

# Vaping and the Developing Brain



*How big tobacco is capitalizing on adolescent brain development and what health professionals can do about it*

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# Disclosures

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Board Memberships: American Academy of Pediatrics (AAP) – MN Chapter

I'm NOT a neuroscientist.

Trends in adolescent  
e-cigarette use

Nicotine and the  
developing brain

Nicotine and other  
substance use

Clinical and community  
strategies

# A little context...



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# Game Plan

1. Describe key trends in adolescent e-cigarette use, including the intersection between e-cigarette use, mental health conditions and substance use.
2. Summarize the current literature on the effect of nicotine on the developing adolescent brain.
3. Describe the link between nicotine and other substance use.
4. Report on several clinical and community-based strategies for addressing adolescent and young adult e-cigarette use.

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When you walk out of the  
“virtual door” ...

Photo by [Brandi Ibrao](#) on [Unsplash](#)



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developing brain

Nicotine and other  
substance use

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# A word on terminology

Vaping vs aerosols

E-cigarettes

Electronic nicotine delivery systems (ENDS)

Specific products: Cig-a-likes, Juul, Blu, Smok, Sourin

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developing brain

Nicotine and other  
substance use

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# Electronic Nicotine Delivery Systems (ENDS)



Photo from FDA.gov: <https://www.fda.gov/tobacco-products/>,

# Anatomy of Electronic Nicotine Delivery Systems (ENDS)



Photo from National Institute on Drug Abuse: <https://www.drugabuse.gov/>

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# Electronic Nicotine Delivery Systems

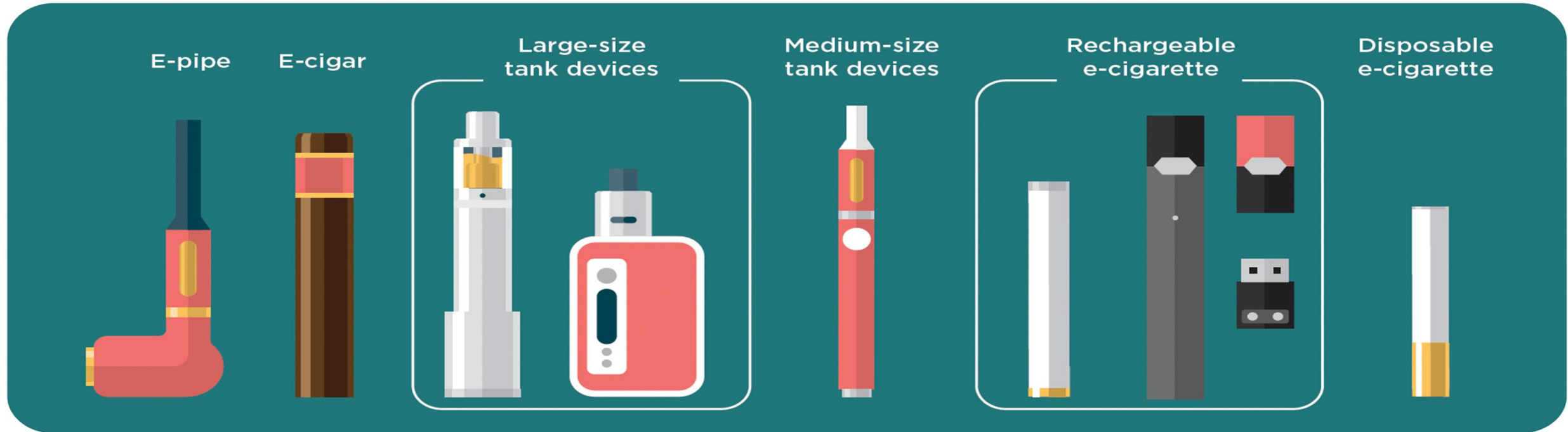


Photo from National Institute on Drug Abuse: <https://www.drugabuse.gov/>

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Nicotine and the developing brain

Nicotine and other substance use

Clinical and community strategies

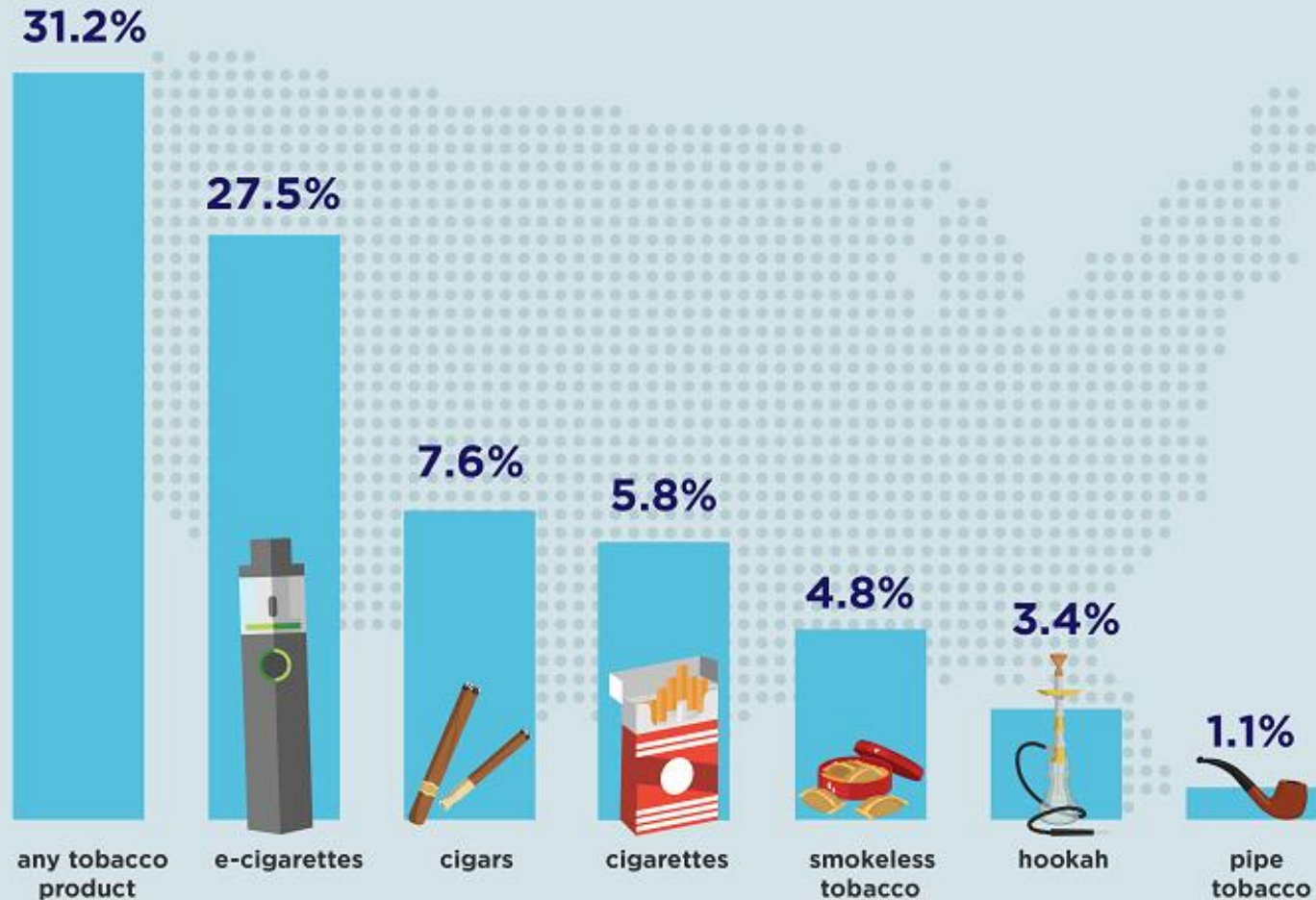
# Adolescent E-cigarette Use

## *National Data*

[National Youth Tobacco Survey Data, 2019](https://www.cdc.gov/tobacco/infographics/youth/index.htm#youth-tobacco)  
<https://www.cdc.gov/tobacco/infographics/youth/index.htm#youth-tobacco>



