

Opioid Response Network

Adolescent Brain Development: Why alcohol and drugs are so impactful

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9.24.2025



Opioid
Response
Network



Disclosures

Consultant/ Speakers bureaus	Consultant for Opioid Response Network (ORN) Consultant for Provider Clinical Support System (PCSS)
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Stock ownership/Corporate boards-employment	No Disclosures.
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Objectives

1. Understand the differences of adolescent versus adult substance use
2. Use the three stages of substance use disorders to explain how use of substances affects the brain
3. Identify effective treatment options and how harm reduction can fit into treatment



Opioid
Response
Network





Opening: Little Known Information

But first, a quote

"Veggie Monster?"



"SID"



Oh, Come On,
Seriously?

"Today, me will live in the moment, unless
it is unpleasant.

In which case me will eat a cookie."



1st Question: What is your favorite cookie?

Wordsalad

Image Description



Think of Inspector Clouseau Investigating Medicine

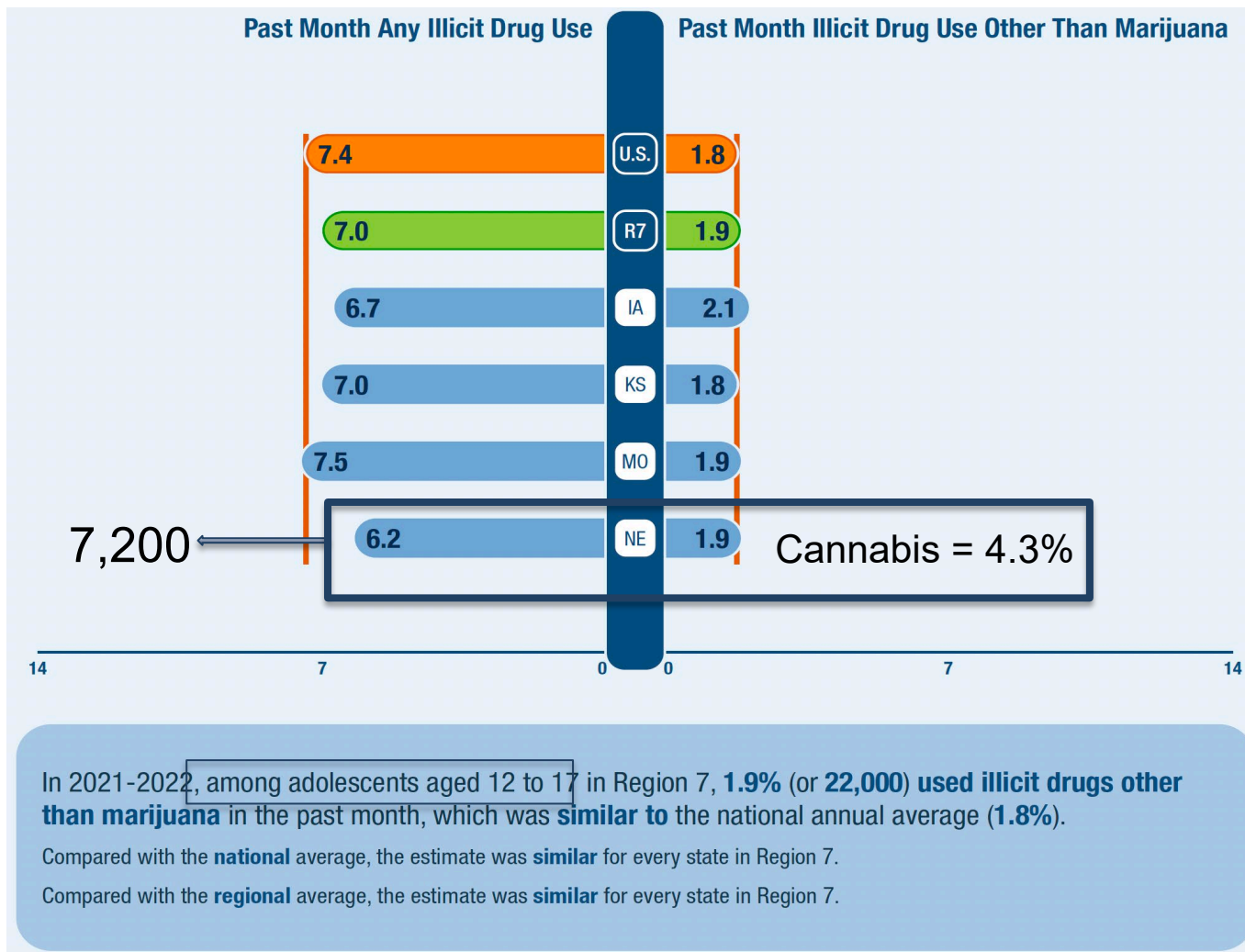


**THE PINK
PANTHER**

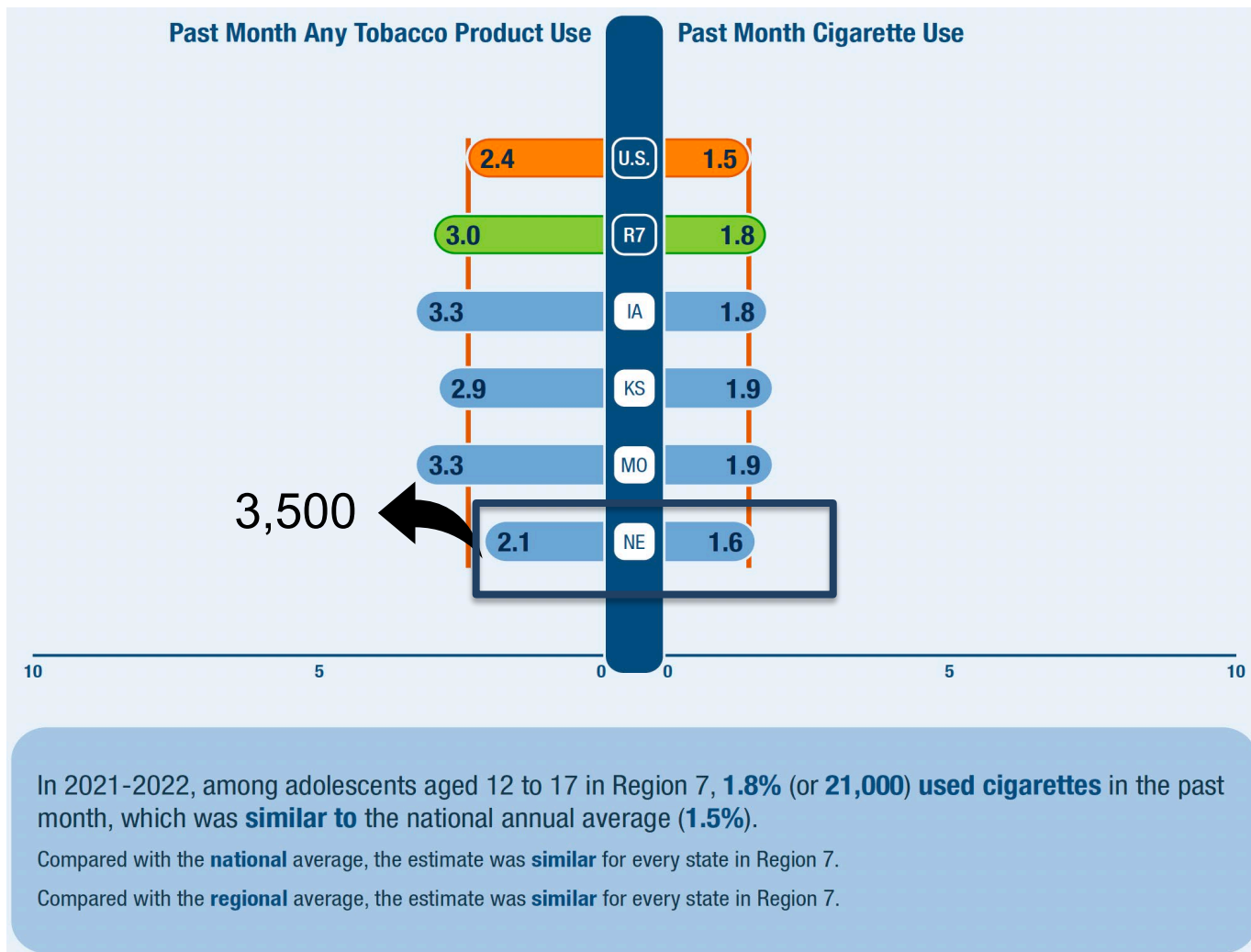


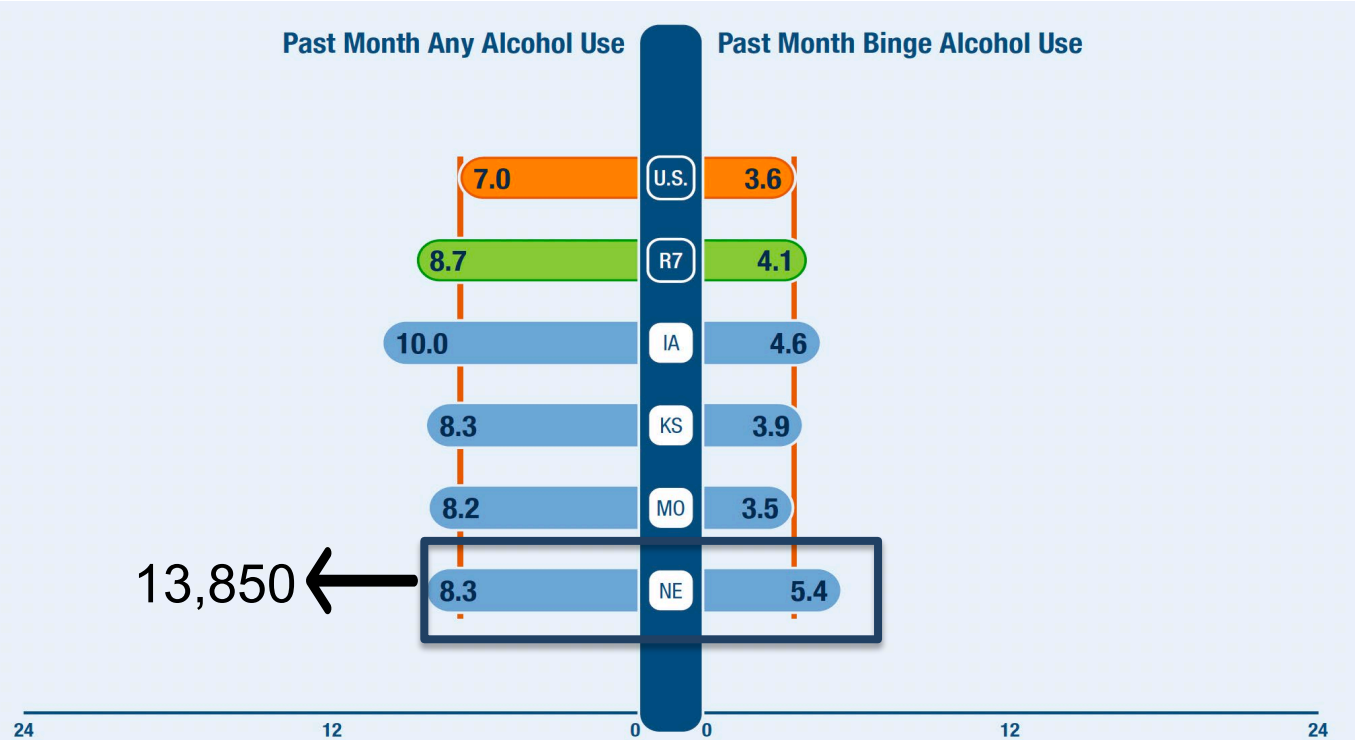
Epidemiology

Marijuana Use



Nicotine Use





In 2021-2022, among adolescents aged 12 to 17 in Region 7, **4.1%** (or **48,000**) **reported binge alcohol use** in the past month, which was **similar to** the national annual average (**3.6%**).

Compared with the **national** average, the estimate was **higher** for Nebraska and **similar** for Iowa, Kansas, and Missouri.

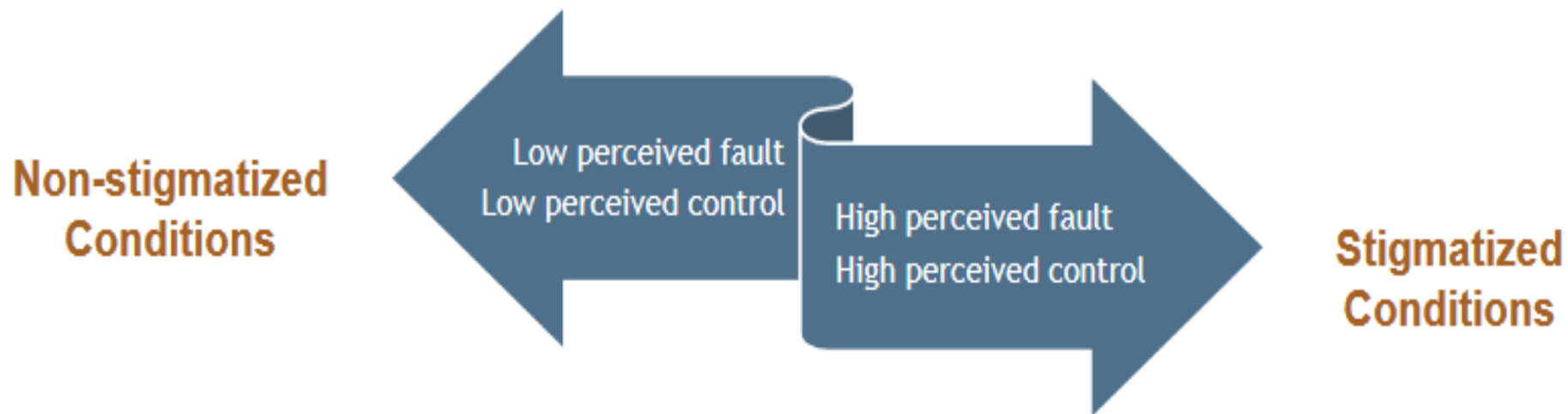
Compared with the **regional** average, the estimate was **similar** for every state in Region 7.



