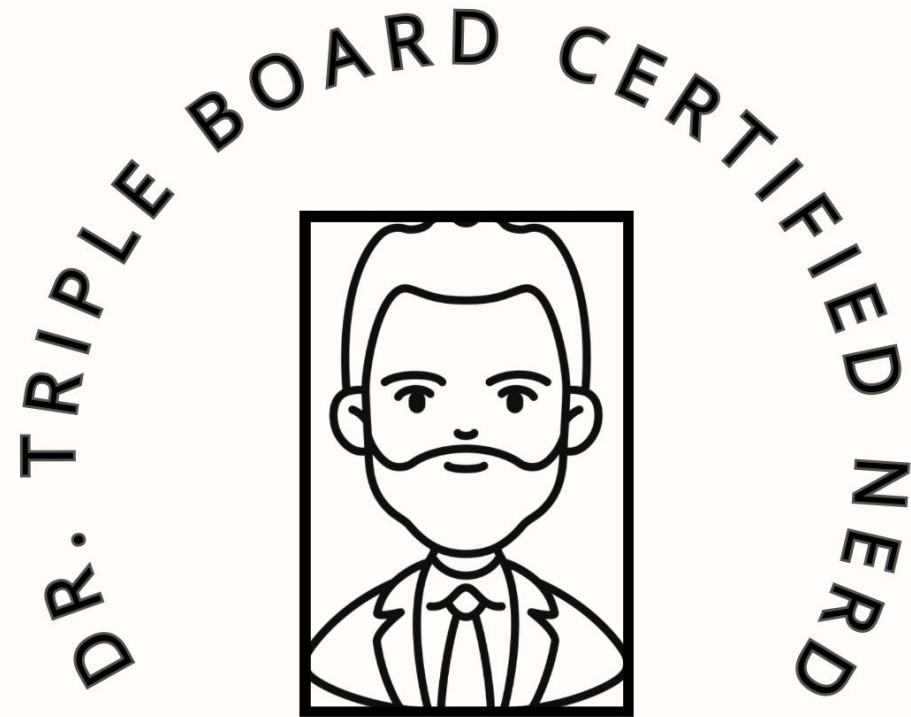


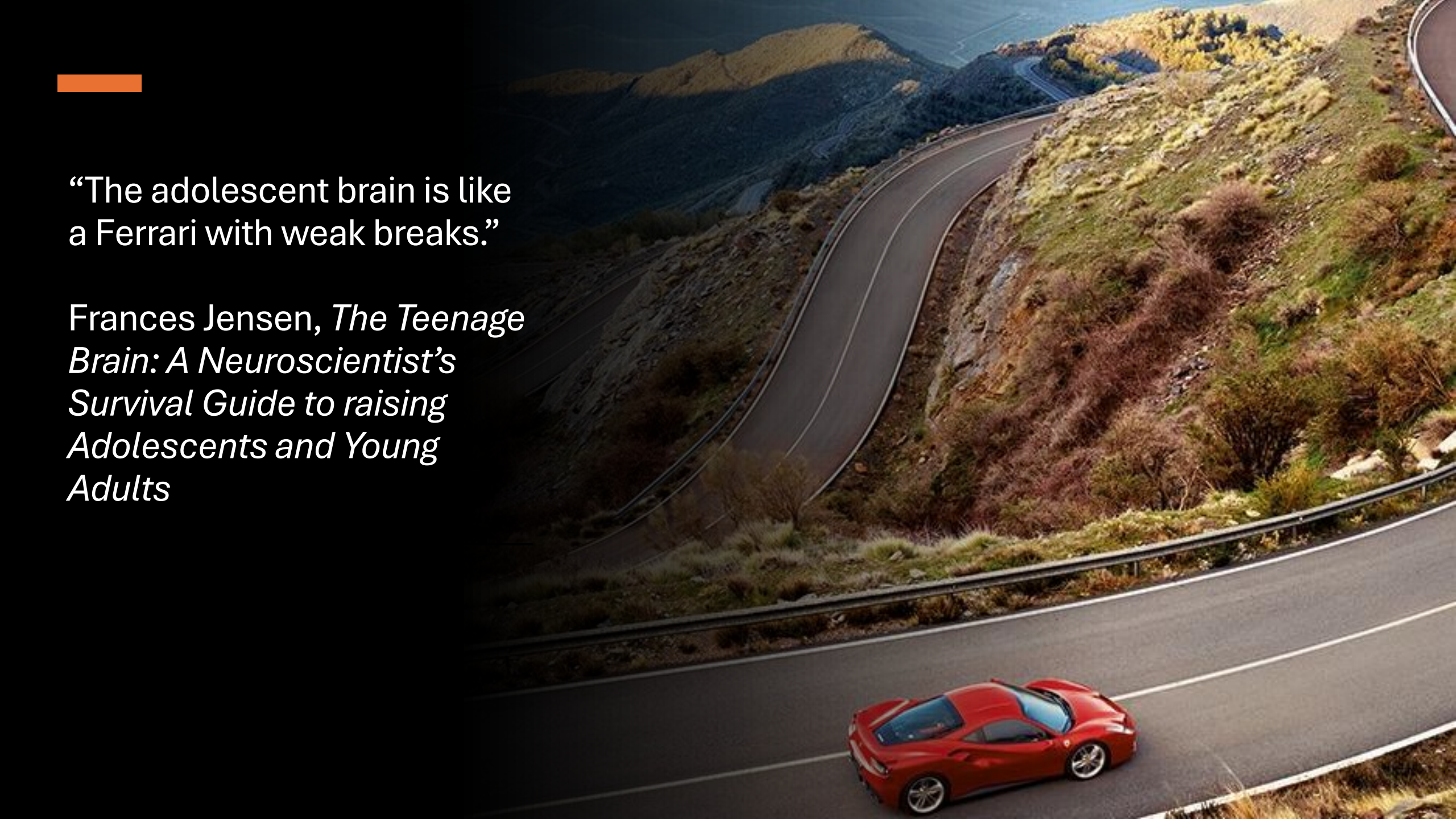
I bought it at
the vape shop

Steve North, MD, MPH





Steve North, MD MPH

A high-angle, aerial photograph of a red Ferrari sports car driving on a two-lane asphalt road that curves through a hilly, arid landscape. The road is dark grey with white lane markings. The surrounding terrain is covered in dry, yellowish-brown grass and sparse, low-lying shrubs. In the background, more hills and a winding road are visible under a clear sky. The car is positioned in the lower right quadrant of the frame, moving away from the viewer along the curve of the road.