## TOBACCO PRODUCT USE AMONG HIGH SCHOOL STUDENTS

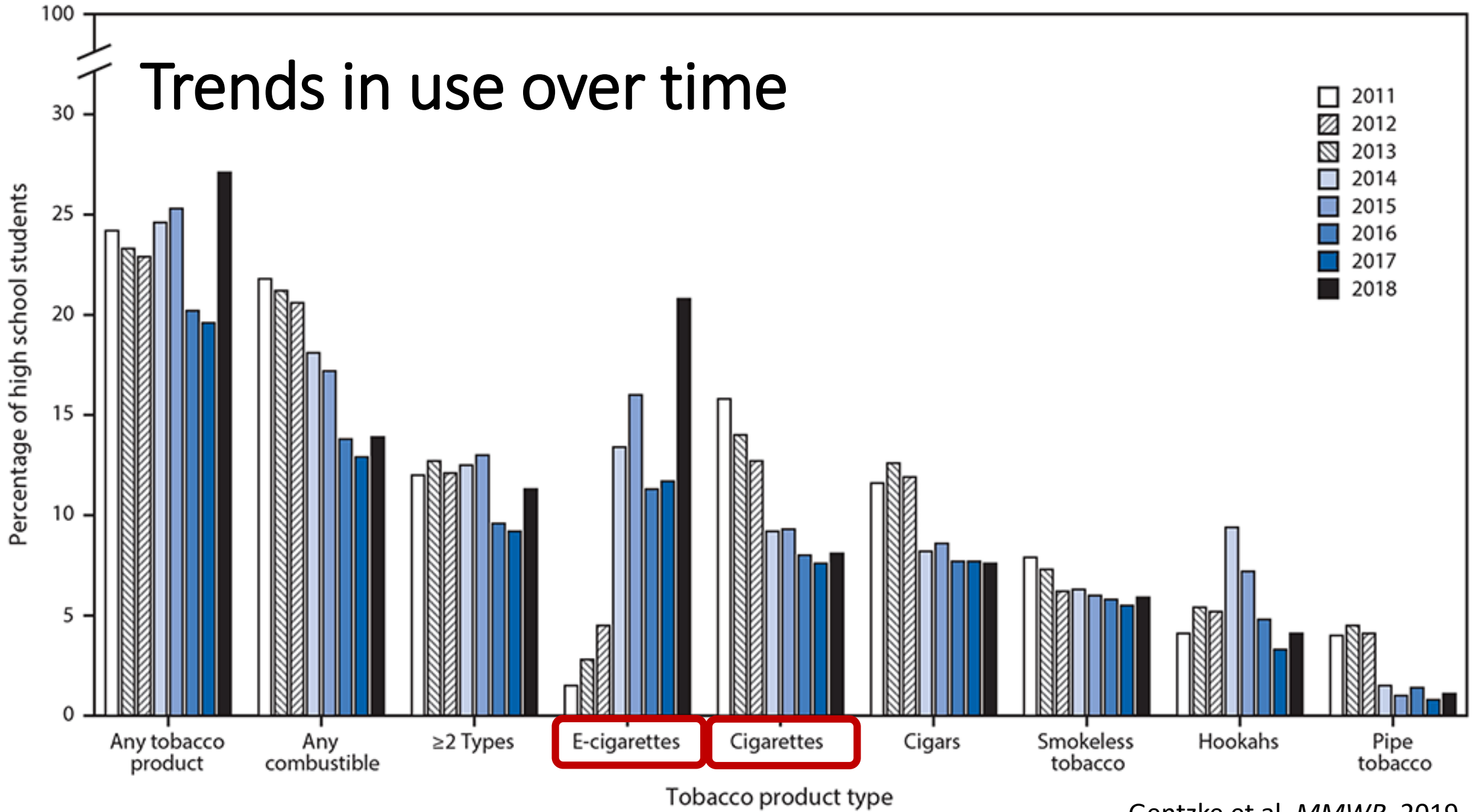


Learn more at [bit.ly/NYTS-2019](https://bit.ly/NYTS-2019)

Source: National Youth Tobacco Survey, 2019



# Trends in use over time

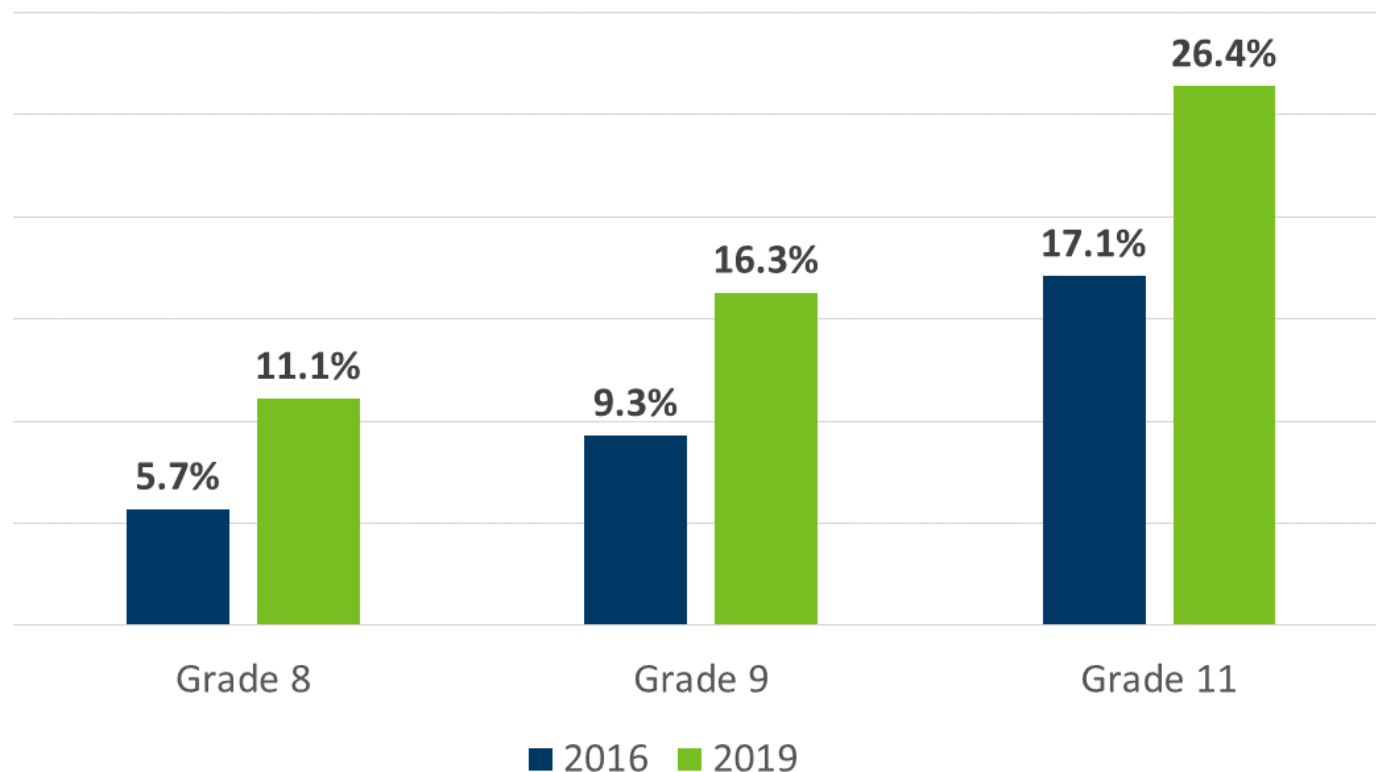


# Adolescent E-cigarette Use

## *Minnesota Data*

Minnesota Student Survey, 2016 and 2019.

Percent of students who vaped in the past 30 days



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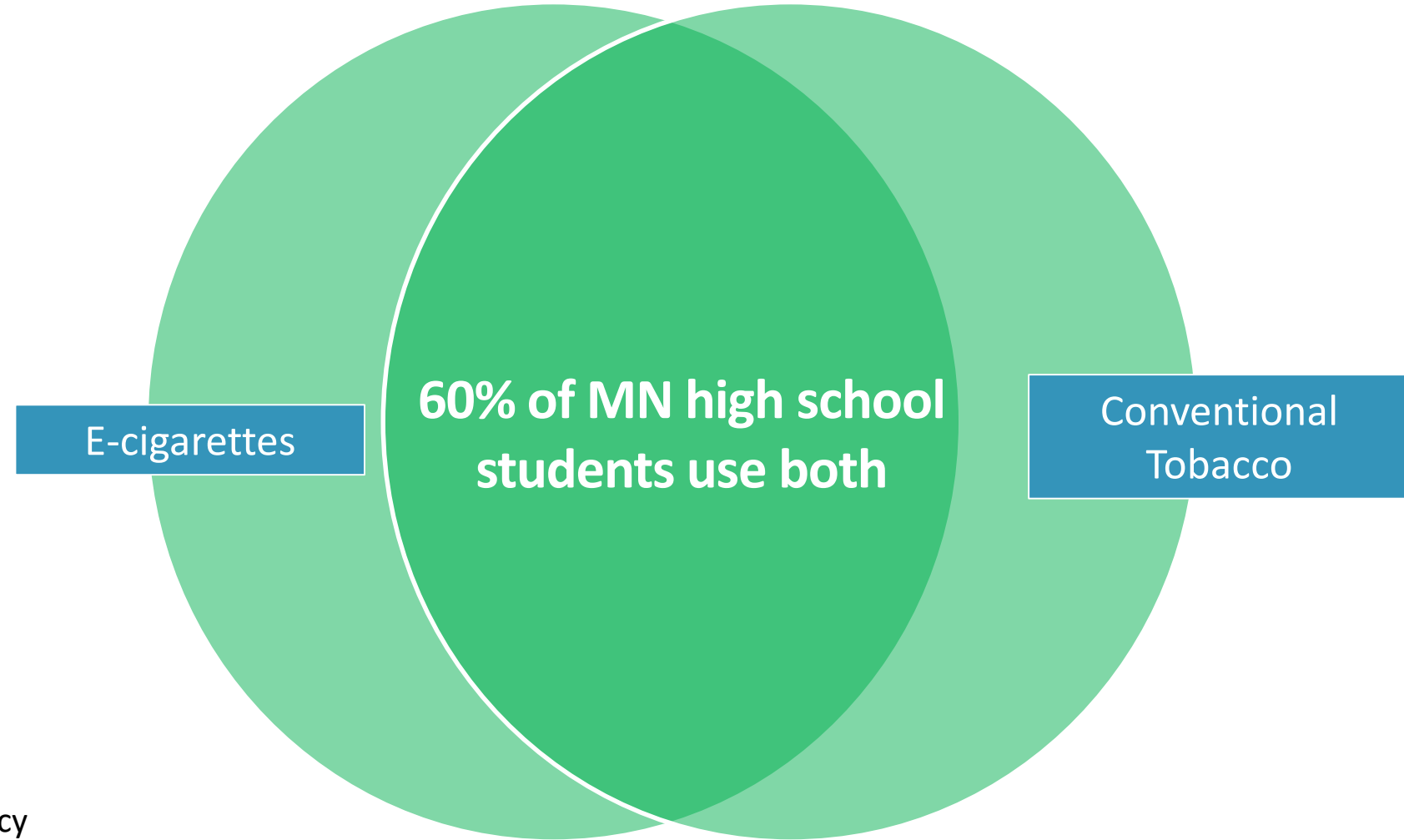
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# Dual Use



Minnesota Student Survey 2016

Dutra & Glantz, *JAMA Pediatrics*, 2014

Vogel et al, *J Adolescent Health*, 2019

\*Slide Image Adapted from Physician Advocacy Network, Twin Cities Medical Society Teen Vaping