Words Matter



Stigma



- ✧ Example
 - Cancer vs substance use disorders

SAMHSA 2017



Instead of...	Use...
Addict User Substance or drug user/abuser Junkie	Person with substance/opioid use disorder Person with addiction Patient
Former addict Reformed addict	Person in recovery/remission
Relapse	Experienced a recurrence of symptoms
Drug problem Drug habit	Substance use disorder
Drug abuse	Drug misuse, harmful use
Compliant	Adherent
Clean drug test	Testing negative
Clean (non-toxicology related)	Being in recovery/remission Abstinent from drugs Not drinking or taking drugs
Dirty drug test	Testing positive
Dirty (non-toxicology related)	Person who uses drugs



Clean vs Dirty Urine

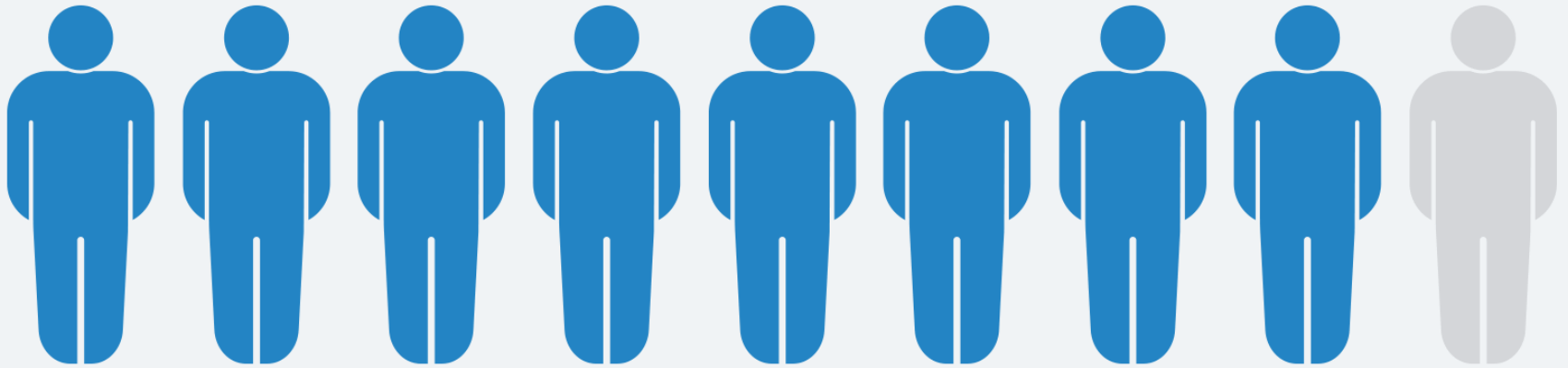


UDTs are Positive or Negative





Why Substance Use is Different in Adolescents



9 OUT OF 10

PEOPLE WITH SUBSTANCE PROBLEMS
STARTED USING BY AGE 18



**> 100 Billion
2500/Neuron**

Synapse Density

**86 Billion
15,000/Neuron**



Newborn



1 Month



9 Months



2 Years



Adult

Source: Corel, J.L. The postnatal development of the human cerebral cortex.
Cambridge, MA: Harvard University Press; 1975



Three Types of ACEs

Adverse Childhood Experiences

ACES

ABUSE



Physical



Emotional



Sexual

NEGLECT



Physical



Emotional

HOUSEHOLD DYSFUNCTION



Mental Illness



Incarcerated Relative



Mother treated violently



Substance Abuse



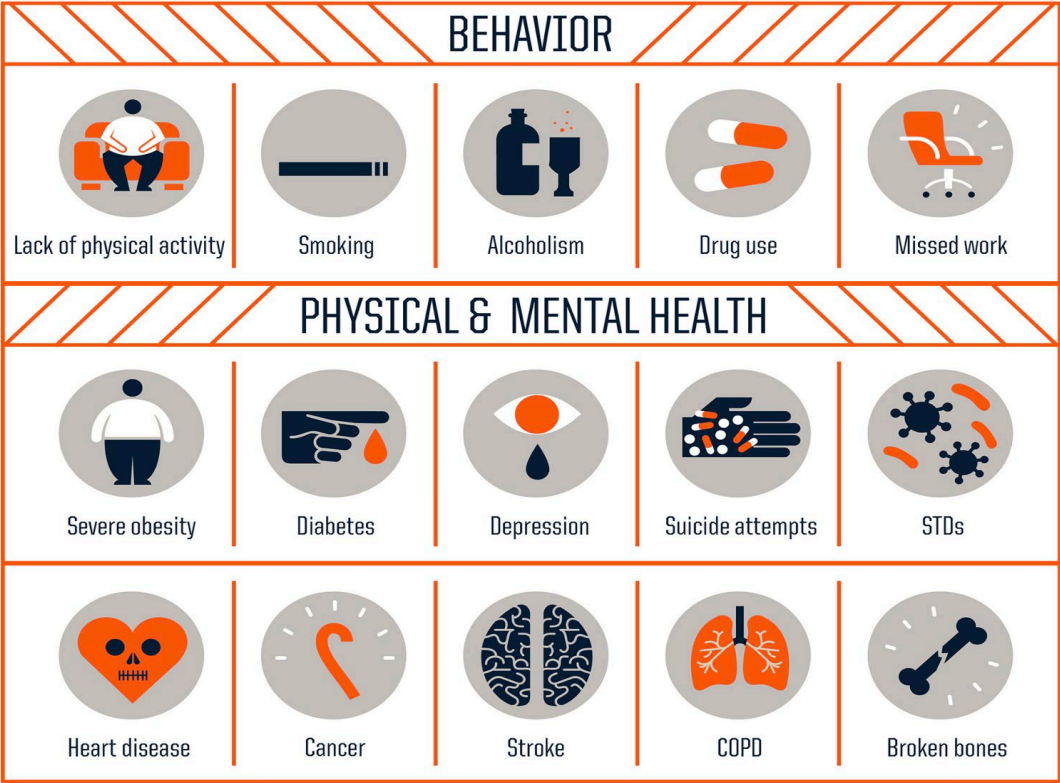
Divorce

Source: Centers for Disease Control and Prevention
Credit: Robert Wood Johnson Foundation



ACEs Increase Health Risks

According to the Adverse Childhood Experiences study, the rougher your childhood, the higher your score is likely to be and the higher your risk for various health problems later.



