

Substance Use Disorders in Adolescents: Why it Matters and General Management Approach

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Boston
Children's
Hospital

Division of
Addiction Medicine



Disclosure of Information

Modar Sukkarieh, MD

June 12, 2025

Modar Sukkarieh, MD

- I do not have any relationships with ineligible companies to disclose.



Learning Objectives:

- Appreciate the Youth-specific Neurobiology of Addiction and how the Developing Adolescent Brain is especially vulnerable to SUD
- Cannabis Use: Neurobiology, Long term consequences, Special Considerations
- Nicotine Vaping: Marketing-Aware framework, consequences, special considerations
- Recognize the important role PCPs have in Screening and Initiating Management for Substance Use Disorders in Teens q

Homer's The Odyssey: The Lotus Eaters



Odysseus: "I know you men. You have been missing for years. Your families need you to return home"

"Why...would we leave this place? We have everything we need"

“Addiction”: Etymology

Chinese: 癮 (Yin). Habitual Craving, Weakness for

Hindi: लत (lat) : A perpetual need, Sin

Hebrew/Arabic: תּמְכּוּת / إدمان (Idmakote/Idman) : Unbreakable adherence to a behavior

German: Sucht: Obsession

Latin: “Addicere” / “Addictus”, Someone ordered by court to become **bound to servitude** in return for unpaid debt.

Accurate understanding of the core process: ***Loss of Control***



What signs indicate a friend's gaming or tech use has become problematic?



What signs indicate a friend's gaming or tech use has become problematic?



Responses from 5th grade students:

- "Spending too much time doing it"
- "Not hanging out with friends anymore"
- "Fighting with parents or friends if they point it out"
- "Grades are dropping"
- "Cannot live without it"

Most common response:

- "If they are becoming crazy about it"

ADDICTION:

“USE DISORDER”

ie: Loss of Control
over a behavior

Criteria for Substance Use Disorder



A patient only qualifies by meeting two or more of these substance use disorder criteria.

If you or a loved one are suffering from substance use disorder, don't wait. Get in contact with Gateway today!

How does one “lose control” over their own decision making?



They **Know** they are not doing great



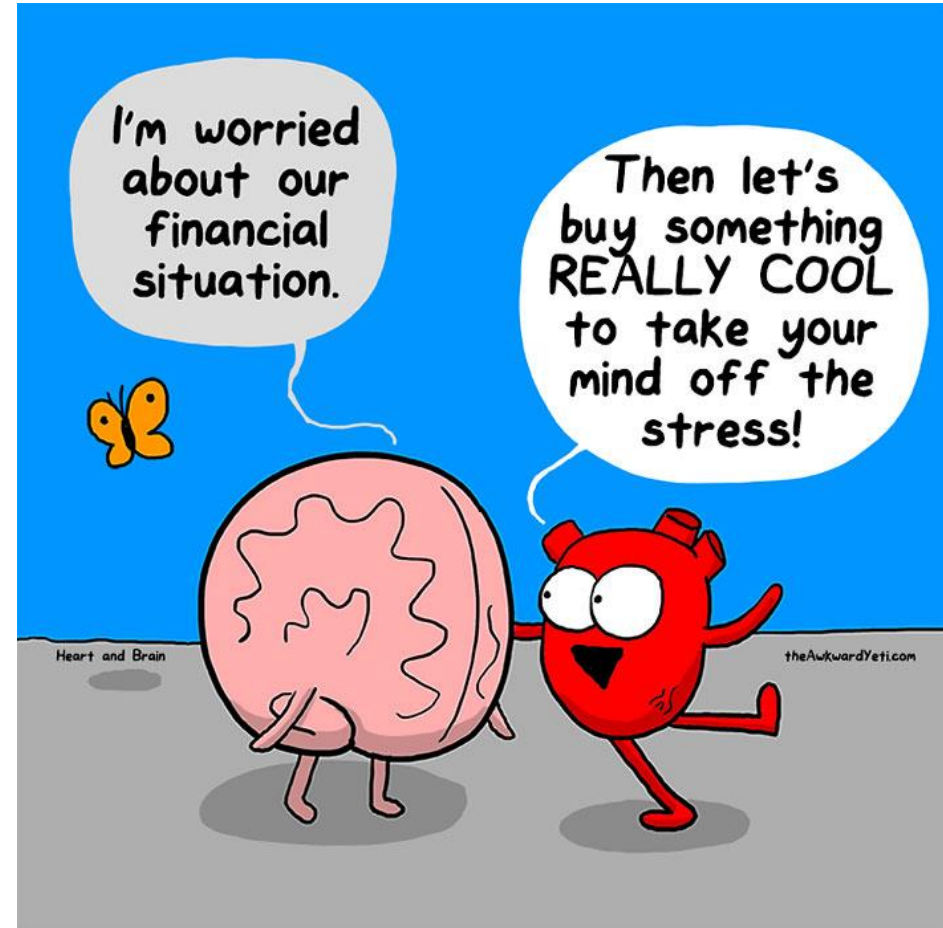
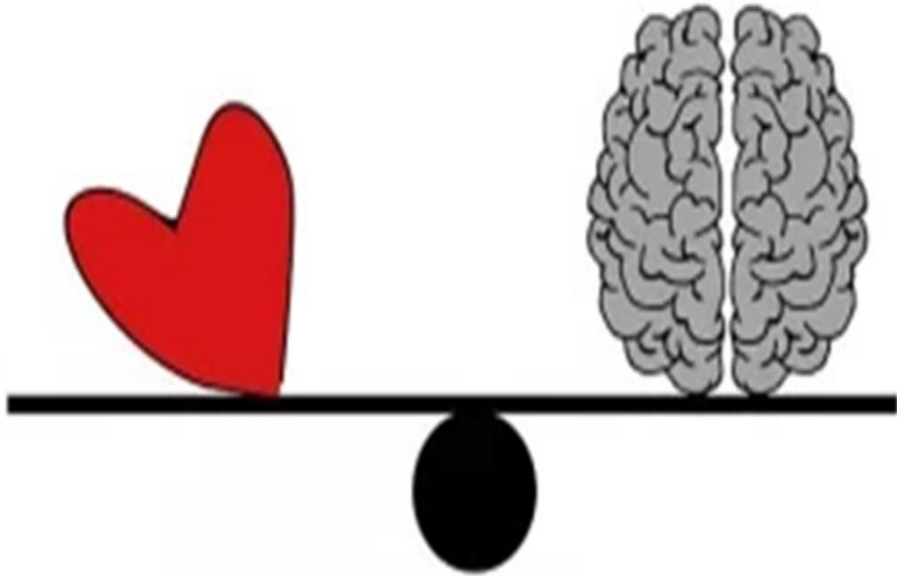
Not stopping use does Not mean they think they are OK



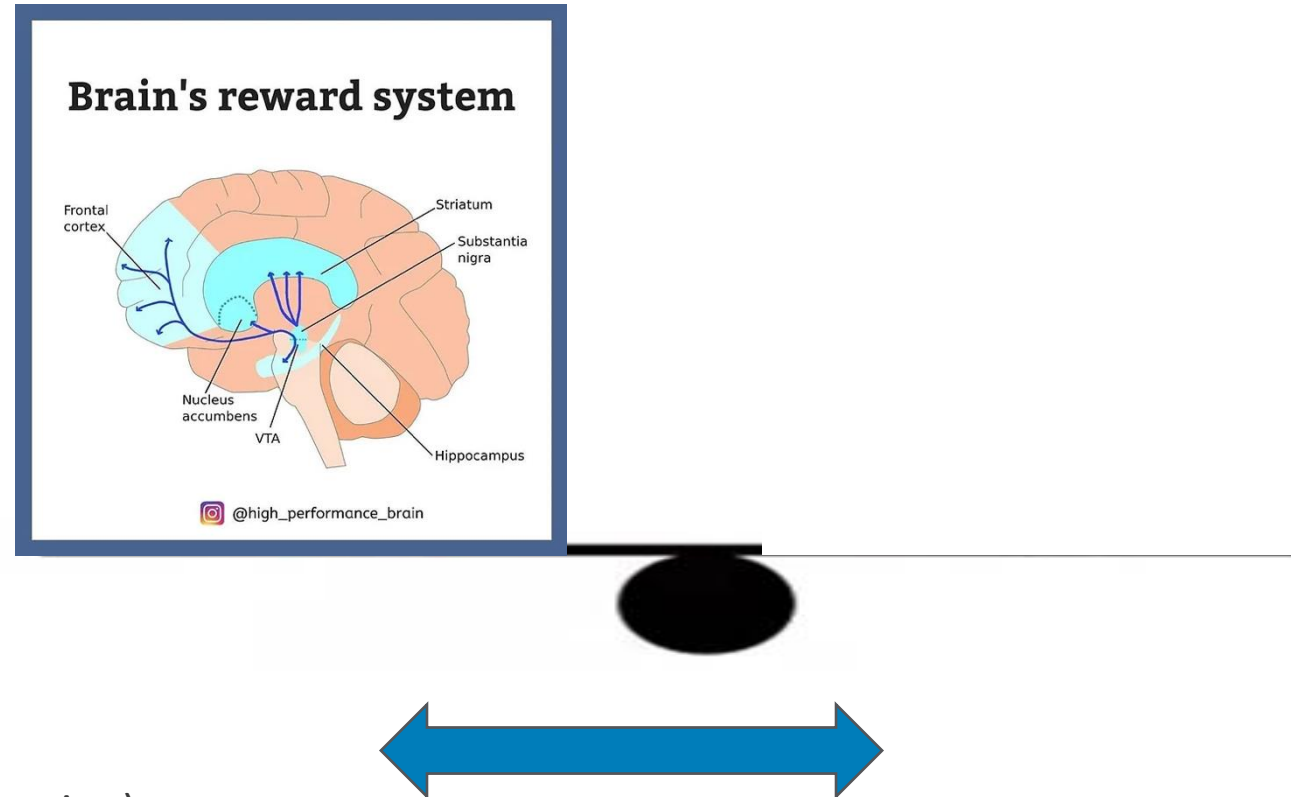
No Celebrities were harmed while making this slide



Risky Decision Making: The End Result of Two Decision Processes



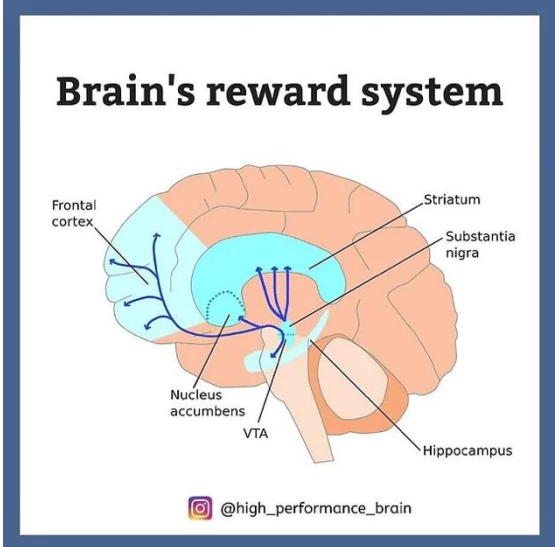
Risky Decision Making: The End Result of Two Decision Processes



Excitation (emotional reaction)

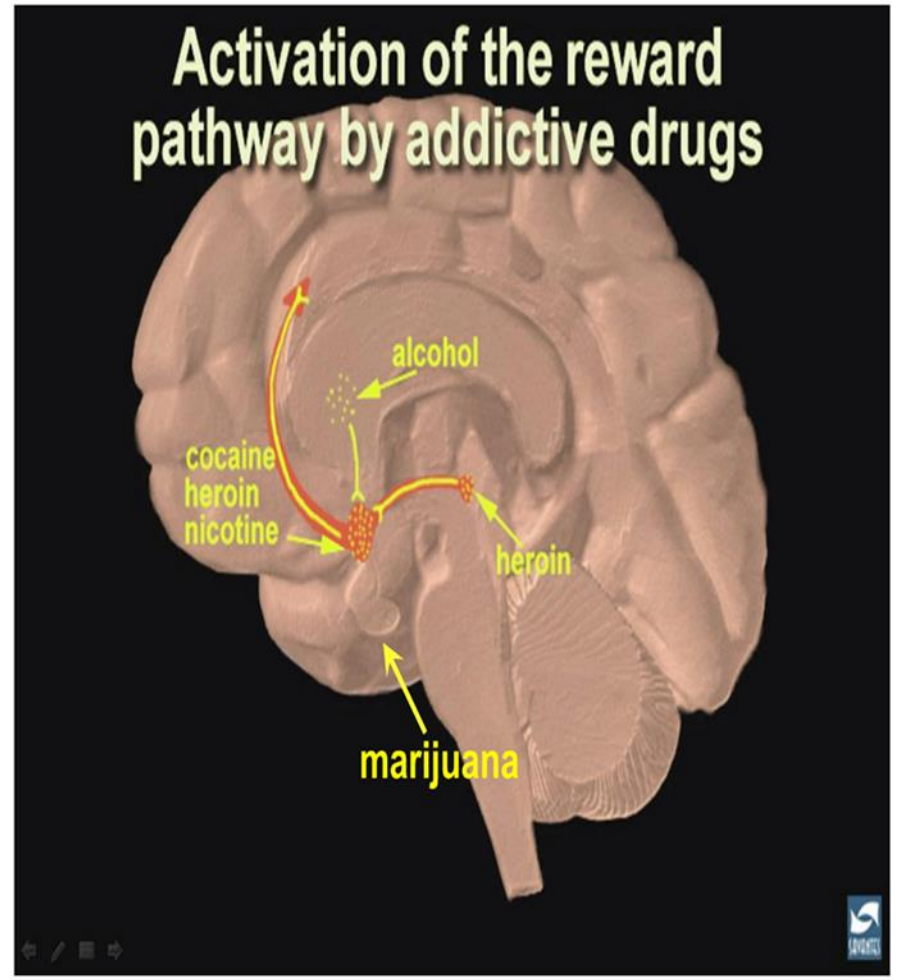
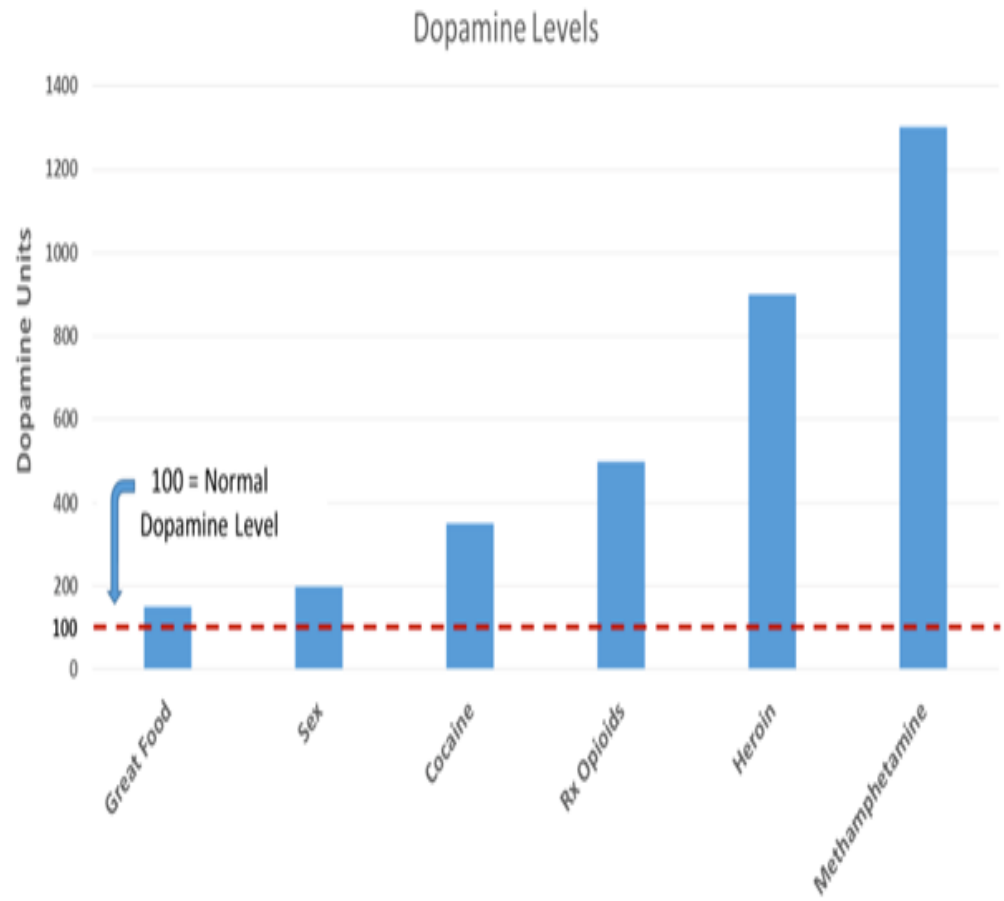
Learned reward-driven response
(Braams 2015, Alarcón 2017)