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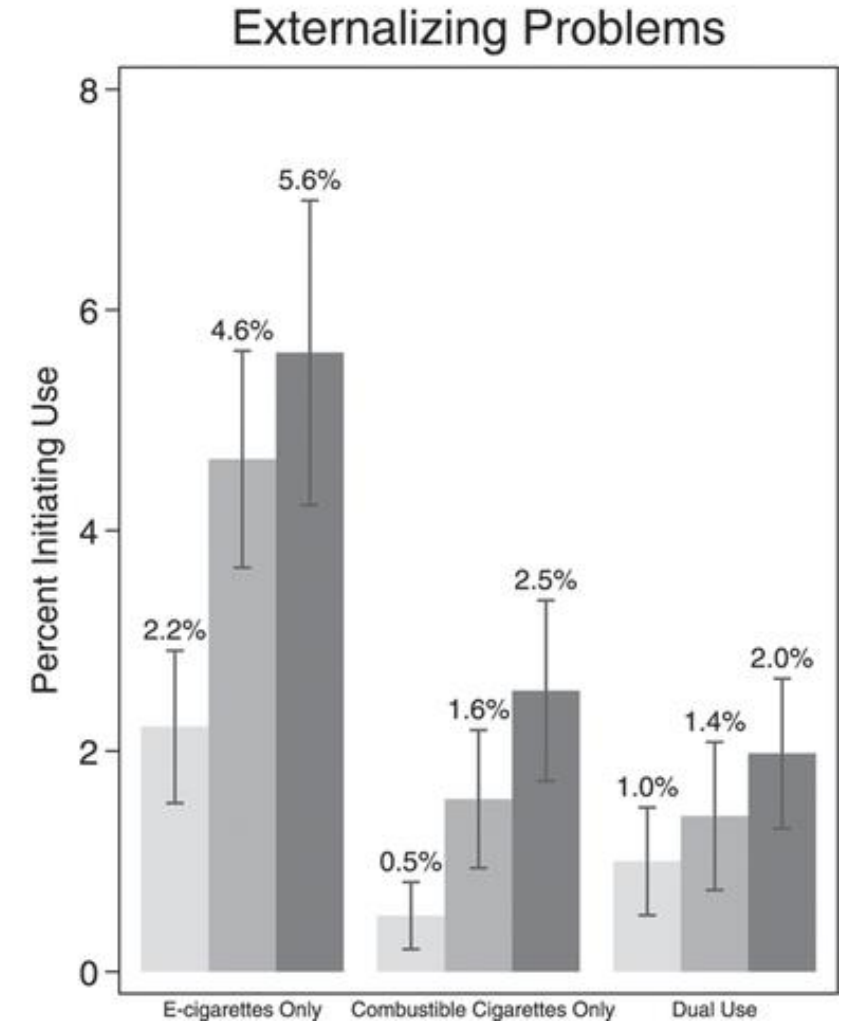
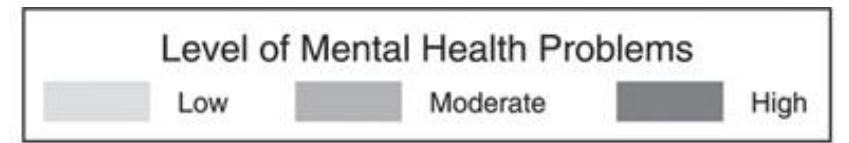
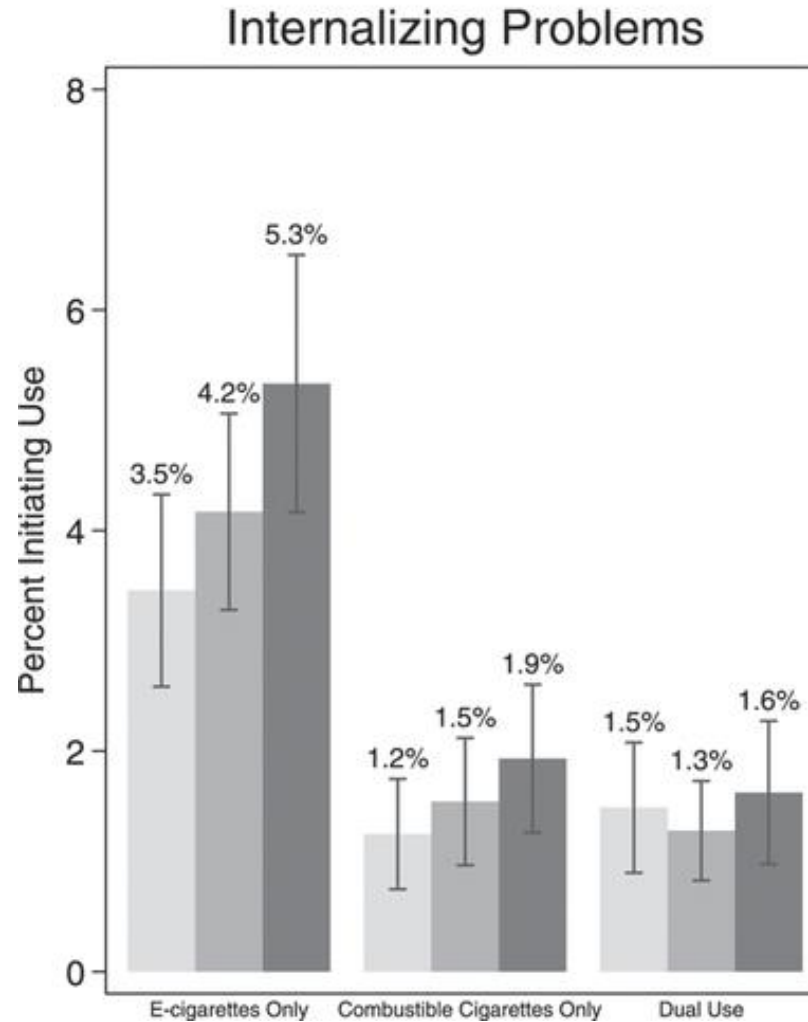
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# E-cigarettes and Mental Health

Riehm et al, Pediatrics, 2019



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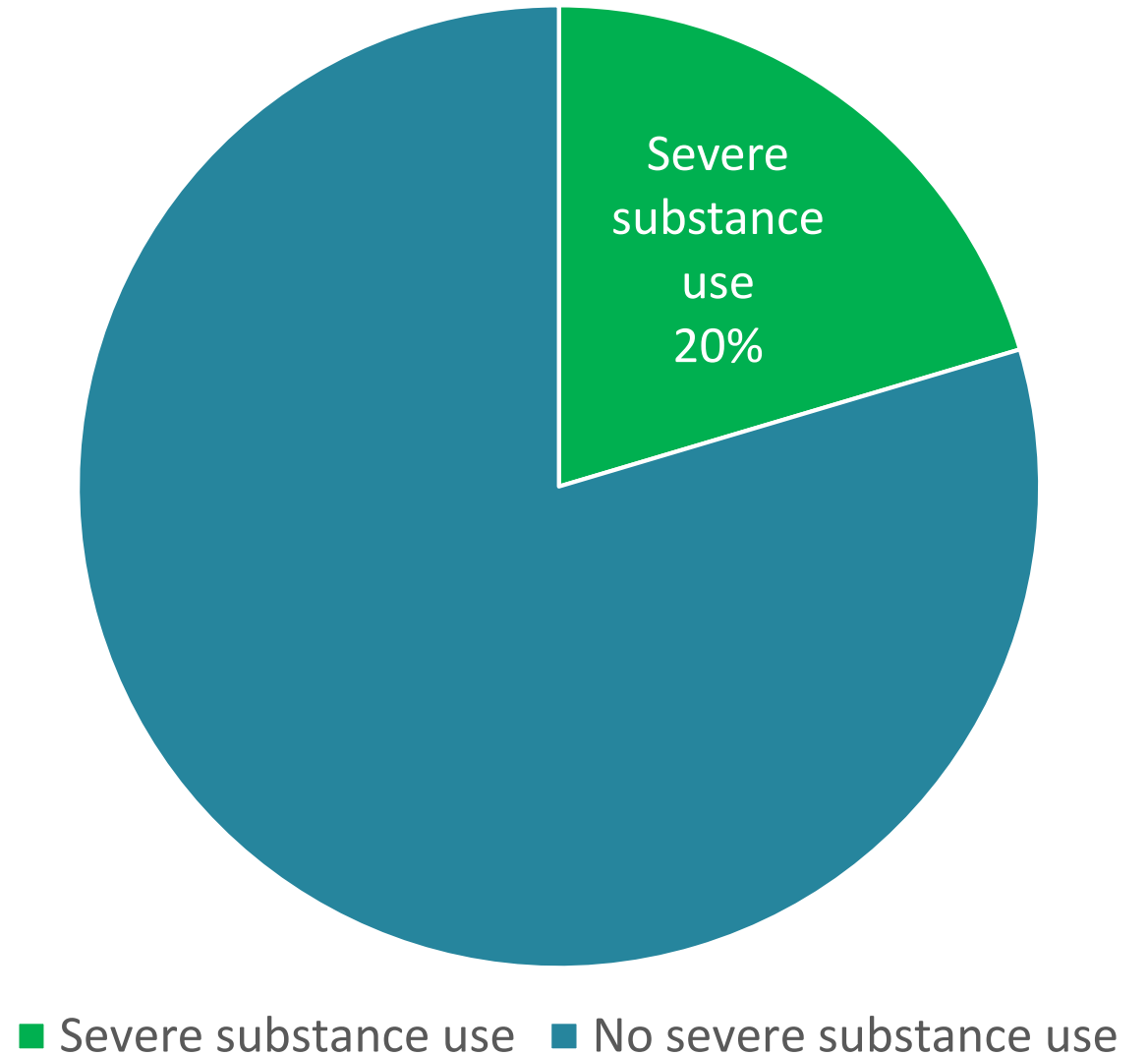
Clinical and community strategies