ACES

Source: Centers for Disease Control and Prevention
Credit: Robert Wood Johnson Foundation



ACEs

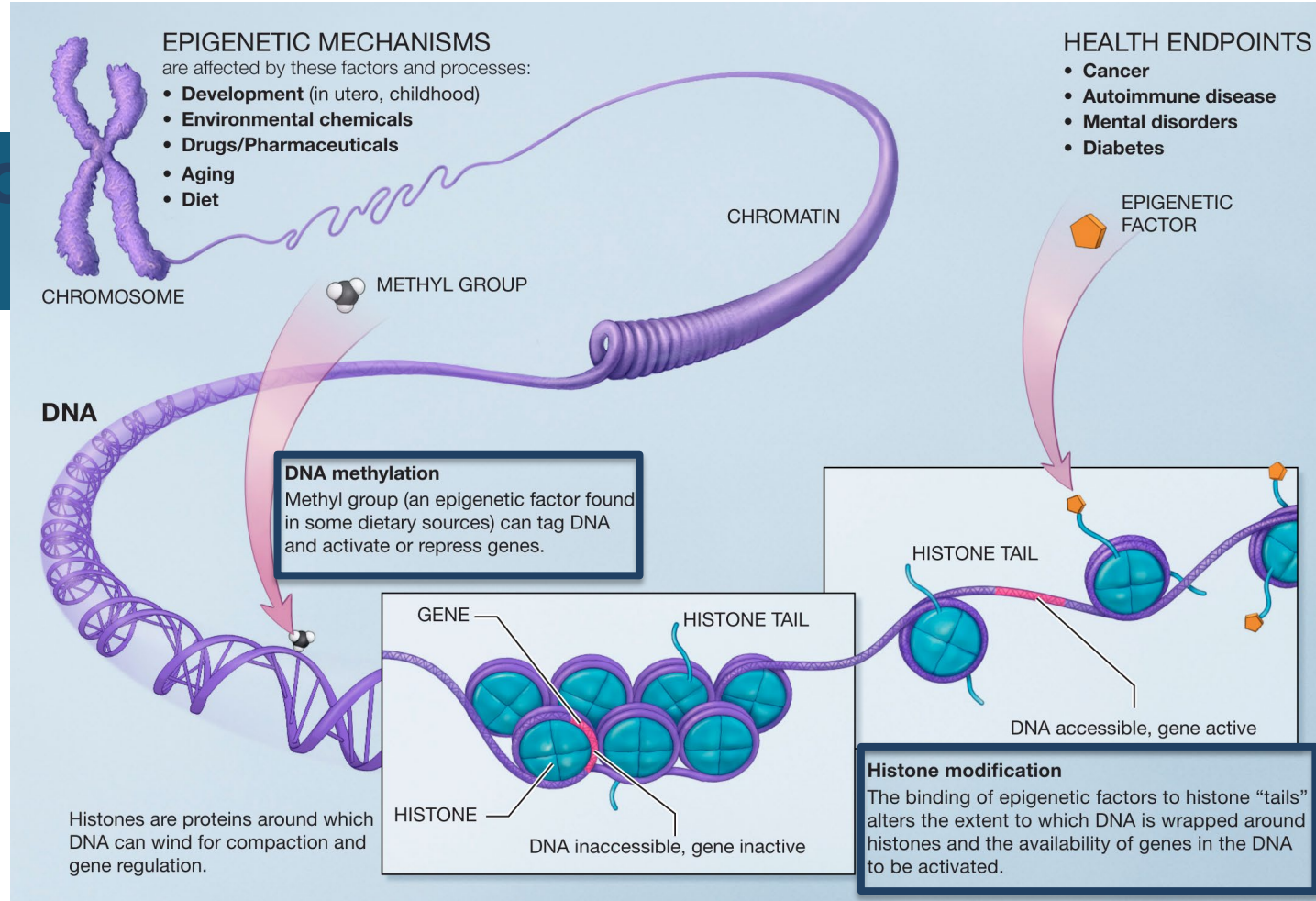
A review of over 2,000 studies of ACEs from all over the world consistently found that individuals experiencing 4 or more ACEs have a higher risk of multiple concerns, including the following:

- 3.7 times more likely to have anxiety;
- 4.4 times more likely to have depression;
- 5.6 times more likely to engage in illicit drug use;
- 5.8 times more likely to have problematic alcohol use;
- 7.5 times more likely to experience violence victimization in adulthood;
- 10.2 times more likely to have problematic drug use; and
- 30.2 times more likely to attempt suicide as an adult than individuals with less than 4 ACEs

(Hughes, Bellis, Hardcastle, Sethi, et al., 2017)



Epigenetic s



National Institutes of Health - <http://commonfund.nih.gov/epigenomics/figure.aspx> (rasterized from [PDF](#))



Physiologic Brain Changes Occur with Early Reading!

- Children experience stronger parent relationships
- Learn valuable language and literacy skills
- Stimulates language and cognitive development
- Stimulates Optimal Patterns of brain development

COUNCIL ON EARLY CHILDHOOD, Pamela C. High, Perri Klass, Elaine Donoghue, Danette Glassy, Beth DelConte, Marian Earls, Dina Lieser, Terri McFadden, Alan Mendelsohn, Seth Scholer, Elaine E. Schulte, Jennifer Takagishi, Douglas Vanderbilt, P. Gail Williams; Literacy Promotion: An Essential Component of Primary Care Pediatric Practice. *Pediatrics* August 2014; 134 (2): 404–409. 10.1542/peds.2014-1384

Image from Pixabay



Your genes and addiction



By [Maria Mavrikaki, PhD](#), Contributor



The Molecular Basis of Drug Addiction: Linking Epigenetic to Synaptic and Circuit Mechanisms

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doi: [10.2217/pgs.12.94](#)

PMCID: PMC3463407

NIHMSID: NIHMS406057

PMID: [22909205](#)

Epigenetics of drug abuse: predisposition or response

[David A Nielsen](#),^{*,1} [Amol Utrankar](#),² [Jennifer A Reyes](#),² [Daniel D Simons](#),² and [Thomas R Kosten](#)¹

Science News

from research organizations

Epigenetics of addiction: Epigenetic study untangles addiction and relapse in the brain

Date: September 27, 2017

Source: Medical University of South Carolina

Summary: New research uncovers an epigenetic reason why drug users who attempt to quit are prone to relapse despite negative consequences to their health and livelihood. The findings help to explain how casual drug use can produce long-lasting brain changes that increase vulnerability to relapse in individuals suffering from substance use disorders.

Frontiers in Genetics

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REVIEW article

Front. Genet., 25 January 2022

Sec. Epigenomics and Epigenetics

Volume 13 - 2022 | <https://doi.org/10.3389/fgene.2022.806685>

This article is part of the Research Topic

Epigenetic basis of neuropsychiatric disease risk

[View all 8 Articles >](#)