Risky Decision Making: The End Result of Two Decision Processes

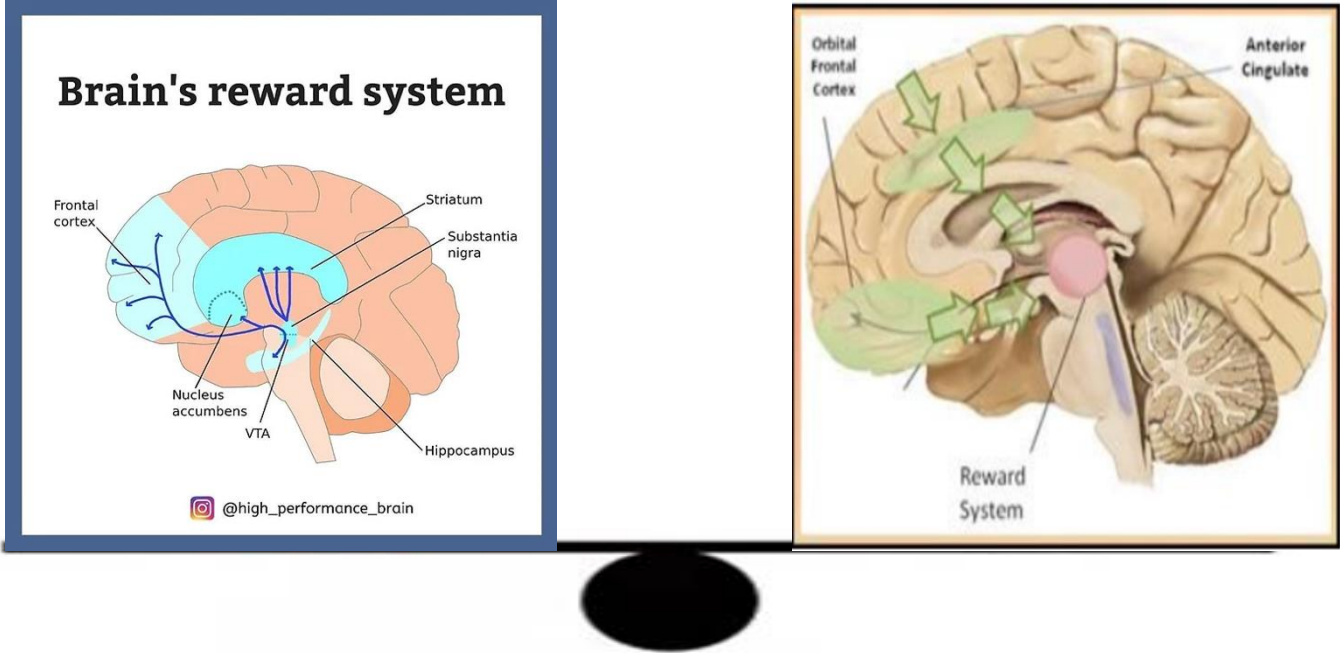


Excitation (emotional reaction)

Learned reward-driven response
(Braams 2015, Alarcón 2017)



Risky Decision Making: The End Result of Two Decision Processes



Excitator

Learned reward-driven response
(Braams 2015, Alarcón 2017)



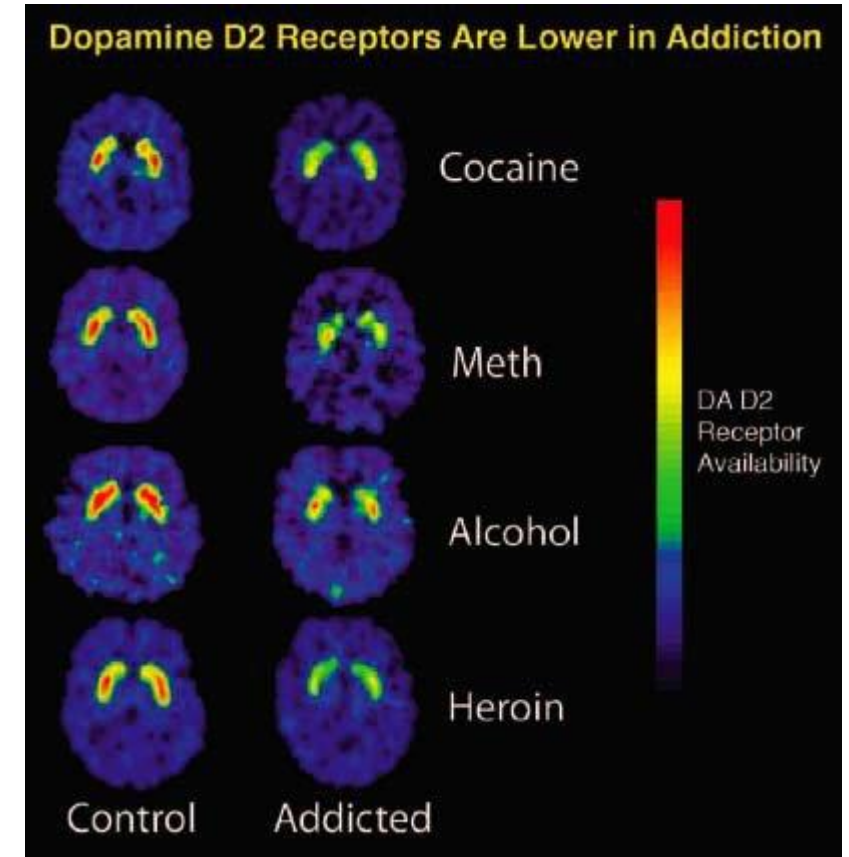
Inhibition: (Cognitive Control)

Goal-relevant information processing and actions
(Casey et al., 2002).

From Use to Use Disorder: How Loss Of Control Develops

1- Desensitization:

Surface expression of D2 dopamine receptors is decreased by long-term self-administration of addictive drugs



Opioids (Wang et al. 1997), cocaine (Nader et al. 2006, Volkow et al. 1993), methamphetamine (Volkow et al. 2001), alcohol (Volkow et al. 2007), and nicotine (Wiers et al. 2017).

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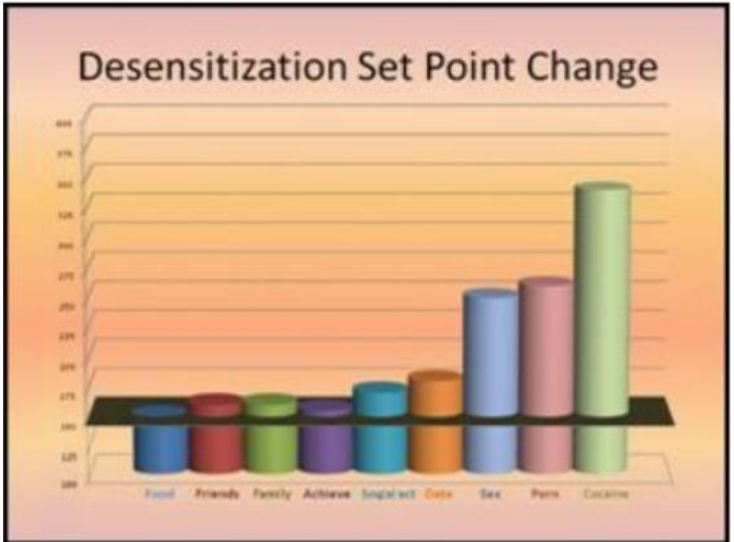
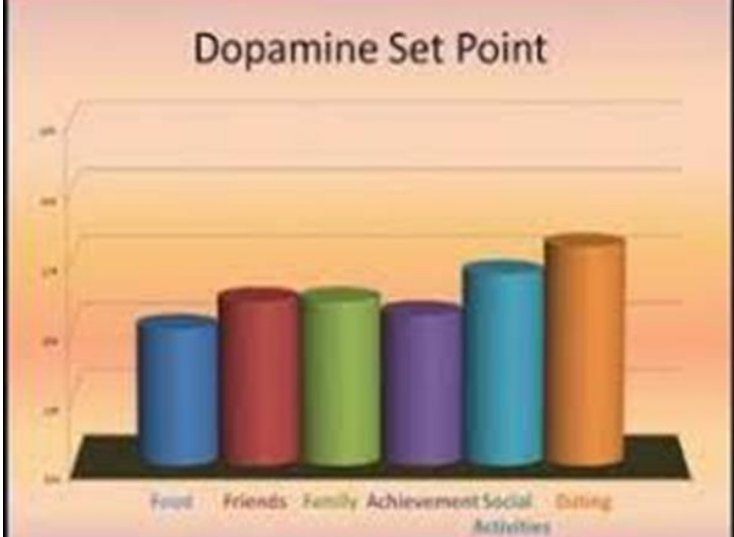
From Use to Use Disorder:

1- Desensitization:

Surface expression of D2 dopamine receptors is decreased by long-term self-administration of addictive drugs

2- Habituation:

This results in decreased sensitivity to the range of rewarding stimuli that are not already established habits



Wise et al 2020

Teens that vape use more alcohol, MJ and other drugs



5.8X



6.5X



3.0X

Source: Curran KA, Burk T, Pitt PD, Middleman AB. Trends and Substance Use Associations With E-Cigarette Use in US Adolescents. 2015. *Clinical Pediatrics*.

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From Use to Use Disorder:

1- Desensitization:

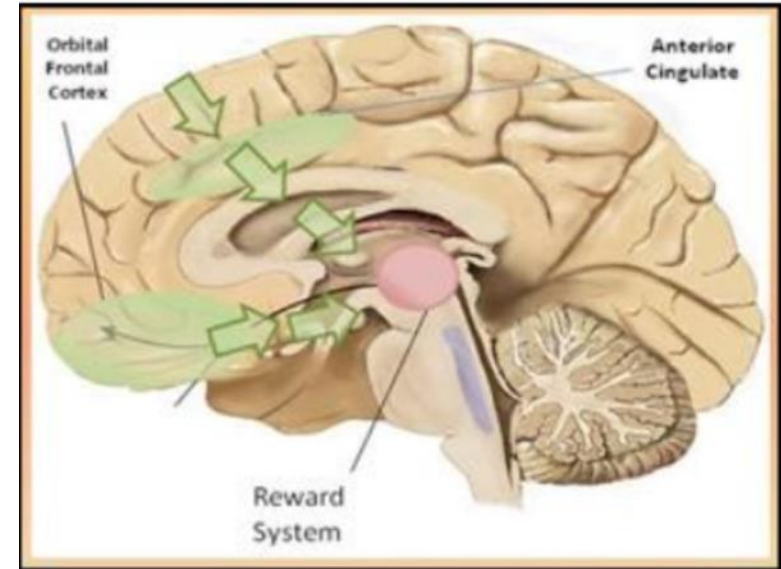
Surface expression of D2 dopamine receptors is decreased by long-term self-administration of addictive drugs

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3- Hypofrontality:

-> Increased Myelination leads to faster information access and “Frontalisation” of the Brain, (Giedd JN et al 2004)



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Surface expression of D2 dopamine receptors is decreased by long-term self-administration of addictive drugs