# E-cigarettes and other substance use

8x

greater odds of severe substance use compared to those who hadn't smoked

Conway et al, *Addictive Behaviors*, 2017



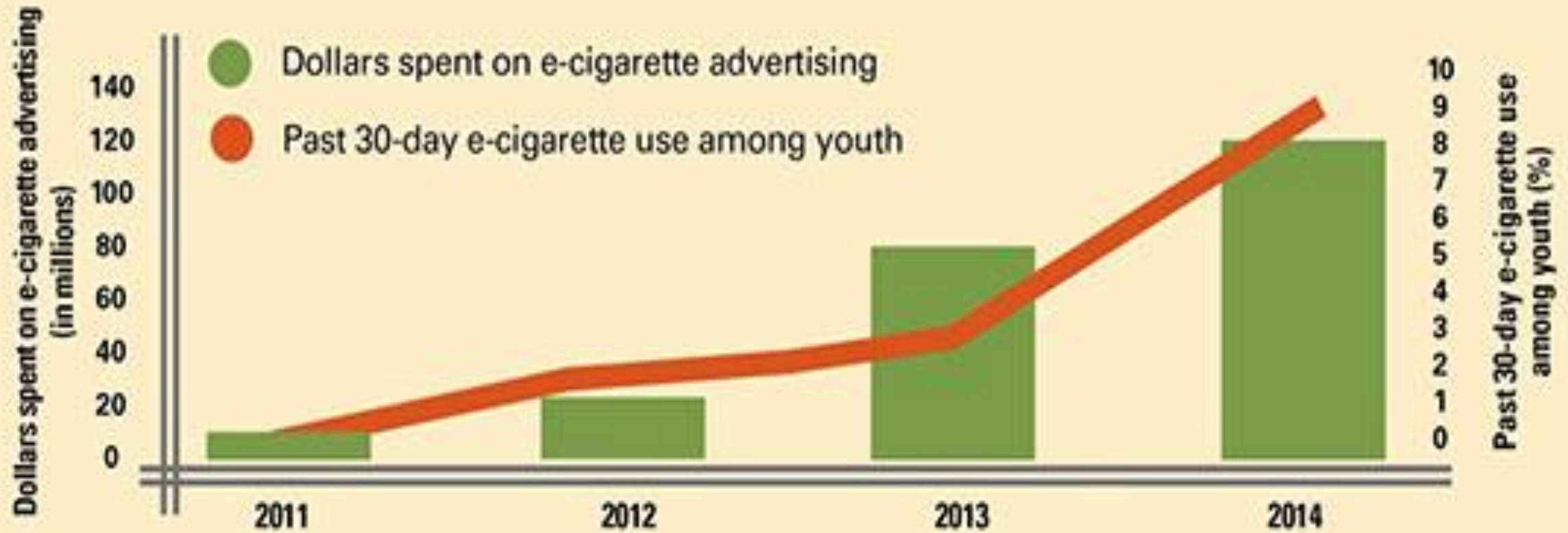
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# E-cigarette use among youth is rising as e-cigarette advertising grows



SOURCE: National Youth Tobacco Survey, 2011-2014; Kim et al (2014), Truth Initiative (2015).

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blucigsusa • Following

blucigsusa #repost via @postmalone | #posty x #blu .

WARNING: This product contains nicotine. Nicotine is an addictive chemical.

asapmami When the blue hits ☐☐

realdylanmonroe Does blu have an official Snapchat?

walkallnite YeahYeah @postmalone, fill that pod with the special #postyco #bluedream juice☐☐☐☐100➡

happylillthang @summpeters ugh....❤

habibidrip yo it's MARWAN 100 check my page out! Lets work 🍀



982 likes

5 DAYS AGO

Add a comment...



blucigsusa



106 likes

blucigsusa Only two accessories needed to live the #blulife this summer: 😎 + #myblu

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# Big tobacco using the same old tricks...



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Nicotine and other substance use

Clinical and community strategies



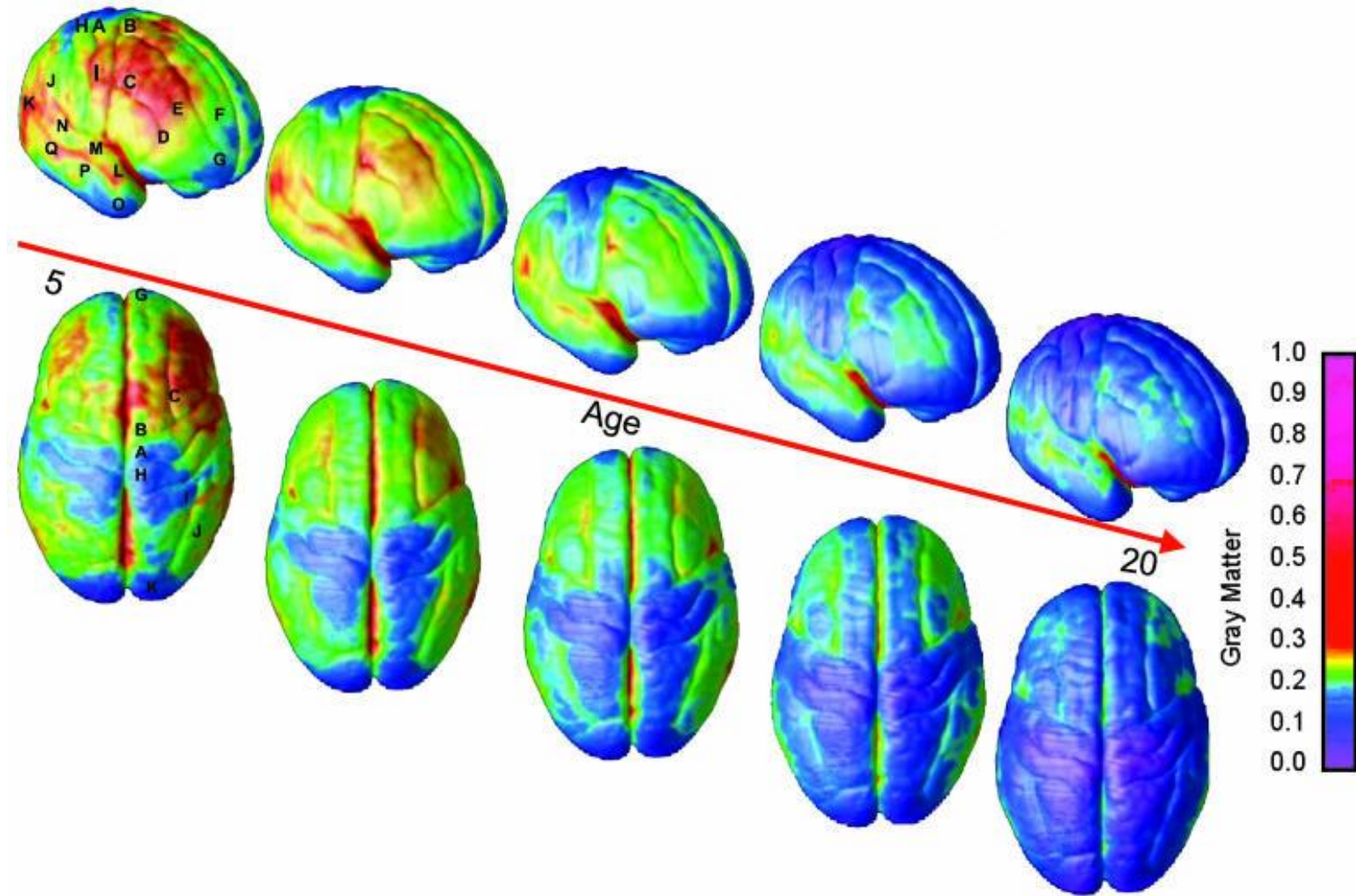
Let's consider the science behind these trends...

Why are adolescents using at such high rates?

Why is big tobacco spending so much money on adolescents?



# The Developing Adolescent Brain



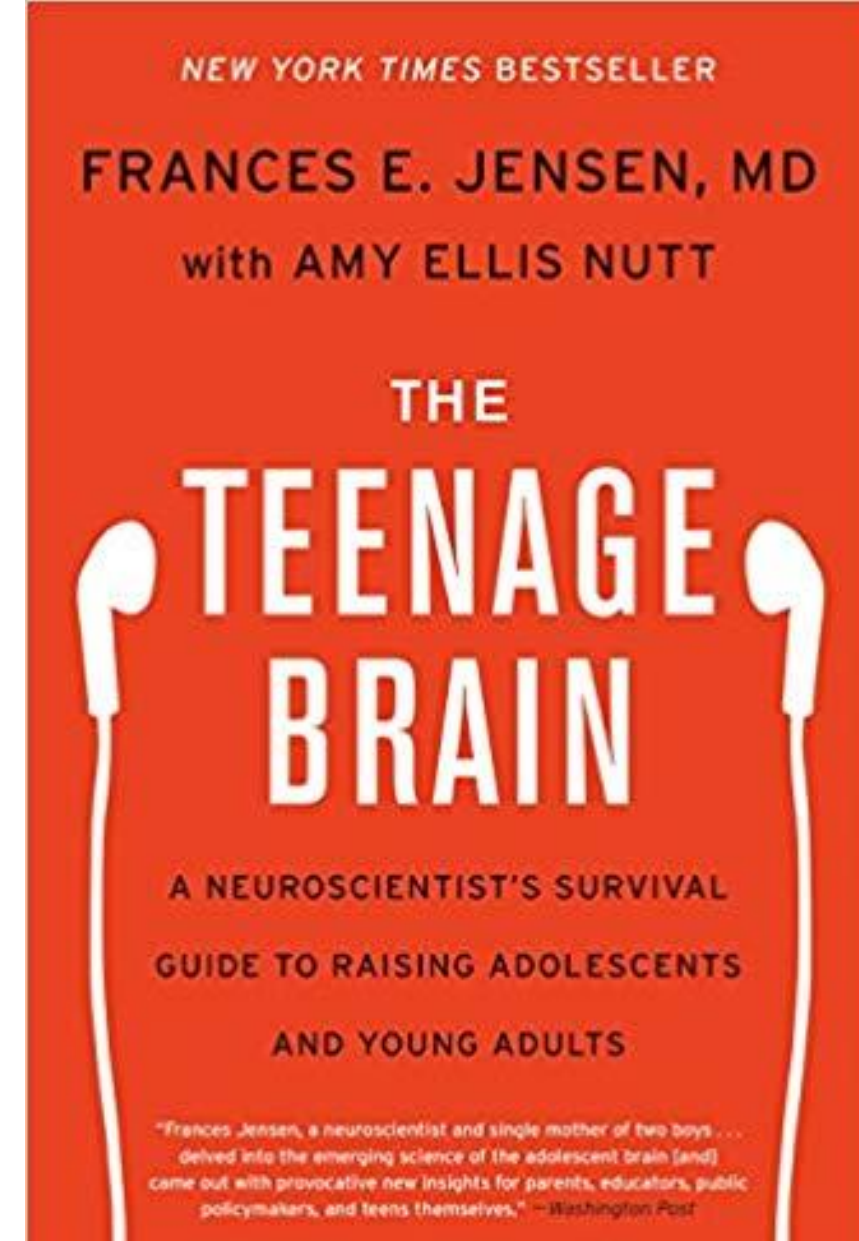
England et al, *Am J Prev Med*, 2015

Gogtay et al, *Proc Natl Acad Sci USA*, 2004

(Photo)

“The adolescent brain is like a Ferrari with weak breaks.”