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

Frances Jensen, *The Teenage
Brain: A Neuroscientist’s
Survival Guide to raising
Adolescents and Young
Adults*

Disclaimer

- The previous slide was my most exciting slide
- I will be discussing off label uses of medications
- Caring for people with substance use disorders is a balance of the art and the science of medicine.
- I will share my slides once the presentation is over

Language Matters

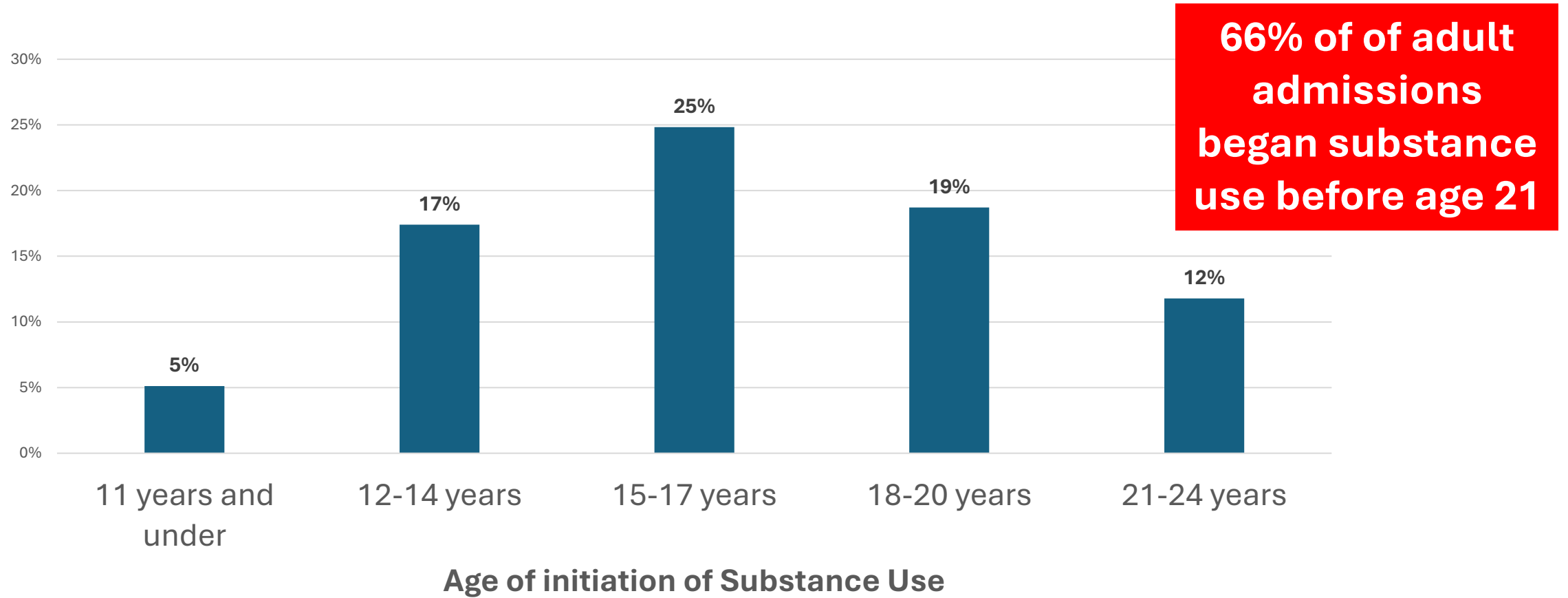
Instead of	Use
Addict	Person with an SUD
User/Junkie	Person with
Alcoholic/Drunk	Person with an alcohol use disorder
Former Addict	Person in long term recovery or Person who previously used XXX
Drug Abuse	Illicit Use Misuse or used other an as prescribed
Opioid Substitution Therapy Medication Assisted Therapy	Pharmacotherapy Medication for Substance Use Disorder
Clean or Dirty Urine	Consistent/Inconsistent with goals of treatment
Clean	In remission or in recovery

<https://nida.nih.gov/nidamed-medical-health-professionals/health-professions-education/words-matter-terms-to-use-avoid-when-talking-about-addiction>