DNA Epigenetics in Addiction Susceptibility



Graham Kaplan



Haiyang Xu



Kristen Abreu and

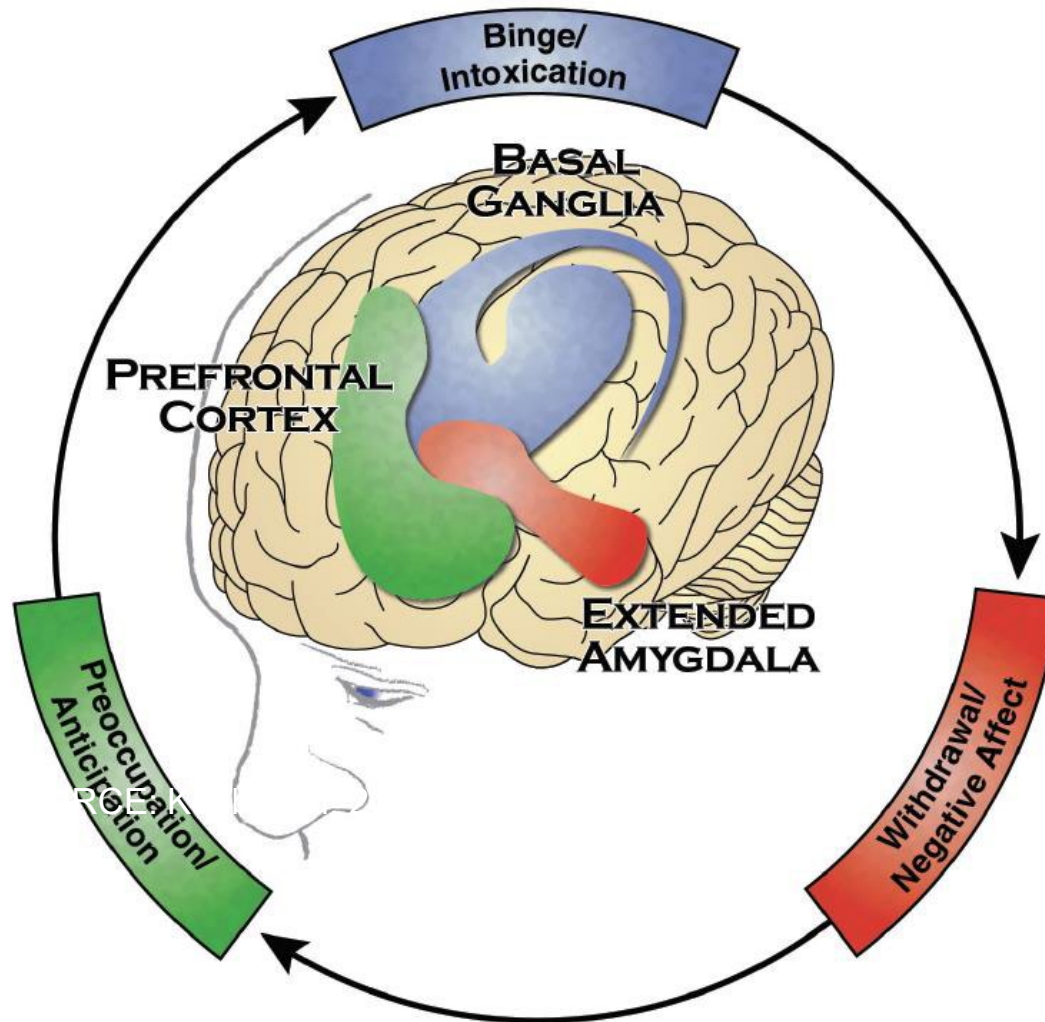


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Cycle Of Addiction



Three Stage Model

Stage 1

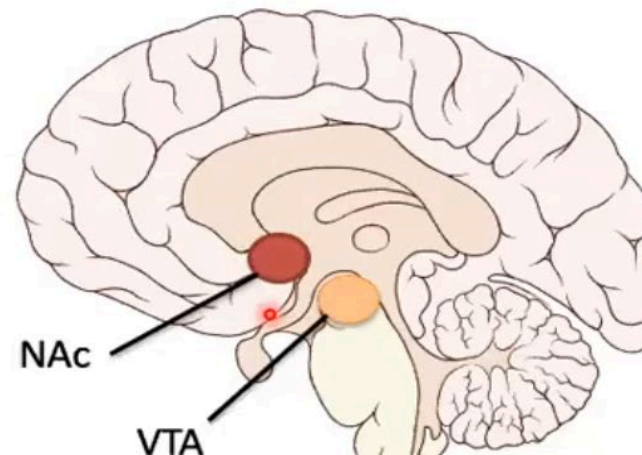
Binge /
Intoxication



e.g., Cat on Catnip

1. Binge / Intoxication

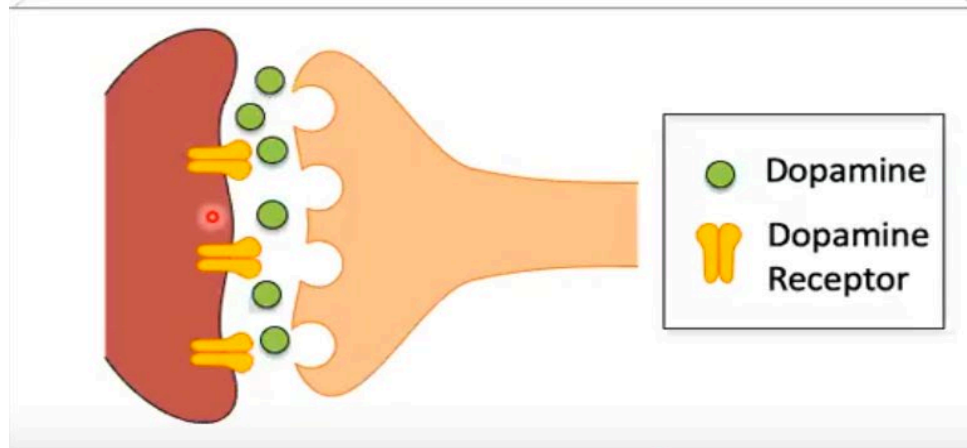
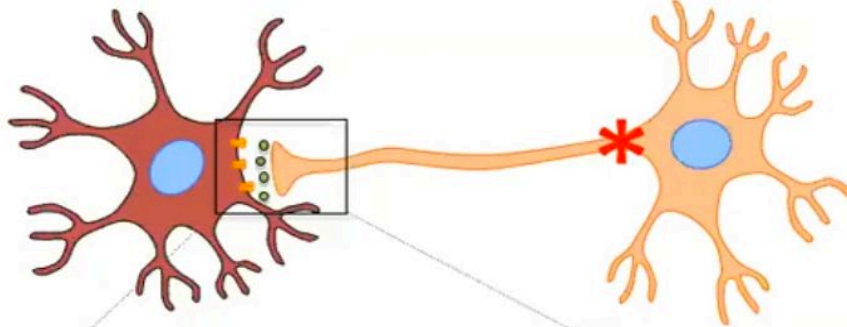
- Associated with positive reinforcement & motivational learning
- Associating cues with reward delivery



Binge/Intoxication

Nucleus Accumbens

Ventral Tegmental Area



What does ↑ dopamine signal

- ↑ Value of future reward / of work to gain the reward
- ↑ Motivation to obtain reward
- ↑ WANT

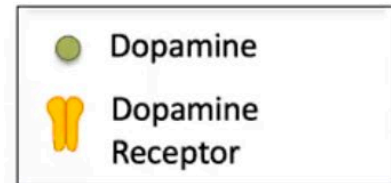
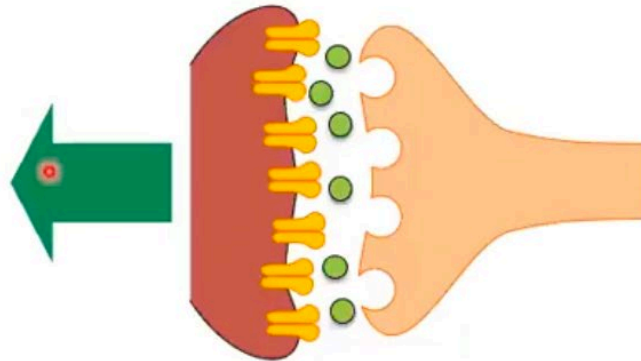
— *Evolved out of survival* —



