

Vaping, JUULing, and E-cigarettes: Public Health Implications

Andrea Villanti, PhD, MPH
Vermont Center on Behavior and Health
University of Vermont
April 2, 2019

Andrea Villanti, PhD, MPH

Associate Professor

Vermont Center on Behavior and Health

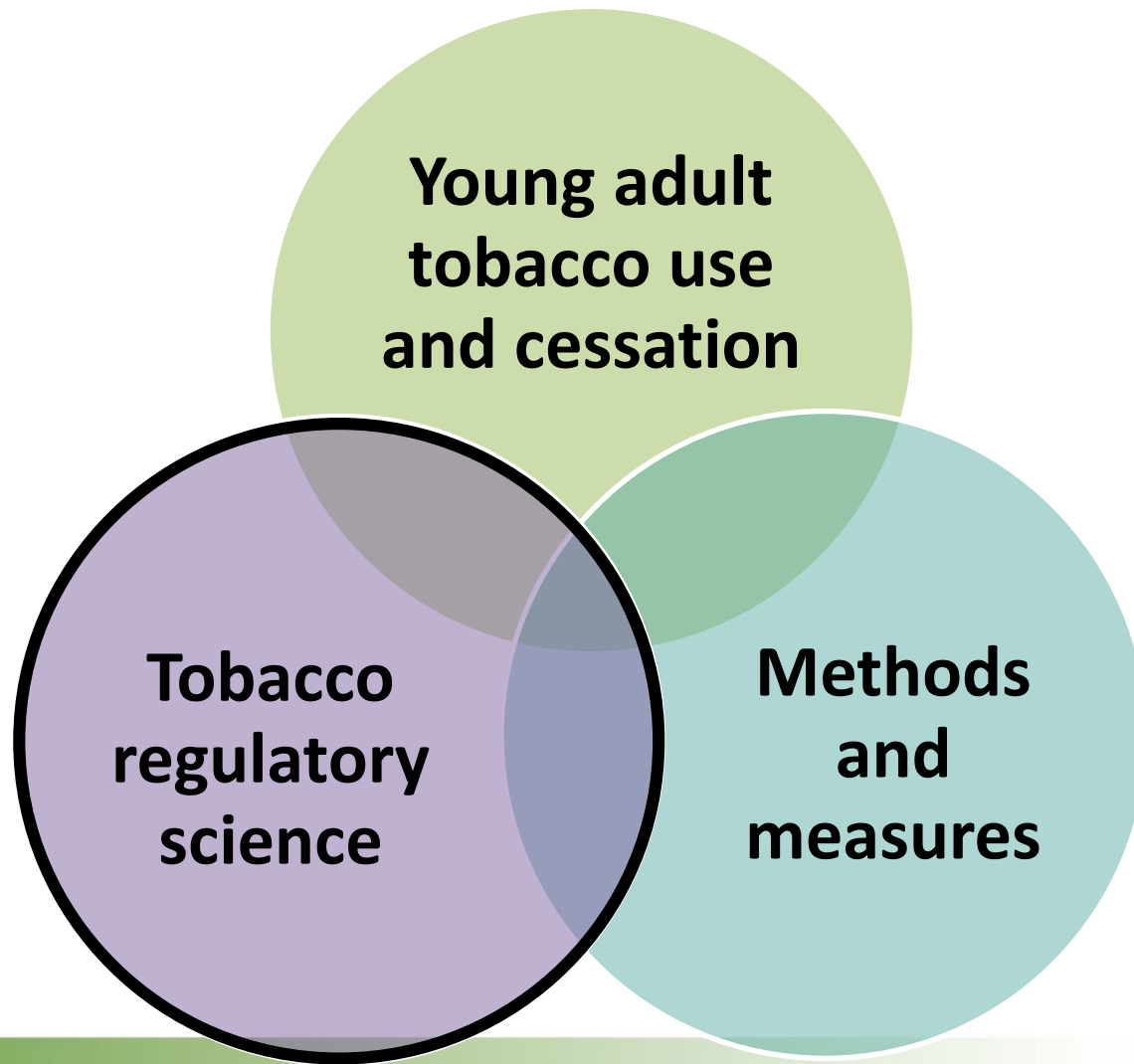
Department of Psychiatry

Larner College of Medicine, University of Vermont

- Funding from NIH (R03CA212694; R21DA046333; COBRE P20GM103644; R01CA229082; TCORS U54DA036114) and FDA
- No other financial relationships to disclose.
- No industry funding; no off-label medications use discussed
- The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health or the Food and Drug Administration.

<http://www.med.uvm.edu/behaviorandhealth/home>

Areas of focus



How to assess impact on public health?

FDA's "public health standard" calls for the review of the scientific evidence regarding:

1. Risks and benefits of the proposed rule to the **population as a whole**, including both users and non-users of tobacco products;
2. Whether there is an increased or decreased likelihood that existing users of tobacco products will **stop using such products**; and
3. Whether there is an increased or decreased likelihood that those who do not currently use tobacco products, most notably youth, will **start to use tobacco products**.

AMERICAN JOURNAL OF
Preventive Medicine

REVIEW ARTICLE

Overview of Electronic Nicotine Delivery Systems: A Systematic Review

Allison M. Glasser, MPH,¹ Lauren Collins, MPH,¹ Jennifer L. Pearson, PhD, MPH,¹
Haneen Abudayyeh, MPH,¹ Raymond S. Niaura, PhD,^{1,2,3} David B. Abrams, PhD,^{1,2,3}
Andrea C. Villanti, PhD, MPH^{1,2}

Table 1 Electronic nicotine delivery systems systematic review study categories and outcomes

Study category	Outcomes
Product features	<ul style="list-style-type: none"> ▶ Product design ▶ Nicotine, propylene glycol, flavouring, particulate matter and other toxicant content
Health effects	<ul style="list-style-type: none"> ▶ Effects of: <ul style="list-style-type: none"> – Nicotine – Tobacco-related toxicants – Non-tobacco-specific toxicants ▶ Impact on: <ul style="list-style-type: none"> – Cardiovascular system – Lung function – Blood count – Other physiology – Cognition – Abuse liability/addictiveness ▶ Adverse events ▶ Cytotoxicity
Consumer perceptions	<ul style="list-style-type: none"> ▶ Awareness ▶ Product perceptions ▶ Interest ▶ Reasons for use
Patterns of use	<ul style="list-style-type: none"> ▶ Ever, current and dual use with other tobacco products ▶ Initiation/progression ▶ Smoking cessation/reduction ▶ Use among various groups: general population, youth, young adults, adults, current smokers, former smokers, never-smokers, etc
Marketing	<ul style="list-style-type: none"> ▶ Advertisement/promotion prevalence and expenditure ▶ Claims and depictions ▶ Receptivity to advertising/promotion ▶ Marketing channels
Sales	<ul style="list-style-type: none"> ▶ Market share/sales volume ▶ Retail and online availability ▶ Pricing
Policies	<ul style="list-style-type: none"> ▶ Federal, state, local and organisational ▶ Existing and proposed ▶ Public support for policy

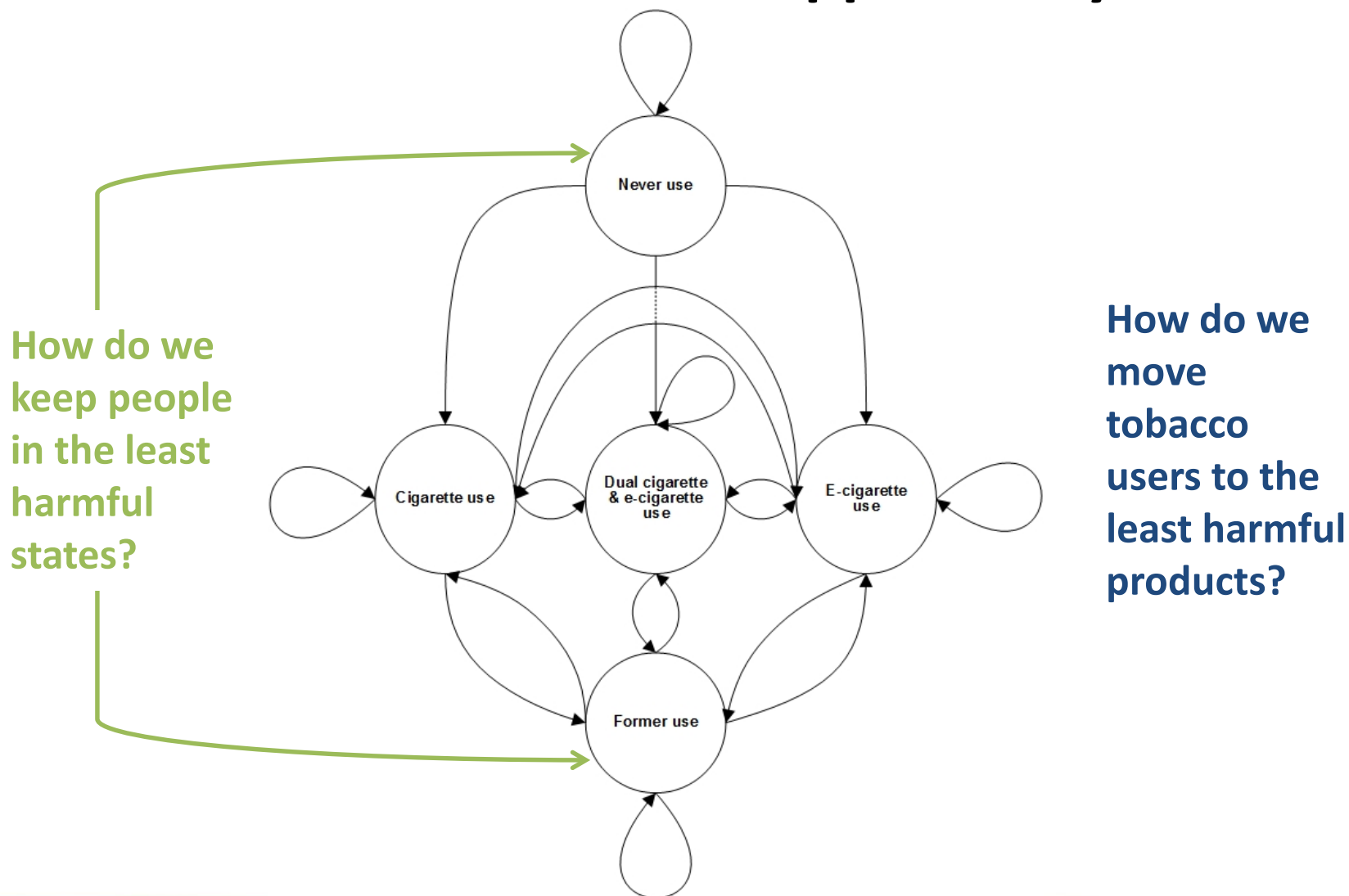
687^a articles included in systematic review

- Patterns of Use (n=252)
- Consumer Perceptions (n=188)
- Health Effects (n=129)
- Product Features (n=86)
- Cessation (n=74)
- Marketing and Communication (n=74)
- Potential to Induce Dependence (n=54)
- Policy (n=51)
- Sales (n=30)

Key questions

- What is the impact of e-cigarettes on **initiation** of tobacco use (including e-cigarettes)?
- What is the impact of e-cigarettes on **cessation** of tobacco use?
- What are the overall **health risks** associated with e-cigarette use?

FDA's mandate and opportunity



Overview

- What is an e-cigarette?
- **Lesson 1:** Products matter
- **Lesson 2:** Context matters
- **Lesson 3:** Target population matters

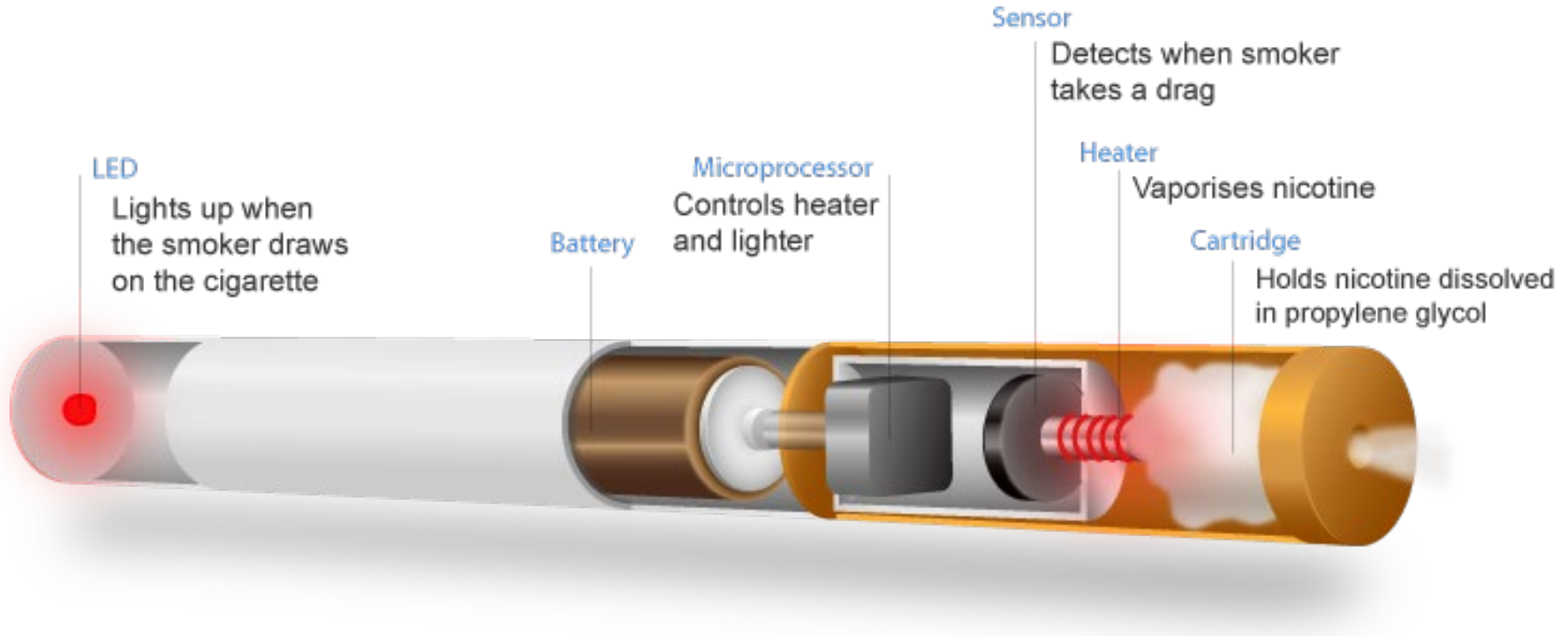


WHAT IS AN E-CIGARETTE?

What do you call these devices?

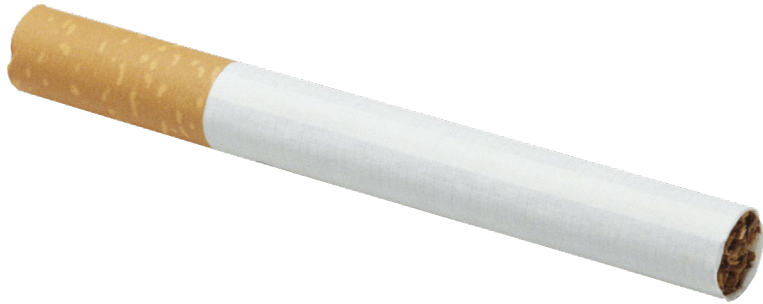


How do these devices work?