- Frances Jensen



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# THE ADOLESCENT BRAIN

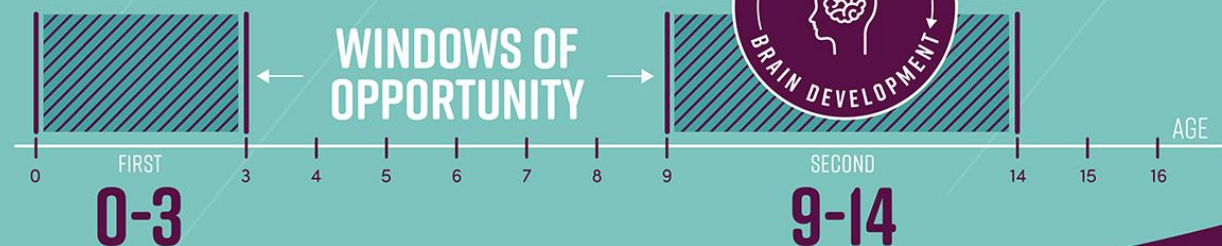
## A SECOND WINDOW OF OPPORTUNITY

EARLY ADOLESCENCE IS  
A TIME OF RAPID  
LEARNING AND  
BRAIN DEVELOPMENT

THESE INCLUDE  
INCREASES IN  
SENSATION-SEEKING,  
MOTIVATION FOR SOCIAL  
RELATIONS AND SENSITIVITY TO  
SOCIAL EVALUATION.

A PERIOD OF  
VULNERABILITY  
AND OPPORTUNITY

PUBERTY INITIATES INTENSE  
LEARNING & BRAIN  
DEVELOPMENT, WHICH LEAD TO  
STRUCTURAL REMODELING AND  
NEURAL RE-CONFIGURATION OF  
KEY BRAIN SYSTEMS. IT'S A  
CRUCIAL TIME TO INVEST IN  
ADOLESCENTS.



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**"THE ADOLESCENT BRAIN:  
A SECOND WINDOW OF OPPORTUNITY"**

[WWW.UNICEF-IRC.ORG/ADOLESCENT-BRAIN](http://WWW.UNICEF-IRC.ORG/ADOLESCENT-BRAIN)



# Nicotine and the Brain: Physiologic Changes



Siquiera, *Pediatrics*, 2017

Photo from: <https://www.becomeanex.org/tobacco-addiction/>

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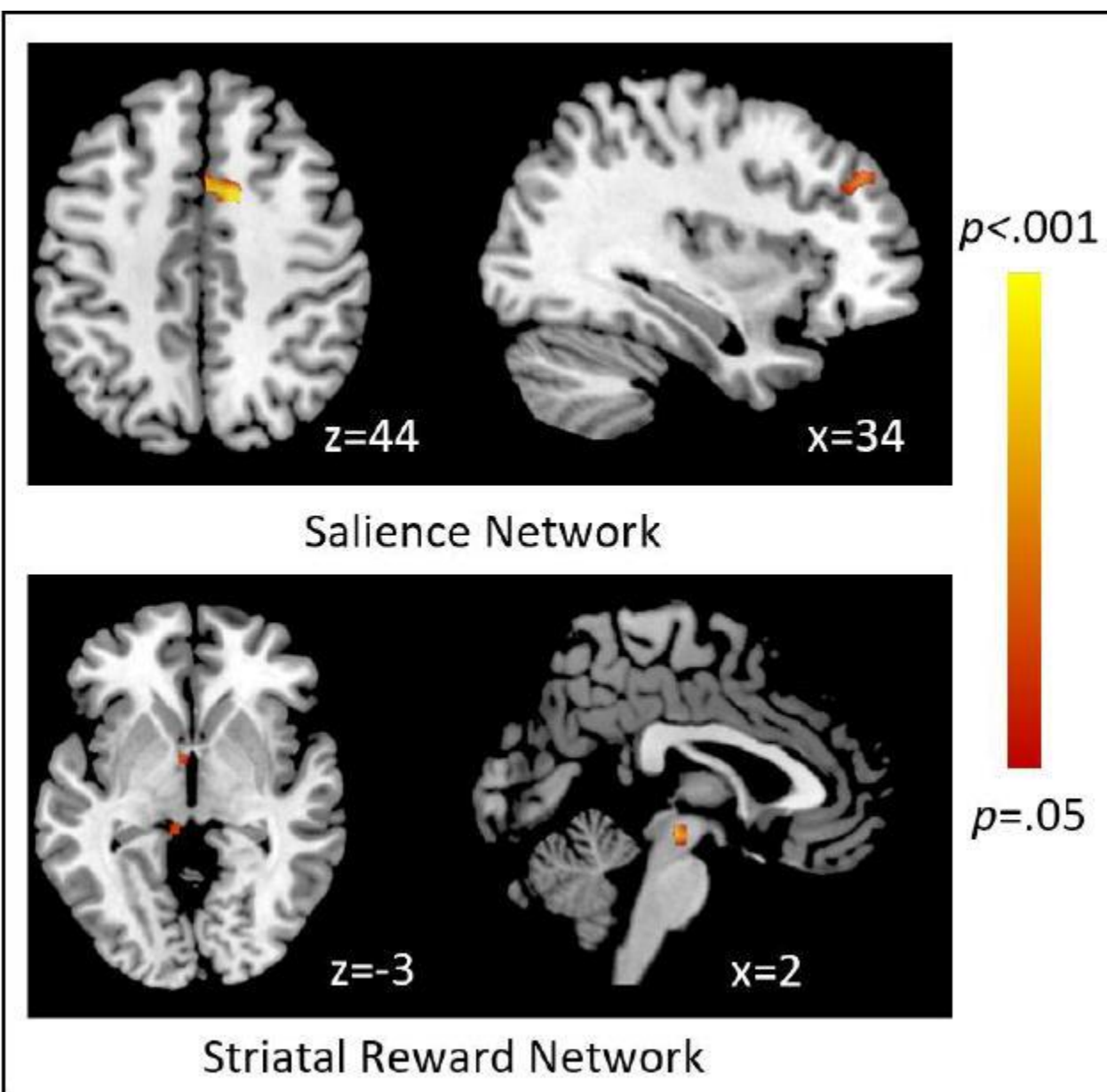
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# Nicotine and the Brain: Structural Changes

Siquiera, *Pediatrics*, 2017.

Hobkirk et al, *Brain Research Bulletin*, 2017.



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# The adolescent brain is particularly vulnerable.

DiFranza et al, *Tobacco Control*, 2002  
England et al, *Am J Prev Med*, 2015  
Office of the Surgeon General, 2012  
Siquiera, *Pediatrics*, 2017

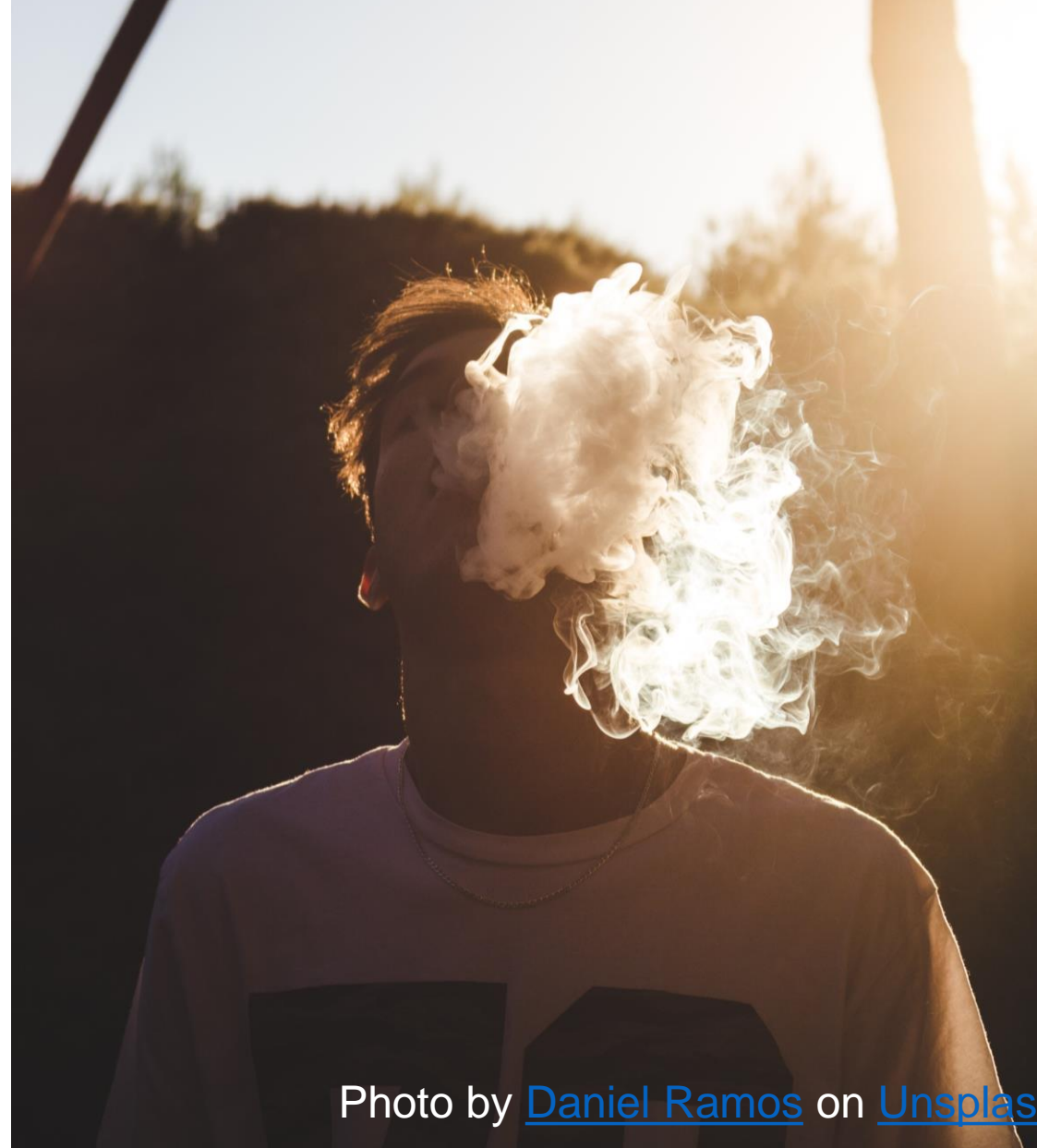


Photo by [Daniel Ramos](#) on [Unsplash](#)