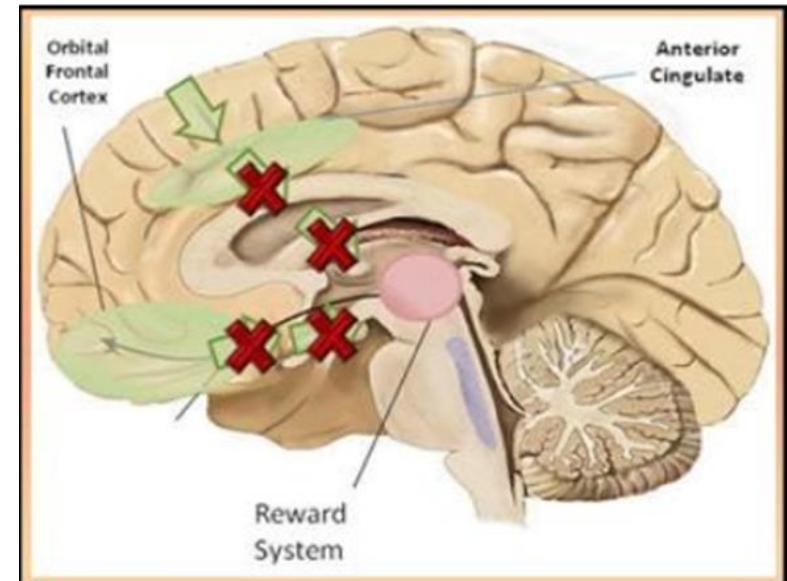
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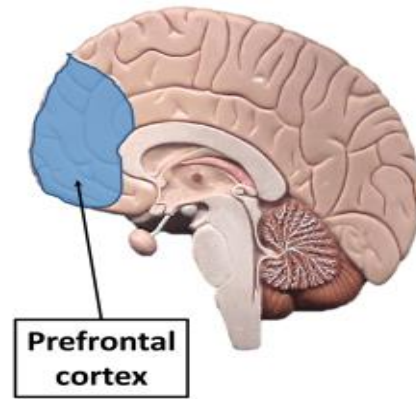
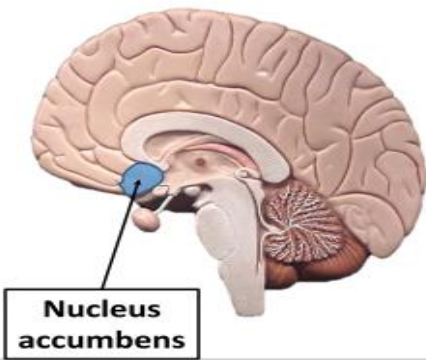
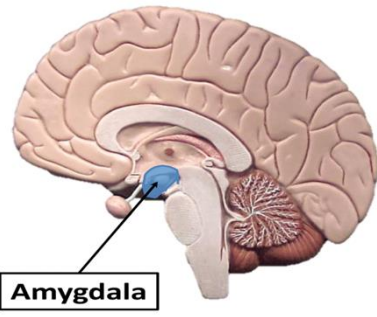
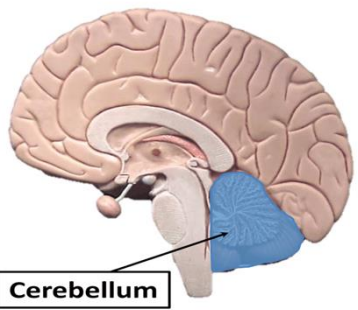
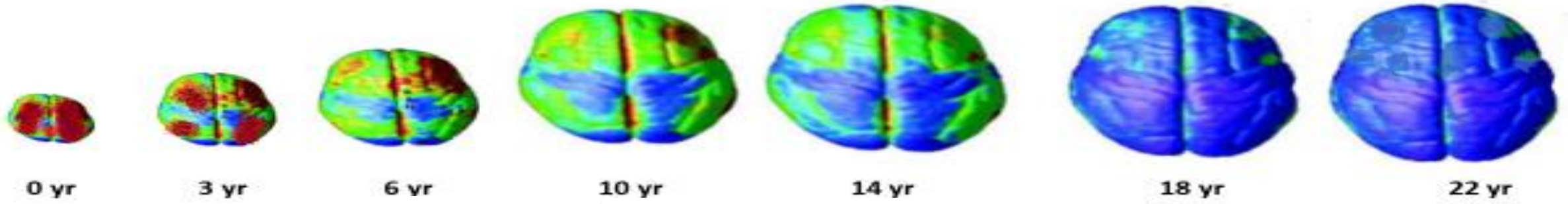
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3- Hypofrontality:

-> Increased Myelination leads to faster information access and “Frontalisation” of the Brain, (Giedd JN et al 2004)

Once an addiction is established, the brain tries to maintain the source of Dopamine surges and protect use through the process of Hypofrontality (Hilton and Watts, 2011, Volkow, 2010)





School Age, Early Adolescence: Reward Circuit Development. 10-16 years of age

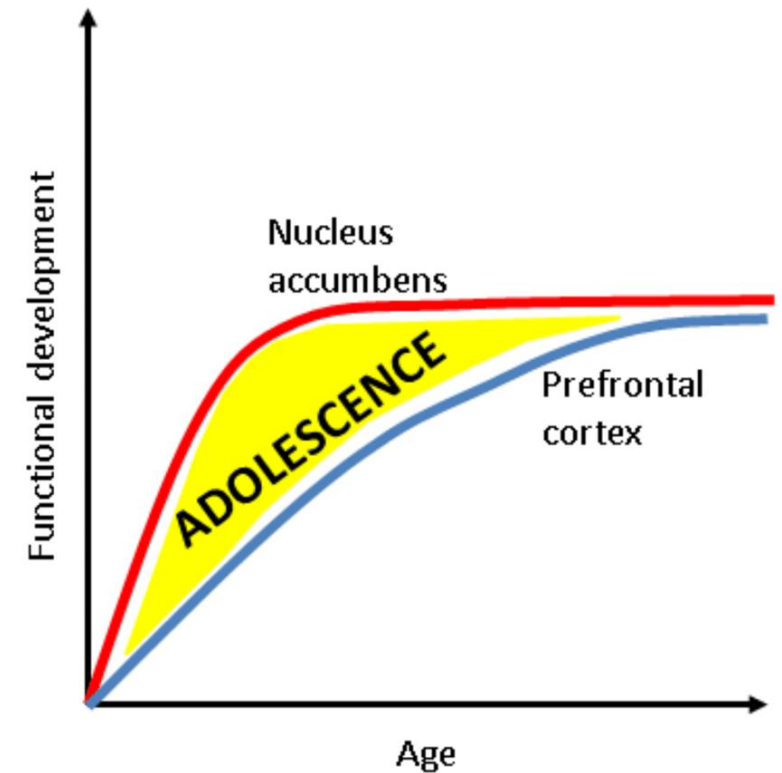
Dopamine-based system that promotes and enforces behavior that is Rewarding (produce a dopamine reaction)

Adolescent Specific Factors: Increased risk taking, Seeking novelty,
Decreased inhibition, heightened Reward response (Overactive Glutamate,
Underactive Gaba circuits)

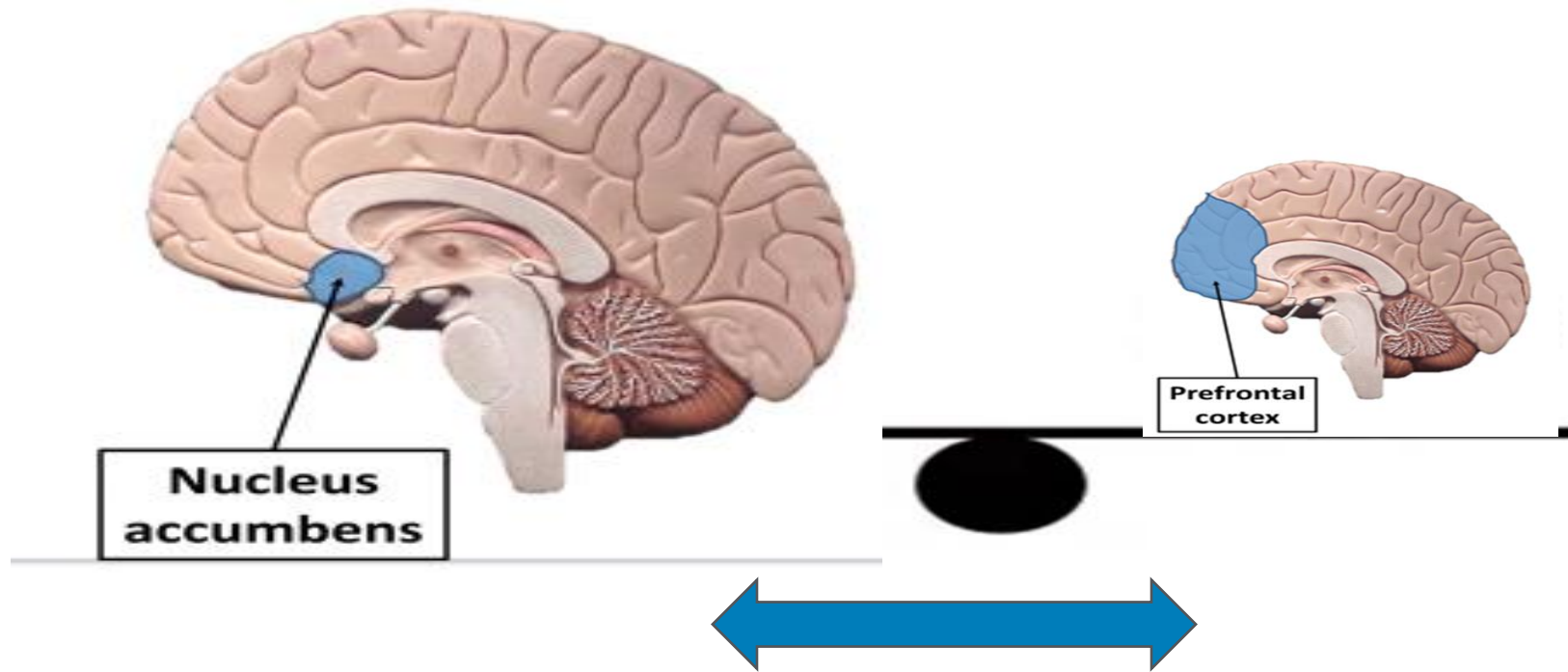
⇒ Adolescents will experiment with domains of functioning

⇒ They will repeat and strengthen behaviors that they succeed at ,
strengthening of these circuits!

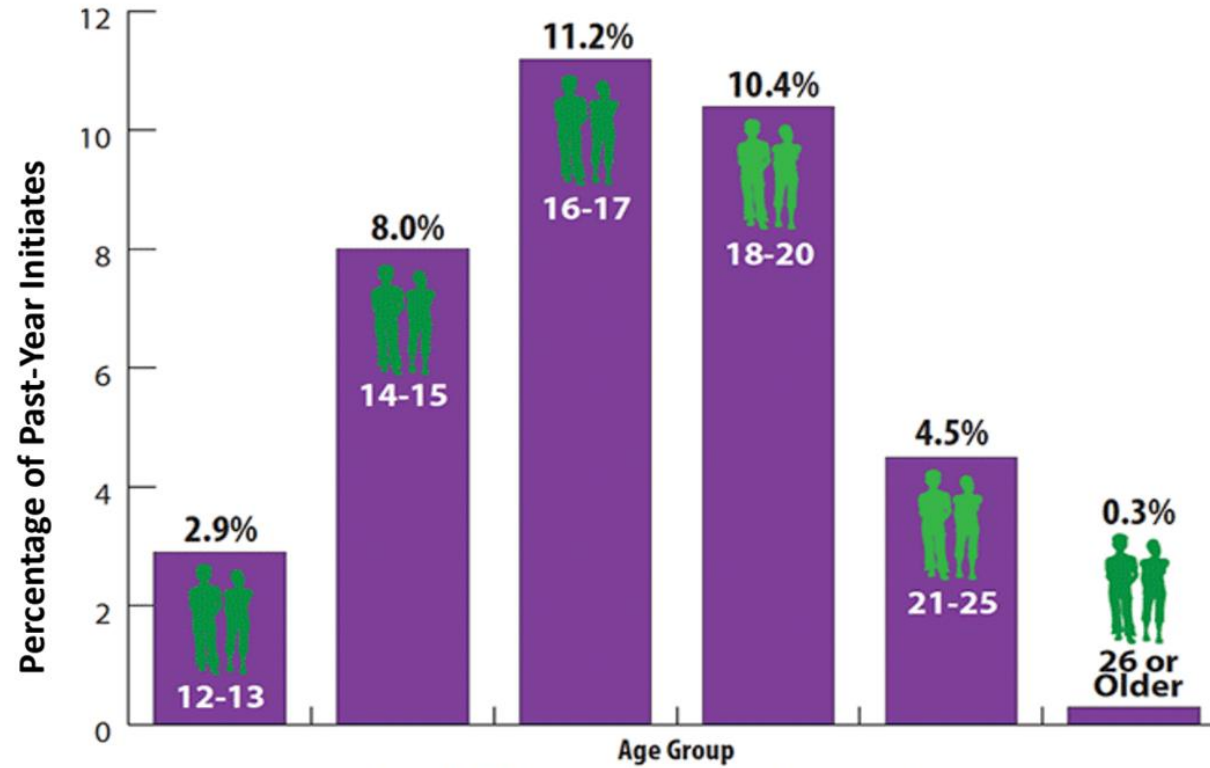
⇒ **No one is good at everything, but everyone eventually finds they are
good at something!**



Youth: Natural tendency to take risks and seek high Dopamine activities



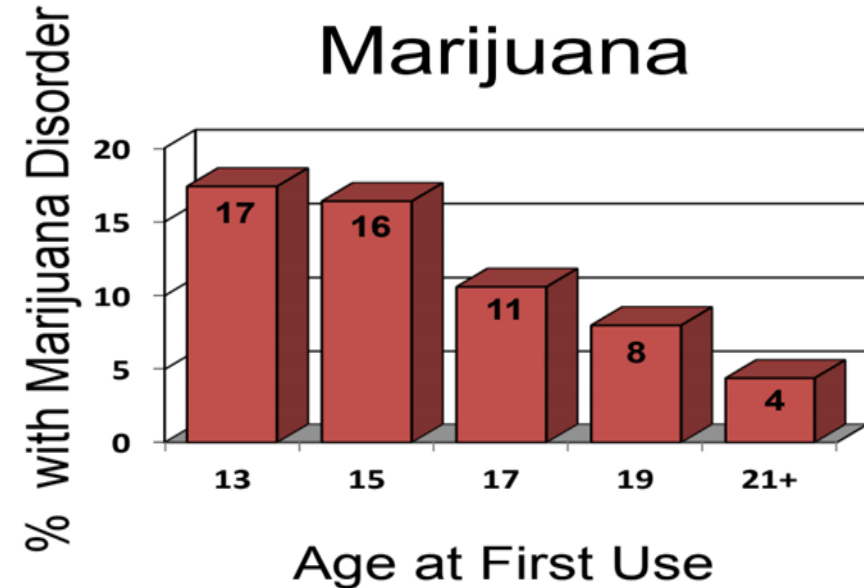
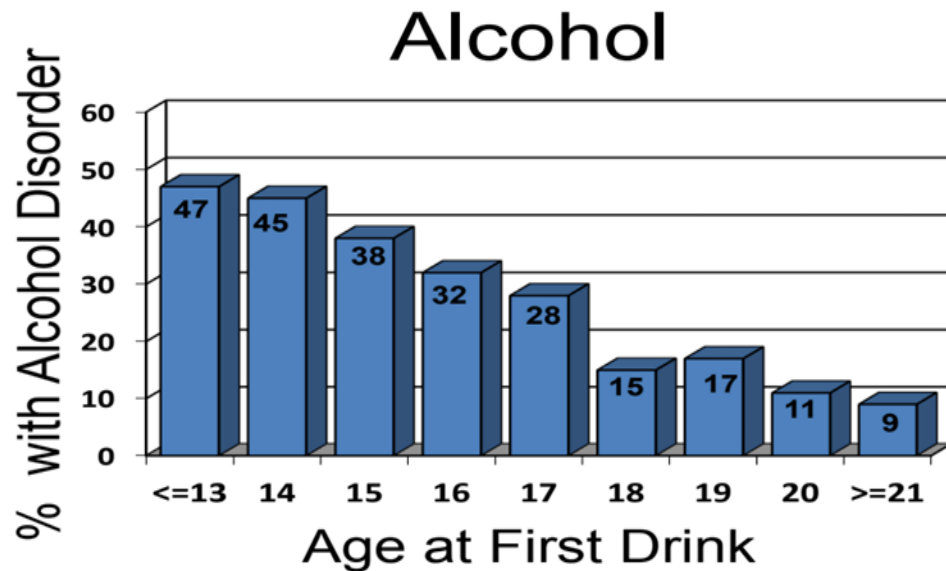
Most drug use starts in adolescence



Source: SAMHSA, Center for Behavioral Health Statistics and Quality, National Survey on Drug Use and Health, 2011 and 2012.