LESSON 1: PRODUCTS MATTER

E-cigarettes are not a single product class

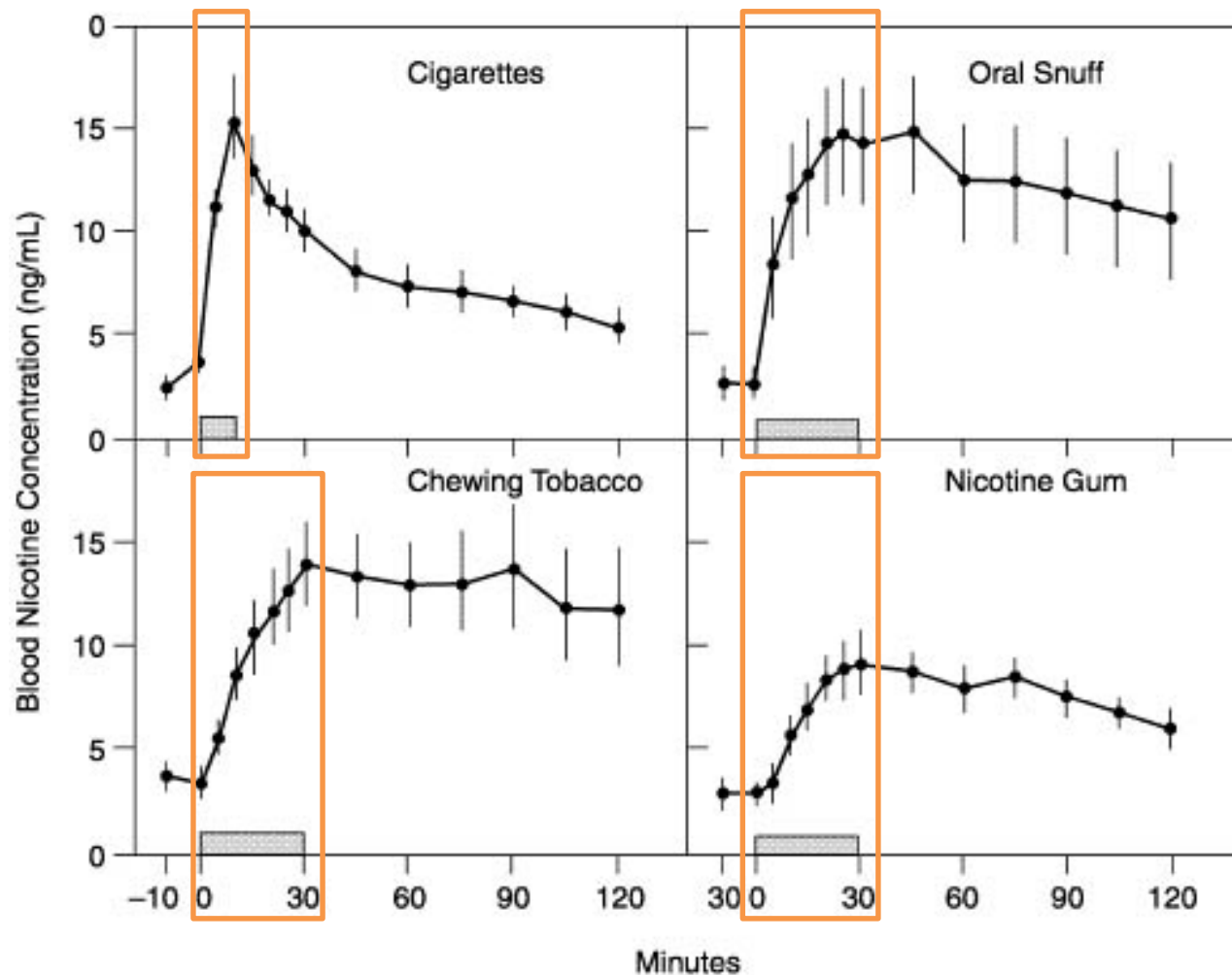


Cigarette ideals:

- Standardized product
- Engineered for nicotine delivery, taste, satisfaction
- Easy to use

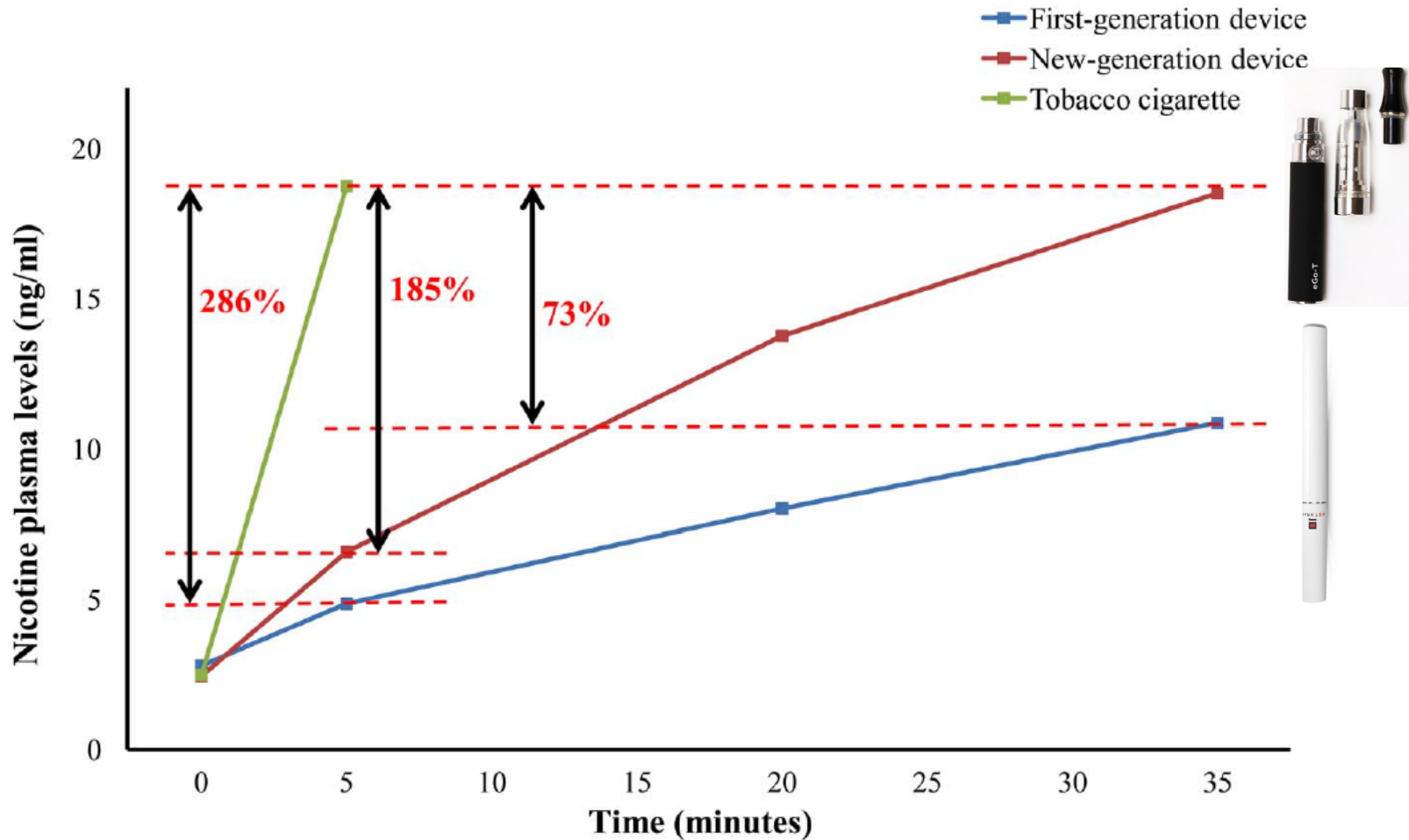


Nicotine delivery, by product

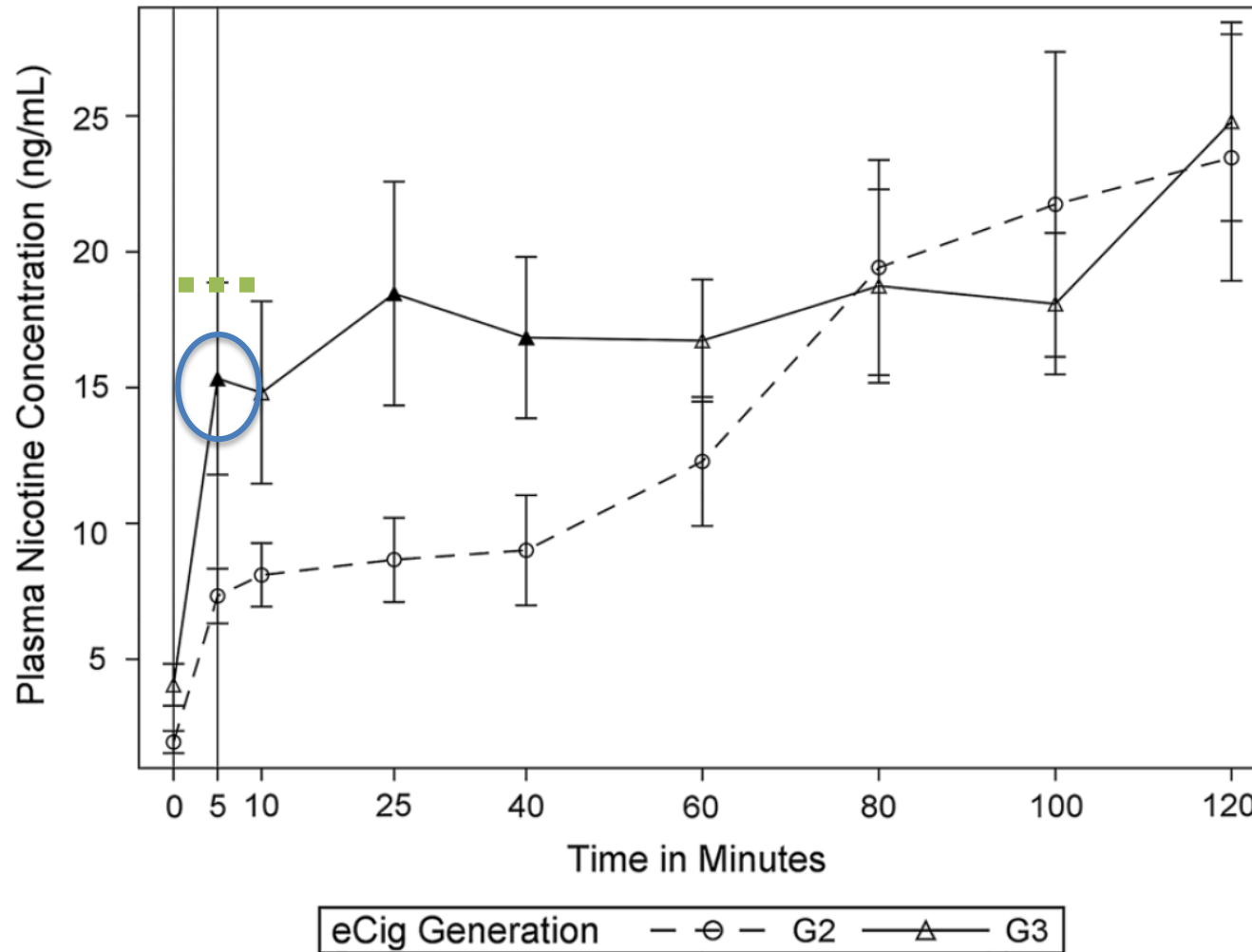


Benowitz NL, et al. *Clin Pharmacol Ther.* 1988;44(1):23-28.

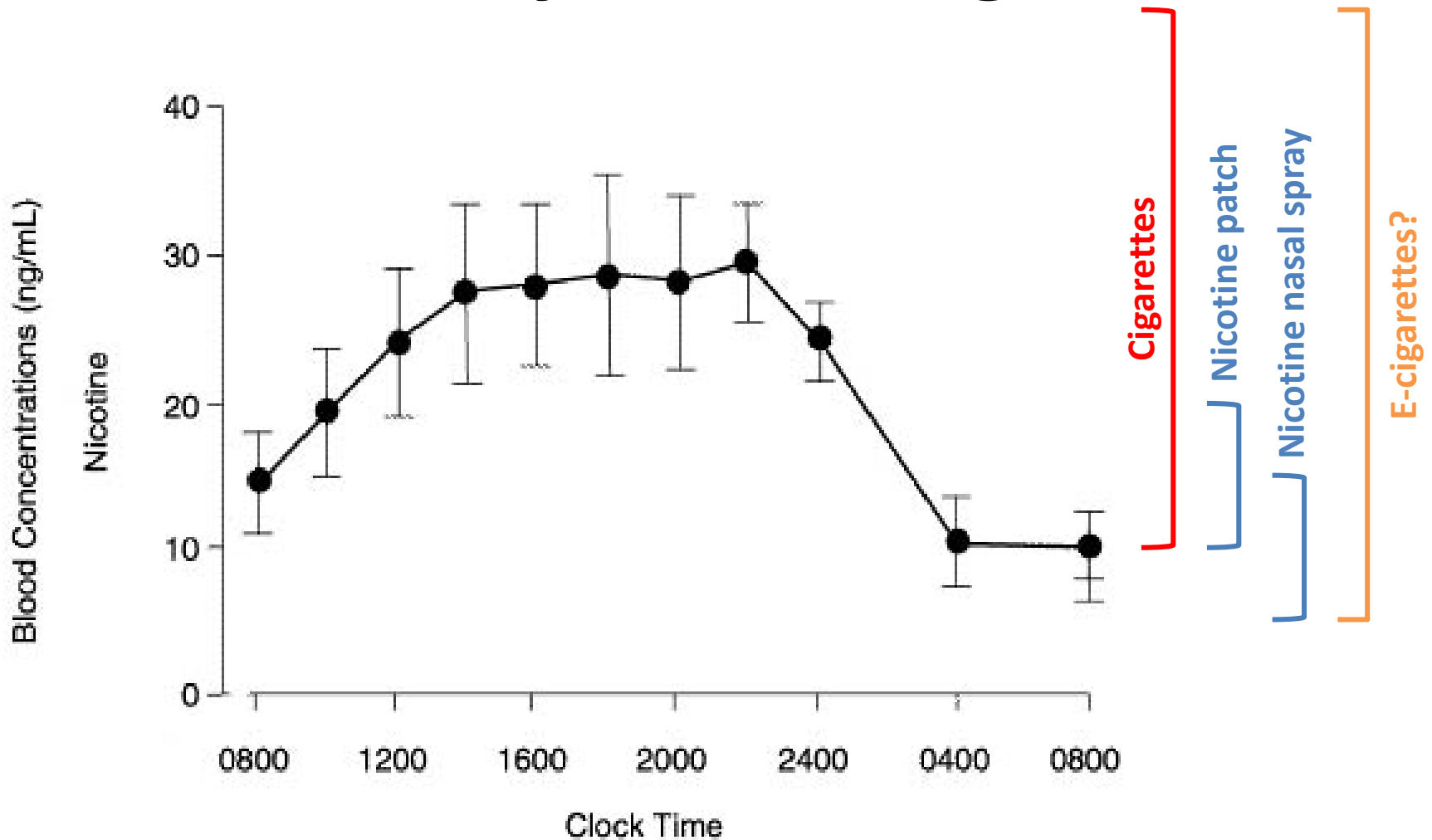
E-cigarette nicotine delivery: Device matters



E-cigarette nicotine delivery: Device matters



Circadian rhythms of cigarette use



E-cigarette manufacturers vary



Lorillard Acquires blu ecigs for \$135M

04/2

GRE

throu

"blu

way.

that

Kes:

sale

man

BUSINESS OF DESIGN

BUSINESS

Altria To Launch MarkTen E-Cigarette Nationally

BUSINESS

The Ma

Ci

By Mike

Feb. 19, 20

E-cigarette maker files for

bank

By Lisa Ficken

HEALTH AND SCIENCE

BIOTECH AND PHARMA

HEALTH INSURANCE

HOSPITALS

SCIENCE

Ci

Leading
electron

threat to

Dan

Publis



The mak
its Mark
testing t

Tobacco giant Altria takes 35% stake in Juul, valuing e-cigarette company at \$38 billion

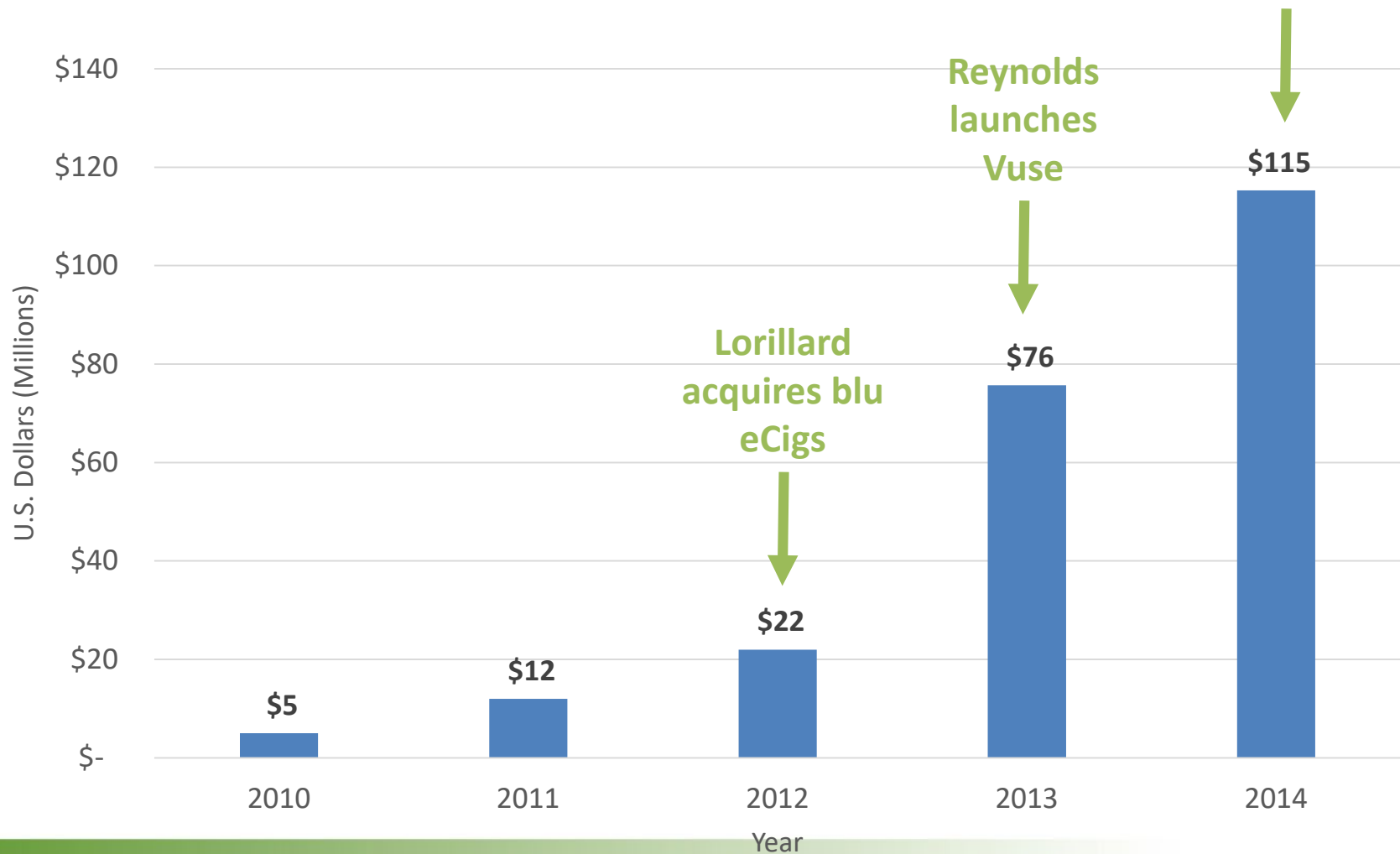
- Altria has taken a 35 percent stake in Juul, the companies announce.
- Juul represents about 75 percent of the e-cigarette market.

Angelica LaVito | @angelicalavito

Published 7:04 AM ET Thu, 20 Dec 2018 | Updated 4:43 PM ET Thu, 20 Dec 2018



E-cigarette Advertising Expenditures, U.S.



Kornfield R, al. *Tob Control*. 2015;24(2):110-111. Truth Initiative. Vaporized: E-Cigarettes, Advertising, and Youth; 2014, 2016. Huang J, et al. *Tob Control*. 2018.

E-cigarette Advertising Expenditures, U.S.