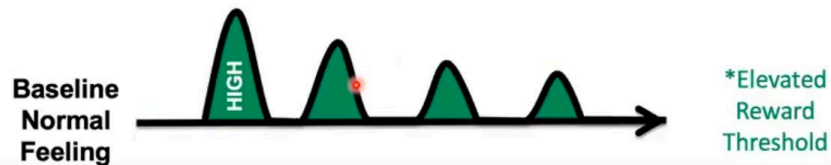
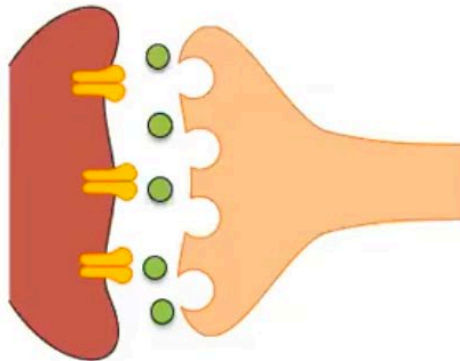
Effects of Ongoing Intoxication

Normal

Reward
Circuits

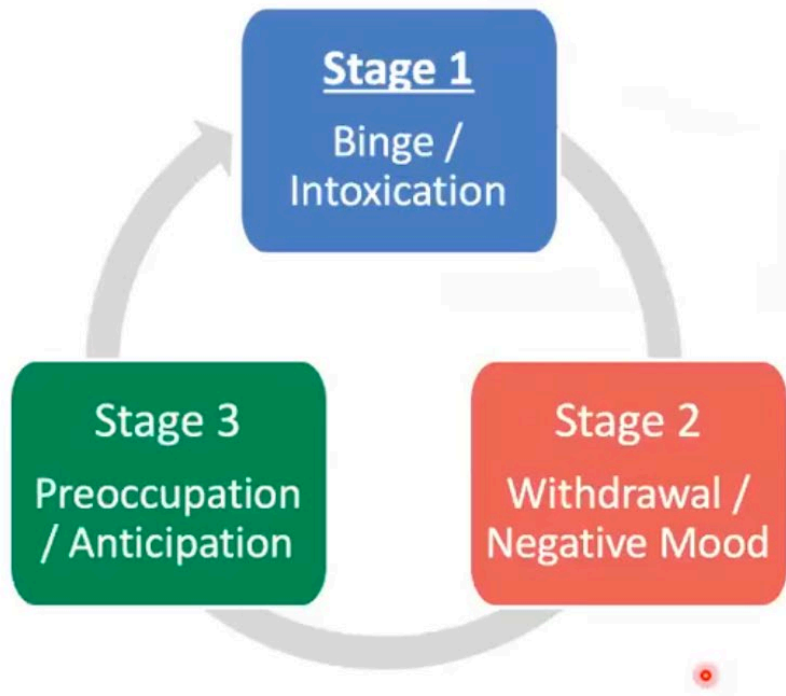


Prolonged Drug
Use



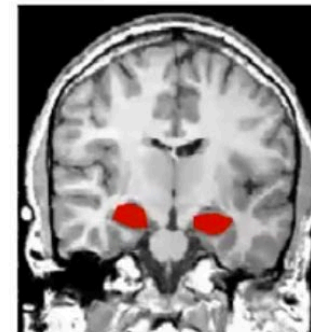
Negative Affect/Withdrawal

Three Stage Model of Addiction



2. Negative Affect & Withdrawal

- Associated with negative reinforcement and increases in stress



Koob & Le Moal 2008



Effect of Ongoing Substance Use

Take Away Substance



Dopamine

SYMPTOMS OF DOPAMINE DEFICIENCY

1. PHYSICAL SYMPTOMS



a. Muscle stiffness (rigidity)