Age at first use and later risk



Adolescent Depressant Use Disorders: Cannabis and Alcohol



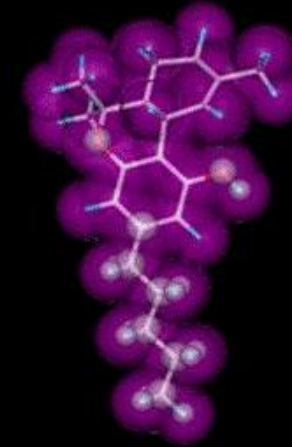
Cannabis: Fooling the brain...

Brain's Chemical



Anandamide

Drug



THC

Source: NIDA

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Where the world comes for answers



Cannabis Use and Use Disorder Consequences:

⇒ **Academic decline due to deficits in information retention** (Luna B. Et al 2017)

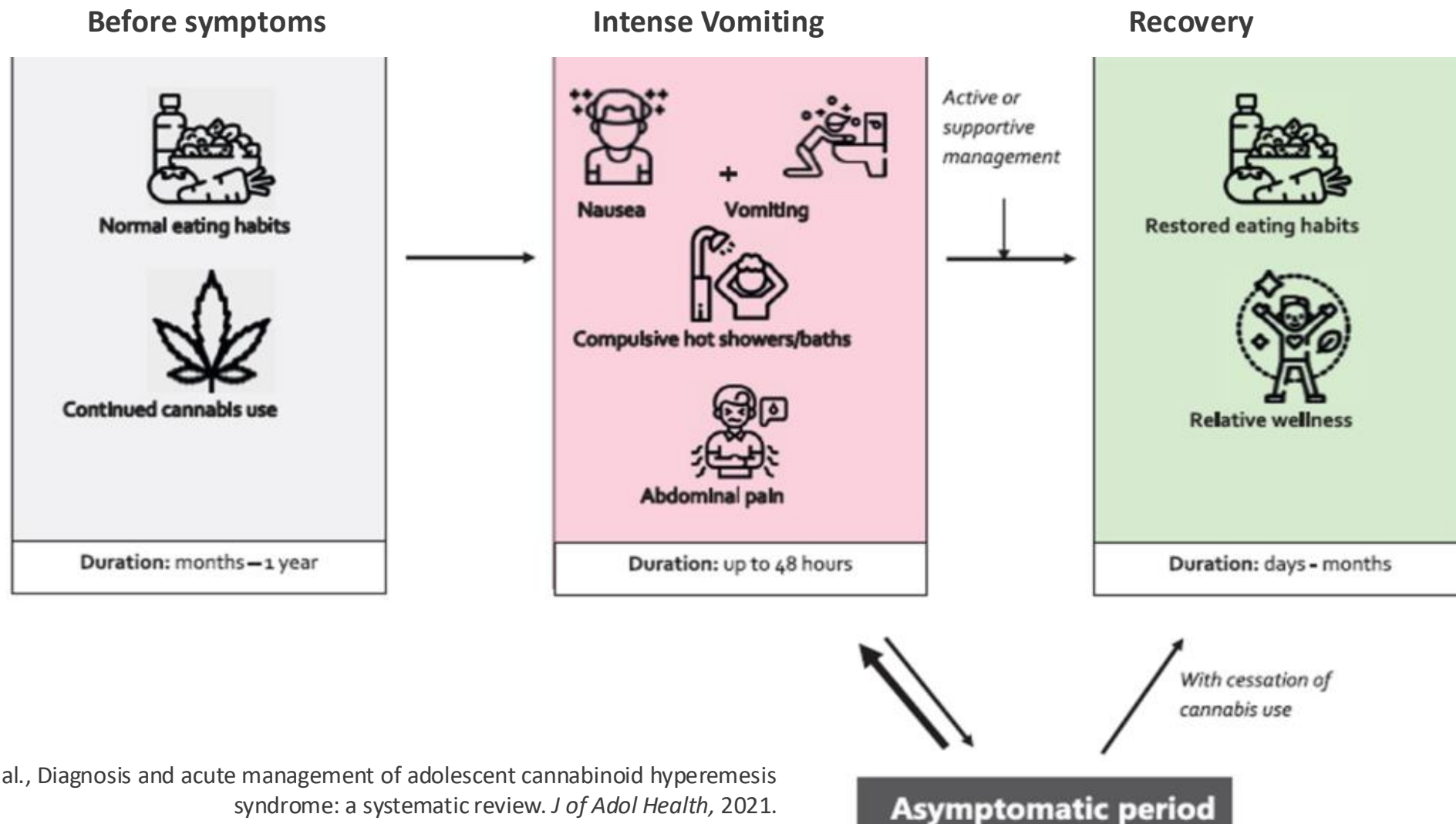
⇒ Working memory deficits that can last for years after stopping use.

⇒ **Sleep disruption:** THC has been found to **decrease stage 3 (N3)** sleep (Robson et al 2004). Stage 3 (N3) sleep has been shown to be important in the **consolidation of hippocampus-dependent declarative memories** (Born J. 2010)

⇒ **Chronic Pain:** there is no evidence to support the use of medical **cannabis** to treat **chronic pain** and spasticity in children (Zürcher K et al 2022), and heavy use can worsen chronic pain (Clauw et al, 2020)



Cannabis Hyper-Emesis Syndrome: Dysregulation of Nausea and Vomiting Physiological Controls



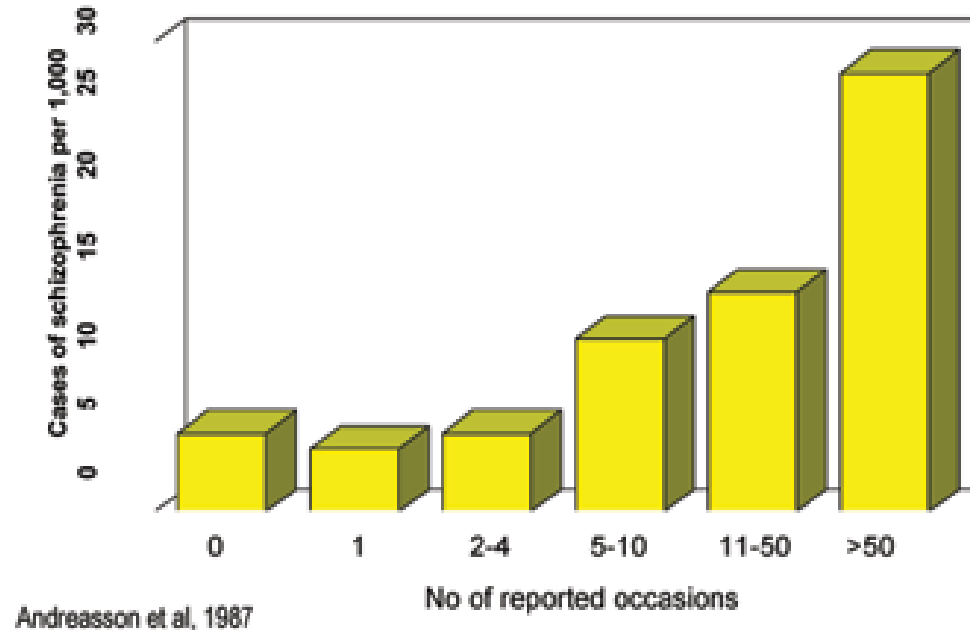
Zhu et al., Diagnosis and acute management of adolescent cannabinoid hyperemesis syndrome: a systematic review. *J of Adol Health*, 2021.

Cannabis-Induced Psychosis:

⇒ 28 - 50 % of individuals who experience an initial episode of cannabis-induced psychosis are diagnosed with schizophrenia 2 to 4 years later.

(Rognli et al 2023, Hjorthoj C. et al 2018)

Cannabis consumption at age 18 and later risk of schizophrenia



Cannabis and Driving

Studies of performance show that THC impairs attention, working memory, coordination, reaction time, and visual perception.

=> If use was initiated before 16 yrs of age, impaired driving persists even when not acutely intoxicated!

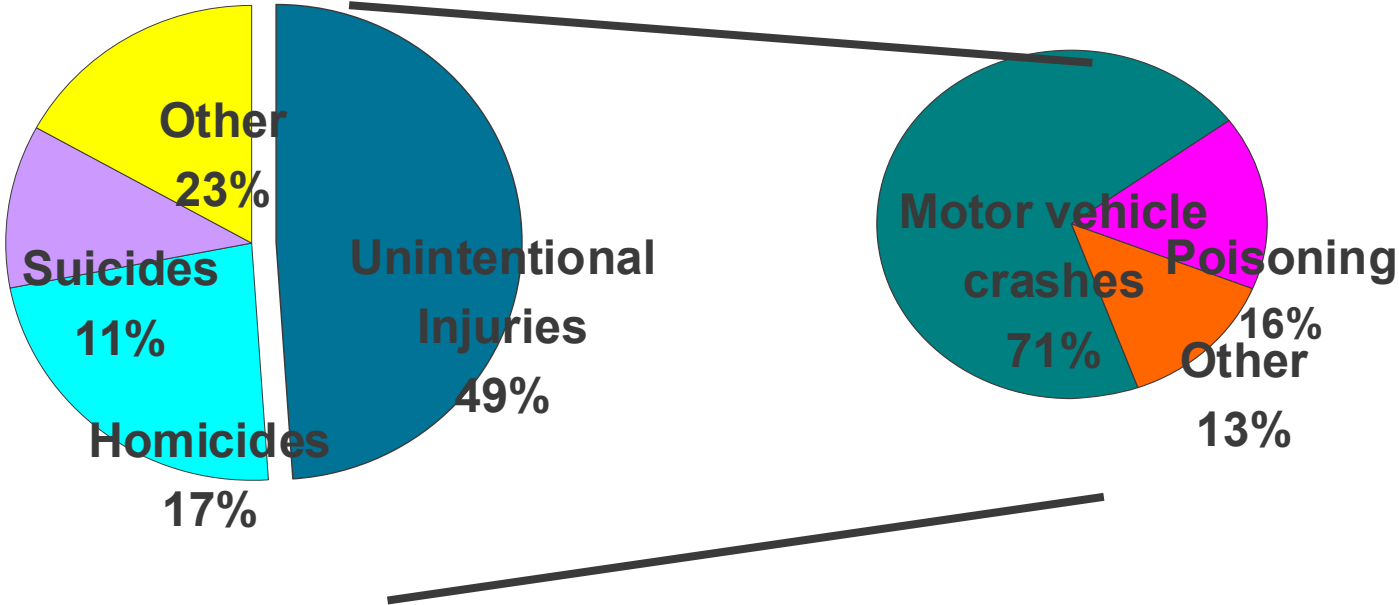


Source: Castle D, Solowij N. Acute and subacute psychomimetic effects of cannabis in humans. In: Castle D, Murray R, eds. *Marijuana and Madness*. Cambridge, UK: Cambridge University Press; 2004:41-53.