Altria launches MarkTen

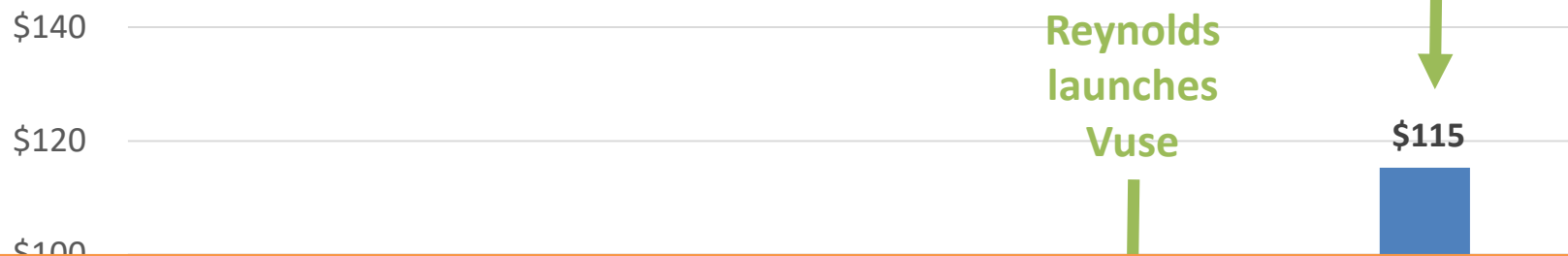
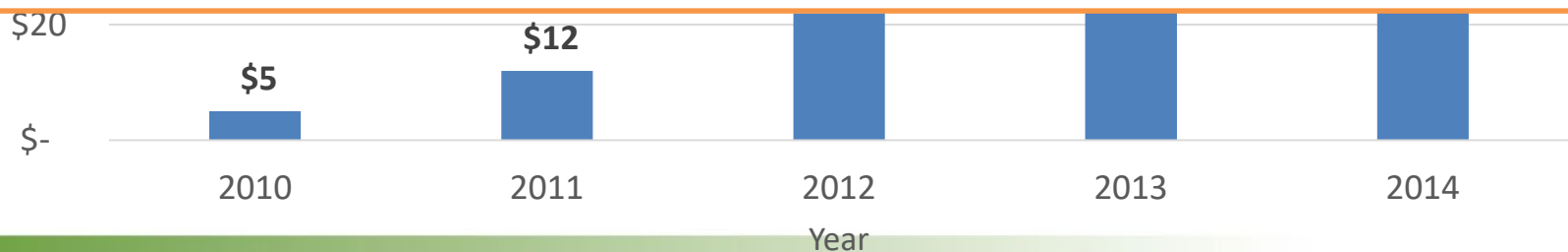


Table 1 JUUL marketing expenditures in Kantar-tracked channels: 2015–2017

Year	B-to-B DOLS (000)	RADIO DOLS (000)	INT DISPLAY DOLS (000)	OUTDOOR DOLS (000)	Total \$ (000)
2015 (Q3–Q4)	US\$23.3	US\$538.6	US\$1034.6	US\$45.1	US\$1641.7
2016	US\$57.5	US\$388.8	US\$0.6	US\$78.2	US\$525.1
2017 (Q1–Q2)*	US\$19.6	US\$ -	US\$ -	US\$ -	US\$19.6
Total	US\$100.4	US\$927.4	US\$1035.2	US\$123.3	US\$2186.4

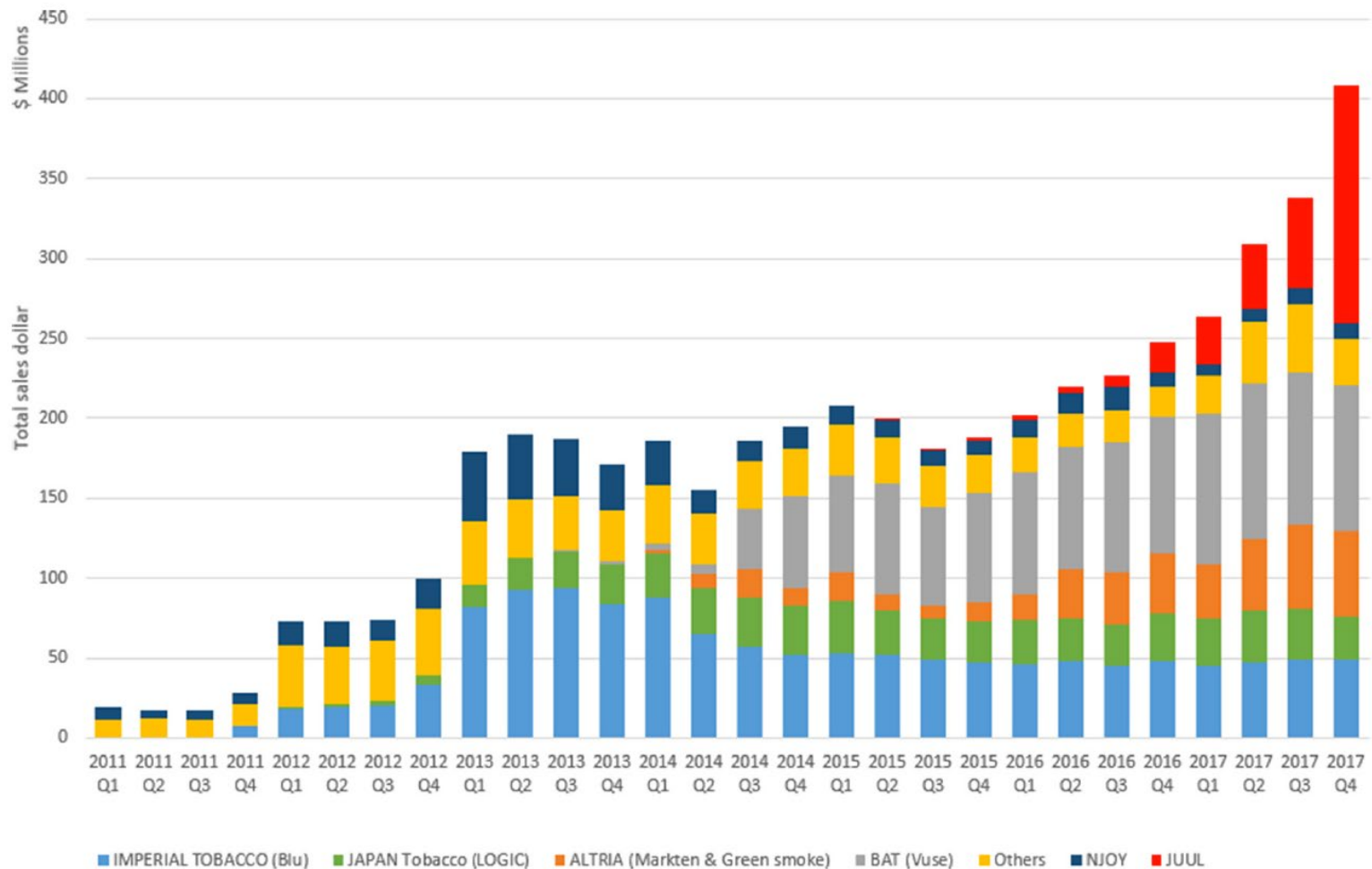
*Due to the lag in data collection and reporting, the marketing expenditure data for the third and fourth quarters of 2017 were not available at the time of this report.

JUUL Total Advertising 2015-2017: \$2M

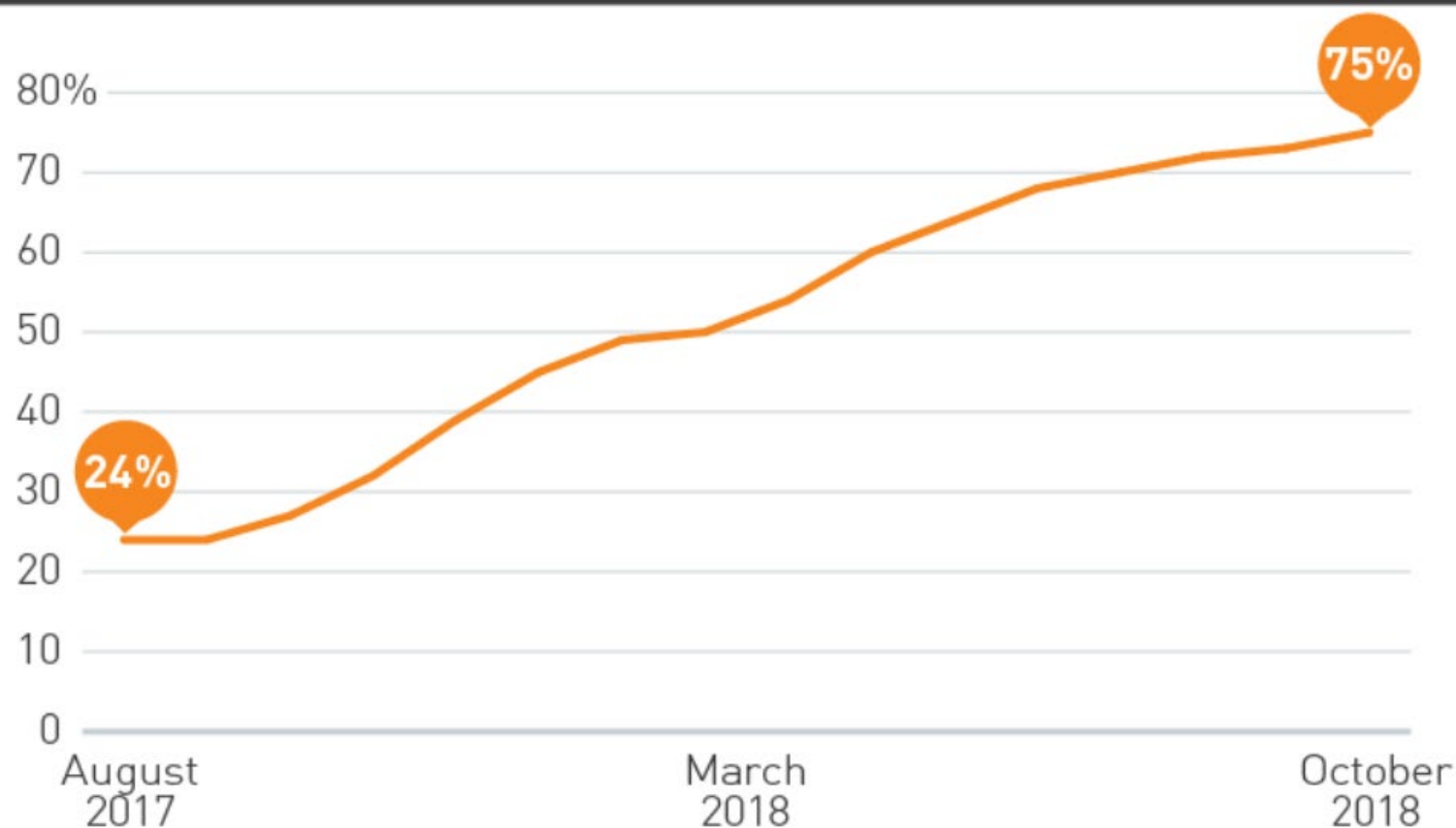


Kornfield R, al. *Tob Control*. 2015;24(2):110-111. Truth Initiative. Vaporized: E-Cigarettes, Advertising, and Youth; 2014, 2016. Huang J, et al. *Tob Control*. 2018.

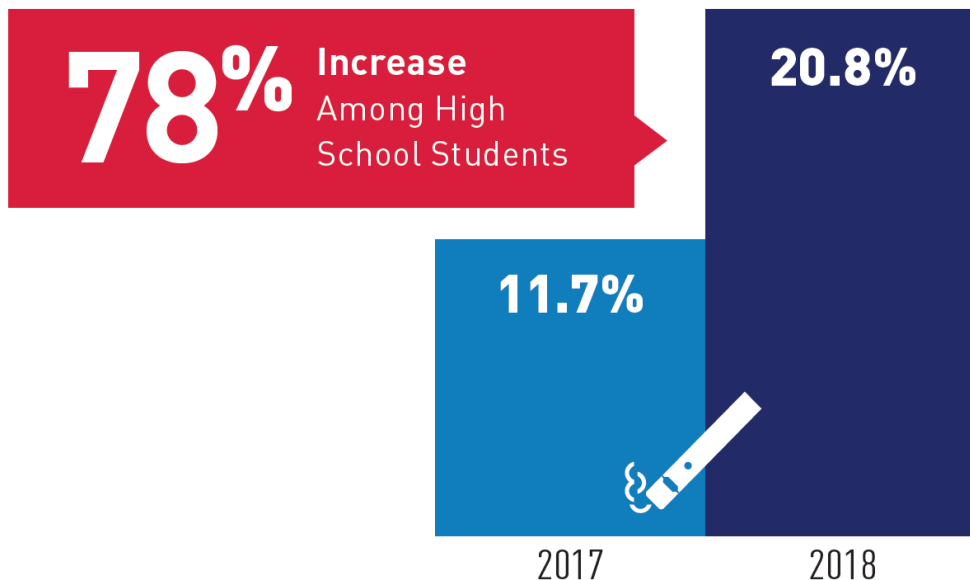
E-cigarette sales by brand: 2011 - 2017



JUUL sales as a percentage of all e-cigarette sales



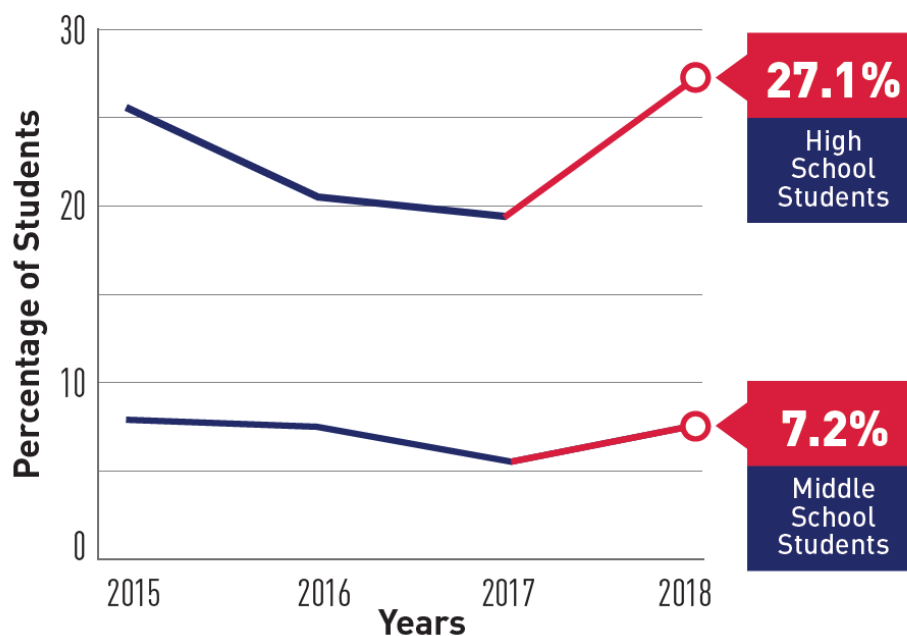
Source: Nielson: Tobacco "All Channel" Data. August 2017-October 2018



Significant increase in past 30-day e-cigarette use in high school students between 2017 and 2018.

<http://www.scholastic.com/youthvapingrisks/>

Current Use of Any Tobacco Product



E-cigarettes

1. E-cigarettes are a heterogeneous group of products.
2. These products vary in nicotine delivery and consumer satisfaction – both of which are likely to impact their uptake.
3. Variety of e-cigarette manufacturers, including cigarette companies.
4. Product advertising largely driven by cigarette company products.
5. There are no established quality or safety standards for these products.



LESSON 2: CONTEXT MATTERS

Nicotine & Tobacco

- Nicotine = stimulant
- Other compounds in tobacco smoke (e.g., acetaldehyde) may enhance nicotine's effects on the brain
- Characteristic response:
 - increases in blood pressure
 - increases in heart rate
 - increases in respiration
 - improved mood
 - better concentration



SMOKING TOBACCO

Tobacco smoking is the act of burning dried or cured leaves of the tobacco plant and inhaling the smoke. Combustion uses heat to create new chemicals that are not found in unburned tobacco, such as tobacco-specific nitrosamines (TSNAs) and benzopyrene, and allows them to be absorbed through the lungs.

Manufactured cigarettes



Kreteks



Roll-your-own (RYO) cigarettes



Pipes



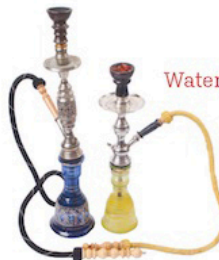
Sticks



Bidis



Water pipes



SMOKELESS TOBACCO

Smokeless tobacco is usually consumed orally or nasally, without burning or combustion. Smokeless tobacco increases the risk of cancer and leads to nicotine addiction similar to that produced by cigarette smoking. There are different types of smokeless tobacco: chewing tobacco, snuff, and dissolvables.

Chewing tobacco



Moist snuff



Dry snuff



Dissolvable smokeless tobacco products



Prevalent products in the U.S.