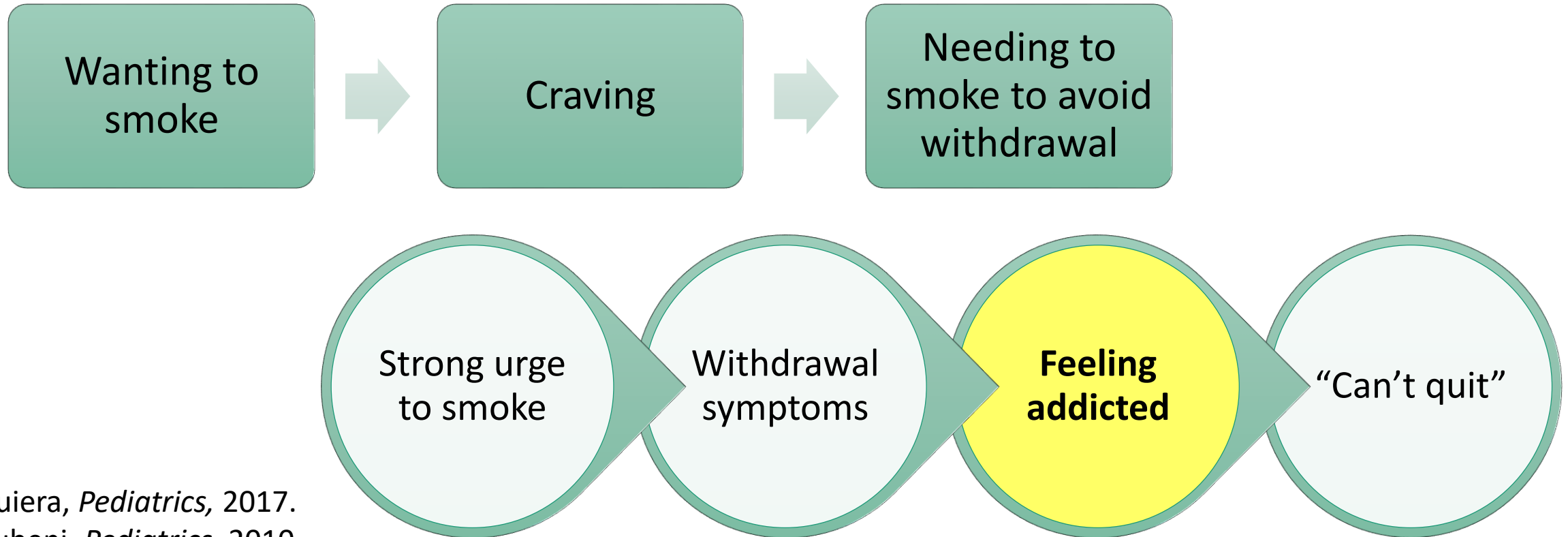
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# Symptoms of dependence arise in order



Siquiera, *Pediatrics*, 2017.  
Doubeni, *Pediatrics*, 2010.

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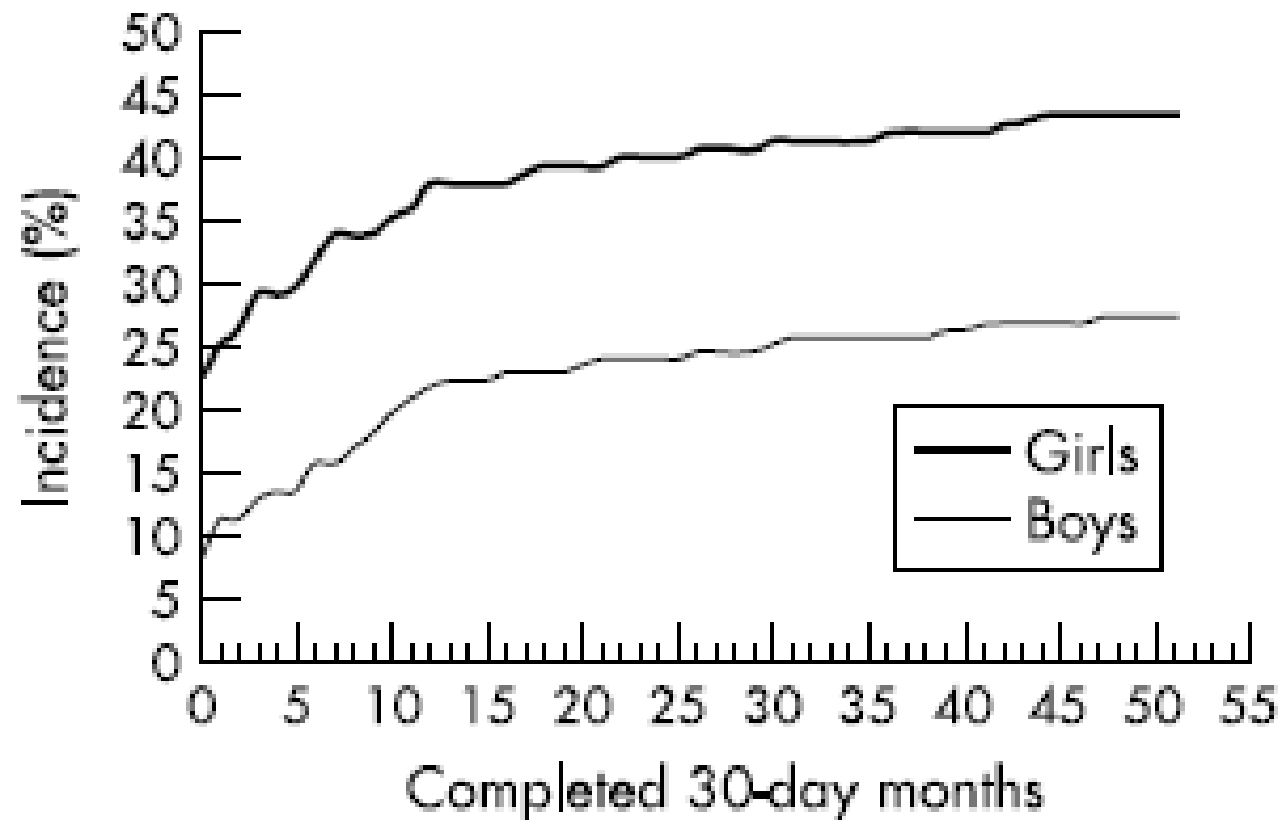
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Symptoms of dependence arise early.



DiFranza et al, *Tobacco Control*, 2002

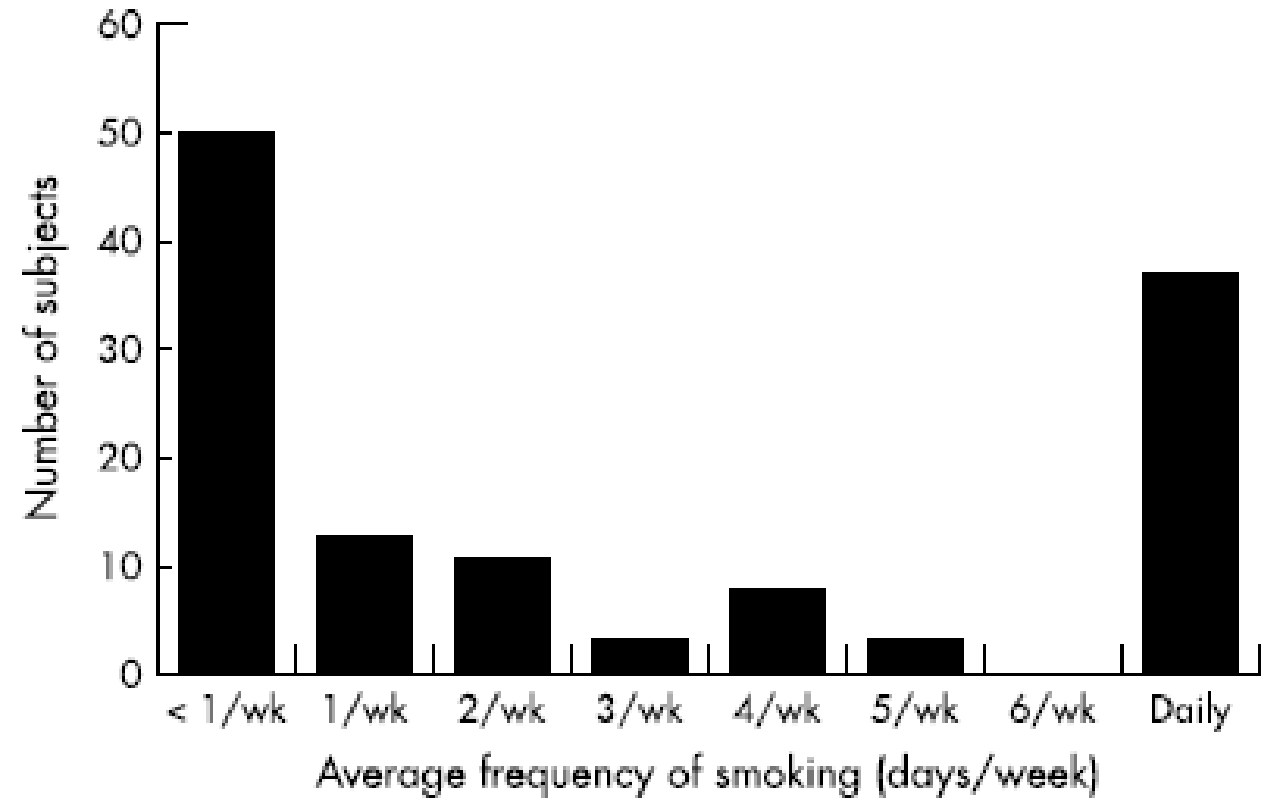
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Symptoms of dependence arise even with intermittent use.