b. Muscle spasms



c. Muscle cramps



d. Tremors



e. Aches & pains



f. Loss of balance when standing or walking

2. PSYCHOLOGICAL SYMPTOMS



a. Lack of focus or concentration



b. Low energy



c. Lack of motivation



d. Constant feelings of fatigue



e. Low mood or feelings of sadness

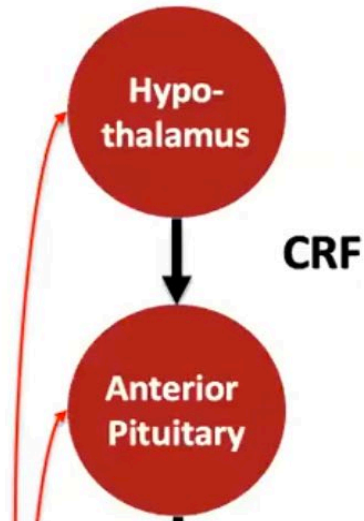


f. Feeling hopeless



Negative Affect/Withdrawal

HPA/Stress Axis



Stress Systems Dysregulated

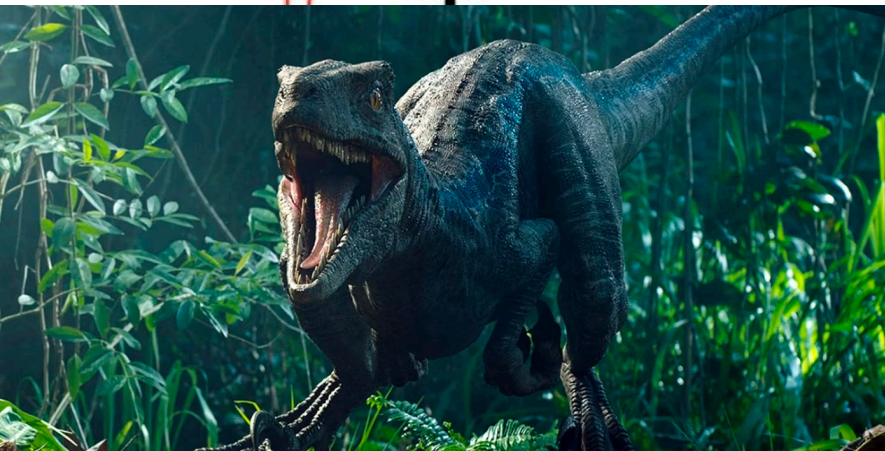


Stress Systems Dysregulated



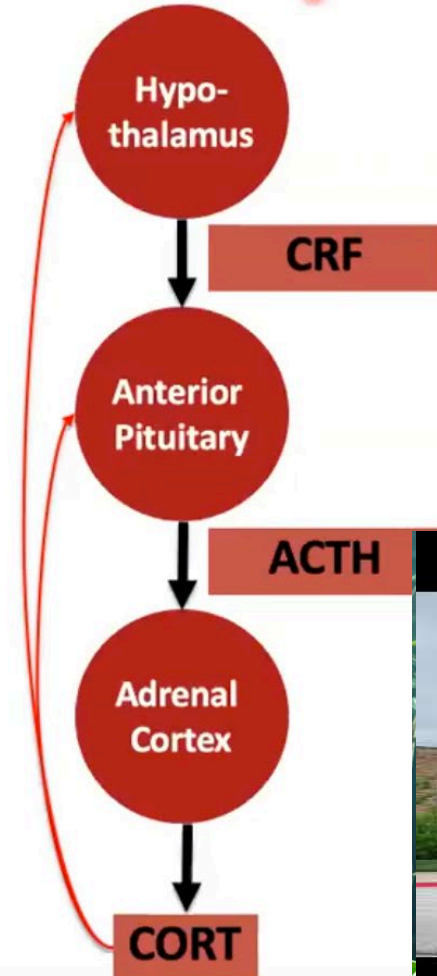
CRF

Decrease Appetite
Increase Anxiety
Increase Fear
Tremor
Hyperarousal
Insomnia

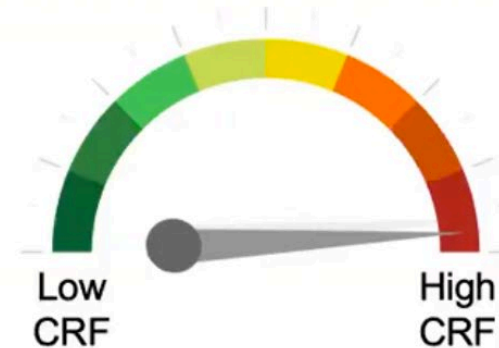


Negative Affect/Withdrawal

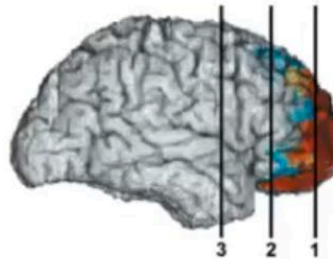
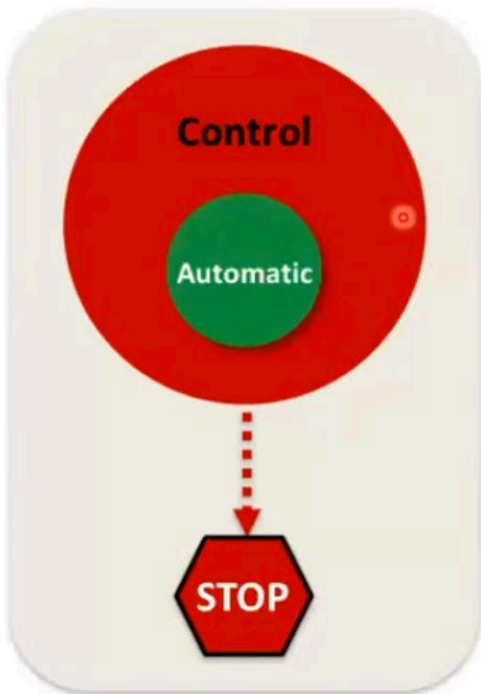
HPA/Stress Axis



Stress Systems Dysregulated



What happens if there is PFC dysfunction?



Bechara 2008

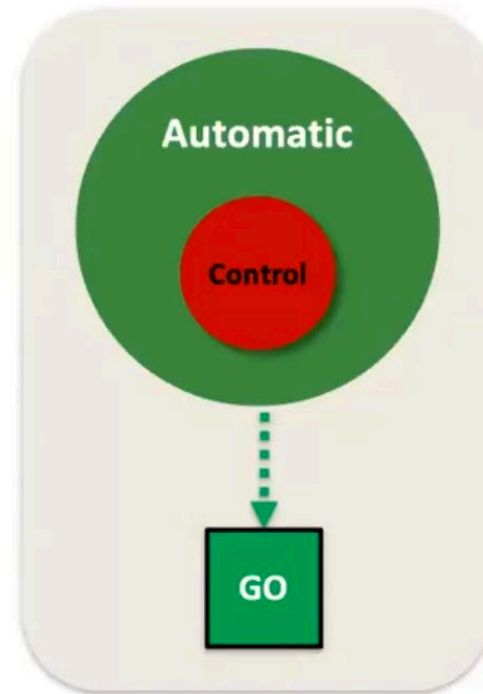


Exhibit 4. Possible Symptoms of Protracted Withdrawal

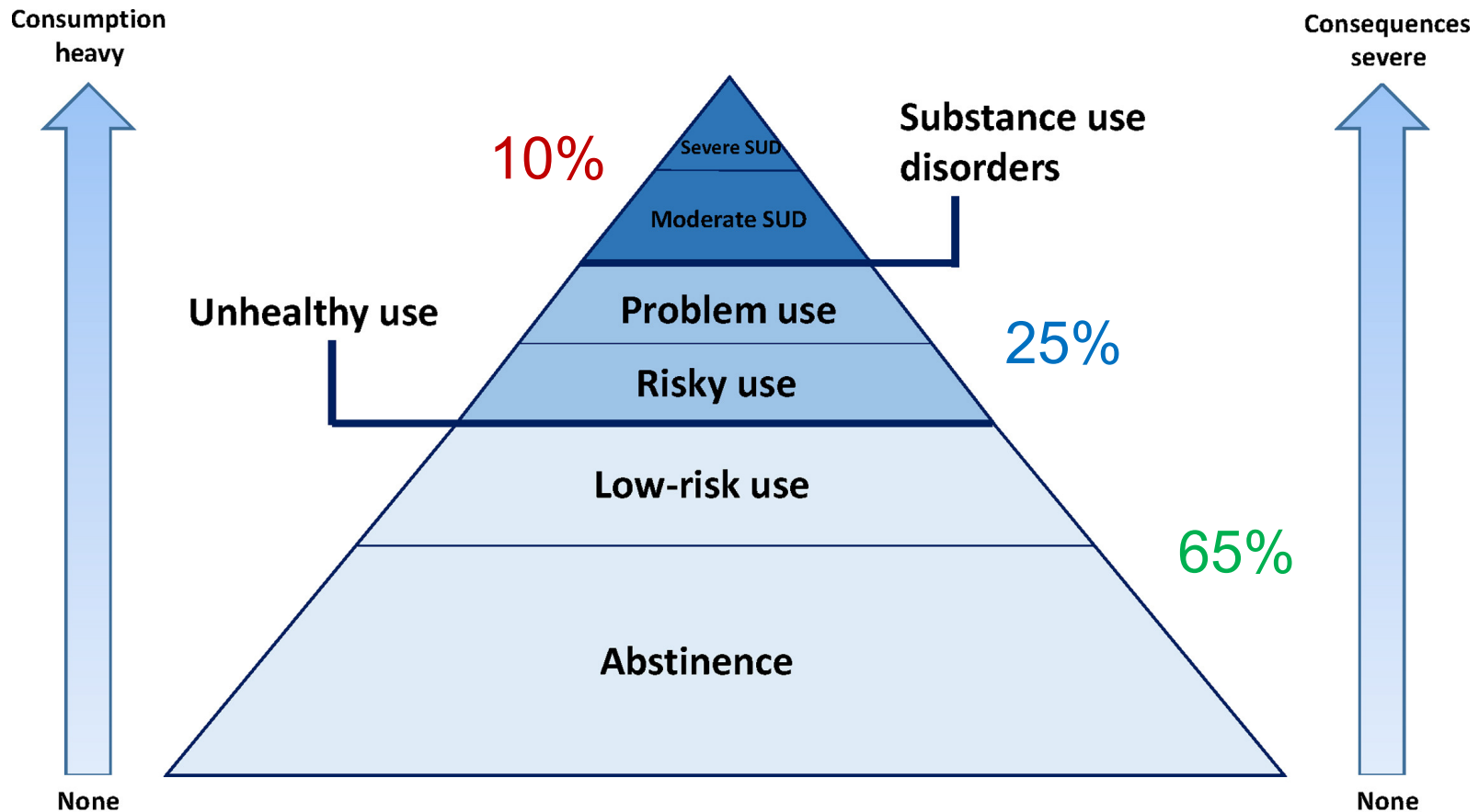
- Anxiety
- Sleep difficulties
- Problems with short-term memory
- Persistent fatigue
- Difficulty concentrating and making decisions
- Alcohol or drug cravings
- Impaired executive control
- Anhedonia
- Difficulty focusing on tasks
- Dysphoria or depression
- Irritability
- Unexplained physical complaints
- Reduced interest in sex