E-cigarettes



Cigarettes & cigars



CIGARETTE



LITTLE CIGAR



CIGARILLO (TIPPED)

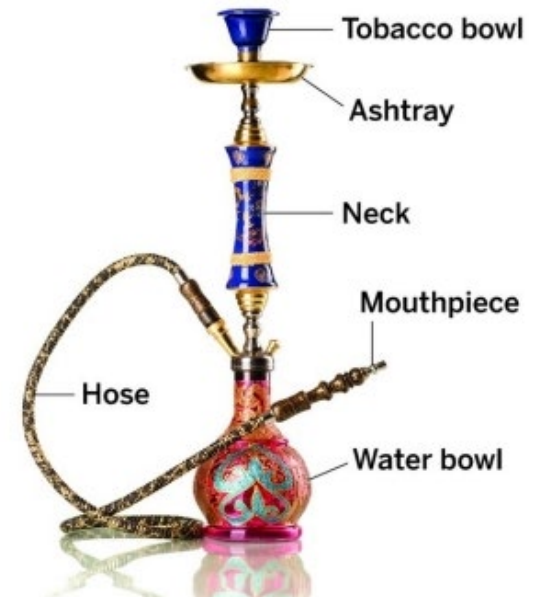


CIGARILLO

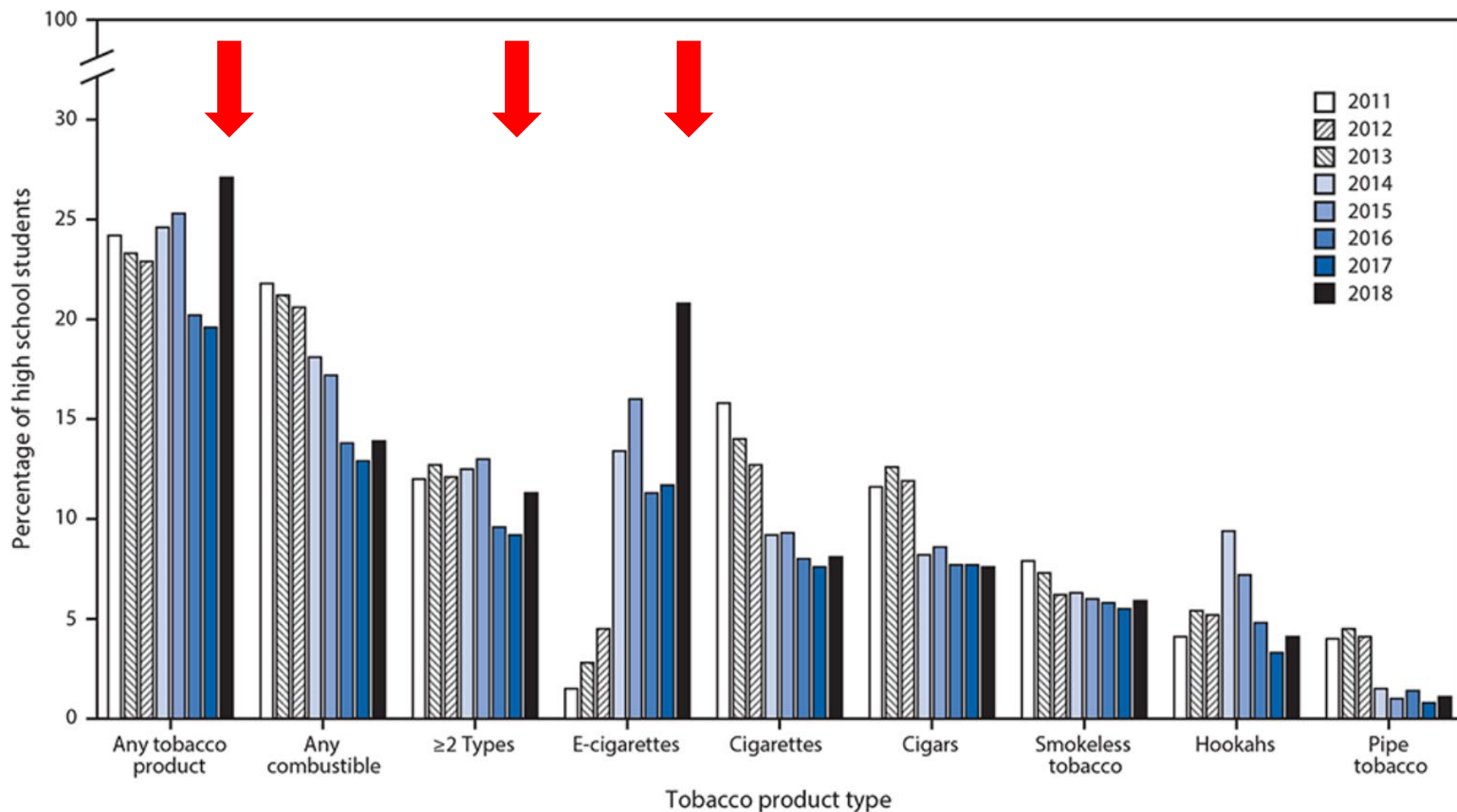


CIGAR

Hookah

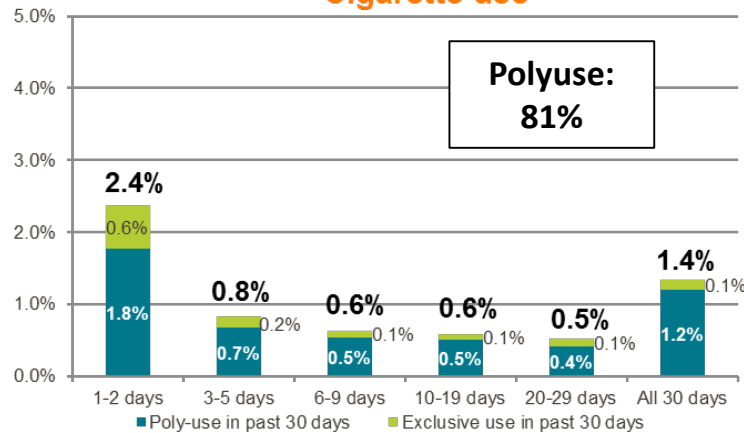


Tobacco use among high school students, NYTS 2011-2018

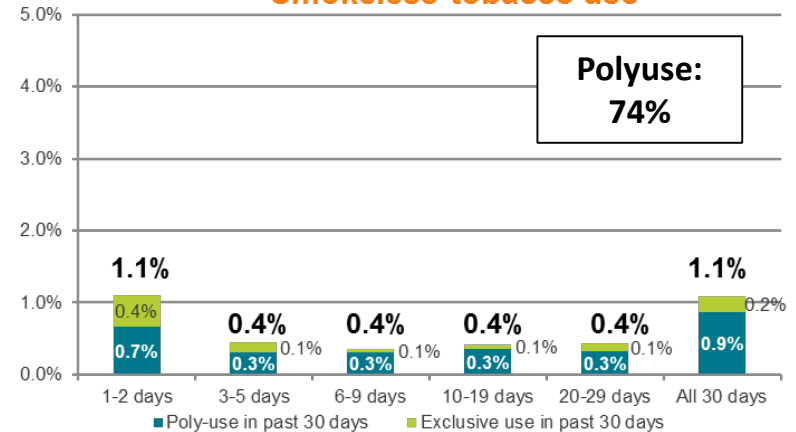


Youth frequency of product use, 2014 NYTS

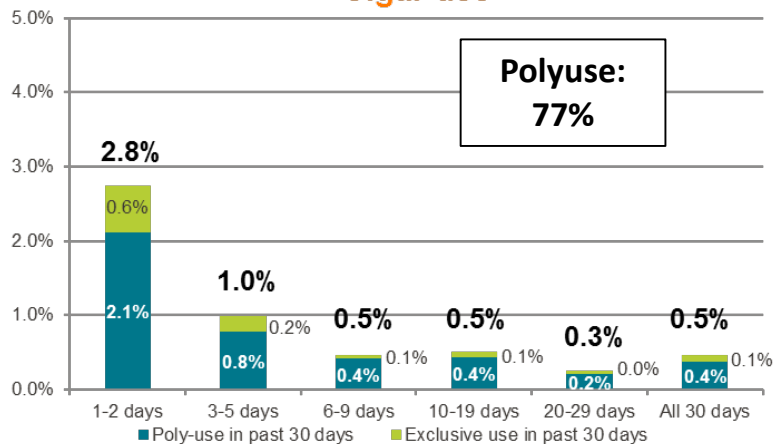
Cigarette use



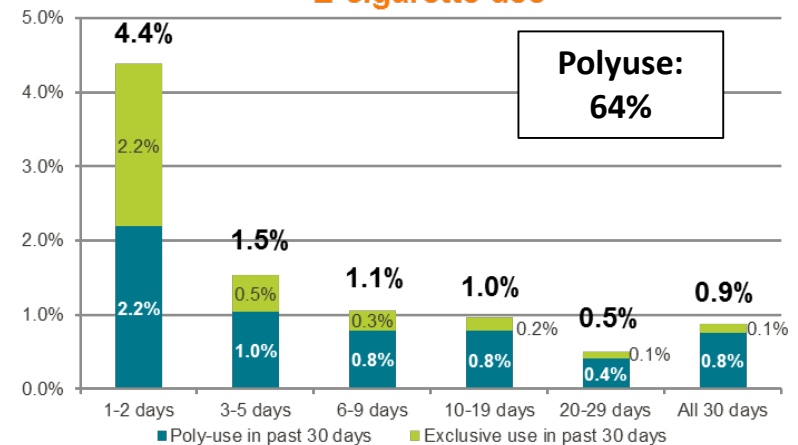
Smokeless tobacco use



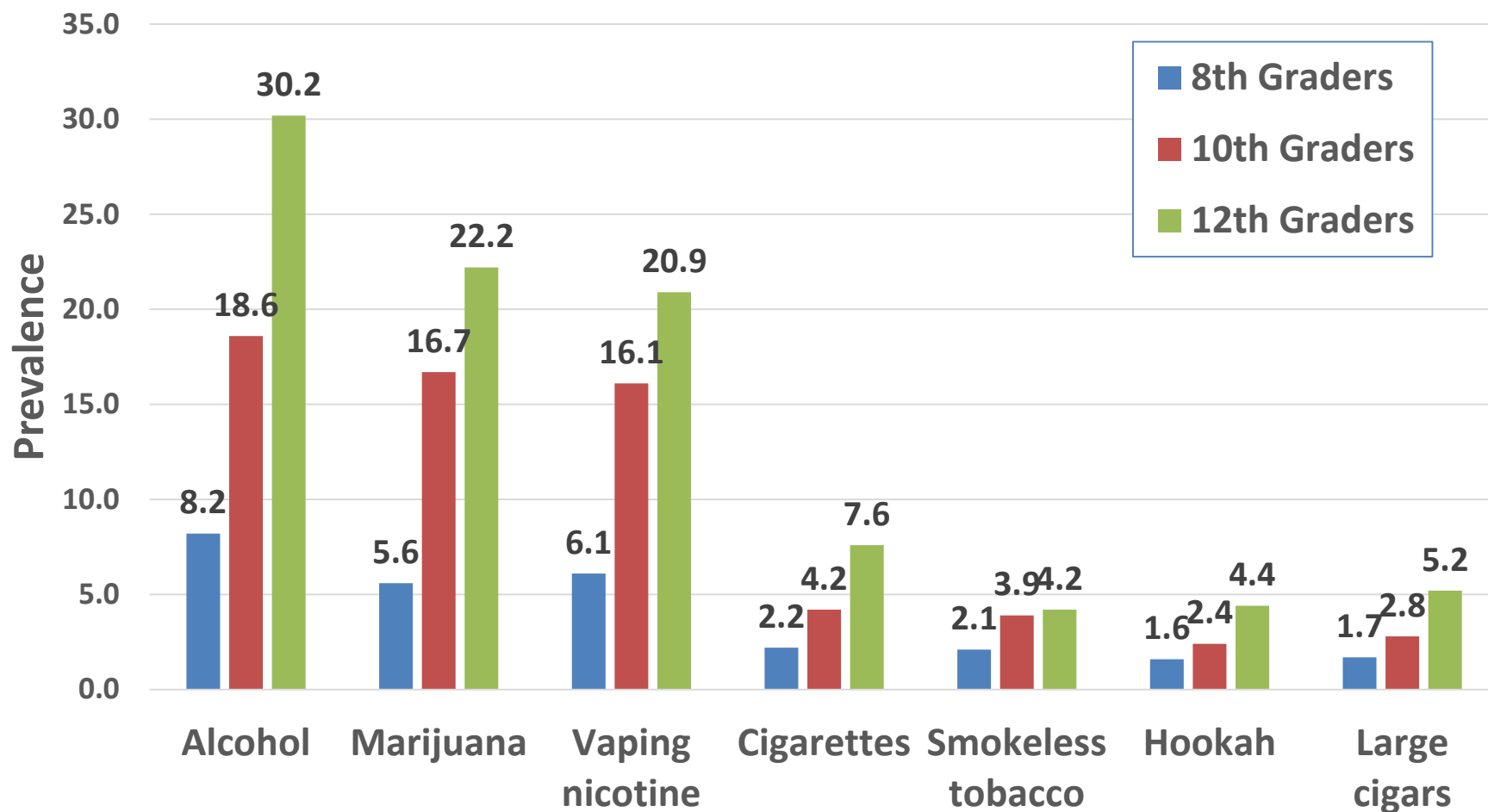
Cigar use



E-cigarette use

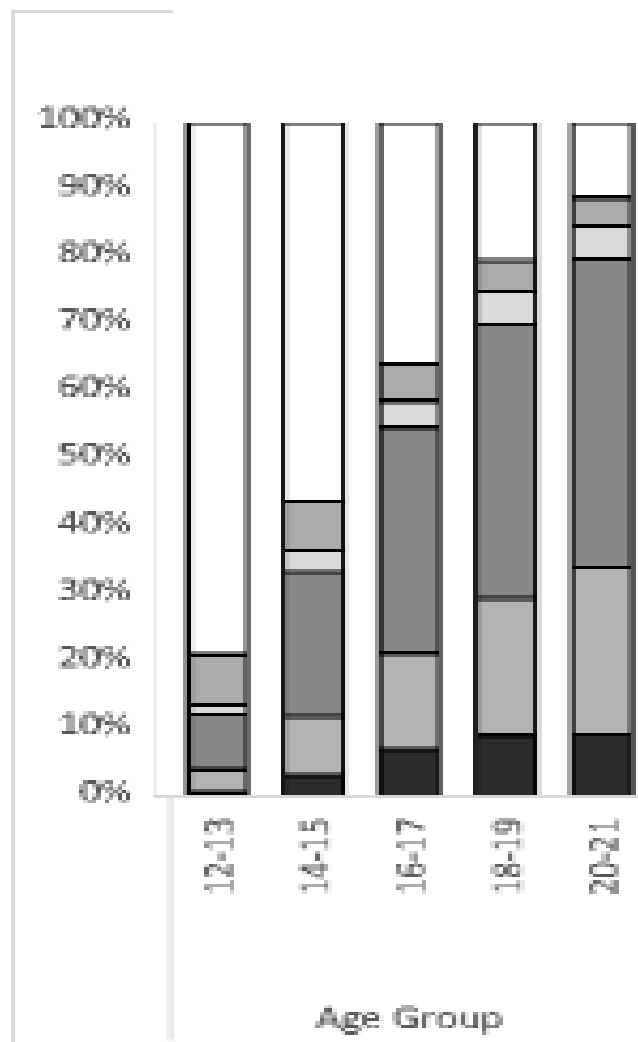


Tobacco and Substance Use in Past 30-Days among Youth

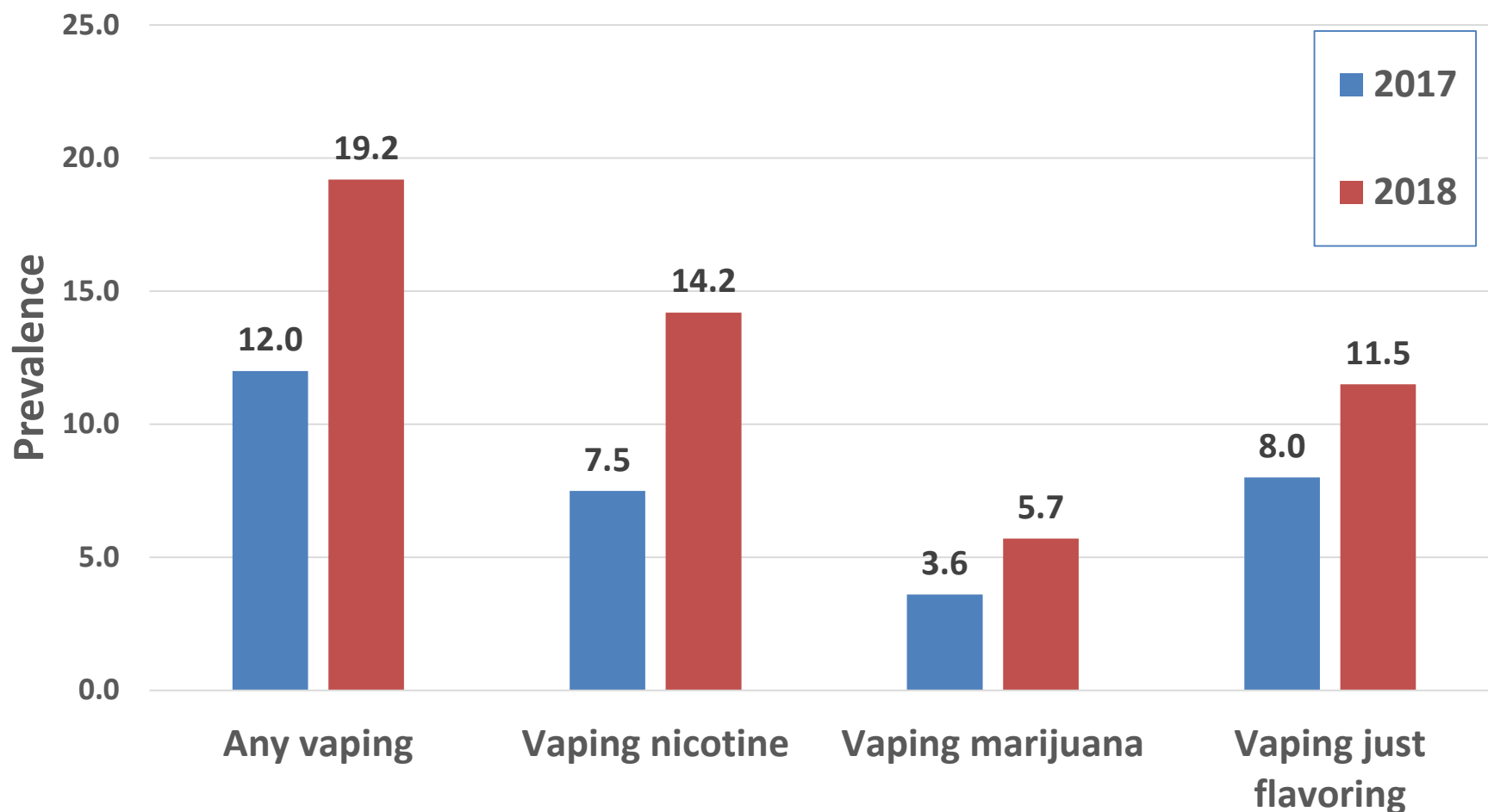


**Percent of youth
aged 12–21 years
whose first drug use
was marijuana,
cigarettes, alcohol,
other tobacco, other
drugs, or no drug use**

■ Marijuana (Bottom) ■ Cigarettes ■ Alcohol ■ Other Tobacco ■ Other Drugs ■ No Drug Use (Top)



Vaping in Past 30-Days among Youth



Context matters

- Youth e-cigarette use increased from 2017-2018.
- Any tobacco product and polytobacco use increased from 2017-2018.
- Polytobacco use is highly prevalent in youth.
- E-cigarette and tobacco product use occurs in the context of:
 - Other substance use
 - Marketing

Why might JUUL be different?