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Leading Causes of Death, U.S. Ages 15-19,

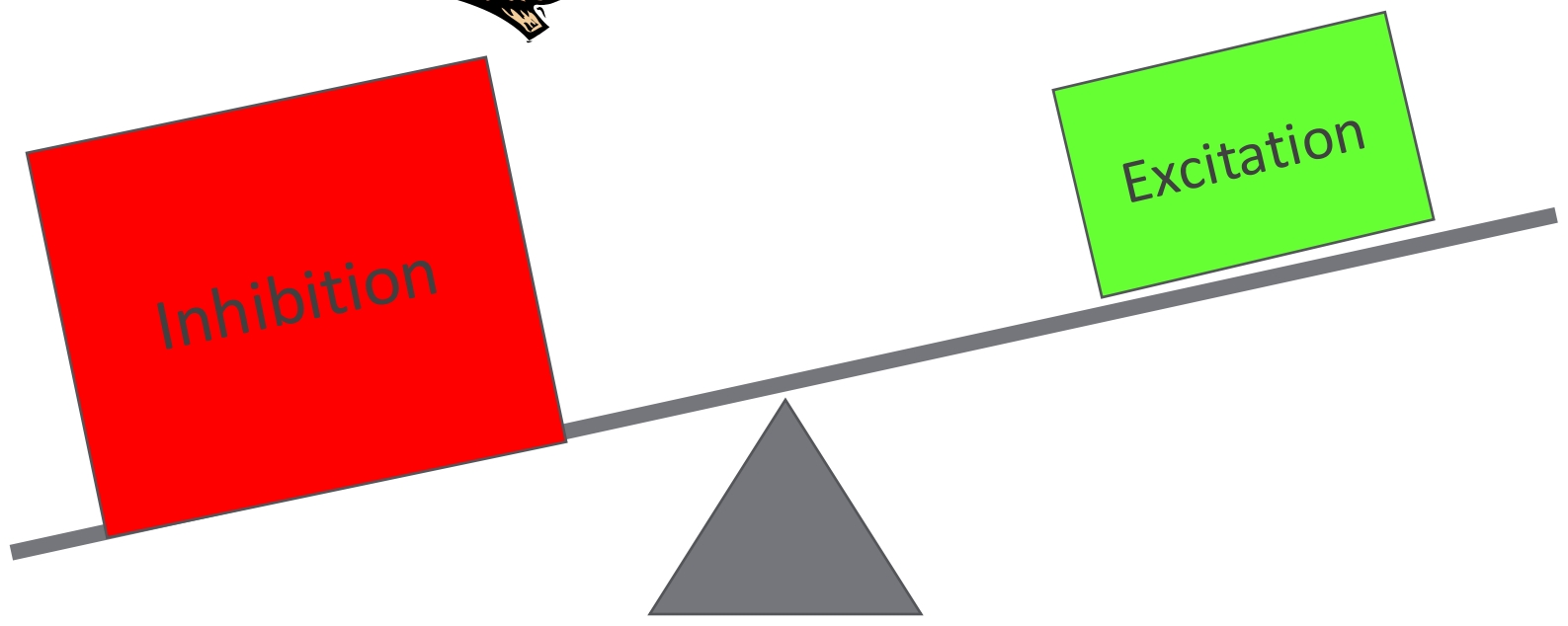
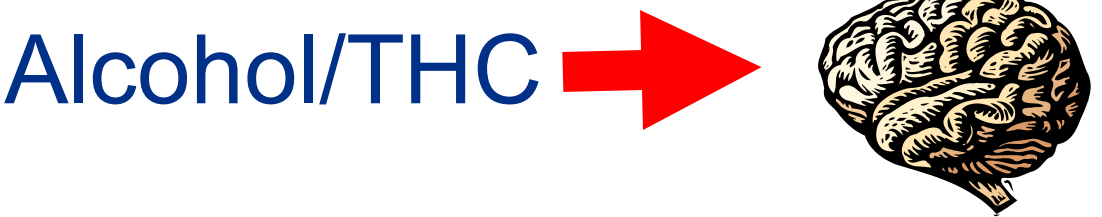


Greater than 75% of all deaths among U.S. adolescents are preventable – **Alcohol** and substance use can have a contributing role in nearly all of the above causes of fatalities

Source: US DHHS, Health Resources and Services Administration, Maternal and Child Health Bureau. *Child Health USA 2010*. Rockville, Maryland: U.S. Department of Health and Human Services, 2010.



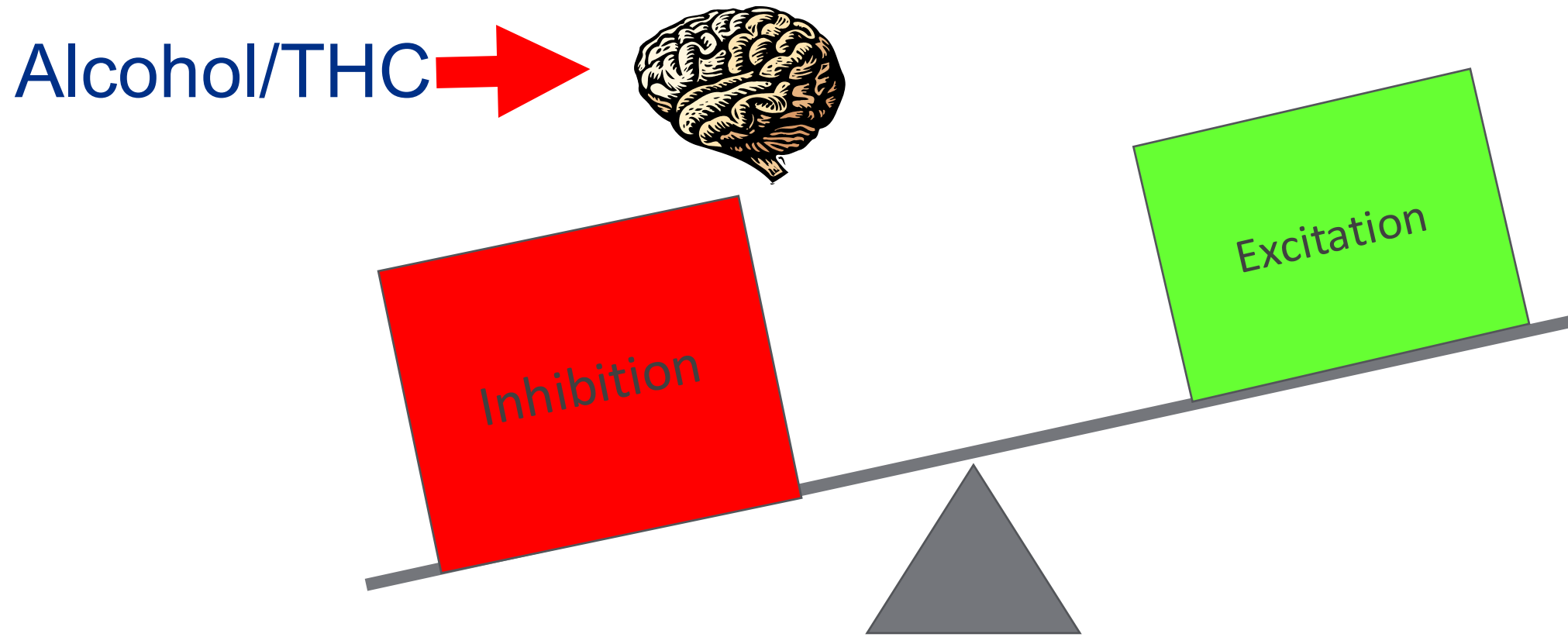
Long Term effects of Alcohol or Cannabis Use: Loss of Innate Emotional Regulation skills



Source: Valenzuela CF. Alcohol Health & Research World, 1997; 21(2), 144-148.



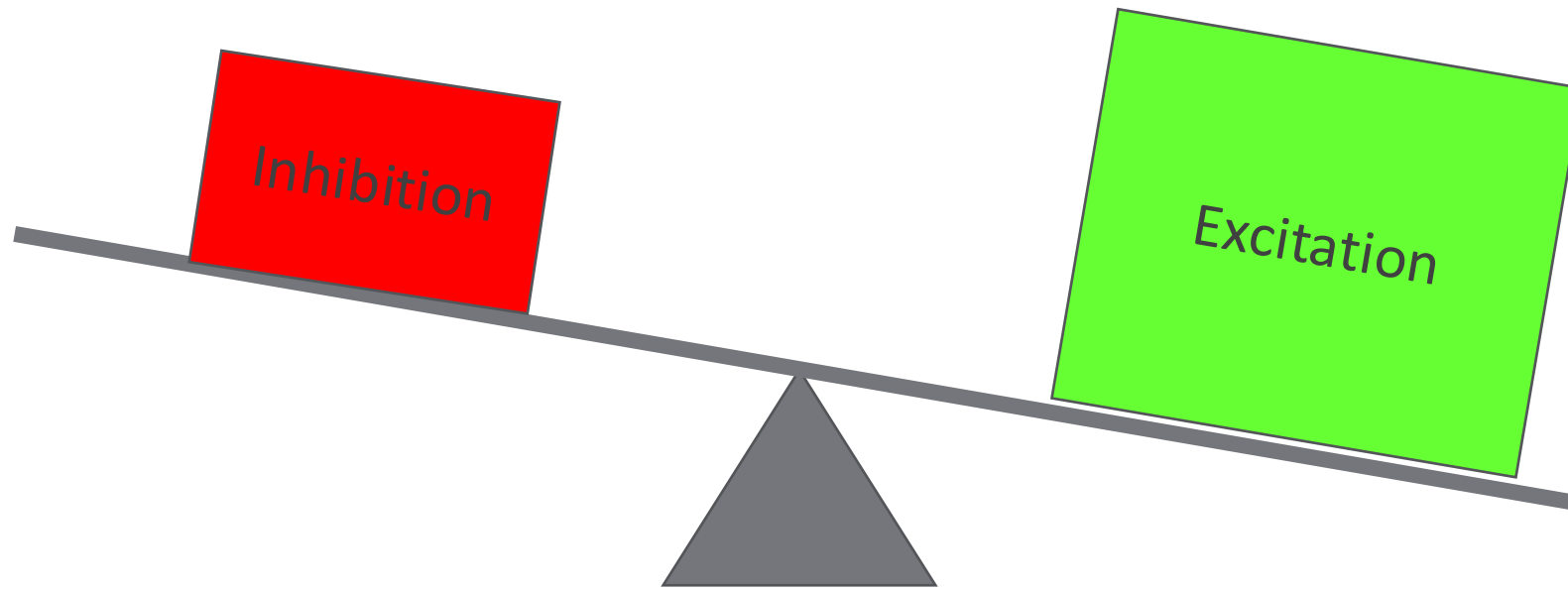
With repeated Alcohol/THC exposure, brain cells adapt...by increasing the baseline excitation level to maintain (control)



Source: Valenzuela CF. Alcohol Health & Research World, 1997; 21(2), 144-148.



When external “self medication” stops, the brain is left hyper-excited AND lacking in ability to cope with stress, leading to higher Anxiety

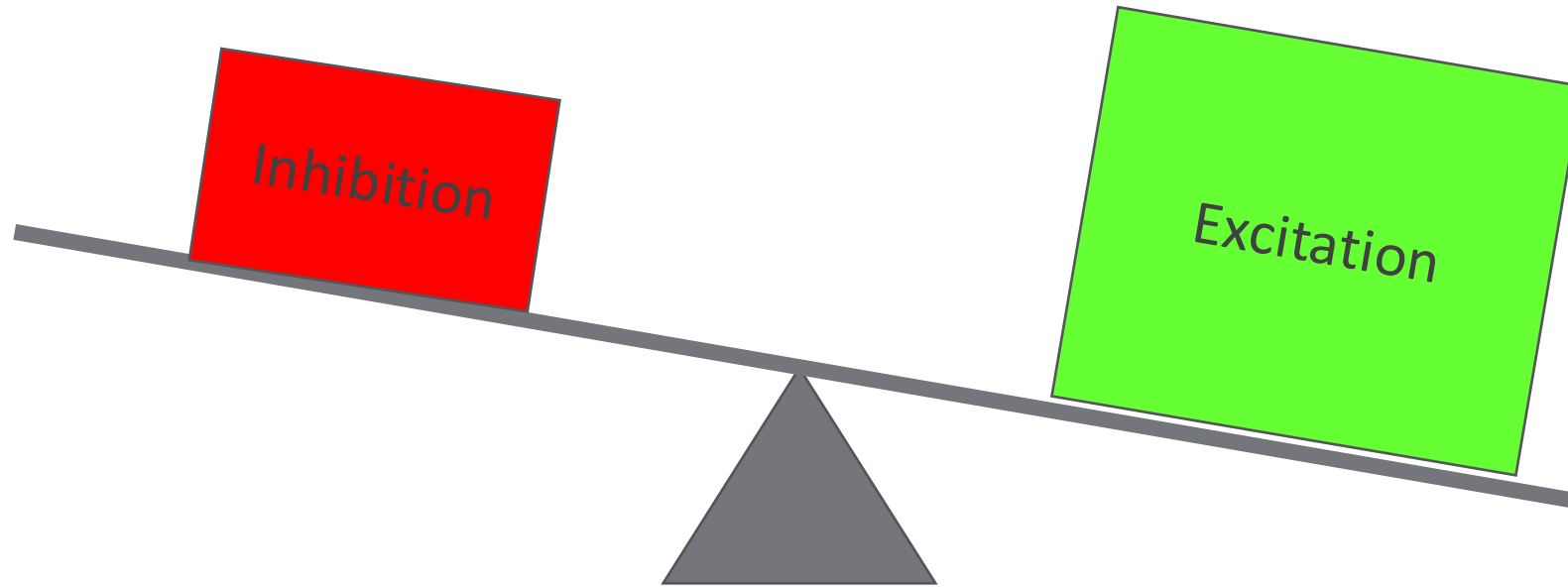


Source: Valenzuela CF. Alcohol Health & Research World, 1997; 21(2), 144-148.

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=> If there is dependence on external “self medication” for the length of the window for developing innate stress-coping mechanisms, this could lead to life-long deficits in this faculty.



Source: Valenzuela CF. Alcohol Health & Research World, 1997; 21(2), 144-148.