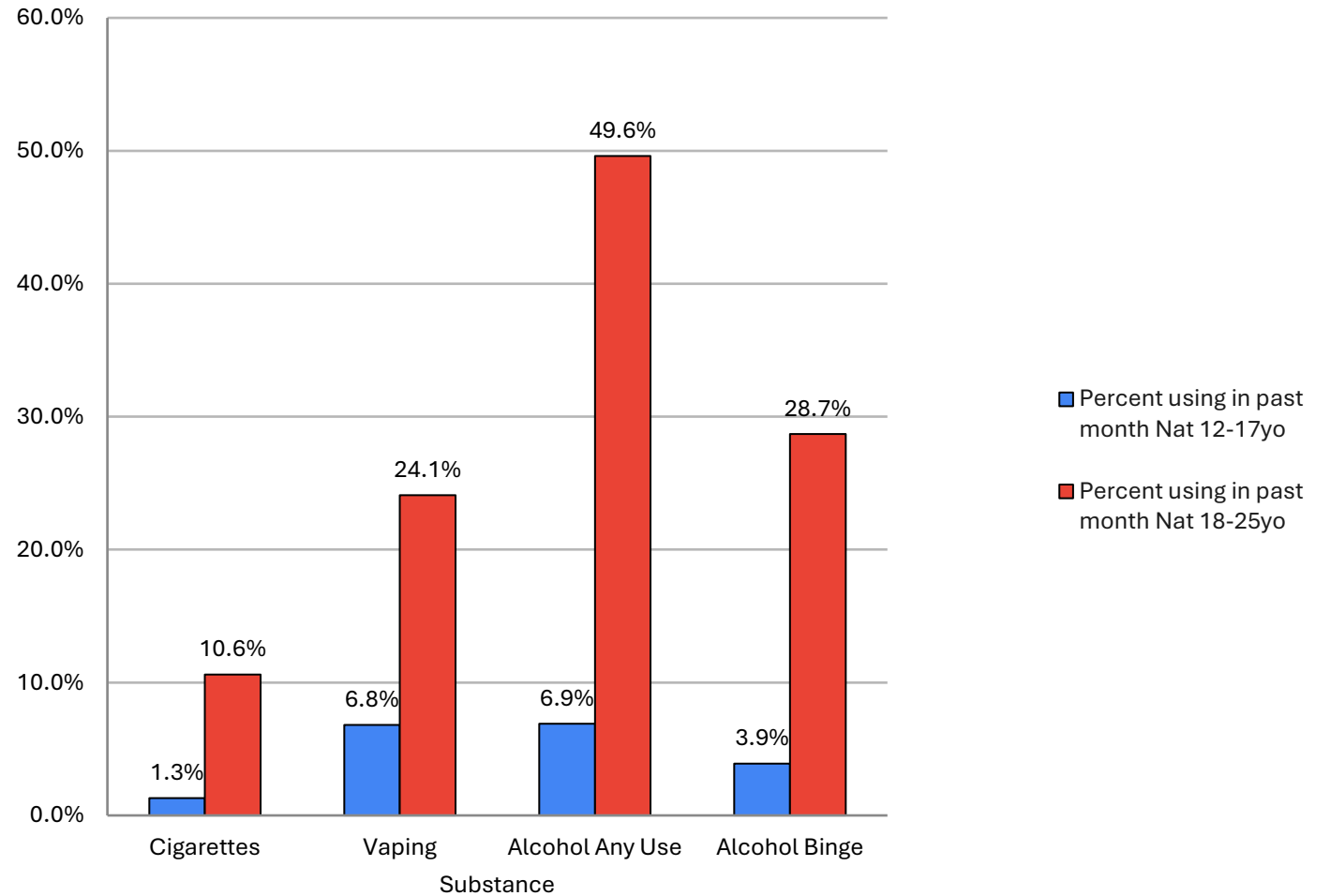
Defining a Substance Use Disorder

Impaired Control	Social Problems	Risky Use	Physical Dependence	Severity
Using more of a substance or more often than intended	Neglecting responsibilities and relationships	Using in risky Settings	Needing more of the substance to get the same effect (tolerance)	Mild = 2-3
Wanting to cut down or stop using but not being able to	Giving up activities they used to care about because of their substance use	Continued use despite known problems	Having withdrawal symptoms when a substance isn't used	Moderate = 4-5
	Inability to complete tasks at home. school or work			Severe = 6 or more

Age of Initiation of Substance Use for Adult Treatment Admissions

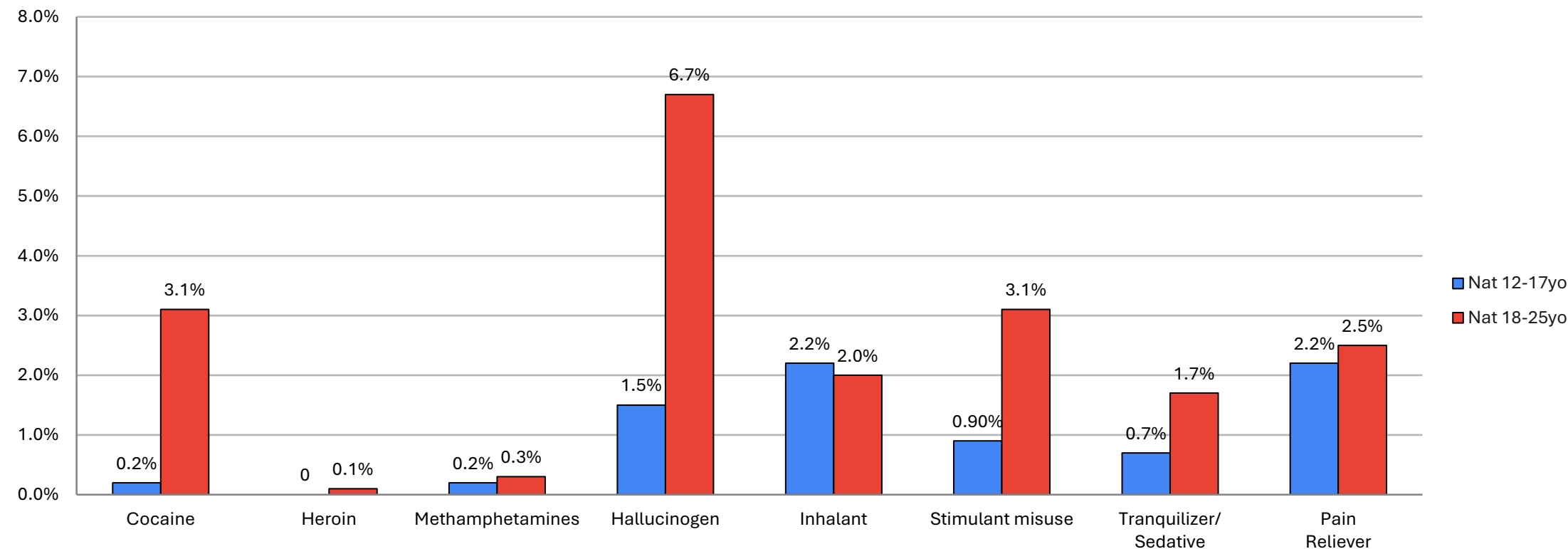


AYA Substance Use in the past 30 days



Source: Substance Abuse and Mental Health Services Administration. (2024). [Key substance use and mental health indicators in the United States: Results from the 2023 National Survey on Drug Use and Health](#) (HHS Publication No. PEP24-07-021, NSDUH Series H-59). Center for Behavioral Health Statistics and Quality, Substance Abuse and Mental Health Services Administration.