**Figure 1** Average frequency of smoking at the time when the first symptom of dependence was experienced by 125 young adolescent smokers.

DiFranza et al, *Tobacco Control*, 2002

DiFranza et al, *Nicotine & Tobacco Res*, 2005

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Nicotine and the  
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Clinical and community  
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Adriani W et al, *Neuropsychopharmacology*, 2004  
Jacobsen et al, *Biologic Psychiatry*, 2005  
Musso et al, *Psychopharmacology*, 2007  
England et al, *Am J Prev Med*, 2015



# Long-term changes in cognition and behaviors

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Memory

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Attention

---

Auditory processing

---

Impulse control

---

Anxiety and depressive symptoms

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Sleep changes

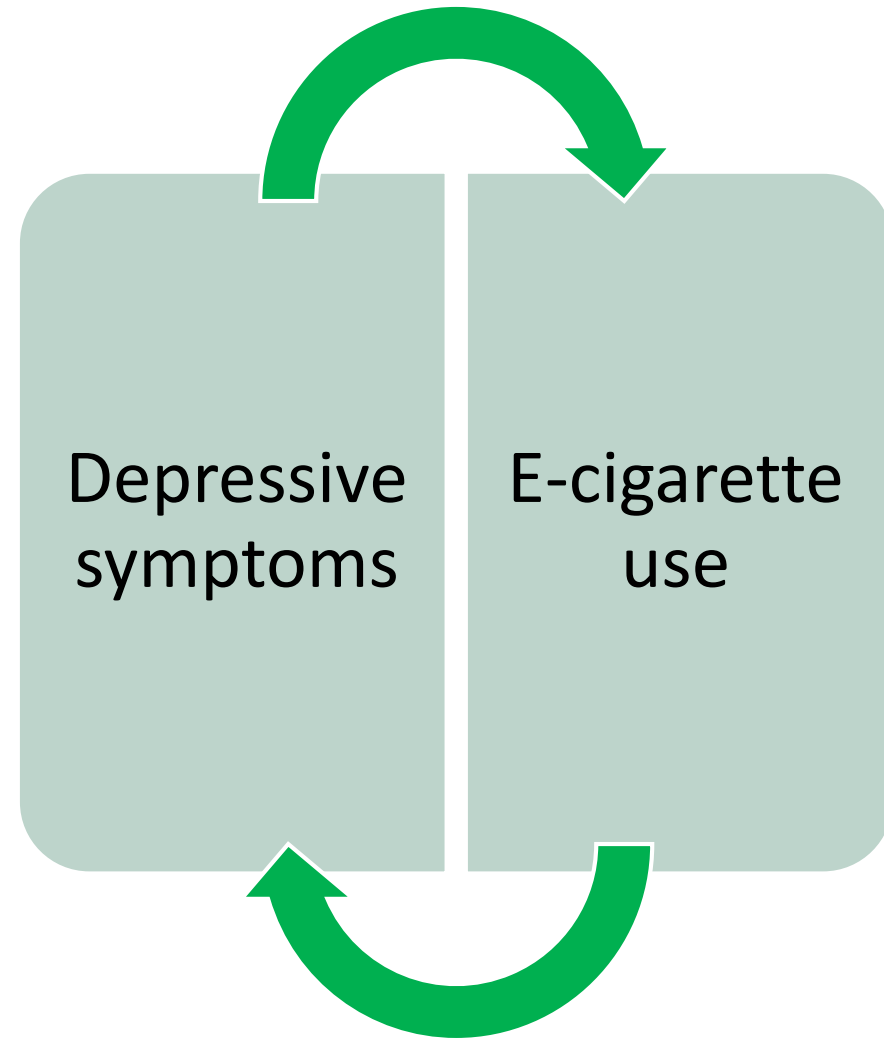
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Nicotine and the developing brain

Nicotine and other substance use

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# E-cigarettes and Mental Health: *A bidirectional* relationship



Bandiera et al, *Nicotine Tob Res*, 2017  
Lechner et al, *Prev Med*, 2017

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Nicotine and the  
developing brain

Nicotine and other  
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# Let's reconsider our questions...

Why are adolescents using at such high rates?

Why is big tobacco spending so much money on adolescents?



# Nicotine primes the brain for addiction.

Ren & Lotfipour, *Western J Emergency Med*, 2019  
Siqueira, *Pediatrics*, 2017



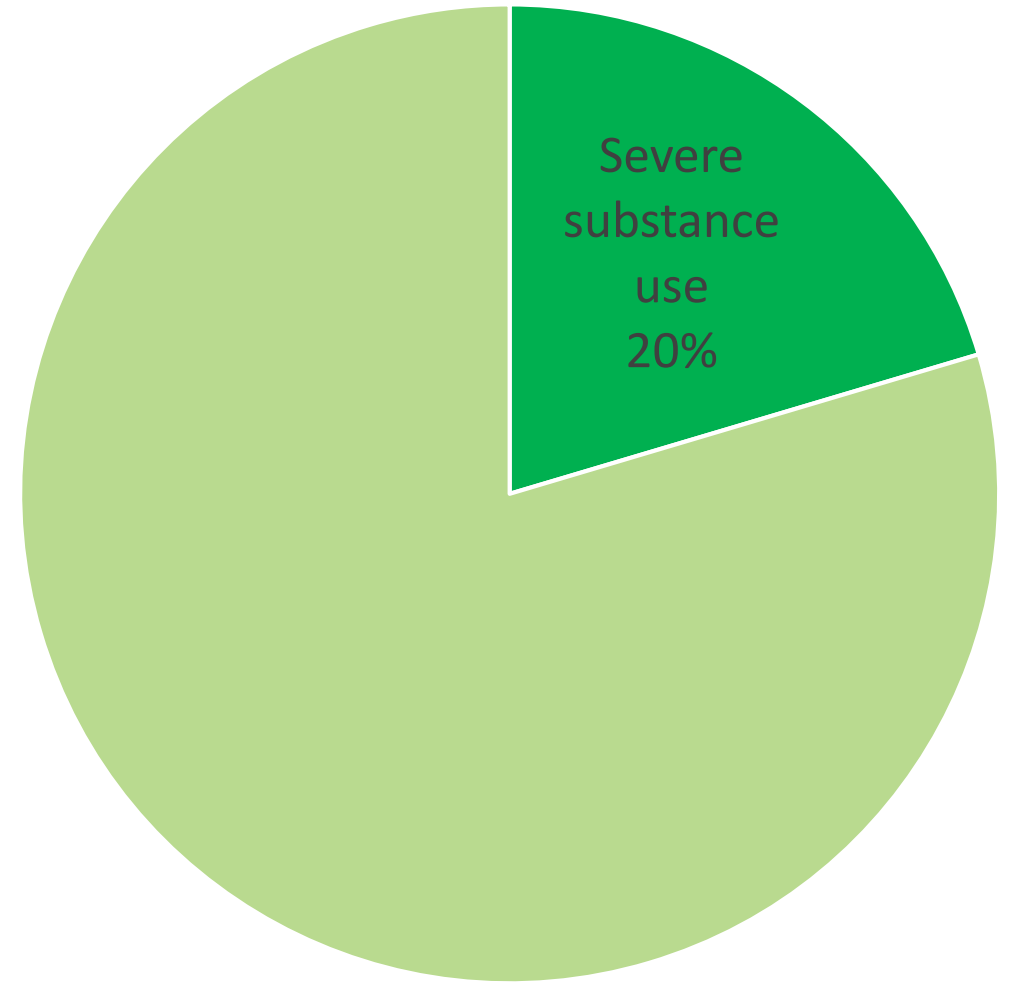
Photo by [Yuliya Kosolapova](#) on [Unsplash](#)

## Remember this?

# E-cigarettes and other substance use

**8x**

greater odds of severe substance use



■ Severe substance use ■ No severe substance use

Conway et al, *Addictive Behaviors*, 2017

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Nicotine and the developing brain

Nicotine and other substance use

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Klein, *Exp and Clin Psychopharm*, 2001

Yoon, Lane, & Weaver, *J Pain & Palliative Care*, 2015

FDA, *Backgrounder Report*, 2018

Photo by [Kaley Dykstra](#) on [Unsplash](#)