- ALL commercially-available JUUL pods contain nicotine liquid; available in a range of flavors.
- Nicotine salts
 - More stable
 - More efficient nicotine delivery
 - Higher nicotine concentration
 - Easier to inhale
- IT product design
 - Easier to use
- To be marketed next to Marlboro cigarettes in stores around the country
 - Cost of JUUL starter kit: \$30
 - Cost of pack of Marlboro: \$11



MYTH: JUUL cannot be refilled



hack juul



All

Shopping

News

Images

Videos

More

Settings

Tools

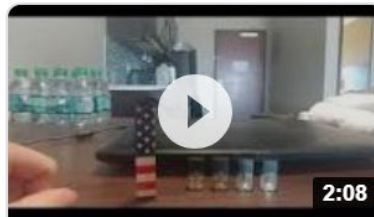
About 640,000 results (0.52 seconds)

Videos



How to Hack Your
JUUL Pod in Two
Minutes

My Vaping Goodies
YouTube - Nov 20, 2017



SUPER EASY JUUL
HACK! GET A BETTER
THROAT HIT

FordFanBoy
YouTube - Oct 3, 2018



MAKE YOUR JUUL
PODS LAST LONGER
(juul hack)

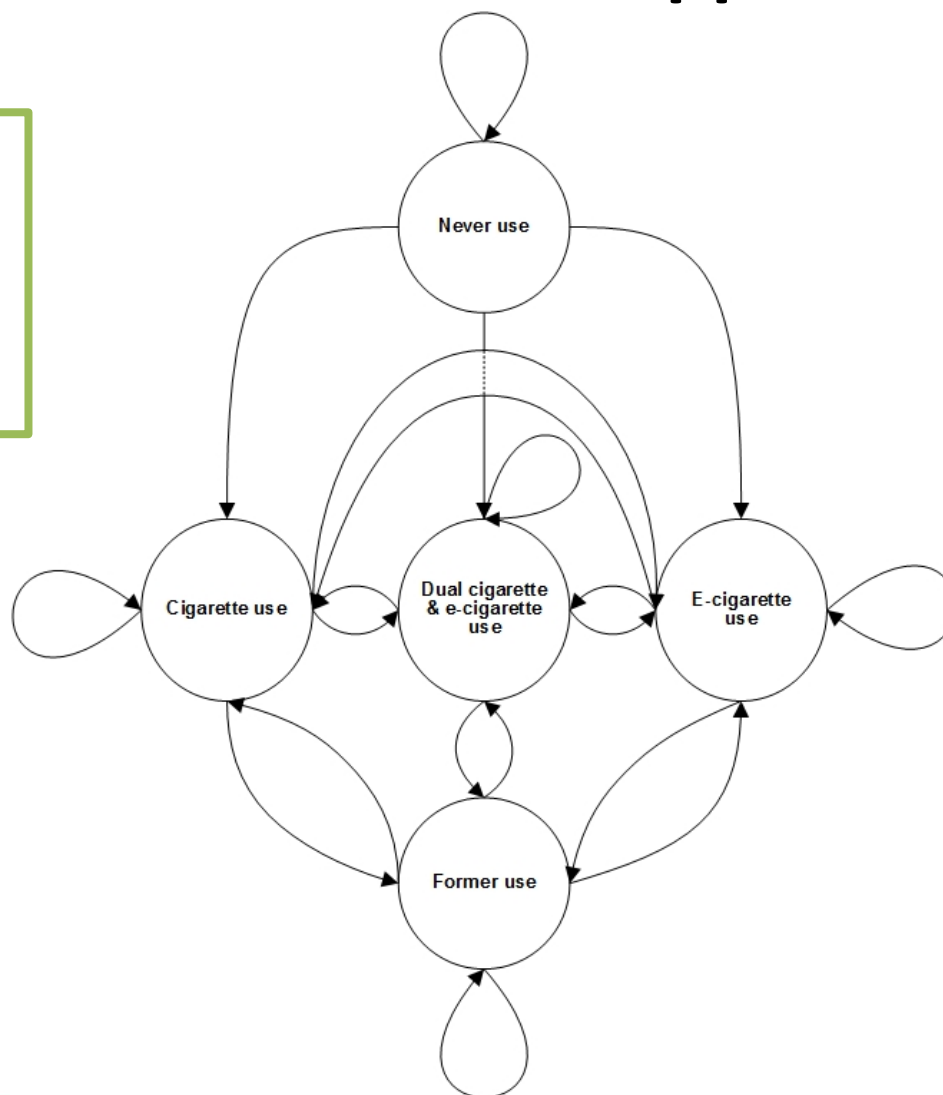
Caleb Rivers
YouTube - Oct 3, 2017



LESSON 3: TARGET POPULATION MATTERS

FDA's mandate and opportunity

Preventing
tobacco
use



Supporting
tobacco
cessation

Main concerns re: youth e-cigarette use

- **Nicotine exposure**
 - Nicotine exposure during the teen years can disrupt normal brain development and alter the physical structure of the brain, creating permanent changes.
- **Nicotine dependence** (addiction)
 - Vaping delivers nicotine to the brain in as little as 10 seconds, and a teen's brain is still developing, making it more vulnerable to nicotine addiction.

How does nicotine addiction happen?

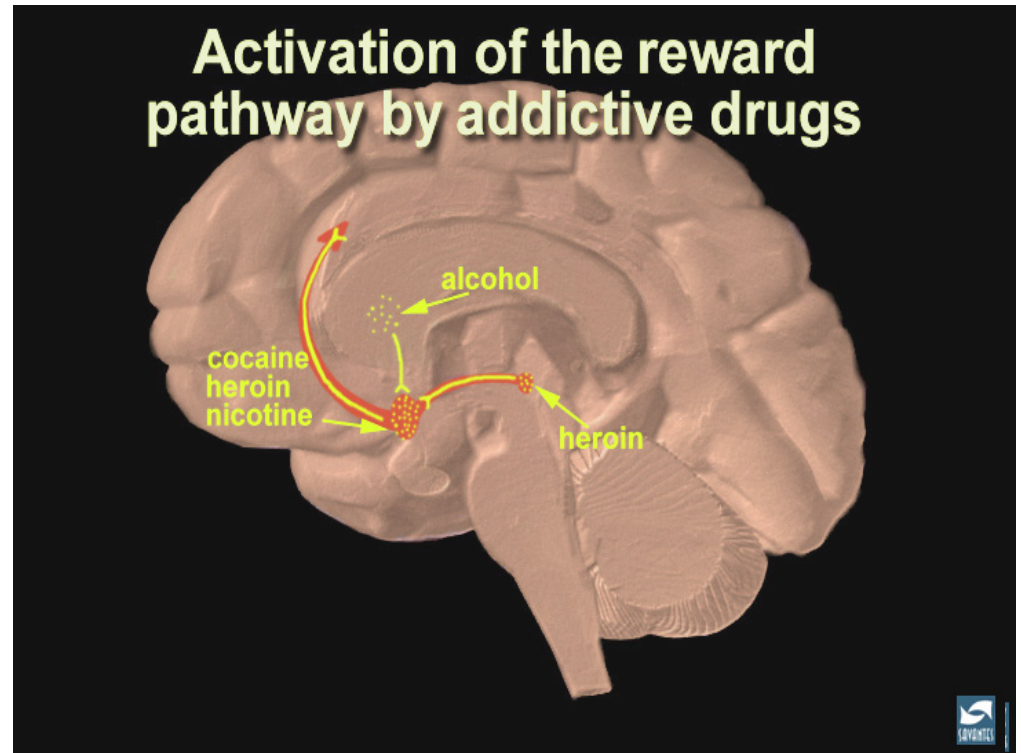
Release of dopamine



Produces feelings of pleasure



Teaches/reinforces behavior

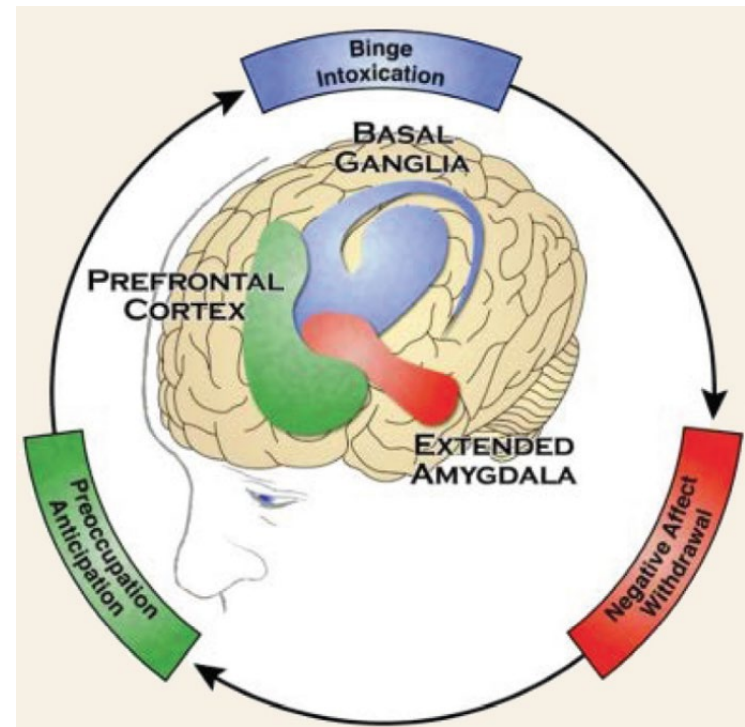


Creates a cycle of: Craving ➡ Reward ➡ Withdrawal

<https://www.drugabuse.gov/publications/teaching-packets/neurobiology-drug-addiction/section-ii-reward-pathway-addiction/1-reward-pathway-addiction>

What does nicotine dependence look like?

- Going out of way to obtain or use
 - Altering one's routines
- Withdrawal symptoms
 - Negative mood
 - Boredom
 - Stress/anxiety
- Hard to stop



Criteria for nicotine addiction (tobacco use disorder)

1. Tobacco taken in larger amounts or over longer periods of time.
2. Persistent desire or unsuccessful efforts to cut down or control use.
3. A great deal of time is spent on activities necessary to obtain or use tobacco.
4. Craving or a strong desire or urge to use tobacco.
5. Recurrent tobacco use resulting in a failure to fulfill major role obligations at work, school, or home.
6. Continued tobacco use despite having persistent or recurrent social or interpersonal problems caused or exacerbated by effects of tobacco (e.g., arguments with others about tobacco use).
7. Important social, occupational, or recreational activities are given up or reduced because of tobacco use.
8. Recurrent tobacco use in situations in which it is physically hazardous (eg, smoking in bed).
9. Tobacco use is continued despite knowledge of having a persistent or recurrent physical or psychological problem that is likely to have been caused or exacerbated by tobacco.
10. Tolerance, as defined by either the need for markedly increased amounts of tobacco to achieve the desired effect or a markedly diminished effect with continued use of the same amount of tobacco.
11. Withdrawal, as manifested by either the characteristic withdrawal syndrome or the use of tobacco to relieve or avoid withdrawal symptoms.

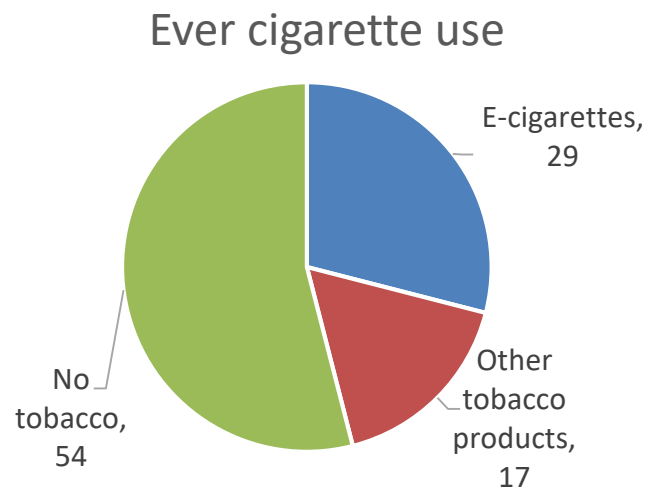
At least 2 in the
past 12 months

Main concerns re: e-cigarette use

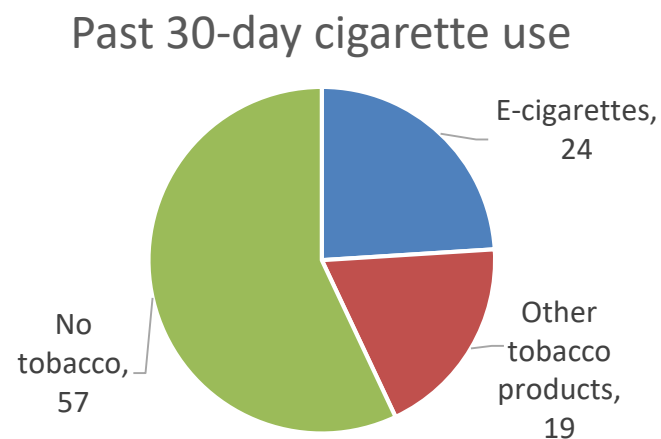
- **Transition to combusted tobacco products**

At the end of 3 years, compared to youth who had not tried any tobacco product, youth who first tried e-cigarettes or other tobacco products had...

**4x higher odds
of ever trying
cigarettes**

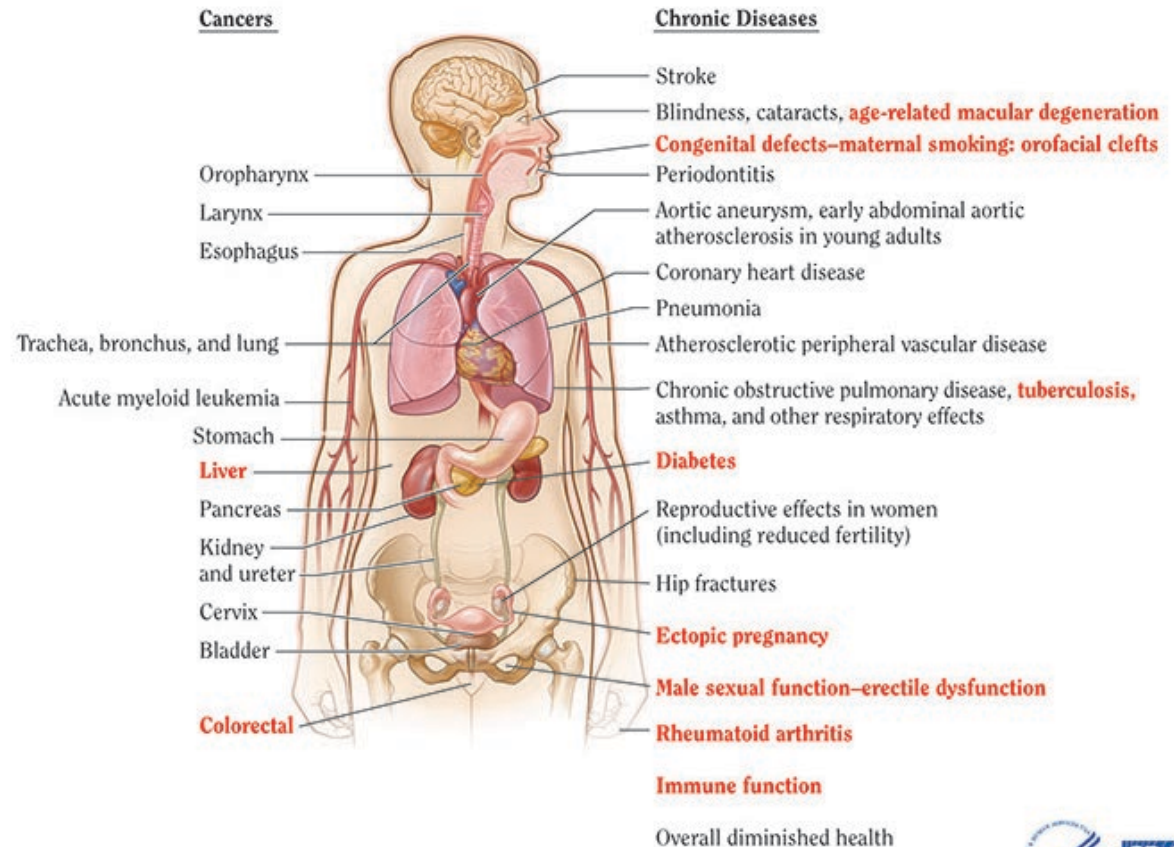


**3x higher odds
of having used cigarettes
in the past 30 days**



Health effects of cigarette smoking

- Smoking accounts for 480,000 deaths annually in the U.S.
 - ~1,300 smoking-related deaths per day
- 5.6 million of today's youth expected to die prematurely from smoking