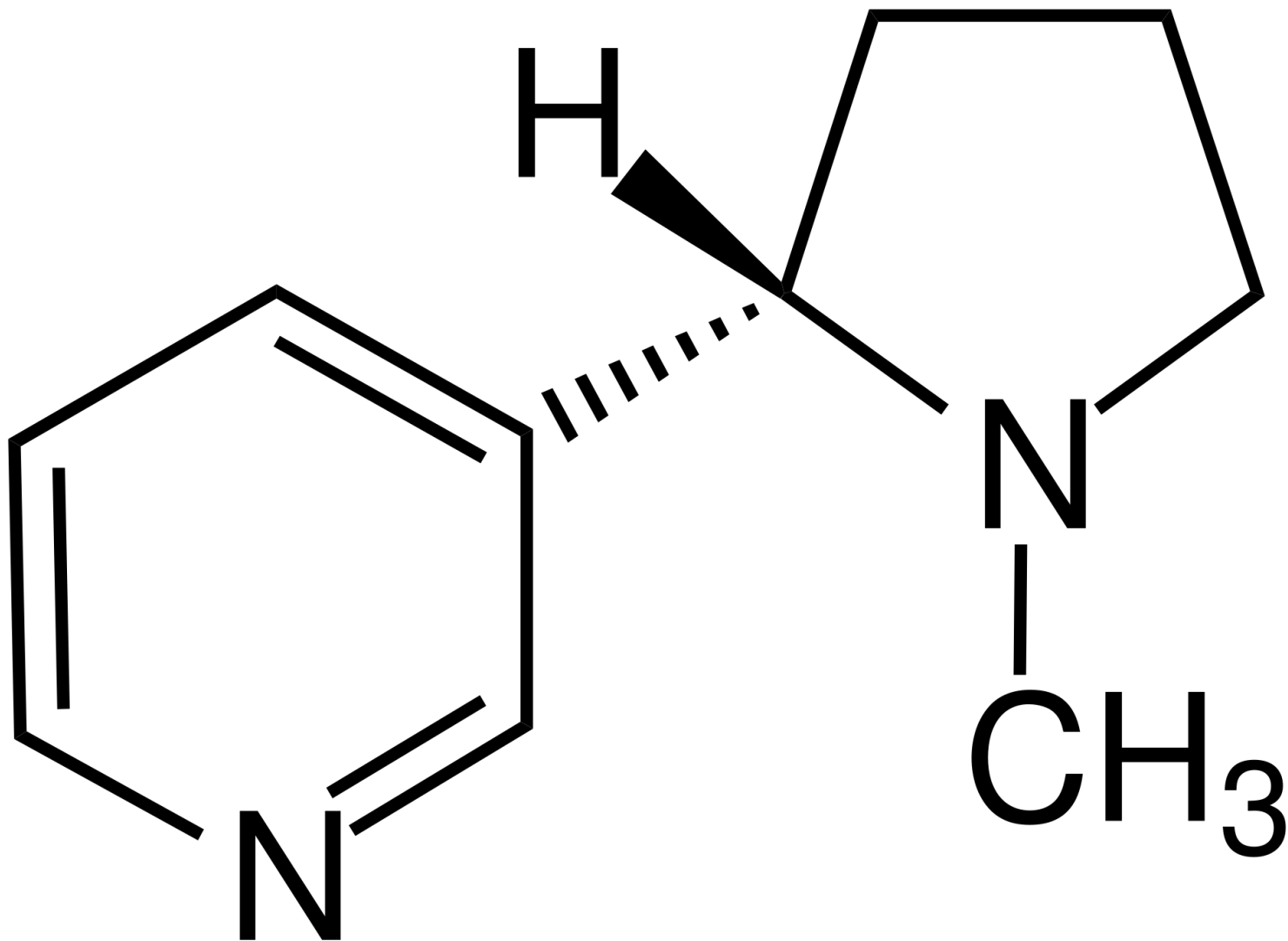
AYA Substance Use in the past year



Source: Substance Abuse and Mental Health Services Administration. (2024). [Key substance use and mental health indicators in the United States: Results from the 2023 National Survey on Drug Use and Health](#) (HHS Publication No. PEP24-07-021, NSDUH Series H-59). Center for Behavioral Health Statistics and Quality, Substance Abuse and Mental Health Services Administration.

Nicotine

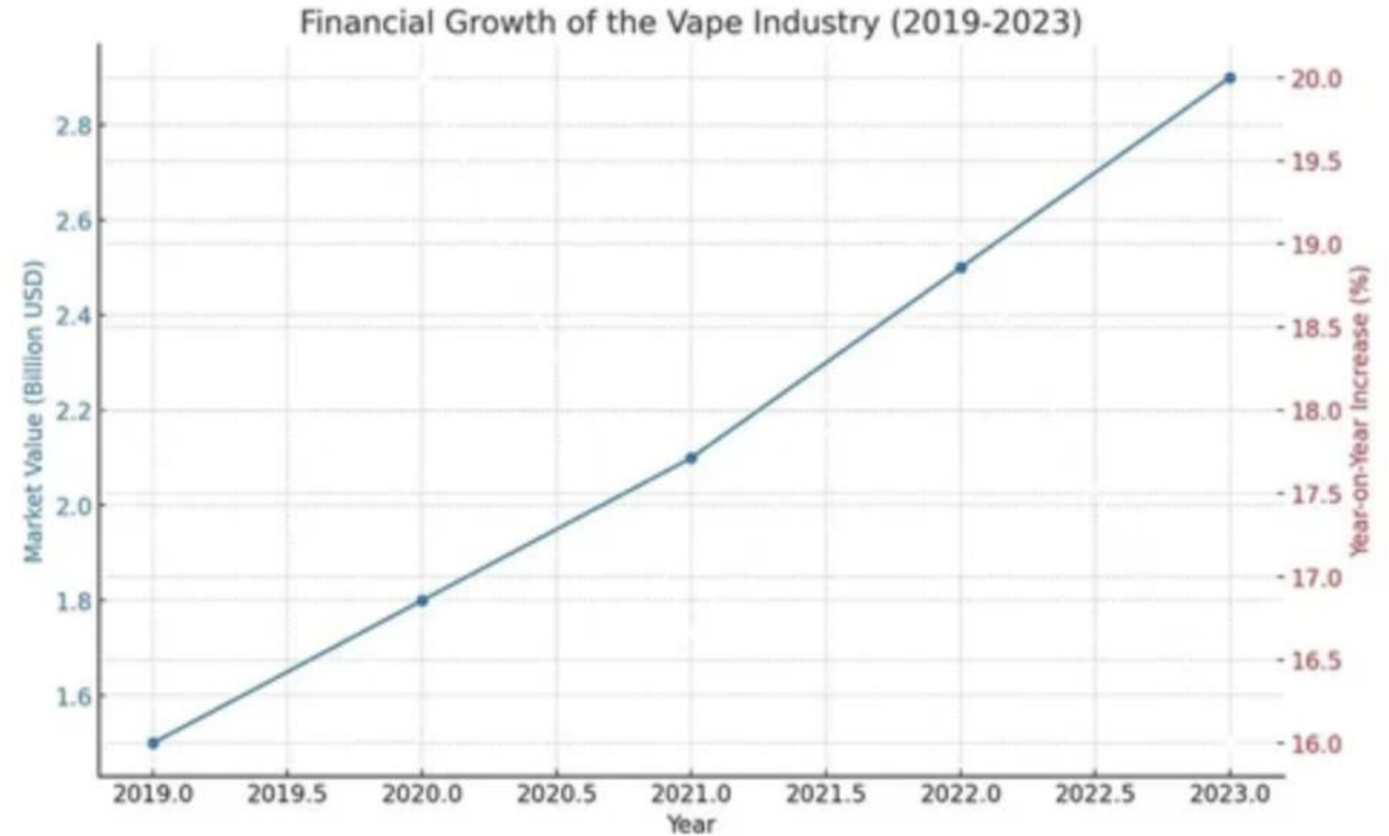
C₁₀H₁₄N₂



100%

The percentage that the vape industry grew between 2019 and 2023

Source: <https://www.thevapeshop.co.uk/blog/vape-industry-analysis-of-financial-growth/>