# Nicotine and Opioids are linked.

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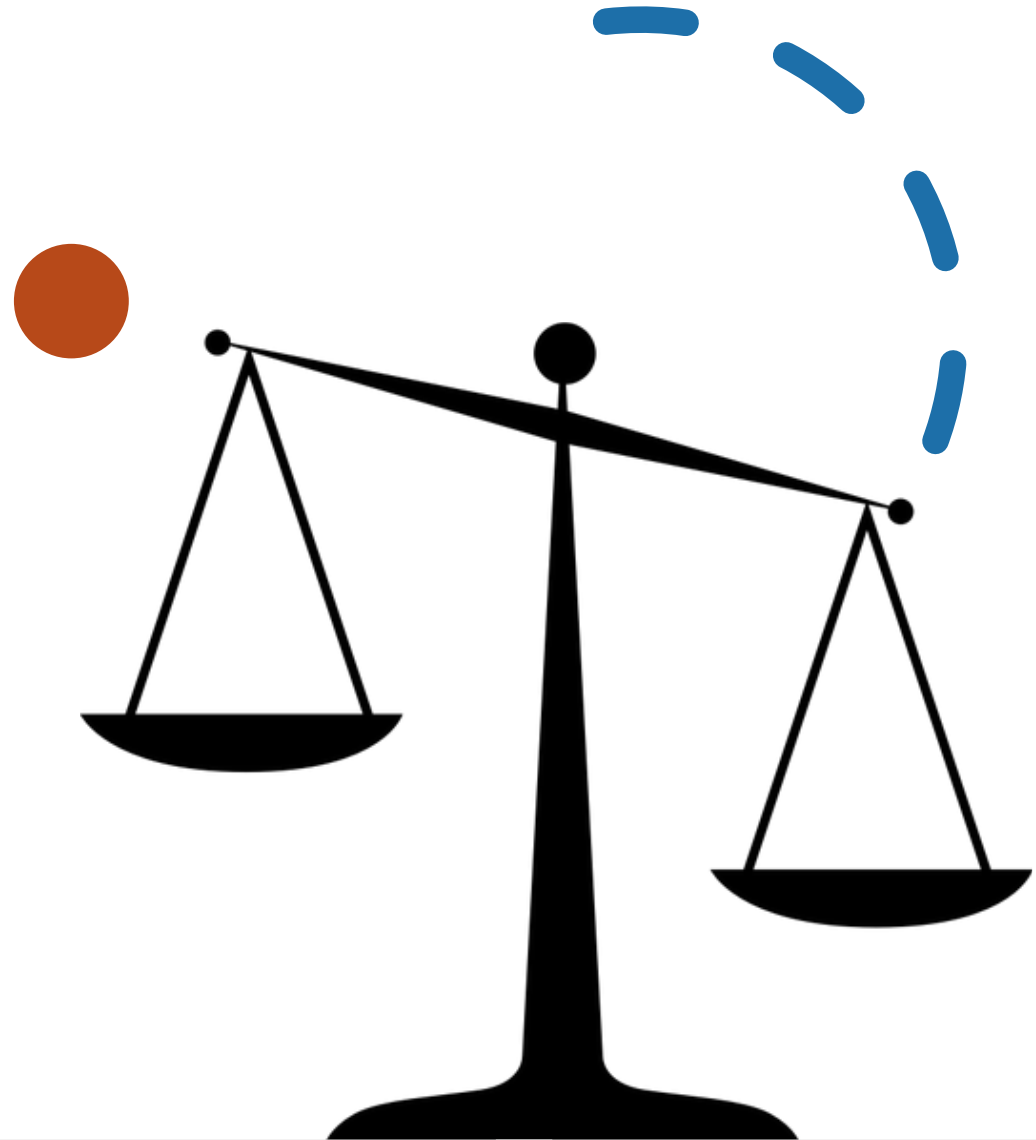
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What can we  
do about it?



**Tobacco prevention as**  
**primary prevention**  
**for substance use?**



Marynak et al, MMWR, 2018.

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It starts with asking the question.

Who's asking?

**49%** mental health facilities

**64%** substance abuse facilities



Marynak et al, MMWR, 2018.

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# 5 As Model



ASK



ADVISE



ASSESS



ASSIST



ARRANGE  
FOLLOW-UP

Pbert et al., *Pediatrics*, 2015

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# Treatment Options: *Behaviorally-based Interventions*

Motivational interviewing

Problem-solving

Support, encouragement

Cognitive behavioral strategies

Social influence strategies

Siquiera, *Pediatrics*, 2017.

Pbert et al., *Pediatrics*, 2015

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developing brain

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# Treatment Options: *Pharmacologic Interventions*

## *Nicotine Replacement Therapy\**

Consider for adolescents with moderate to severe dependence.

*Other medications, e.g. Varenicline and wellbutrin*

Not typically used in adolescence

\* *AAP's Richmond Center: NRT for Adolescent Patients*

Section on Tobacco Control, *Pediatrics*, 2015  
Siquiera, *Pediatrics*, 2017.

Pbert et al., *Pediatrics*, 2015

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Nicotine and the  
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Nicotine and other  
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# What can mental health and substance use treatment professionals do?



Marynak et al, MMWR, 2018.

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Nicotine and the developing brain

Nicotine and other substance use

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# Current State of Affairs...

## Smoking cessation counseling

**38%** mental health facilities

**48%** substance abuse facilities

## Nicotine replacement therapy

**25%** mental health facilities

**26%** substance abuse facilities

Marynak et al, MMWR, 2018.

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developing brain

Nicotine and other  
substance use

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# Leverage existing resources: This is Quitting



**truth initiative**  
INSPIRING TOBACCO-FREE LIVES

WHO WE ARE ▼

WHAT WE DO ▼

OUR TOP ISSUES ▼

RESEARCH & RESOURCES ▼

GET INVOLVED ▼

SEARCH 🔍

Home → This is Quitting

## THIS IS QUITTING

The first-of-its-kind program to help young people quit vaping, This is Quitting gives youth and young adults the motivation and support they need to ditch JUUL and other e-cigarettes. Learn more about how it works and the additional resources available for parents of young vapers and for adults who want to quit.



Text DITCHJUUL to 88709 to leave JUUL or your e-cig

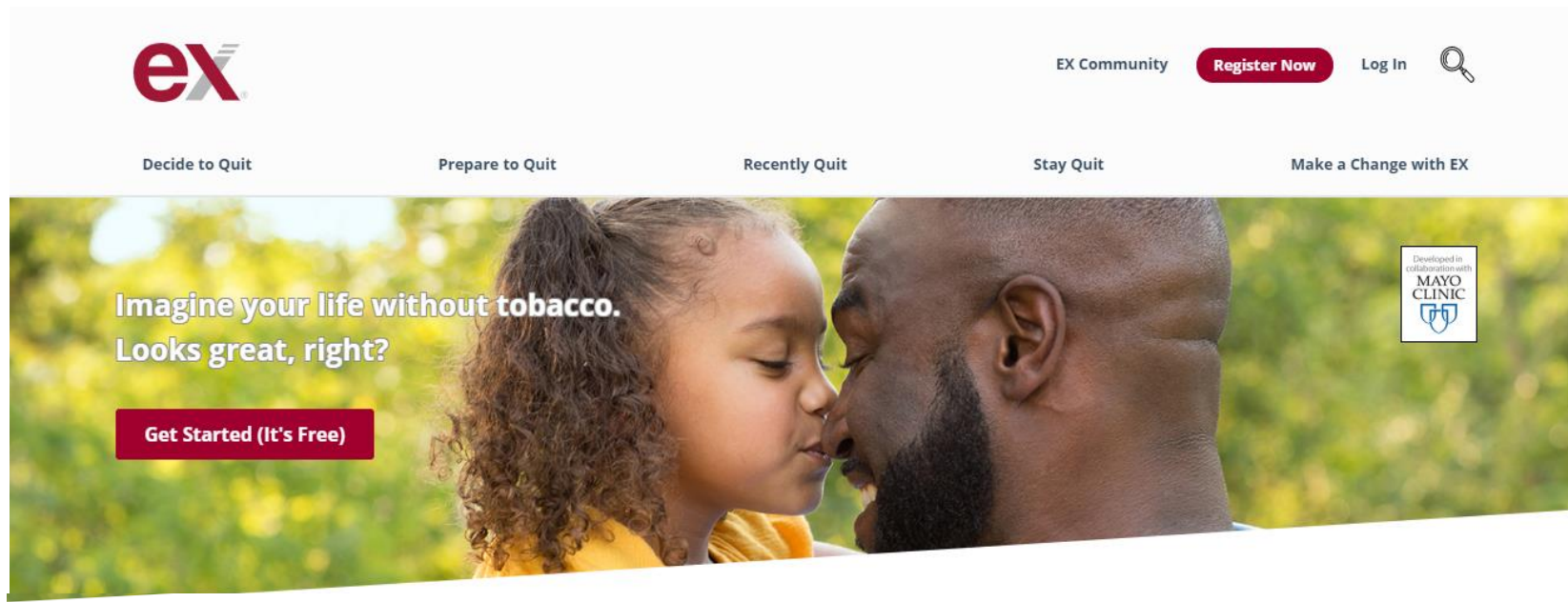
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Nicotine and the  
developing brain

Nicotine and other  
substance use

Clinical and community  
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# Leverage existing resources: Become an Ex



Join BecomeAnEX for Quick Access



A **customized quit plan** that learns and grows with you.



**New!**  
Text messages for support quitting **smoking or vaping**.



Smart, **interactive guides and tools** for you to navigate your tobacco-free journey.



Expert **advice and tips** from Mayo Clinic.



An active, supportive **EX Community** of real tobacco users who have been through it all.

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Nicotine and other substance use

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# Policy Level Changes:

## *Coordinated, multicomponent interventions*

Mass media campaigns

Tobacco tax increases

School-based policies and programs

Statewide and community-wide changes in smoke-free policies

Tobacco 21

Limitations on advertising to youth

Office of the Surgeon General, 2012

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Nicotine and the  
developing brain

Nicotine and other  
substance use

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Revisiting our objectives:

✓ Trends in adolescent e-cigarette use

Adolescent e-cigarette use is on the rise and young people with mental illness are at particularly high risk.

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Revisiting our objectives:

✓ The developing adolescent brain is vulnerable to nicotine.

Teens are more likely to become addicted, with lasting neurocognitive implications.

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Revisiting our objectives:

✓ Nicotine and other substance use:

Nicotine primes the brain for addiction, especially when exposed during adolescence.

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developing brain

Nicotine and other  
substance use

Clinical and community  
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Revisiting our objectives:

✓ Clinical and community-based strategies:

There are several promising behaviorally-based approaches to addressing adolescent nicotine use.

For those with moderate to severe dependence, consider Nicotine Replacement Therapy.

Policy changes are likely needed to curb the trend.

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We all have a role to play.

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Thank you!

Questions?

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