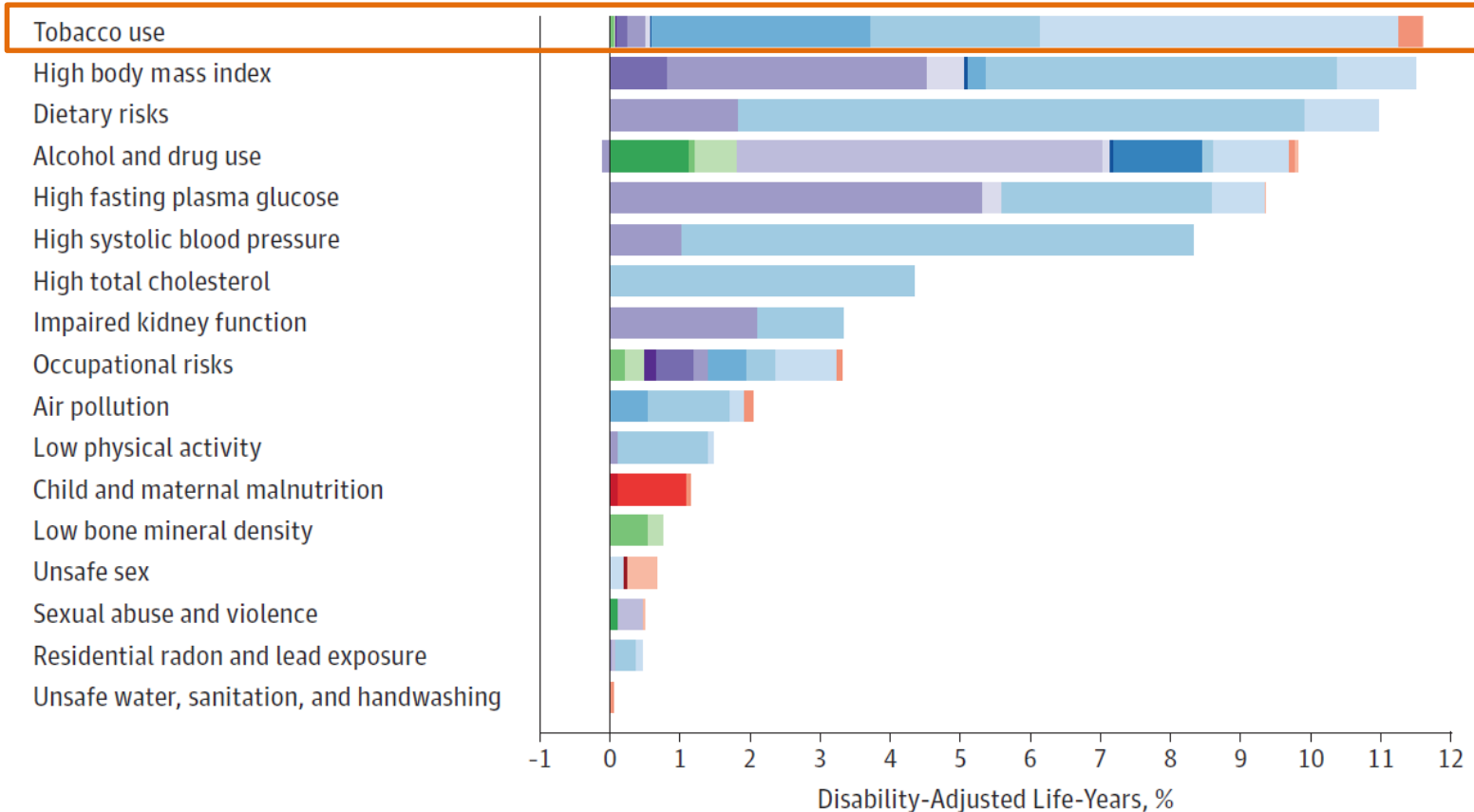
https://www.cdc.gov/tobacco/data_statistics/fact_sheets/health_effects/effects_cig_smoking/index.htm

Tobacco use:

Leading cause of preventable death in the U.S.

B Risk factors as a percentage of disability-adjusted life-years

Risk factors



Community Guide to Preventive Services

Intervention	Outcomes Addressed	CPSTF Finding
Comprehensive Tobacco Control Programs	Cessation Initiation Secondhand Smoke Exposure	Recommended August 2014
Smoke-Free Policies	Cessation Initiation Secondhand Smoke Exposure	Recommended November 2012
Interventions to Increase the Unit Price for Tobacco Products	Cessation Health Disparities Initiation	Recommended November 2012
Mass-Reach Health Communication Interventions	Cessation Initiation	Recommended April 2013
Reducing Out-of-Pocket Costs for Evidence-Based Cessation Treatments	Cessation	Recommended August 2012
Quitline Interventions	Cessation	Recommended August 2012
Mobile Phone-Based Cessation Interventions	Cessation	Recommended December 2011
Internet-Based Cessation Interventions	Cessation	Insufficient Evidence December 2011
Mass Media - Cessation Contests	Cessation	Insufficient Evidence May 2000

Vermont laws re: e-cigarettes

	Prohibits e-cigarette use in worksites, restaurants, and bars	Retail license required to sell e-cigarettes over the counter	Self-service displays of e-cigarettes prohibited	Sales of tobacco products including e-cigarettes to persons aged <21 yrs prohibited	E-cigarette tax (tax rate)	Summary of laws enacted as of September 30, 2017
Vermont	Jul 1, 2016	Jul 1, 2013	Jan 1, 2017	—	—	EF, RL, SS
Total	8 states, DC, and Puerto Rico	16 states, DC, and U.S Virgin Islands	26 states	5 states, DC, and Guam	8 states, DC, Puerto Rico and U.S. Virgin Islands	—

EF: state law prohibits e-cigarette use in indoor areas of private worksites, restaurants, and bars; RL: state law requires retailer to purchase a license to sell e-cigarettes; SS: state law prohibits self-service displays of e-cigarettes; T: state law applies tax to e-cigarettes; T-21: state law prohibits sales of tobacco products, including e-cigarettes, to persons aged <21 years.

National E-cigarette Prevention Campaigns



truth ad (October 2018)



FDA ad (October 2017)

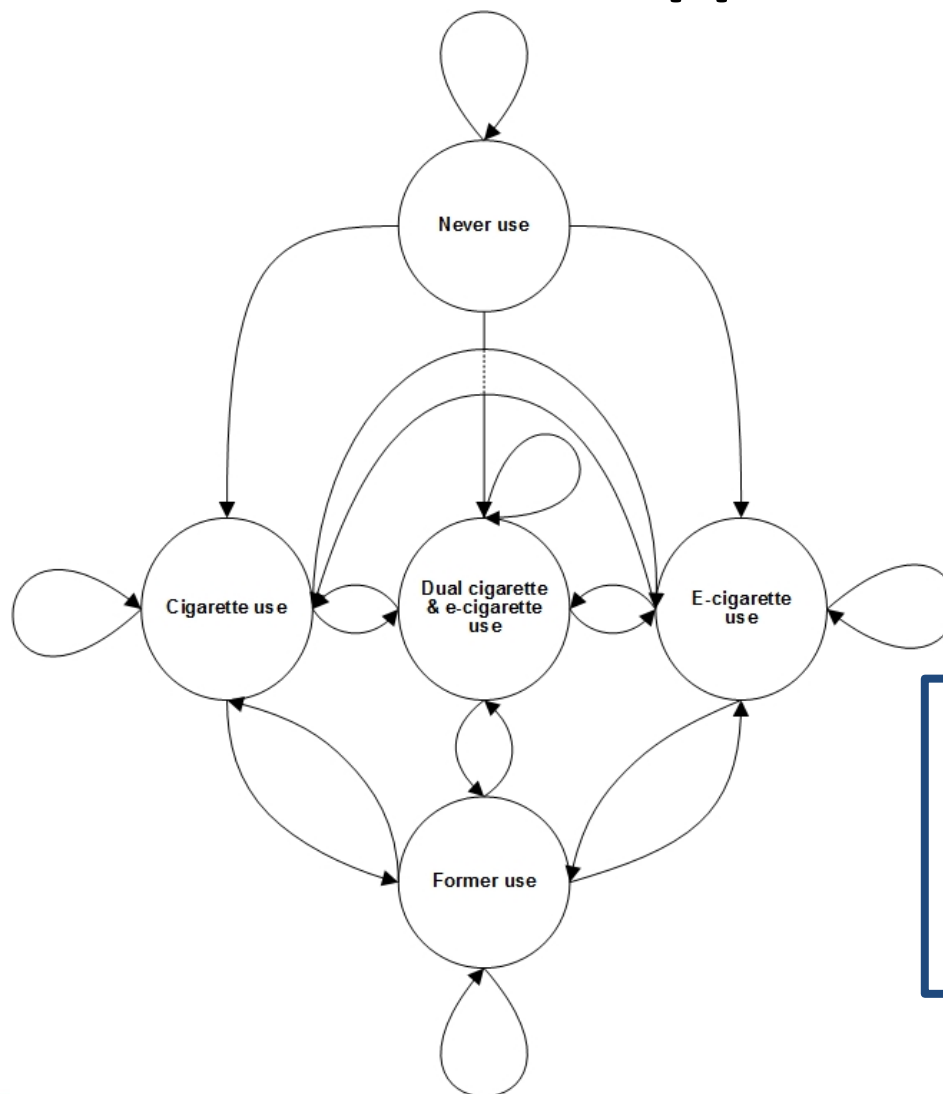
VT – E-cigarette Prevention Campaign



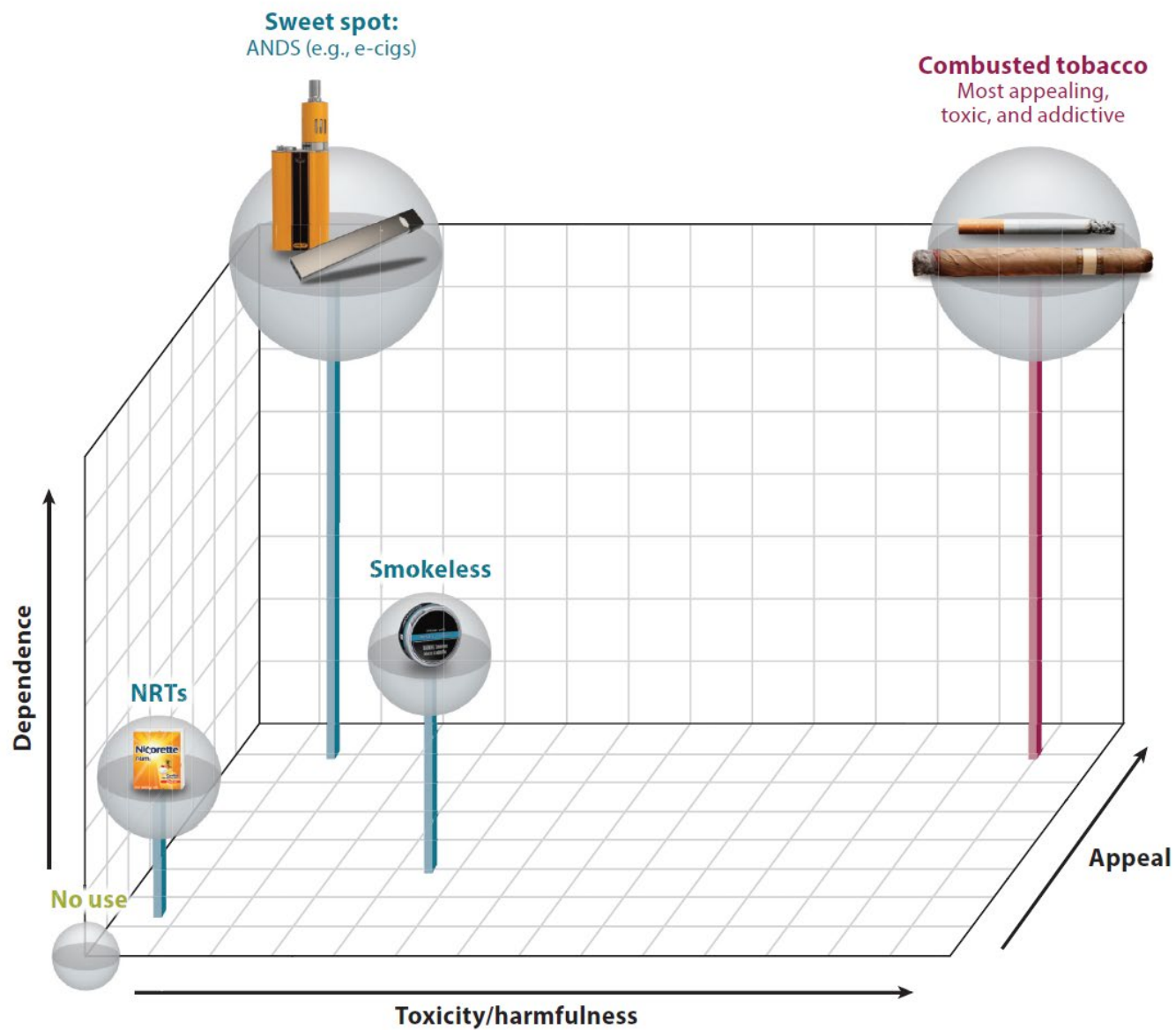
<https://unhypedvt.com/>

FDA's mandate and opportunity

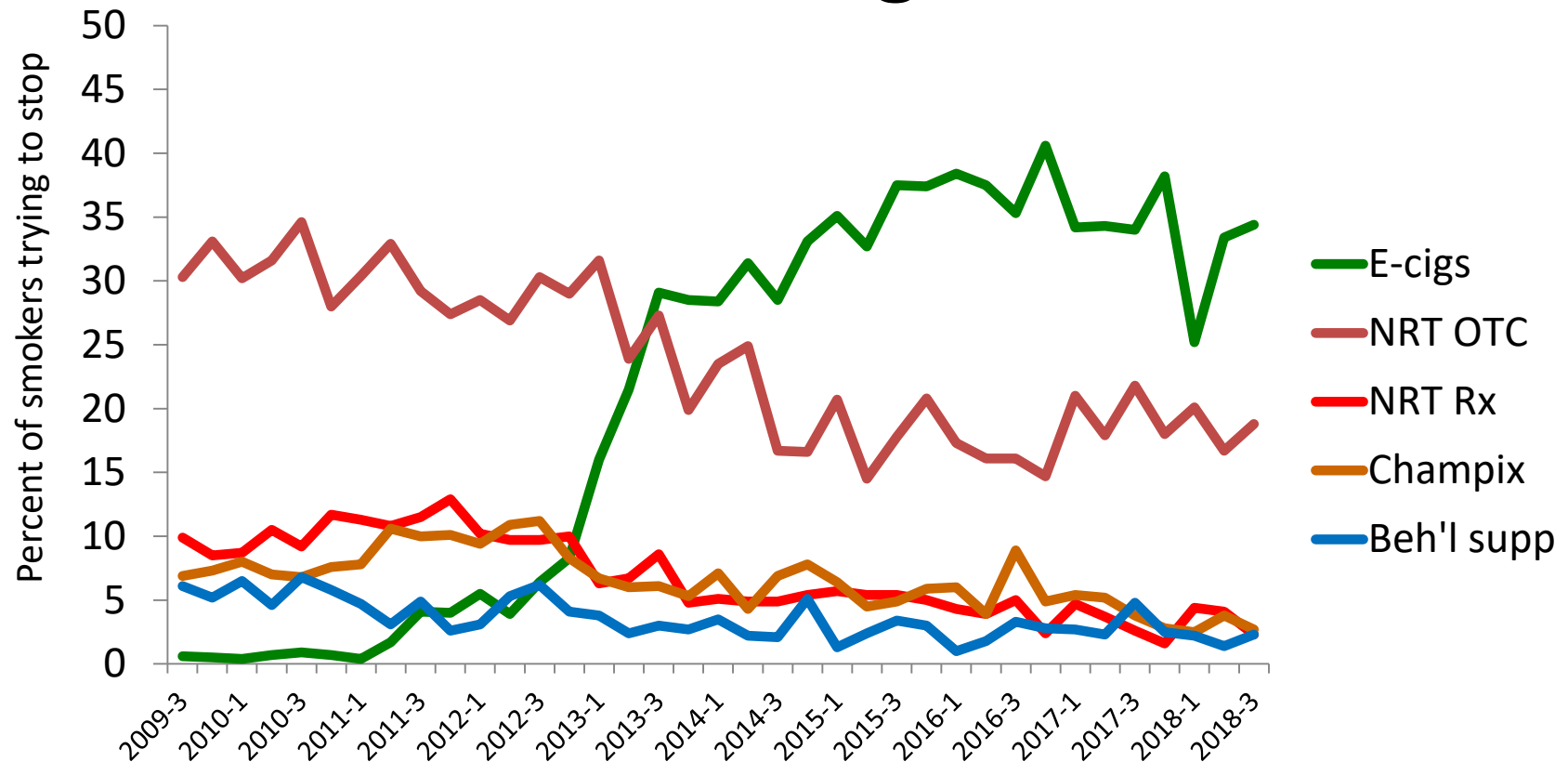
Preventing
tobacco
use



Supporting
tobacco
cessation



Aids used in most recent quit attempt, United Kingdom



N=14289 adults who smoke and tried to stop or who stopped in the past year; method is coded as any (not exclusive) use

E-cigarettes and cessation: TUS-CPS

- The overall rate of smoking cessation for the US population was significantly higher in 2014-15 than in 2010-11, as well as than in all previous survey years.
- Past-year e-cigarette users in 2014-15 were more likely than non-users to make a quit attempt and succeed in quitting smoking
- “E-cigarettes appear to have helped to increase smoking cessation at the population level.”