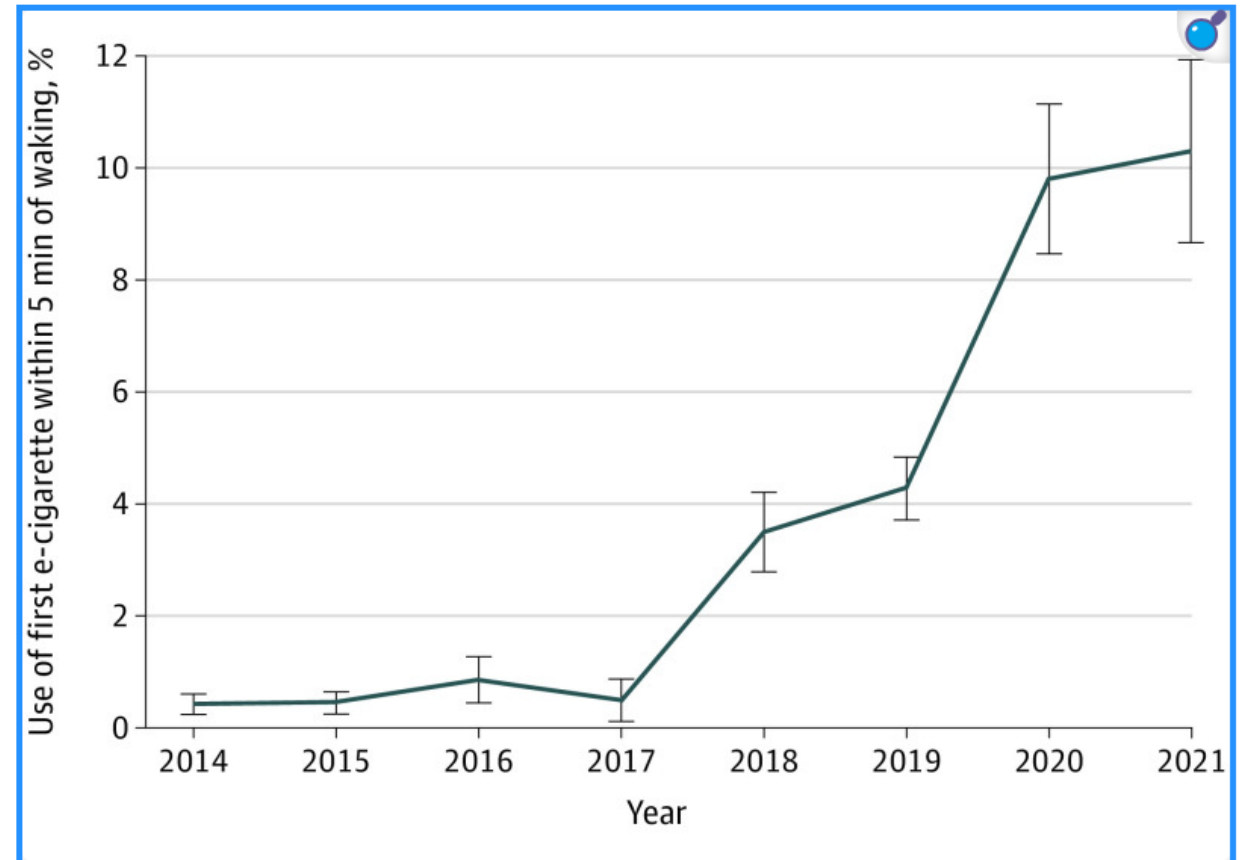


1000%

The percent increase of US adolescents who vaped within 5 minutes of waking up between 2014 and 2021

Source: Glantz S, Jeffers A, Winickoff JP. Nicotine Addiction and Intensity of e-Cigarette Use by Adolescents in the US, 2014 to 2021. JAMA Netw Open. 2022;5(11):e2240671. [doi:10.1001/jamanetworkopen.2022.40671](https://doi.org/10.1001/jamanetworkopen.2022.40671)

Figure 4. Use of e-Cigarettes Within 5 Minutes of Waking.



How Nicotine works

Brain region	Cortico-limbic pathway • Stimulant impact in the locus coeruleus – norepinephrine release • Reward effect in the limbic system
Mechanism of action	Increased dopamine release through binding on nicotinic acetylcholine receptors on dopaminergic neurons
Perceived benefits	Focus, <i>relaxation</i>
Adverse impact	Vomiting, tachycardia, balance issues, increased salivation
Withdrawal	irritation, frustration, trouble sleeping and trouble concentrating

GENERATIONS OF E-CIGARETTES & VAPE PENS



CIG-A-LIKE (2007)

E-Cigarettes came onto the market around 2007. Most looked very similar to a traditional cigarette.

0mg/mL - 6mg/mL



MODS/TANKS (2012)

Large size, modifiable e-cigarettes allow for more aerosol, nicotine, and other chemicals to be breathed into the lungs at a faster rate. E-juice and e-liquid often put in externally.

0mg/mL - 36mg/mL



SINGLE-USE/DISPOSABLE* (2018-NOW)

These e-cigarettes are currently the most popular and range in sizes and color. They typically contain high nicotine content and are highly addictive.

0mg/mL - 50mg/mL



VAPE PENS (2009)

These have batteries that can reach higher temperatures, have refillable e-liquid cartridges, and allow users to regulate the frequency of inhalations.

0mg/mL - 18mg/mL



POD-BASED (2015-2017)

These e-cigarettes are shaped like USBs or different shapes, and contains pods with higher amounts of nicotine than previous generations.

0mg/mL - 50mg/mL

*Disposable vapes contain harmful chemicals and cannot be thrown away normally and should be disposed in proper manner.

CIGS IN AN E-CIG



1 Pack of Cigarettes
= ~22mg of Nicotine



AMOUNT OF NICOTINE IN

~20
CIGARETTES



1 JUUL Pod
= ~41.3mg of Nicotine



AMOUNT OF NICOTINE IN

~37
CIGARETTES



1 Vuse Pod
= ~90mg of Nicotine



AMOUNT OF NICOTINE IN

~82
CIGARETTES



1 Elf Bar
= ~650mg of Nicotine



AMOUNT OF NICOTINE IN

~590
CIGARETTES



THE MORE YOU KNOW

What are oral nicotine pouches?

Pouches are a form of nicotine delivery that are growing in popularity. The product is derived from tobacco and contains nicotine.

The pouch is placed between the upper lip (or "upper deck") or lower lip (or "lower deck") and gum.



OUR CONCERNS ABOUT ZYN

What is ZYN?

ZYN is the name of a popular brand of oral nicotine. ZYN are small pillow-like pouches that contain pre-portioned amounts of white nicotine powder.

ZYN comes in many flavors, including menthol, spearmint, cool mint, peppermint, wintergreen, citrus, coffee, unflavored, and cinnamon.