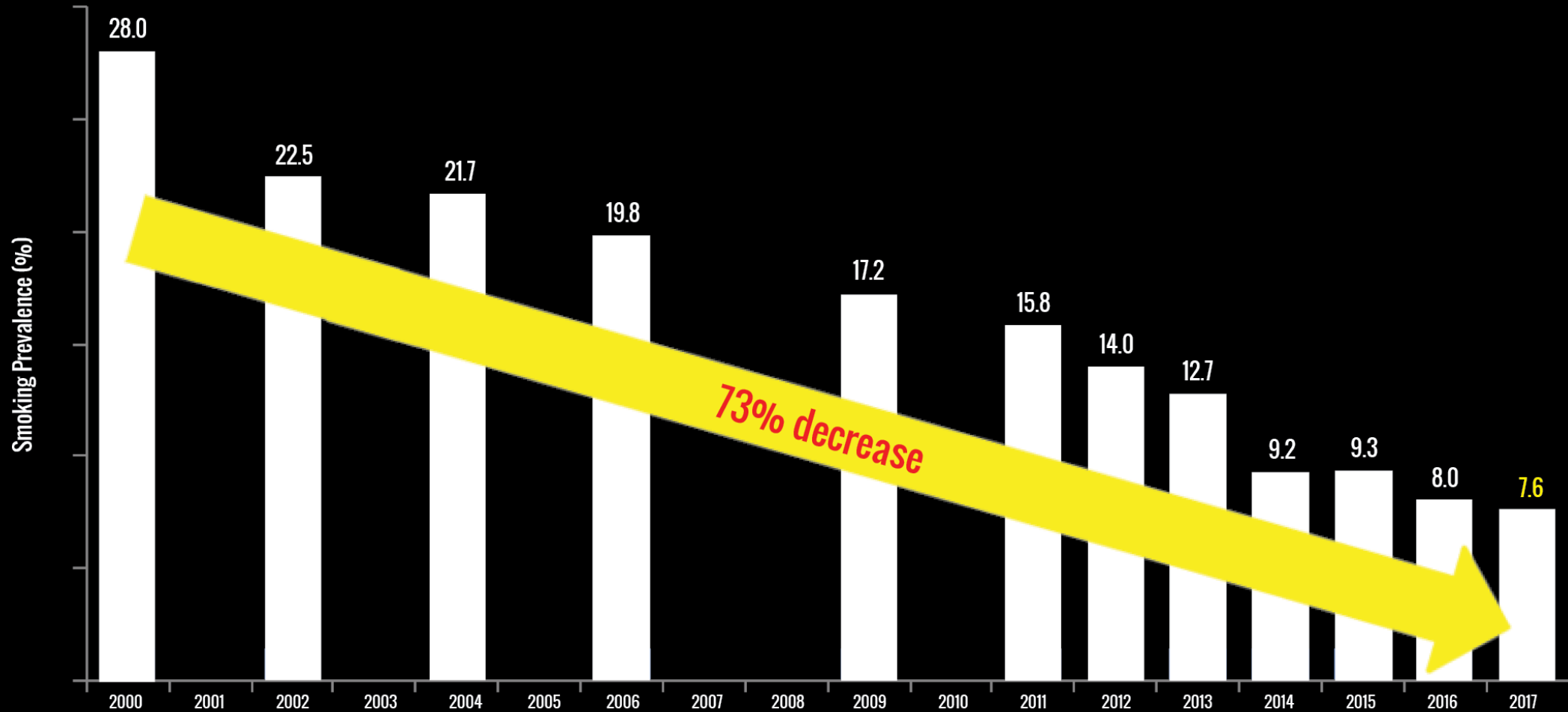
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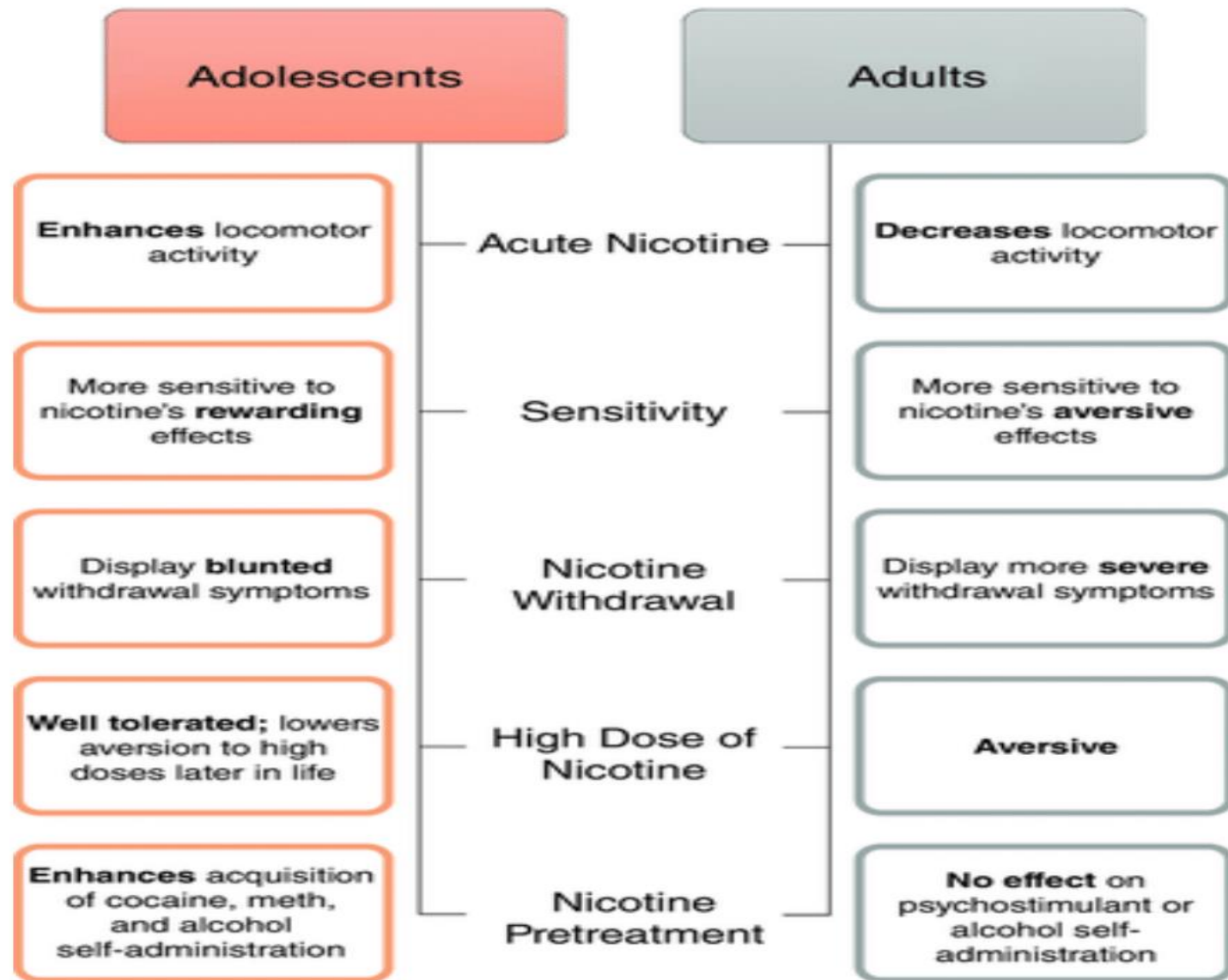
NICOTINE VAPES

**WHAT IS IT AND
HOW DID WE
GET HERE?**

U.S. High School Smoking Rate (2000-2017)



Source: CDC, National Youth Tobacco Survey





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MARKETING

Science 2020:

“Juil Bought Ads On Cartoon Network, Nickelodeon, And Other Kids Websites, A New Lawsuit Claims

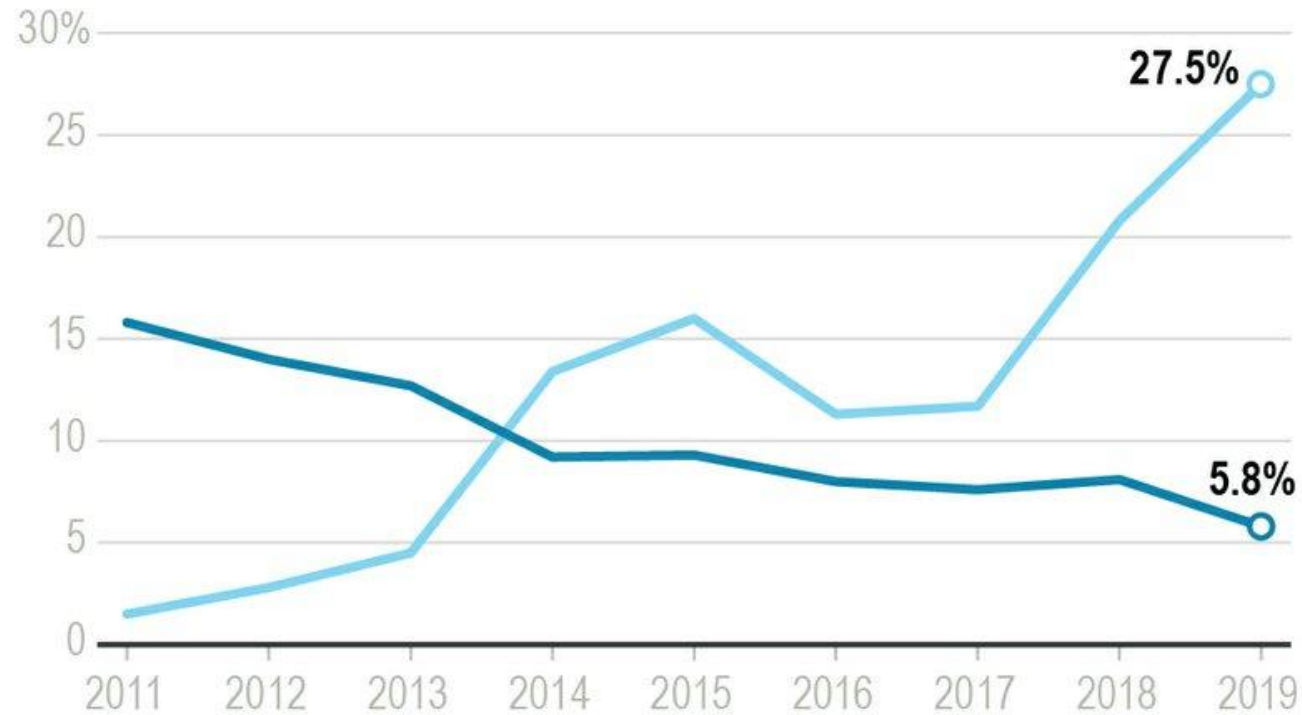
Internal documents obtained by the Massachusetts attorney general as part of a new lawsuit”



Teen cigarette-use declines as vaping gains popularity

High school students who use cigarettes and e-cigarettes.

— Cigarettes — E-cigarettes



Source: National Youth Tobacco Survey

AP



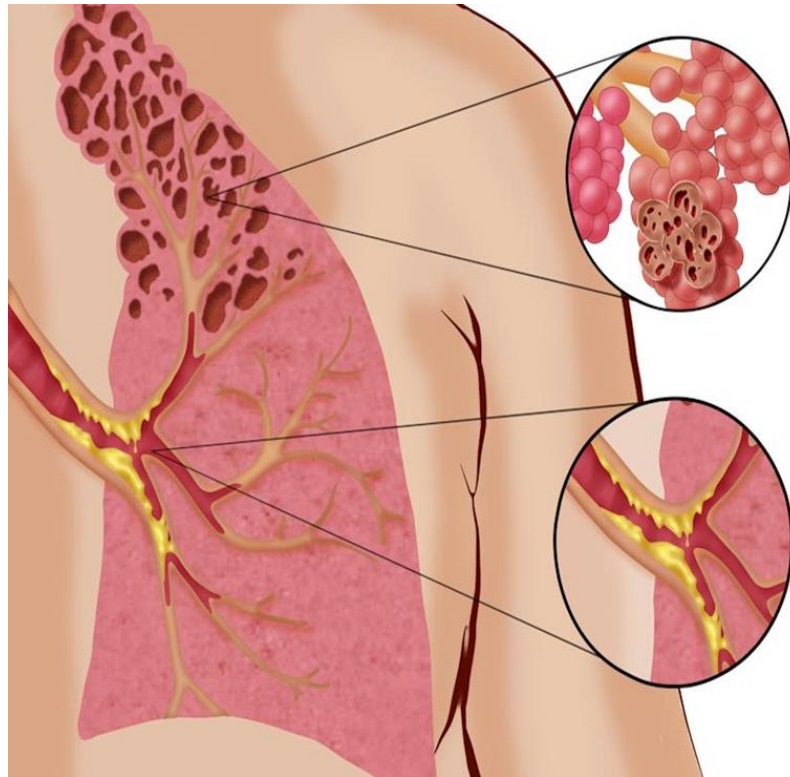
**3 out of 4 young
adult cigarette
smokers started
with vaping**

**The non-vape
tobacco industry is
worth 850 billion
dollars and can
only be sustained
with new users**

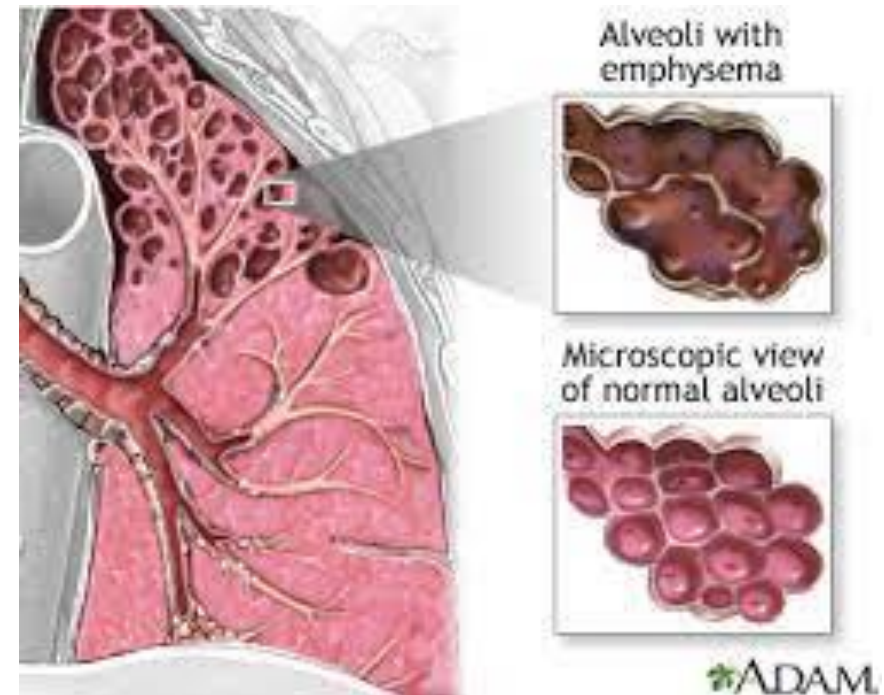
**Teens who Vape
are 3.6x more
likely to start using
cigarettes than
teens who do not**

CIGARETTE SMOKE vrs VAPING FUMES:

Popcorn Lung: After 2 years of vaping



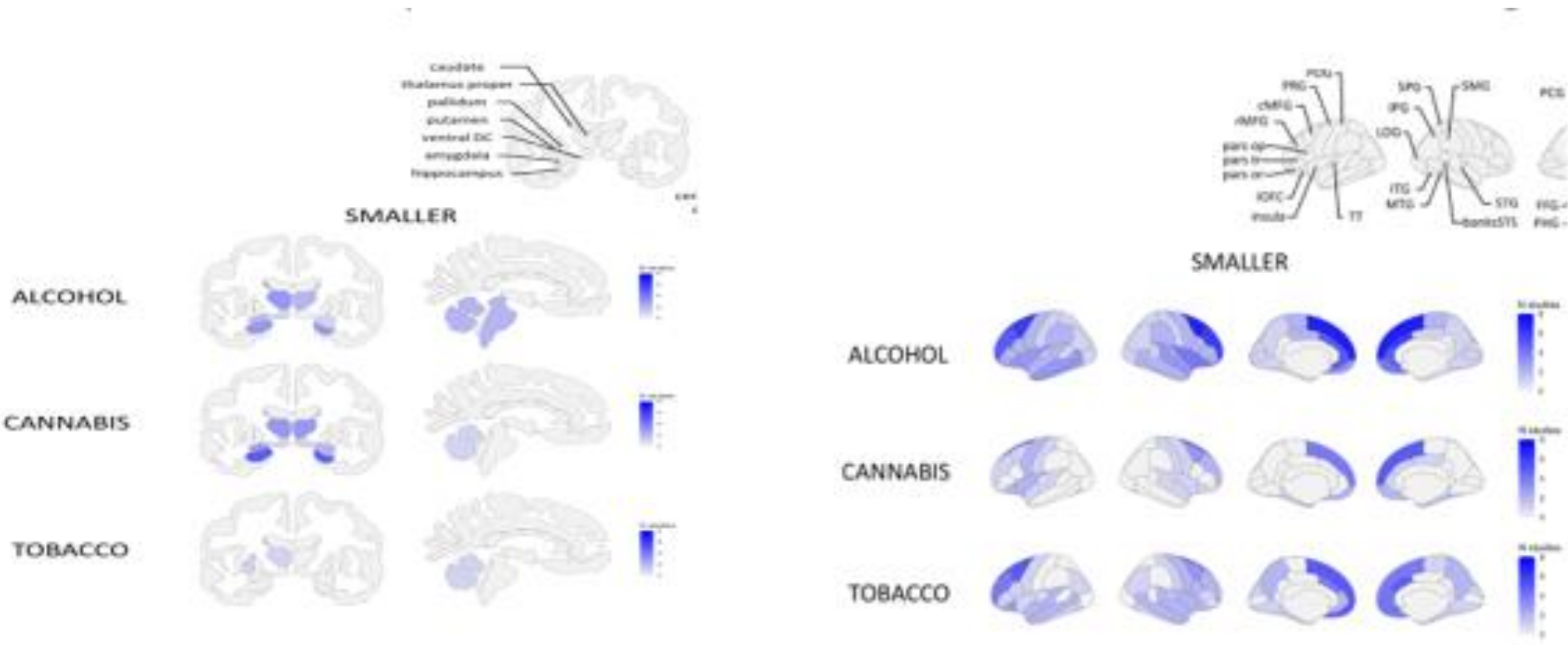
Emphysema: After 15-20 years of smoking



Role of PCPs in Screening for and initiating treatment for SUD in Youths



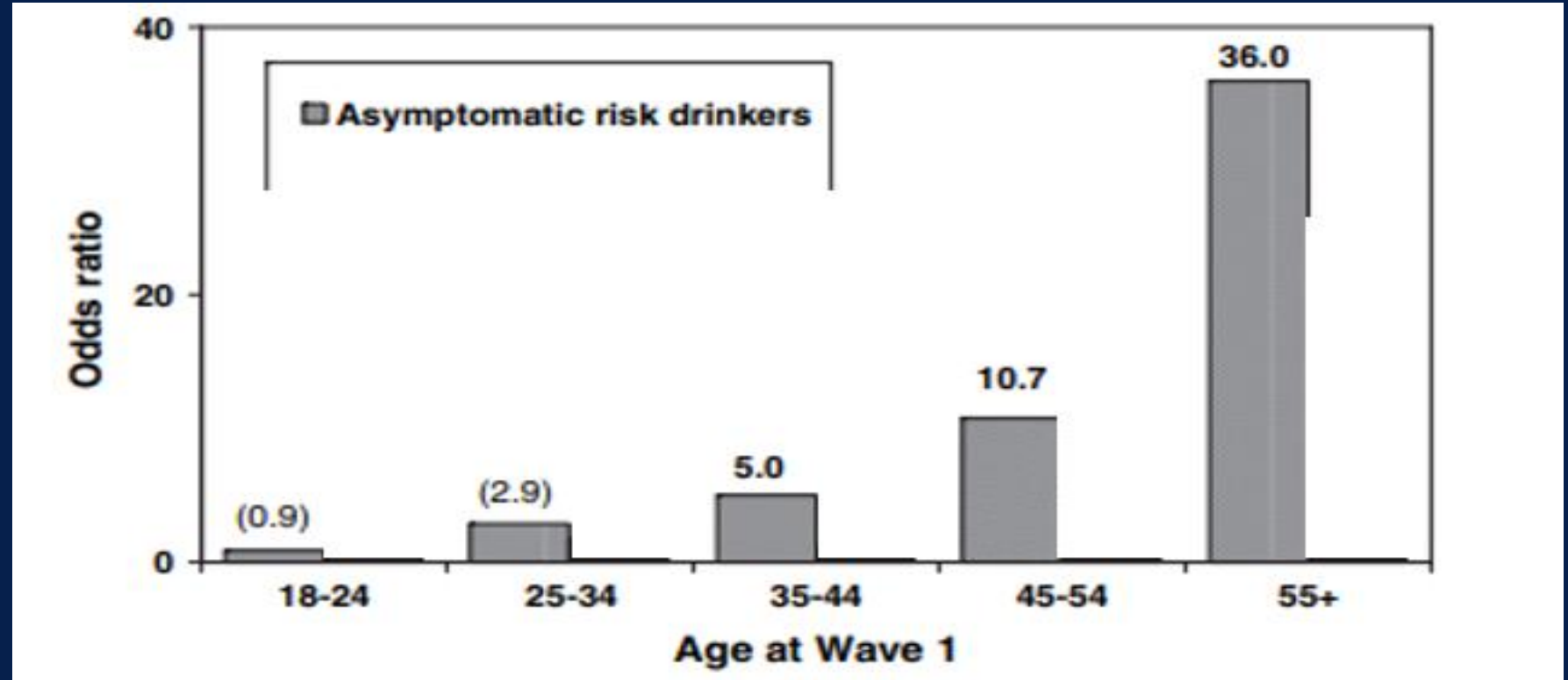
SUD in Adolescents leads to deficits in areas that moderate impulse control and decision making:



Boer OD, Adolescent substance use initiation and long-term neurobiological outcomes: insights, challenges and opportunities. Mol Psychiatry. 2024 Jul;

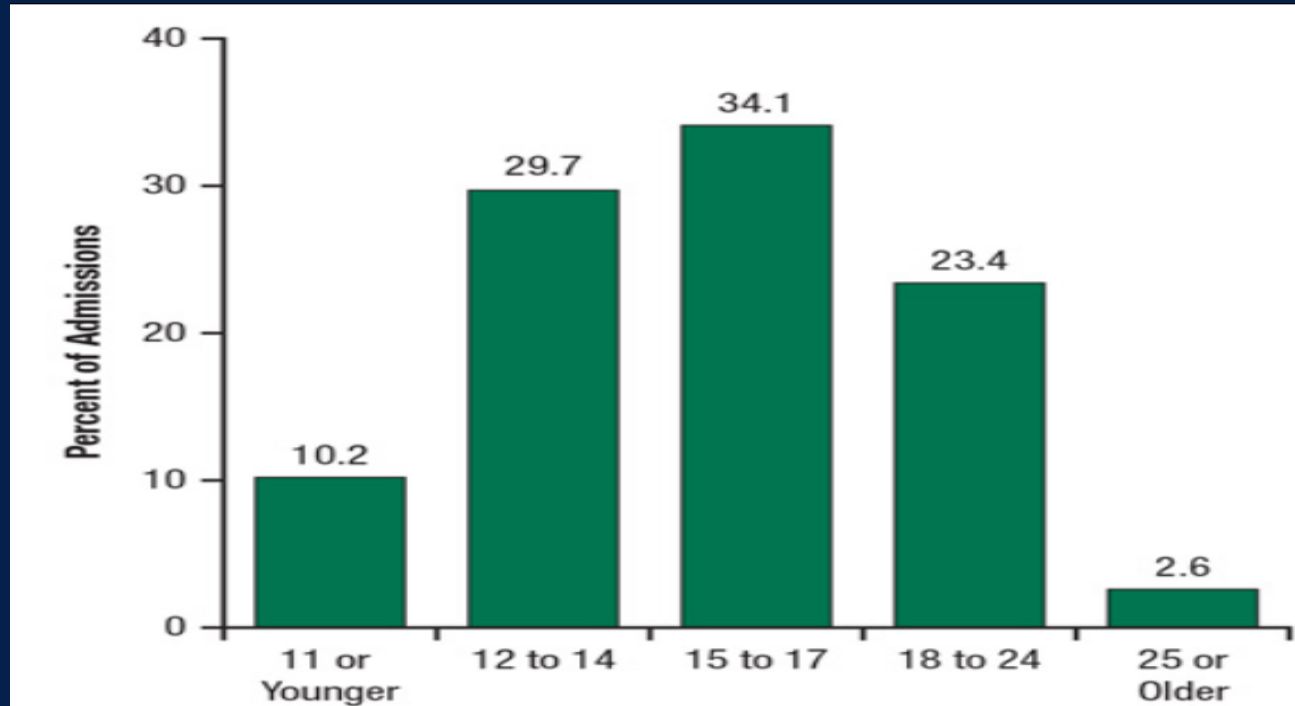
Early initiation of SUD treatment correlated directly with recovery success

Odds of Alcohol Use Disorder (AUD) recurrence Three years after achieving recovery

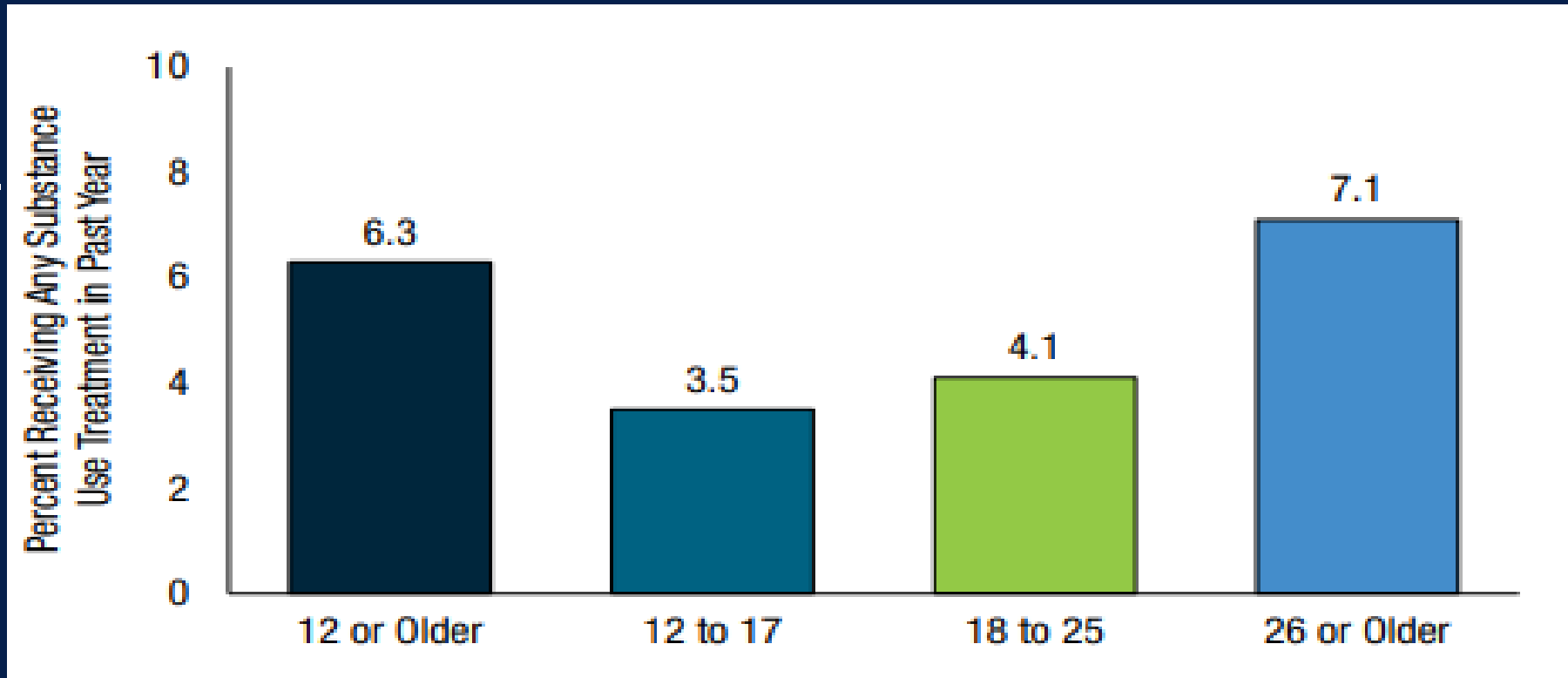


Age at the time of achieving full Recovery from AUD (Wave 1)

80% of all adults with SUD started use before age 17 yrs



And yet, very few kids with Substance Use or SUD get care:



Main Challenge to receiving early quality care in Youth: Not seeking help

=> 98 % of Youth 12-25 years of age with an SUD did not perceive a need for treatment (1)

=> Only 4.2% of adolescents with opioid dependence and 0.5% of those with abuse perceived a need for treatment (2)

=> 48% of College seniors met criteria for SUD, but only 3.6% perceived a need for help (3)

=> 40-60% of school age e- cigarette users, 26% of (e- cigarette+ THC), and 35% of Alcohol users, intended to quit. (4,5,6) but < 12% reached out for help

1- 2021 National Survey of Drug Use and Health

2- Wu LT, Treatment use and barriers among adolescents with prescription opioid use disorders. Addict Behav. 2011

3- Caldeira KM, et al "College students rarely seek help despite serious substance use problems. J Subst Abuse Treat. 2009

4-Smith TT et al "Intention to Quit Vaping Among United States Adolescents. JAMA Pediatr. 2021 Jan

5-Dai H. et al Prevalence and Factors Associated With Youth Vaping Cessation Intention and Quit Attempts. Pediatrics. 2021 Sep

6-Terry-McElrath YM, Patrick ME. U.S. adolescent alcohol use by race/ethnicity: Consumption and perceived need to reduce/stop use J Ethn Subst Abuse. 2020 Jan-Mar;