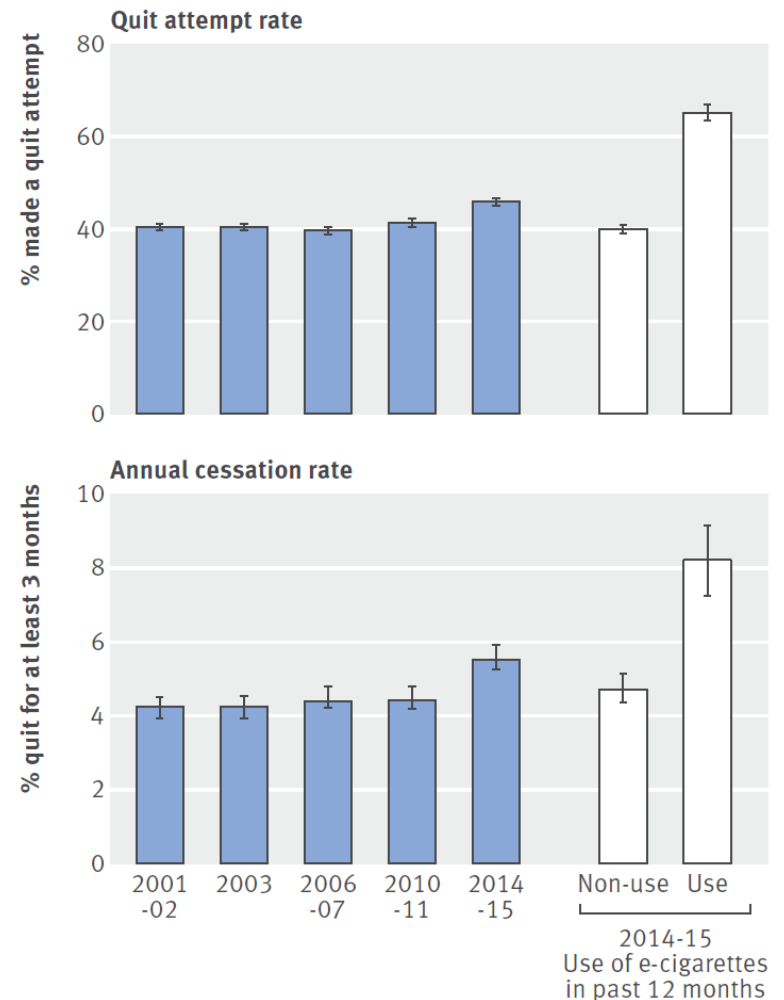
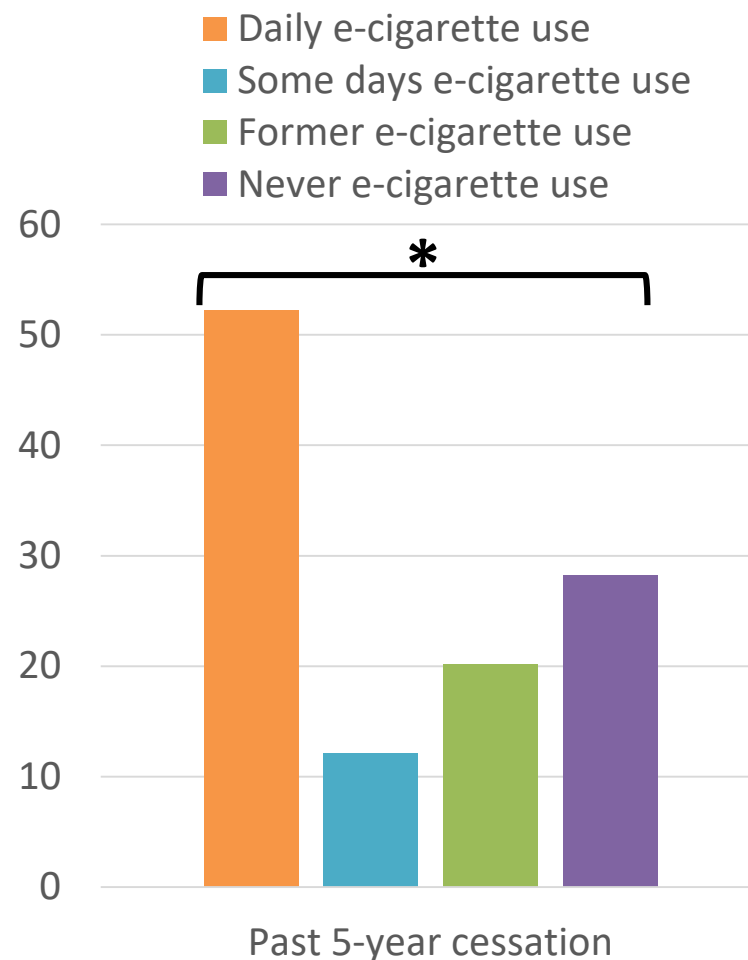
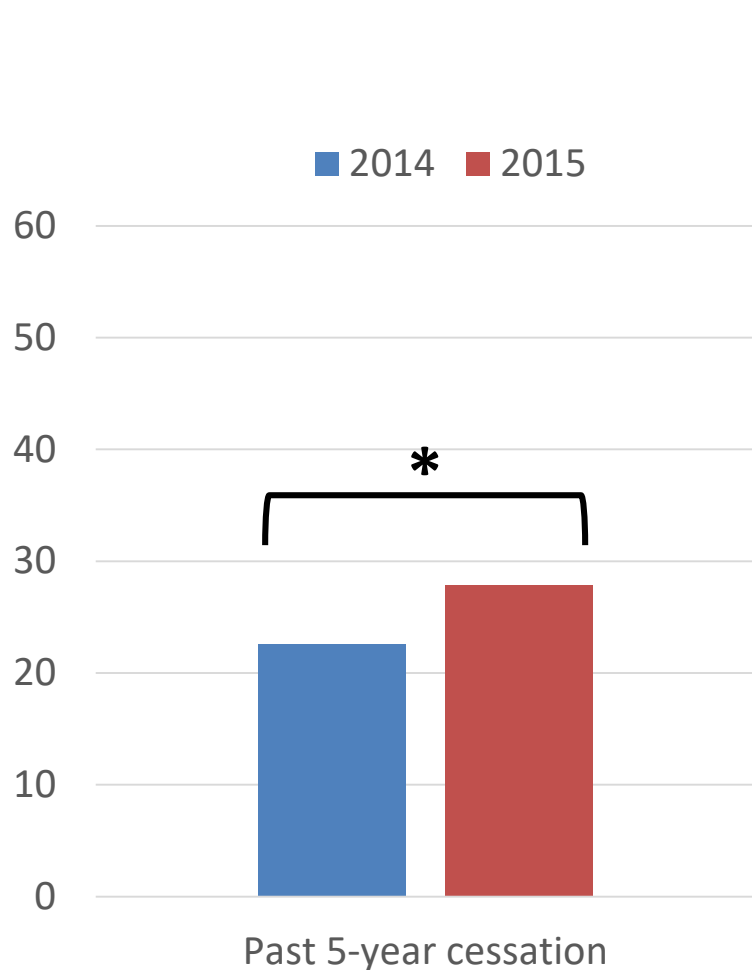


Fig 2 | Quit attempt rate and annual cessation rate from 2001-02 to 2014-15, USA. CPS-TUS=Current Population Survey-Tobacco Use Supplement

E-cigarettes and cessation: NHIS



Reach x efficacy = impact

Treatment modality	Estimated reach	Effectiveness	Potential Impact
Telephone quitlines	325,000	12.7%	41,275
Brief advice from health care provider	20,878,000	13.4%	2,797,652
OTC NRT	10,950,000	21.3%	2,332,350
Internet interventions	12,434,691	12.8%	1,591,640
E-cigarettes*	15,254,499	8.2%**	1,250,870

*Adults who looked for information on using e-cigarettes to quit or reduce smoking (HINTS Cycle 2, FDA 2017)

**Annual cessation rate among those who had used e-cigarettes in the past year

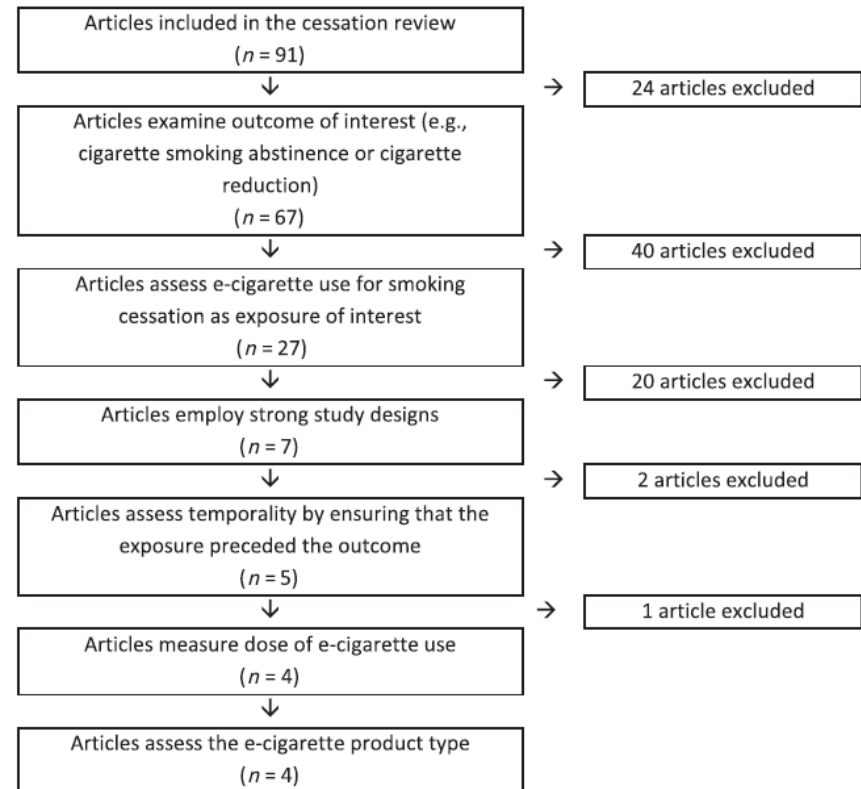
How do we determine the impact of e-cigarettes on cigarette smoking cessation or reduction? Review and recommendations for answering the research question with scientific rigor

Andrea C. Villanti^{1,2,3} , Shari P. Feirman¹, Raymond S. Niaura^{1,2} , Jennifer L. Pearson^{1,2} , Allison M. Glasser¹, Lauren K. Collins¹ & David B. Abrams^{1,2,4} 

The Schroeder Institute for Tobacco Research and Policy Studies, Truth Initiative, Washington, DC, USA,¹ Department of Health, Behavior and Society, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, USA,² Vermont Center on Behavior and Health, Department of Psychiatry, University of Vermont, Burlington, VT, USA³ and Department of Oncology, Lombardi Comprehensive Cancer Center, Georgetown University Medical Center, Washington, DC, USA⁴

E-cigarettes and cessation: Intervention studies

- Only four papers from three RCTs meet all six recommended criteria.
- These studies suggest that e-cigarettes are effective in helping adult smokers to quit or to reduce their cigarette consumption, and that rates of smoking cessation with e-cigarettes are similar to rates of cessation with NRT.



Quitting e-cigarettes/vaping/JUULing

Borrowing from tobacco cessation research:

- Set a quit date!
- Make it hard to access a vape.
- Identify high risk for vaping situations and be prepared.
- Wait out cravings by distracting with other activities, especially those incompatible with vaping.
- Keep your hands busy; keep your mouth busy (e.g., gum).
- Review quit reasons frequently.
- Avoid others while they are vaping.
- Reach out to family, friends and physician for support.
- For adults (18+), use FDA-approved medications (nicotine replacement therapy, bupropion, varenicline).

Quitting e-cigarettes/vaping/JUULing

- Practical counseling (problem solving/skills training)
 - strengthen the patient's skills in coping with situations associated with a high risk of smoking; can be specific to certain high-risk situations or involve general social skills
- Social support
 - encouragement and positive reinforcement of quit attempts by family, friends, coworkers, etc.

These are approaches used by most state quit lines (1-800-QUIT-NOW) and online resources (e.g., smokefree.gov).



Quitting resources

- Vermont:
 - <https://802quits.org/>
- National:
 - <https://smokefree.gov/>
 - <https://teen.smokefree.gov/>
 - <https://www.becomeanex.org/>
 - <https://truthinitiative.org/quitecigarettes>

4:40

87%

← Truth - Quit JUUL



Tuesday, Feb 26 • 8:06 AM

Hey! I'm from truth and here to help you quit JUUL or any other e-cigarette. Ready to quit? Text back your quit date (mm/dd) for 6 wks of 1/day tips. Not sure yet? That's cool too - let's do 2 weeks together to help you figure it out. HELP for help, STOP to cancel. StdMsgRatesApply. Reply MORE for more info.

04/01

Awesome, I've got your quit date as April 1, 2019. ~1 msg/day for 30 days to see you through this (a few more on quit day and the few days before/after) + how to cut down to quit if your quit date is more than a month away.

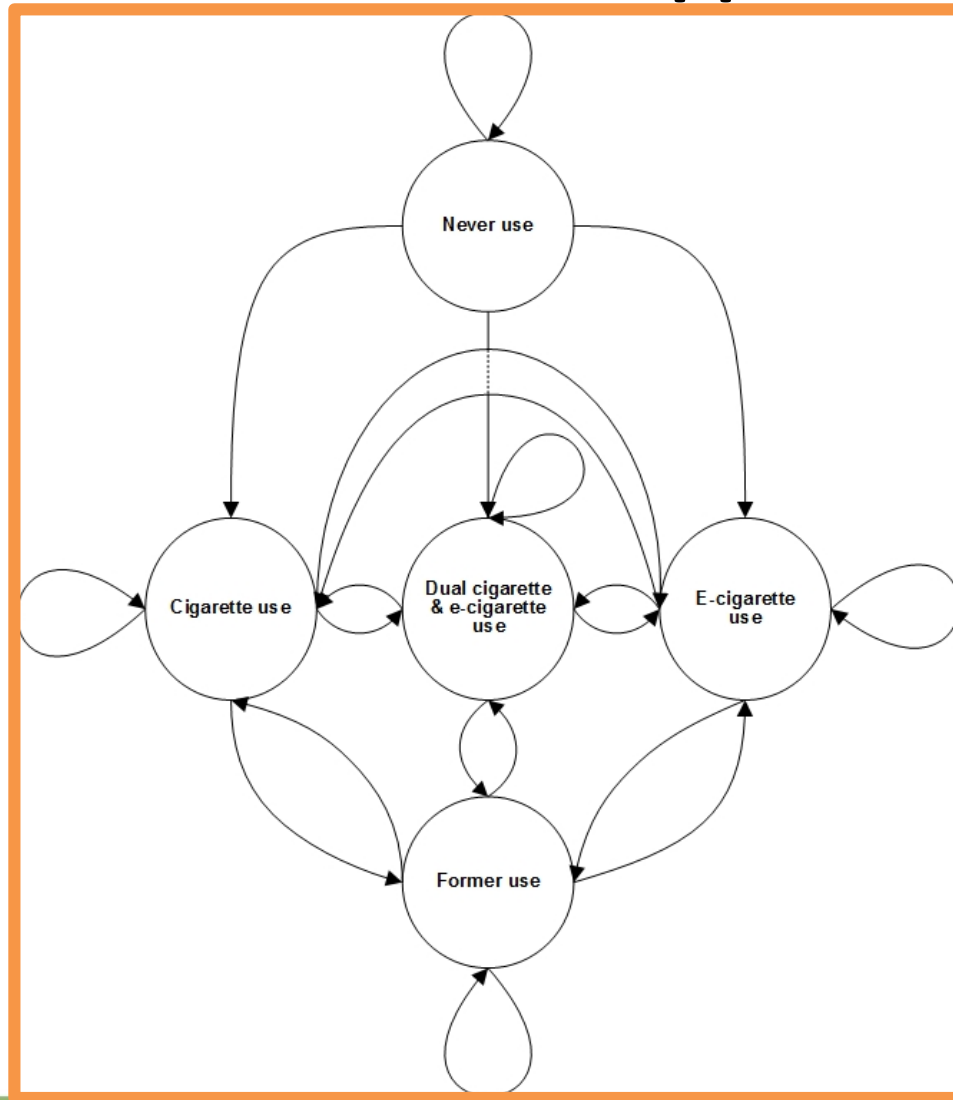
Wednesday, Feb 27 • 3:50 PM

Abigail says "Giving yourself a reason to quit is a good motivator!"