- ZYN comes in **3 milligram** and **6 milligram** nicotine pouches
- Each tin of ZYN contains **15-20 nicotine pouches**
- Adolescents use multiple pouches throughout the day, and **often place more than one in their mouth at once**

Oral nicotine pouches

- Marketed as tobacco free
- Zyns, On!, Velo
 - AKA – “lip pillow” or “upper decky”
- Comes in flavors
- Higher per dose nicotine concentration:
 - Cigarettes: 1.1-1.8mg per cigarette
 - Nicotine pouches: 2-8 mg per pouch



Vaping evaluation

Type of substance (Brand name, flavors, concentration)

Product source

Age at initiation

Use patterns (*time of day, frequency, quantity, sleep*)

Deliver mechanism/ method of use/ tricks

Assess for other substance use

Assess Respiratory symptoms

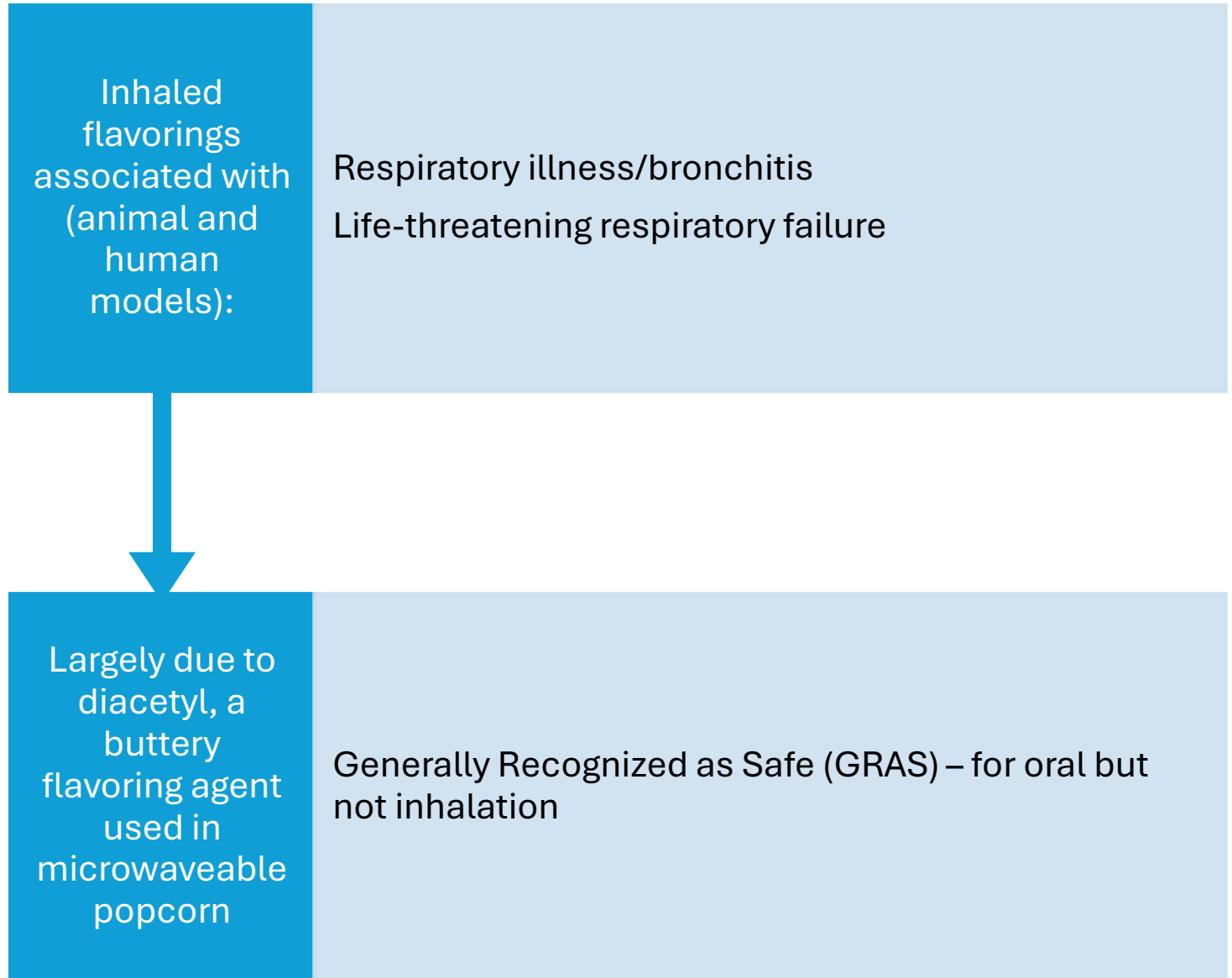
Assess neuro-behavioral complications (*components of addiction*)

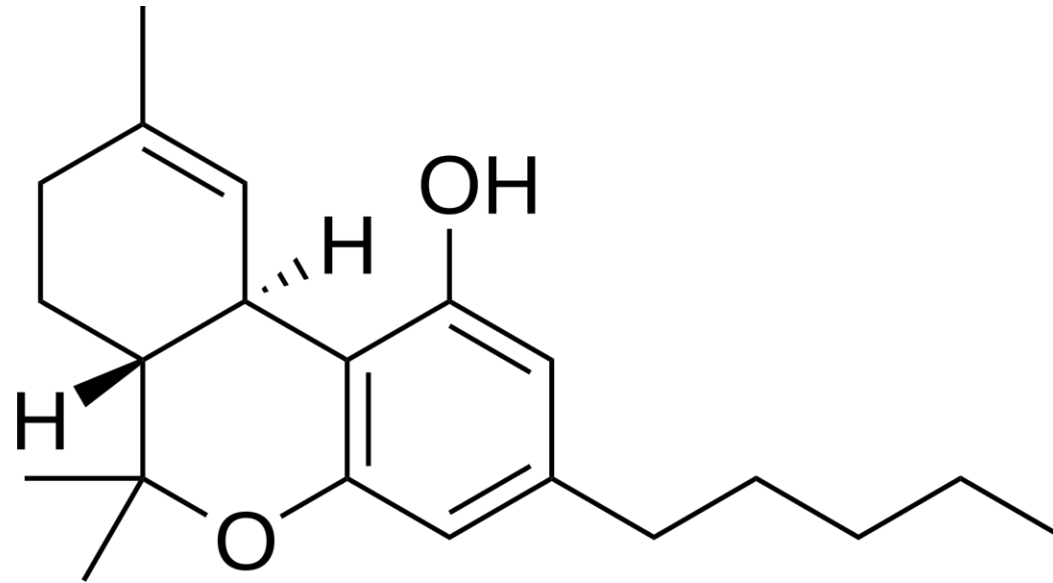
Screen for mental health issues

Nicotine Dependence Treatment

- Vaping is not treatment!!
- Gradual Reduction
- Bupropion –
 - 150mg ER bid x 12 weeks
 - Begin 150mg ER qd x 3-5 days
- Nicotine Replacement Therapy
 - PATCHES: 21 mcg/14 mcg /7 mcg