CLINICAL INSTINCTS UNDERESTIMATE SUBSTANCE USE PROBLEMS

Comparison of Provider Impressions with Diagnostic Interview

	Medical Provider Impressions	
	Sensitivity	Specificity
Any use	.63 (.58, .69 CI)	.81 (.76, .85 CI)
Any problem	.14 (.10, .20 CI)	1.0 (.99, 1.0 CI)
Any disorder	.10 (.04, .17 CI)	1.0 (.99, 1.0 CI)
Dependence	0.0	1.0

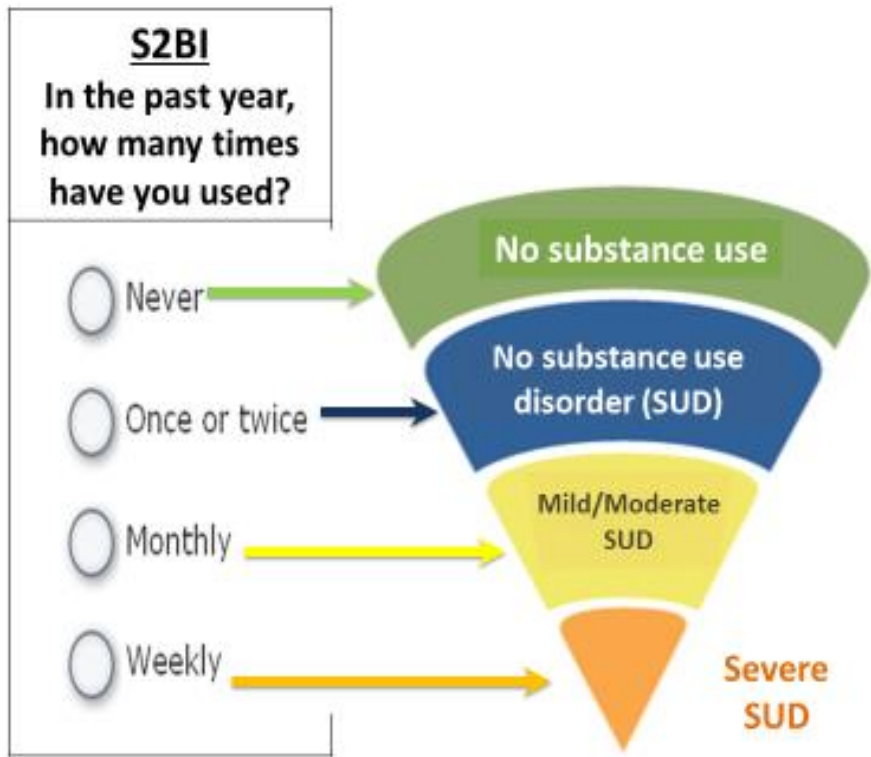


S2BI Screen

In the past year, how many times have you used				
	Never	Once or Twice	Monthly	Weekly +
• Tobacco	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
• Alcohol	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
• Marijuana	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

STOP if all **“Never.”** Otherwise, **CONTINUE**

In the past year, how many times have you used				
	Never	Once or Twice	Monthly	Weekly +
• Prescription drugs not prescribed for you (such as pain medication or Adderall)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
• Illegal drugs (such as cocaine or ecstasy)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
• Herbs or synthetic drugs (such as salvia, K2, or bath salts)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



Sensitivity and Specificity of S2BI for Identifying SUD (Cut point: monthly or more)

	Sensitivity (95% CI)	Specificity (95% CI)
Tobacco/Nicotine	0.89 (0.52, 1.00)	0.97 (0.94, 0.99)
Alcohol	0.50 (0.07, 0.93)	0.95 (0.92, 0.97)
Cannabis	0.92 (0.64, 1.00)	0.98 (0.95, 0.99)
Non-medical use of Rx meds	-	0.916 (0.875, 0.948)



Levy S, Brogna M, Minegishi M**, Subramaniam G, McCormack J, Kline M, Menzin E, Allende-Richter S, Fuller A, Lewis M, Collins J, Hubbard Z, Mitchell SG, Weiss R, Weitzman ER. Assessment of Screening Tools for Identifying Substance Use Disorders in Adolescents: Results of the Adolescent Screening To Help Eliminate Misuse Trial. JAMA Network Open. 2025 May 22;8(5):e2314422. PMID: 37213108.



So, Is Cannabis really bad for a kid?



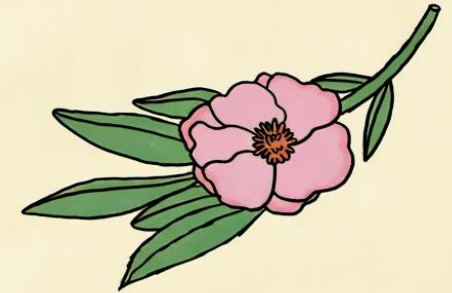
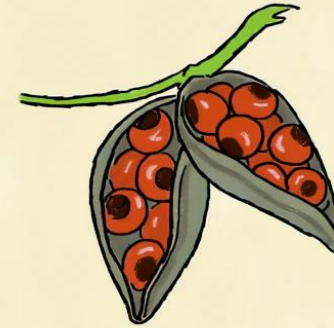
European Yew



Daffodil



Angel's Trumpet



Myth #1: Cannabis is Natural, so it is safe

⇒ There are more than 50 flowers in the USA that can kill you.

⇒ Gasoline is natural, it does not mean you would drink it



Cannabis Is Not Natural Anymore!

Natural: 1-2% THC

Cheech and Chong, Woodstock, 1970's



Current Cultivated: 20-30% THC



Myth # 2: Cannabis is Not Addictive

Remember the Definition of Addiction as losing control of a behavior?

- ⇒ If you are using cannabis more than expected
- ⇒ spending a long time doing it
- ⇒ Getting in trouble with family or school
- ⇒ Missing important life events because of it
- ⇒ Having strong cravings to do it

And many other signs, = You are addicted!



Motivate for Change Common Approach: Avoid Conflict

“ I use Cannabis to help me relax when I am with my friends.”

Instead of saying: - Medications and therapy work better for social anxiety
- Maybe you should look for friends you can relax around
- Cannabis does the opposite in long term use

Try: Surface Reflections: “It helps you relax with friends”

Deeper Reflections: “Spending quality time with your friends is very important for you”

Agreement with a twist: “You can never relax around your friends without Cannabis use”

Reframing: “If you are able to relax with your friends without using Cannabis, you would be more open to abstinence”



Get Parents Involved:

⇒ Normalize:

“We are not surprised you are trying substances. Many kids are. “

“There are multibillion dollar predatory companies bombarding you and your peers with adds that take advantage of your curiosity, because getting addicted as a teen is much better for their business. “

Get Parents Involved:

⇒ **Keep it Positive:** (People with Use or Use Disorders have dominant Reward-Based Brains)

“We feel we are condoning this is we do not do anything about it.”

“We think you are awesome, and we will do everything we can to protect you from the damage these companies are trying to do to you ”

Get Parents Involved:

People with Use or Use Disorders have dominant Reward-Based Brains:

Replace **Punishment** with “**Natural Consequences**” and **Rewards**

Punishment: “If you continue drinking alcohol, I will not let you drive anymore”

Natural Consequences: “Using alcohol makes you prone to accidents. For your safety, I cannot let you drive until you stop use”

Reward Abstinence: “I want you to drive and enjoy driving. How can I help not use Alcohol”

Cannabis Use Disorder Treatment Options in contemplative patients:

Cannabis Withdrawal:

- ⇒ Symptom **onset typically occurs 24–48 hours after cessation** and most symptoms generally peak at days 2–6, with some symptoms lasting up to 3 weeks or more in heavy cannabis users.
- ⇒ The **most common features** of cannabis withdrawal are anxiety, irritability, anger or aggression, disturbed sleep/dreaming, depressed mood and loss of appetite
- ⇒ **supportive counselling and psychoeducation are the first-line approaches**
- ⇒ Medications for symptom relief: **Clonidine** (sleep, agitation), **Mirtazapine** (appetite, sleep), **Hydroxyzine** (sleep, restlessness). **GABA for Cravings**

Clinical management of cannabis withdrawal Jason P. Connor, Addiction 2022

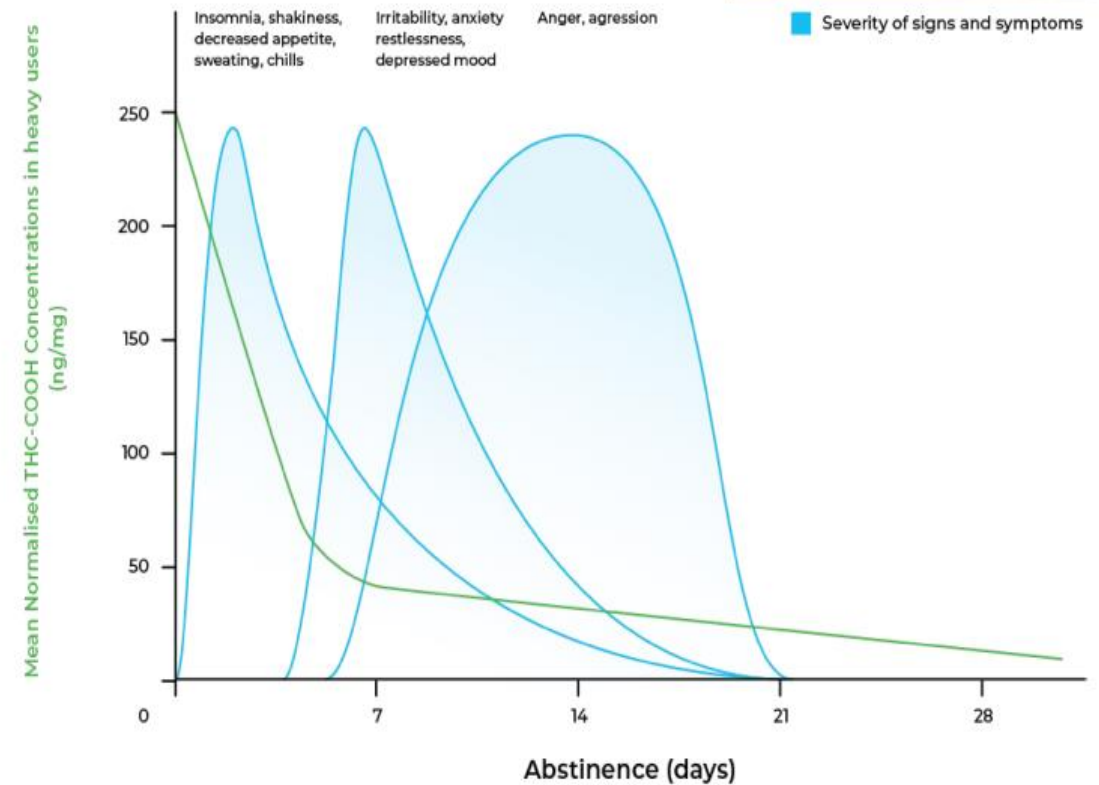


FIGURE 1 Typical course of cannabis withdrawal. Adapted from Goodwin *et al.* [35] and Queensland Health (2012) [34, 90]. Typical urine tetrahydrocannabinol carboxylic acid (THC-COOH; the main secondary metabolite of THC) levels are drawn from Goodwin *et al.* [35] and reflect high-range, chronic cannabis use



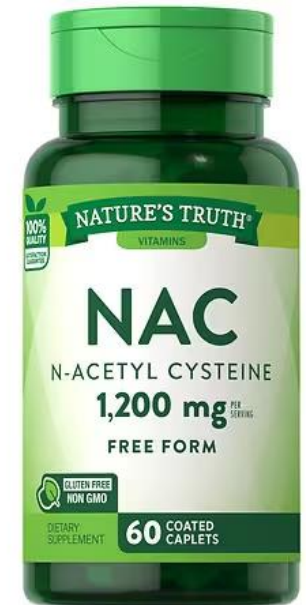
Cannabis Use Disorder Treatment Options in contemplative patients:

Medical Treatment for CUD: N-Acetyl Cysteine (NAC)

- ⇒ Increases Cysteine level inside Brain, which in turn modulates Dopamine and Glutamate pathways (1)
- ⇒ Protects against reduction in Dopamine Transporter levels with exposure to Addictive Substances (2)

Gray et al 2012:

- ⇒ Double blinded randomized trial on 116 treatment seeking adolescents:
- ⇒ 10 minute weekly cessation counseling + NAC (600 mg BID or 1200 mg QD) or Placebo
- ⇒ 2.4 O.R. of having negative UDT during the 8 week long study



1. Saransaari P et al. , 2. Nishiyama S, et al. 2004



NICOTINE REPLACEMENT THERAPY: DUAL NRT



Nicotine Patch Dose:

Heavy Use: (Vaping all day, > one Vape/week) : **21 mg/d for 4 weeks, then 14 mg/d for 4 weeks, then 7 mg/d for 4 weeks**

Moderate Use: (Vaping several times daily, 1 Vape /1-2 weeks): **14 mg/d for 4 weeks, then 7 mg/d for 4 weeks**

Mild Use: (Vaping once or twice a day or less): **7 mg/d for 4 weeks**



Varenicline for smoking cessation (Chantix)

Original Investigation | Substance Use and Addiction



June 27, 2024

Varenicline and Nicotine Replacement Therapy for Smokers Admitted to Hospitals A Randomized Clinical Trial

Dosage and Administration

- Dosage
 - Starting week
 - 0.5 mg once daily on days 1 to 3
 - 0.5 mg twice daily on days 4 to 7
 - Continuing weeks
 - 1 mg twice daily for a total of 12 weeks
- Administration
 - Begin varenicline dosing 1 week before the date set by the patient to stop smoking
 - Alternatively, patient can begin varenicline dosing and then quit between days 8 and 35 of treatment



Naltrexone for binge drinking

Naltrexone for Alcohol Use Disorder

Mechanism of Action

- Decreases GABA inhibition
- Reduces dopamine release

Pharmacokinetics

- Short half-life
- Active metabolite has a longer half-life

Dose

- Therapeutic dose: 50 mg/day

- ⇒ More effective for reducing Binge drinking episodes that “Alcohol Use Disorder”
- ⇒ Better used daily, BUT also effective “as needed” before going out on a weekend



Thank You



**Boston
Children's
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Division of
Addiction Medicine

Where the world comes for answers