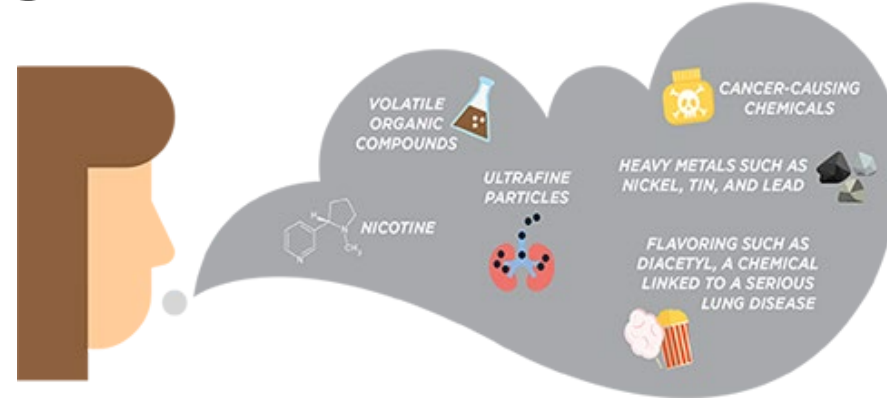
Text message



FDA's mandate and opportunity



E-cigarettes: Health effects



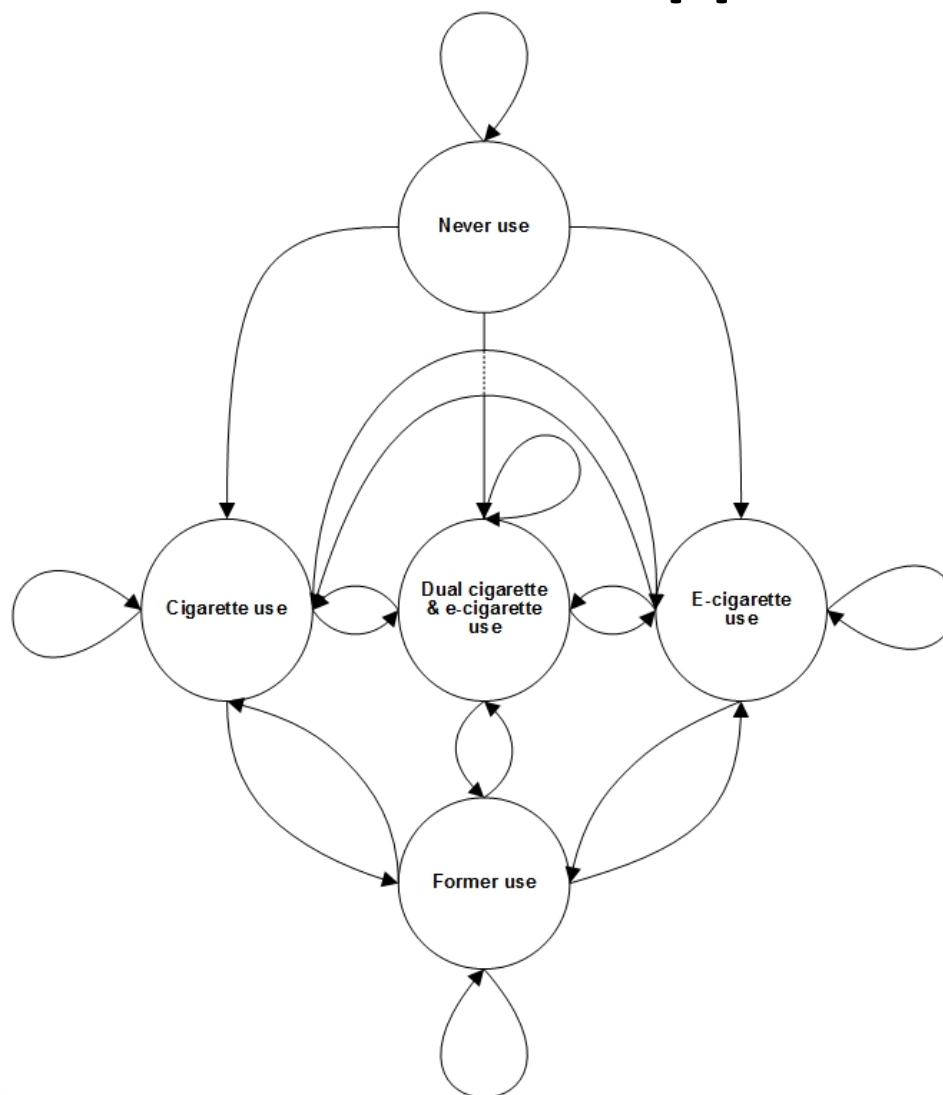
- **E-cigarette liquids typically contain nicotine, flavorings, and humectants (to retain moisture).**
 - Overall, e-cigarette aerosol contains fewer numbers and lower levels of toxicants than smoke from combustible tobacco cigarettes.
 - Nicotine exposure can mimic that found with use of combustible tobacco cigarettes, but it is highly variable.
 - The exposure to nicotine and toxicants from the aerosolization of flavorings and humectants depends on device characteristics and how the device is used.

E-cigarettes: Health effects

- **E-cigarettes have short-term negative effects on health.**
 - Cell dysfunction, tissue injury, increased heart rate, DNA damage, injury, poisoning, nicotine dependence.
 - Implications for long-term effects on morbidity and mortality are not yet clear.
- **Evidence suggests that while e-cigarettes might cause youth who use them to transition to use of combustible tobacco products, they might also increase adult cessation of combustible tobacco cigarettes.**

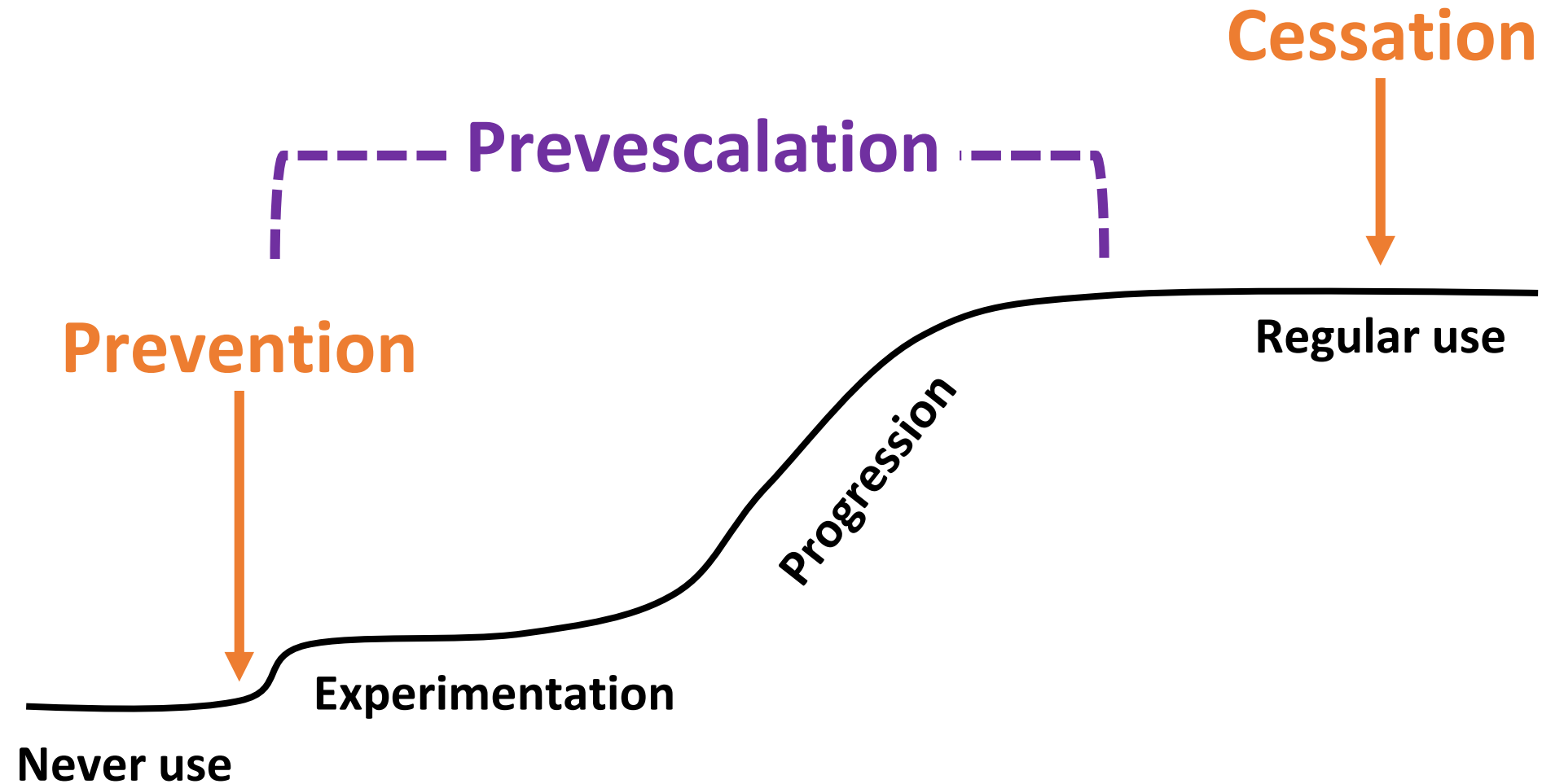
FDA's mandate and opportunity

Preventing
tobacco
use



Supporting
tobacco
cessation

Novel intervention points



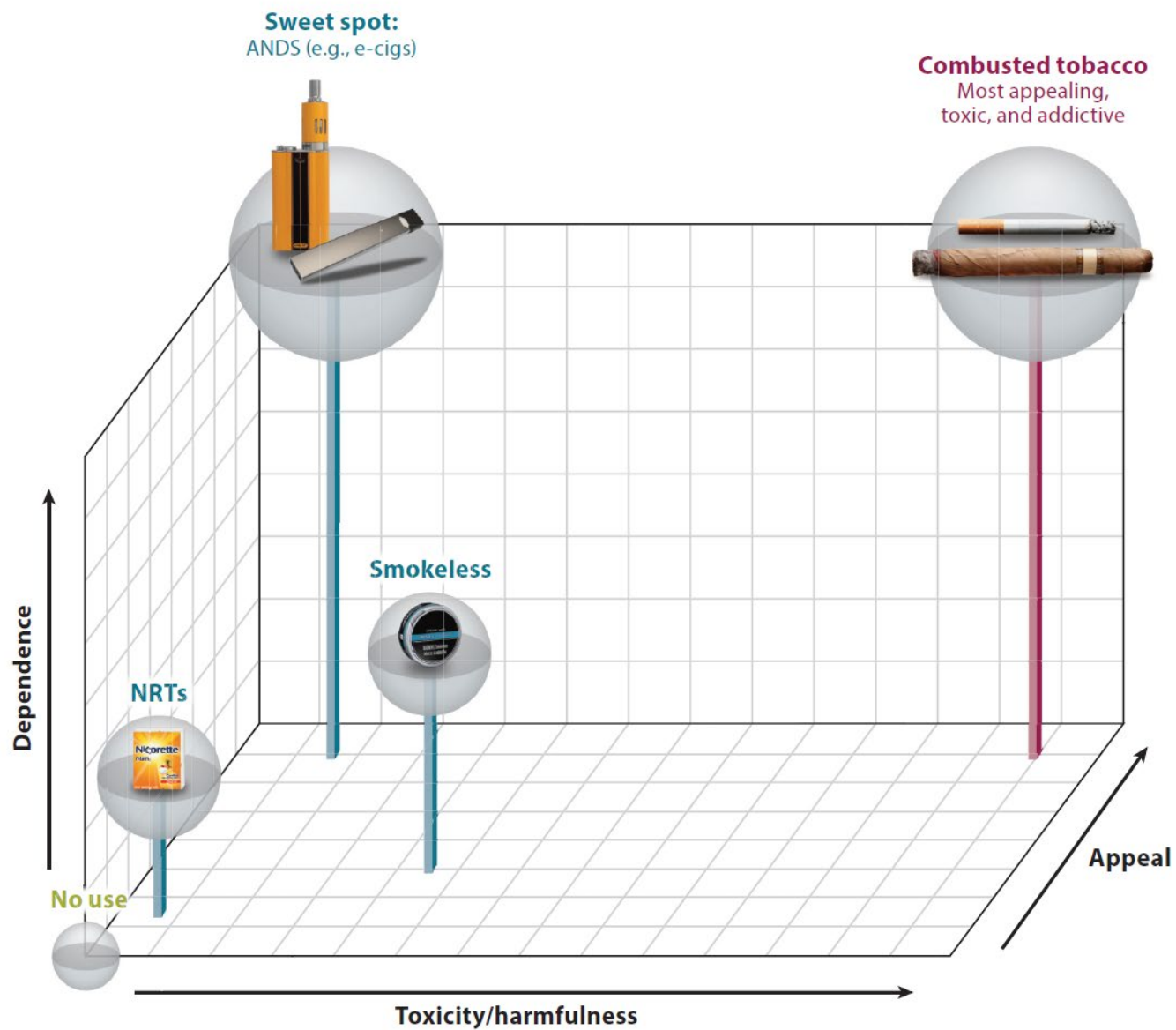


To understand the impact of state-level policies and communication campaigns on substance use beliefs and behaviors in young Vermonters.

www.pacevt.org



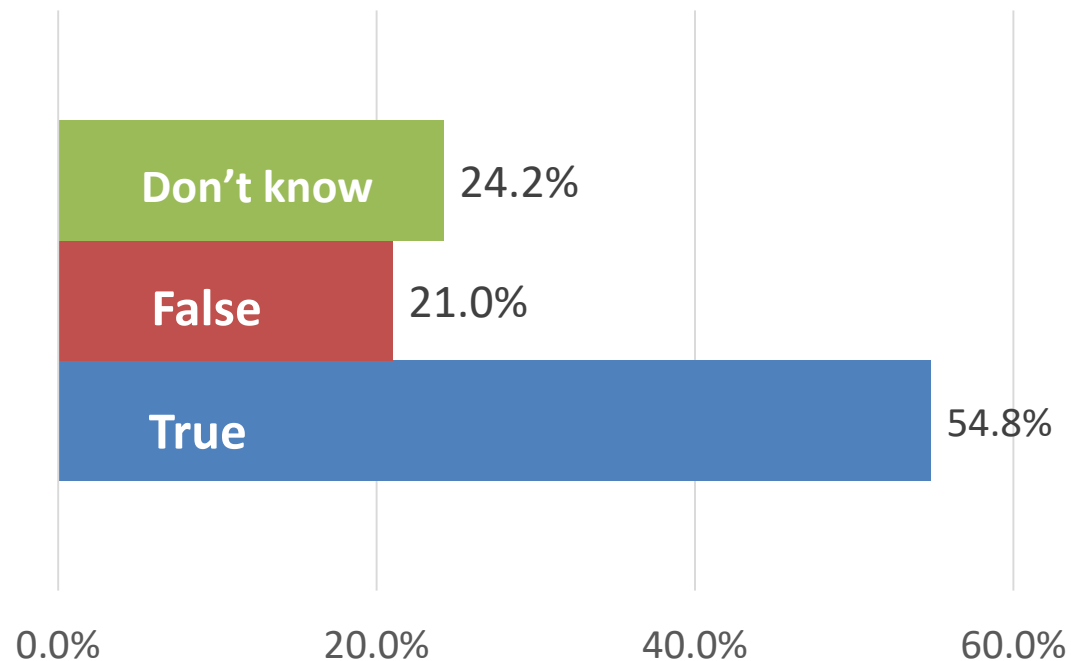
pace_vt



Nicotine beliefs

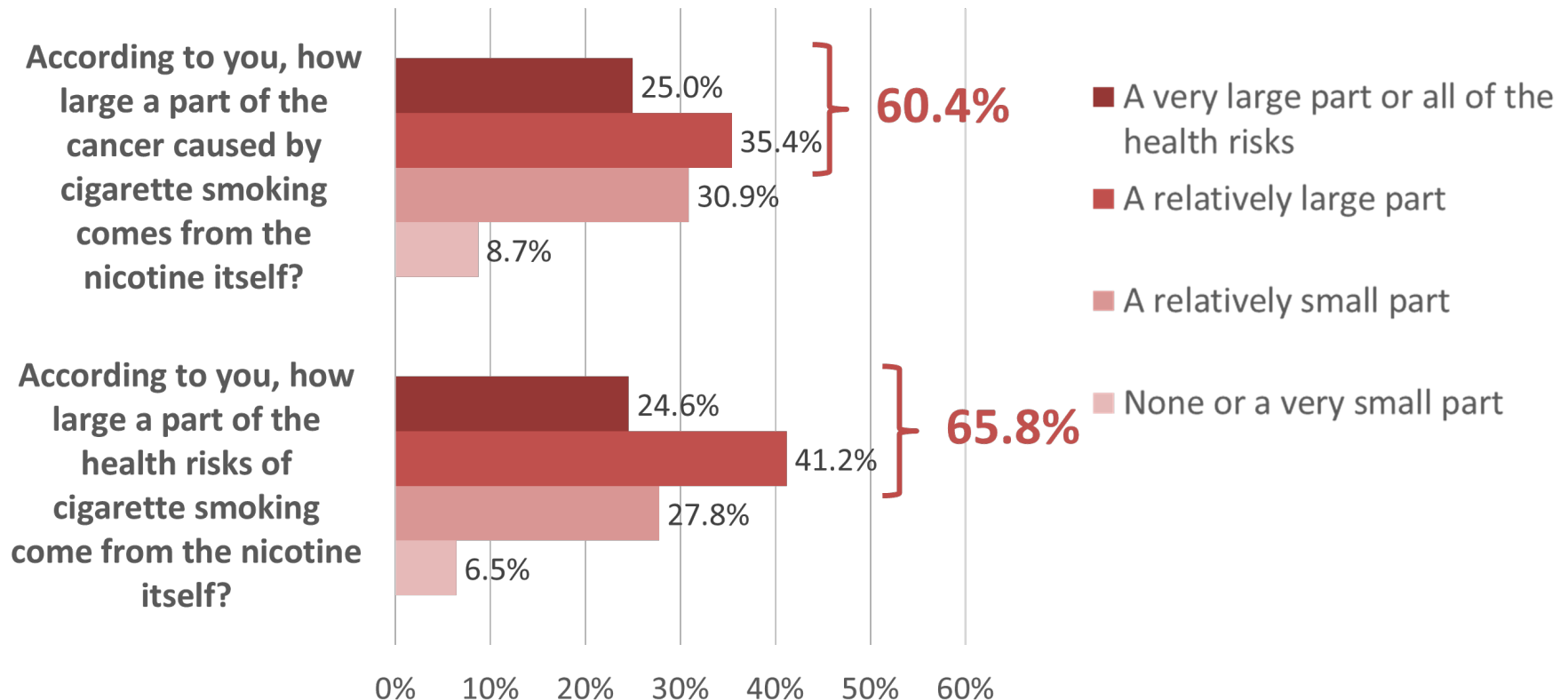
4,091 participants aged 18-40 completed Wave 10 of the Truth Initiative Young Adult Cohort Study

**Nicotine is a
cause of
cancer.**




Nicotine beliefs

Nicotine perceptions re: health risks



Nicotine beliefs



Chemicals in
cigarette smoke,
not nicotine, largely
cause cancer, heart
disease, and other
health problems
related to smoking.

Summary



- **Lesson 1:** Products matter
- **Lesson 2:** Context matters
- **Lesson 3:** Target population matters

Resources

- **Vermont Department of Health “E-cigarettes, Vaping and Juul Resources: 2019”**
 - http://www.healthvermont.gov/sites/default/files/documents/pdf/Health%20Department%20E-Cigarette%20Resources%202019%202.5.19_0.pdf
- **National Academy of Sciences, Engineering and Medicine Consensus Study Report “Public Health Consequences of E-Cigarettes”**
 - <https://www.nap.edu/resource/24952/012318ecigaretteHighlights.pdf>
- **Office of the U.S Surgeon General and the U.S. Centers for Disease Control and Prevention**
 - <https://e-cigarettes.surgeongeneral.gov/>