Pulmonary Effects Unique to Vaping





Cannabis/THC

C₂₁H₃₀O₂

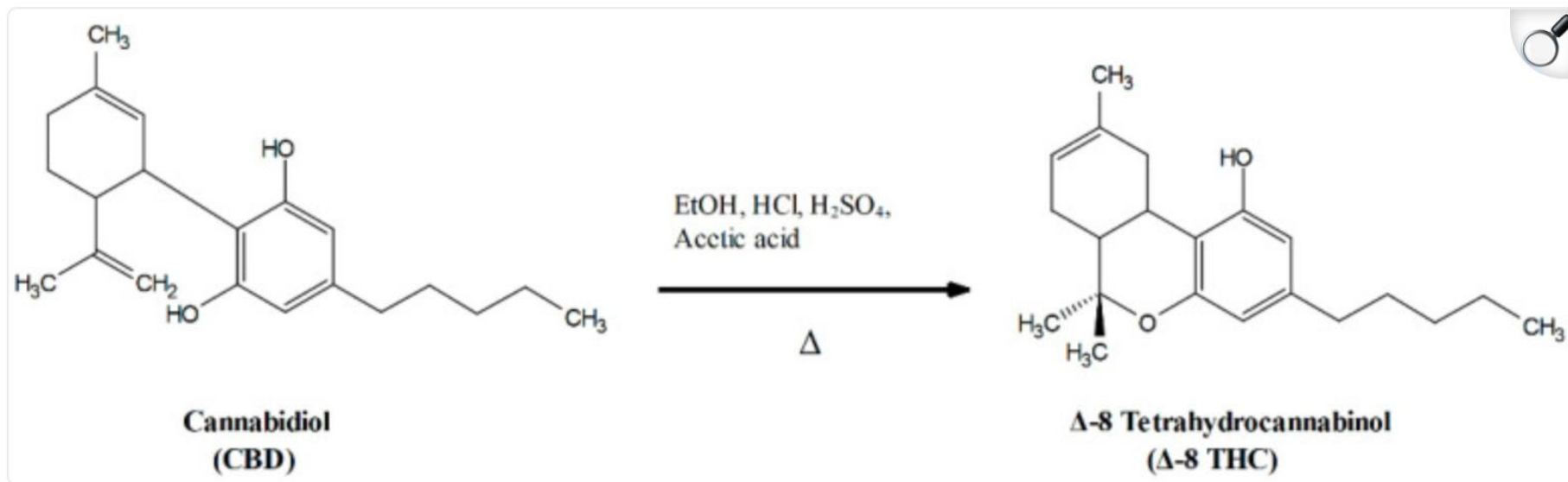
Delta-9 vs. Delta 8 vs. CBD....

Delta-9 vs. Delta-8

- Delta-8 is an isomer of Delta-9
- Delta-8 less affinity for CB-1 receptor and therefore *less psychoactive potency*
- Not addressed in the 2018 farm bill

Cannabidiol (aka CBD)

- Must be derived from Hemp to be legal in the US.
- Has one fewer ring structure than THC
- Minimal affinity for CB-1 or CB-2 receptors



CBD to Delta-8 THC

Source: 2022 Oct 15;27(20):6924. doi: [10.3390/molecules27206924](https://doi.org/10.3390/molecules27206924)

Perceptions of Delta-8

Benefits

- Relaxation
- Euphoria
- Decreased chronic pain

Adverse reactions

- Difficulty concentration
- Changes in short term memory
- Altered sense of time

Delta-9 is
perceived
to help with

anxiety

low appetite

muscle spasticity

Obstructive sleep apnea

nausea

pain

How Marijuana works

Brain regions	Frontal Cortex, Hypothalamus Amygdala Hippocampus
Neurotransmitter	cannabinoid receptors (CB1 and CB2)
Mechanism of action	Increased release of dopamine
Perceived benefits	Relaxation, decreased inhibition
Adverse impact	Palpitations, anxiety, nausea, vomiting, poor coordination and seizures

Impact of chronic marijuana use

Psychiatric	• Increased depression and anxiety • Increased risk of psychosis (5x)
Cardiovascular	• Increased rate of angina and arrhythmias via CB2 Receptors • Acute coronary syndrome due to vasospasm
Neurovascular	• Increased risk of TIAs
Peripheral vascular	• Cannabis arteritis – vasospasm due to endothelial irritation • Platelet aggregation
Immune system	• Increased rates of HIV, Hep C and HTLV-I/II

Marijuana: Treatment Options

- TREAT MENTAL HEALTH DISORDER
- Cognitive Behavioral Therapy
- Contingency management
- Motivational Enhancement Therapy
- No FDA approved medications
- NAC – N-acetyl cystine has shown some promise in adolescents



K2 and Spice: Synthetic Cannabinoids

- Readily available at gas stations
- Smoked, vaped or brewed in tea
- Potential for addiction
- Overdoses:
 - Tachycardia
 - Vomiting
 - violent behavior
 - suicidal thoughts



How the synthetic cannabinoids work

Brain region	neocortex, hippocampus, basal ganglia, cerebellum and brainstem
Neurotransmitter	acetylcholine, adenosine, and serotonin + Endocannabinoid System
Mechanism of action	Act on the CB1(nervous system) and CB2(immune system, bowel, cardiac) receptors
Perceived benefits	Relaxation, mood regulation, anxiety control
Adverse impact	tachycardia (elevated heart rate), elevated blood pressure, unconsciousness, tremors, seizures, vomiting, hallucinations, agitation, anxiety, pallor, numbness, and tingling



Salvia Divinorum

- A member of the mint family
- Typically chewed, may be smoked
- Absorbed through the oral mucosa and lungs
- Causes Hallucinations



Tianeptine

- Available in 15 European countries as an OTC or prescribed medication
- Illegally available online in US to “boost working memory” and “improve mental clarity”
- First thought to increase serotonin reuptake
- Work at the opioid receptor
- Treat overdose with naloxone
- Longterm management = buprenorphine



How the tianeptine works

Brain region	Frontal cortex and hippocampus
Neurotransmitter	Dopamine
Mechanism of action	Full antagonist at the <i>mu</i> -opioid receptors
Perceived benefits	10-15mg: Mood enhance, antidepressant, anxiolytic TREATMENT OF OUD
Adverse impact	Nausea, Headache, Constipation, Dizziness Opioid Overdose at high doses – NALOXONE WORKS

Kratom (*Mitragyna Speciosa*)

- Grows naturally in southeast Asia.
- ~50 active psychoactive components
- Consumed as a powder or brewed in a tea
- DEA “Drug of concern”
- Small doses (1-5g): stimulatory effects resembling
- Larger doses(>5g): sedative-narcotic, pain reducing effects that resemble opioids
- Can treat with buprenorphine

