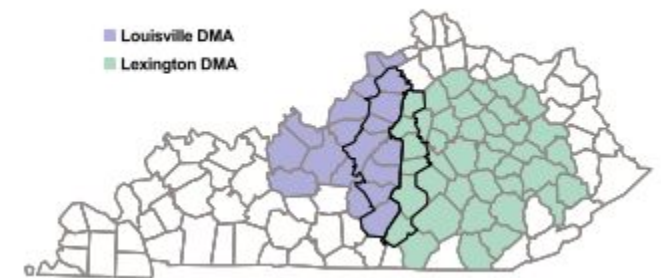
# Literature on E-cigarette Advertising

- [Dave et al. \(2019\)](#) study the causal effect of whether e-cigarette advertising on television and in magazines encourages adult smokers to quit.
- Authors use detailed information on individual-level TV and magazine viewing patterns in the Simmons National Consumer Survey, which contains information on smoking.
- Authors match this individual-level viewing information to all e-cig ads aired on national and local broadcast and cable stations and all ads published in magazines from Kantar Media.
- Quasi-random variation in advertising exposure provides a credible strategy to identify the causal effects of advertising.
- Authors find TV advertising causally impacts smoking cessation, but magazine advertising does not.
- The results indicate that a policy banning TV advertising of e-cigs would have reduced the number of smokers who quit in the recent past by approximately 3%.

# Literature on E-cigarette Advertising

- [Tuchman \(2019\)](#) studies the effects of e-cigarette advertising on e-cigarette, cigarette, and nicotine replacement therapy sales and purchases by exploiting a discontinuity in local advertising markets, using stores and households right along advertising market borders.
- Data:
  - Nielsen retail and household scanner data from 2012-2015.
  - Product level advertising data from Nielsen, showing increases in e-cigarette television advertising mid-2012.
- In the absence of e-cigarette advertising,
  - E-cigarette sales would have been 0.9% lower.
  - Cigarette sales would have been 1.0% higher.
    - 130 million extra packs of cigarettes.
  - Nicotine replacement therapy product sales 1.0% higher.

Figure 6. (Color online) Louisville and Lexington DMA Border Counties



# Summary of E-cigarette Research

- Using quasi-experimental variation in e-cigarette use from e-cigarette policies, most studies suggest that e-cigarettes reduce smoking.
  - E-cigarette policies studied:
    - MLSAs
    - Taxes
    - Indoor vaping restriction
    - Advertising restrictions
- E-cigarette regulation reduces e-cigarette use, but slows the 'creative destruction' that e-cigarettes otherwise have in reducing cigarette use.

# Conclusion:

## Economics Approach to E-cigarette Regulation

- If e-cigarettes are substantially safer than cigarettes, this would suggest socially optimal e-cigarette policy is low regulation of e-cigarettes or subsidizing e-cigarettes (e.g. free e-cigarettes for adults that want to quit).
  - If youth have time-inconsistent preferences, or nicotine is more dangerous for youth than adults, this could motivate higher regulation for youth.
- Over-regulation of e-cigarettes can have negative unintended consequences.
  - EVALI cases higher in places where residents do not have legal access to marijuana dispensaries ([Wing et al. 2020](#))
  - FDA approval of crush-resistant OxyContin in 2010 [did not reduce overall abuse, and increased heroin use and other adverse events](#).
  - An economics approach to regulation can help avoid unintended and unanticipated harmful events.

# If You'd Like to Learn More...

- Tobacco Online Policy Seminar (TOPS)
  - [www.tobaccopolicy.org](http://www.tobaccopolicy.org)
  - Seminar every two weeks highlighting experimental and quasi-experimental research.
  - Averages >100 attendees per seminar.
  - Submit your research through the TOPS website for consideration.
  - Sign-up for mailing list through the website.
  - Supported in part by an R13 Conference Grant from the Food and Drug Administration Center for Tobacco Products.