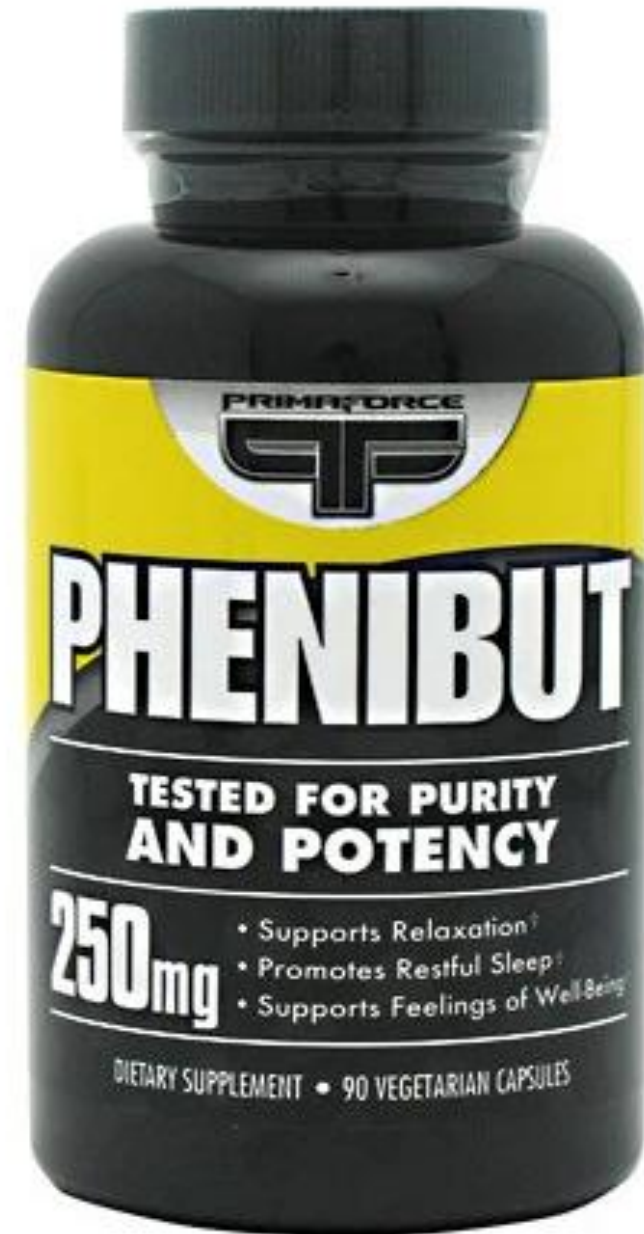


How kratom works

Brain region	Multiple
Mechanism of action	Mitragynine and 7-hydroxymitragine – partial agonist at the <i>mu</i>-opioid receptor <i>limited b-arrestin activation – decreased overdoses</i> - Binding to adenosine, serotonin and dopamine - Alpha-2 adrenergic receptor – <i>like clonidine</i>
Dosing	<u>Small doses (1-5g):</u> stimulatory effects resembling cocaine or amphetamines. <u>Larger doses(>5g):</u> sedative-narcotic, pain reducing effects that resemble opioids
Perceived benefits	Relaxation, pain control, tx of OUD
Adverse impact	Precipitated withdrawal, agitation, drowsiness

Phenibut (AKA the Russian Cosmonaut Drug)

- Developed in the 1960's in Russia and included in cosmonauts' space kits to help them remain cool under pressure.
- Currently used in eastern Europe for neurologic conditions
- Marketed as a nootropic (aka smart drug) or a “synthetic amino acid derivative”



How Phenibut works

Brain region	Multiple Regions: a CNS depressant
Mechanism of action	Structurally resembles GABA Both benzodiazepines and alcohol act on GABA receptors in the brain Agonist of GABA receptors – increasing relaxation and sedation <i>ALSO – increases dopamine</i>
Perceived benefits	Sense of calm, clear thinking, ecstasy-like effect Mood enhancer, sexual enhancer, recovery for body builders
Adverse impact	Decreased muscle tone, nausea, concentration issues, palpitations/tachycardia, hallucinations and paranoia
Withdrawal	Looks like benzodiazepine or alcohol withdrawal due to the increase in glutamate production that is not balanced.

Bath Salts or Plant Food

- Synthetic cathinones: mirror the khat plant
- Readily available at gas stations
- Inhaled, can be smoked
- High Potential for addiction
- Overdoses:
 - Tachycardia
 - Hyperthermia
 - violent behavior
 - Delusions/Hallucinations



How the synthetic cathinones work

Brain region	Ventral Trigeminal Region
Neurotransmitter	Dopamine
Mechanism of action	Both increases the release of dopamine and prevents the reuptake
Perceived benefits	Energy, elevated mood, focus, increased sex drive
Adverse impact	Agitation, Neuroinflammation, Hyperthermia, Cardiomyopathy, Cardiac arrest

16 yo female with parathesia in limbs

- 16 yo female presents to your office with 1 month hx of tingling and numbness in her extremities.
- Extensive history of trauma and depression. No history of suicide attempts.
- Denies smoking or vaping nicotine, no alcohol use, no cannabis use
- Overall labs are normal except for a slight B12 deficiency.
- Begin oral B12 supplementation

16 yo
female with
parathesia
in limbs

- **2 weeks later** she returns to the ED with progressive sx.
- Struggling to walk
- ED evaluates further but cannot find cause
- Discharged home with neurology referral in 1 week

16 yo female with parathesia in limbs

- Presents to neurology appointment in a wheelchair, she is unable to ambulate.
- Admitted to the hospital immediately
- MRI of lumbar spine shows demyelination of the dorsal column
- Neurology resident does an extensive history that reveal daily nitrous oxide use.

How nitrous oxide (*aka laughing gas*) works

Brain region	Central nervous system
Neurotransmitter	An antagonist of NDMA glutamate receptors
Mechanism of action	Blocking NDMA receptors results in
Perceived benefits	Relaxation and loss of inhibition
Adverse impact	Hallucinations, paranoid delusions, confusion, difficulty concentrating, agitation, alterations in mood, nightmares, catatonia, ataxia, anesthesia, and learning and memory deficits Nitrous Oxide inactivates Vitamin B12 which is essential for nerve function

Nitrous Oxide availability and use

- Readily available at vape shops and on Amazon and Walmart
- Historically sold in single dose format but now being sold in large format
 - Whip-its 8 grams per unit, cost = \$0.125/gram
 - 3 liter tanks ~3000 grams. Cost = \$0.038/gram



Discussion



Resources

- [NIDA: BSTAD and S2BI](#) screening tools
- [Stanford REACH Lab](#): Prevention and Education resources
- Adolescent Health Initiative: [Best Practices for Addressing Adolescent Opioid Use](#)
- [NAC for Cannabis Use Disorder](#)
- [PCSS: Providers Clinical Support System](#): Excellent training and resources for a wide variety of substance use disorders
- [The Clinical Assessment of Vaping Exposure](#)