PAWS

Post Acute Withdrawal Syndrome



Substance Use Severity



How To Spot Use Disorder

- Inability to Abstain
- Loss of control over Behavior
- Craving for substances or rewarding experiences
- Decrease ability to recognize problems of behavior and relationships
- Problems with Emotion regulation



How To Spot Use Disorder

✧ DSM Criteria That Becomes Apparent

- Inordinate amount of time getting/using cannabis
 - Absent from expected obligations
- Desire to use takes priority over other important stuff
 - Truancy, Miss work, Stop favorite activities, hygiene
- Continued use despite adverse consequences
 - Poor school performance, let go from teams/groups
- Relationship problems
 - More disagreements, time away from family/usual friends
- Emotion Dysregulation suggesting intoxication → withdrawal
- Odor, red eyes, sleepy, balance, hygiene, alone



Importance of Flavors

More than 85% of youth
who currently use
e-cigarettes or nicotine
pouches **report using**
flavored products.



Source: National Youth Tobacco Survey, 2024



Why Is Nicotine So Addictive

Serotonin	→	Anhedonia, ↑ Appetite
GABA	→	↑ Anxiety, Insomnia
Acetylcholine	→	Sleepy, Trouble Thinking
β-Endorphins	→	↑ Tension, pain, anhedonia
Glutamate	→	↓ Focus, poor memory
Norepinephrine	→	Fatigue, ↑ Appetite
Dopamine	→	Misery, discomfort, pain

Benowitz, *N Engl J Med*, 2010.





QUITTING TOBACCO

Quitting tobacco in all its forms
has **enormous health benefits.**



Benefits of quitting:



20 minutes:
heart and blood
pressure decrease



1 year:
risk of **coronary heart
disease and heart attack**
is reduced



10 years:

risk of **dying from
lung cancer is 50%
less likely** compared
with a current
smoker's risk



2 weeks:
circulation and lung
functionality improve



5 years:

risk of **mouth, throat, esophagus,
and bladder cancer** are **decreased
by half** and risk of cervical cancer
and stroke decline to that
of a nonsmoker

Nearly
70%
of smokers say
they want to quit.



Of young tobacco users in 2021,
**60% tried to quit using all tobacco
products in the last year.**

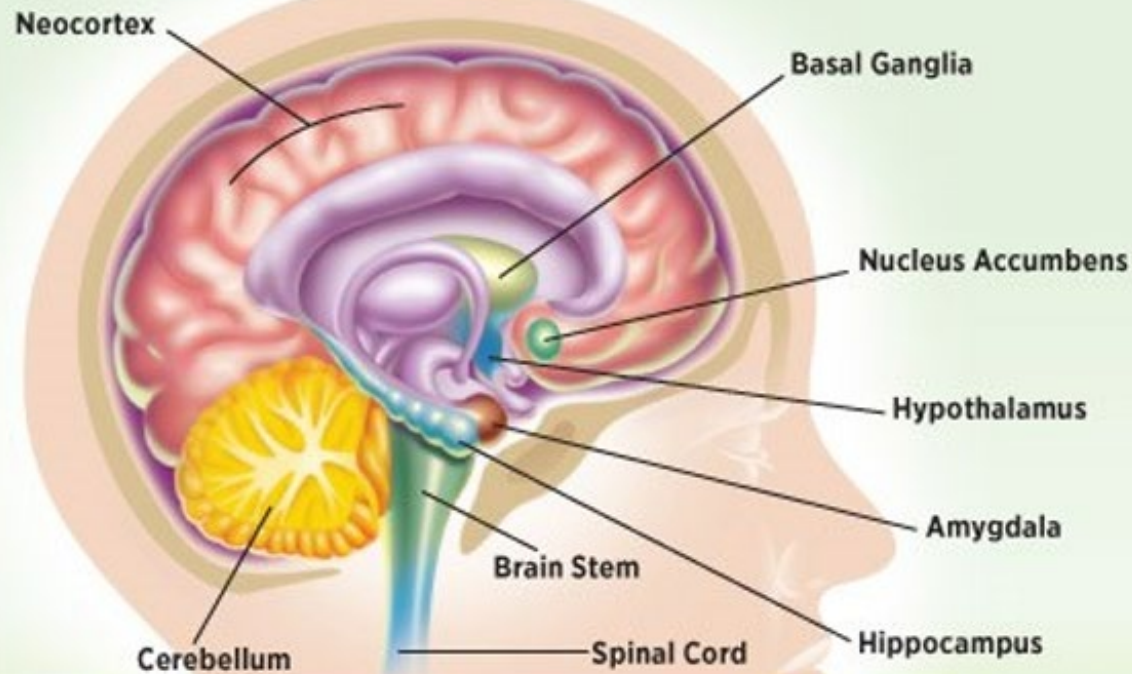
For current users of e-cigarettes,
the most popular tobacco product
among youth, **more than half (54.2%)
reported they intend to quit vaping**
and one-third reported a past-year
quit-vaping attempt.



Counseling and medication
can **triple** a smoker's
chance of quitting.



Marijuana Effects on the Brain



Brain Structure	Regulates	THC Effect on User
Amygdala	emotions, fear, anxiety	panic/paranoia
Basal Ganglia	planning/starting a movement	slowed reaction time
Brain Stem	information between brain and spinal column	antinausea effects
Cerebellum	motor coordination, balance	impaired coordination
Hippocampus	learning new information	impaired memory
Hypothalamus	eating, sexual behavior	increased appetite
Neocortex	complex thinking, feeling, and movement	altered thinking, judgment, and sensation
Nucleus Accumbens	motivation and reward	euphoria (feeling good)
Spinal Cord	transmission of information between body and brain	altered pain sensitivity



Signs of Cannabis Intoxication

By
JL



Risk of Cannabis Use Disorder

✧ Long term or heavy use effects

✧ Addiction

- 9% overall,
- 17% who begin adolescence
- 25—50% Daily

✧ Initiation < 18 years are 4-7x more likely to develop CUD

✧ Poor educational outcome – increase in not completing



Dangers of Ongoing Use

Substantial evidence from animal/human studies – marijuana causes long-term, possibly irreversible brain changes

Rats: exposed to THC during adolescence ➡ **impaired learning, memory tasks**; structural, functional changes in hippocampus

Humans: regular marijuana use in adolescence to adulthood ☐ **IQ loss**, not regained after quitting





How to quit vaping: What experts want you to know

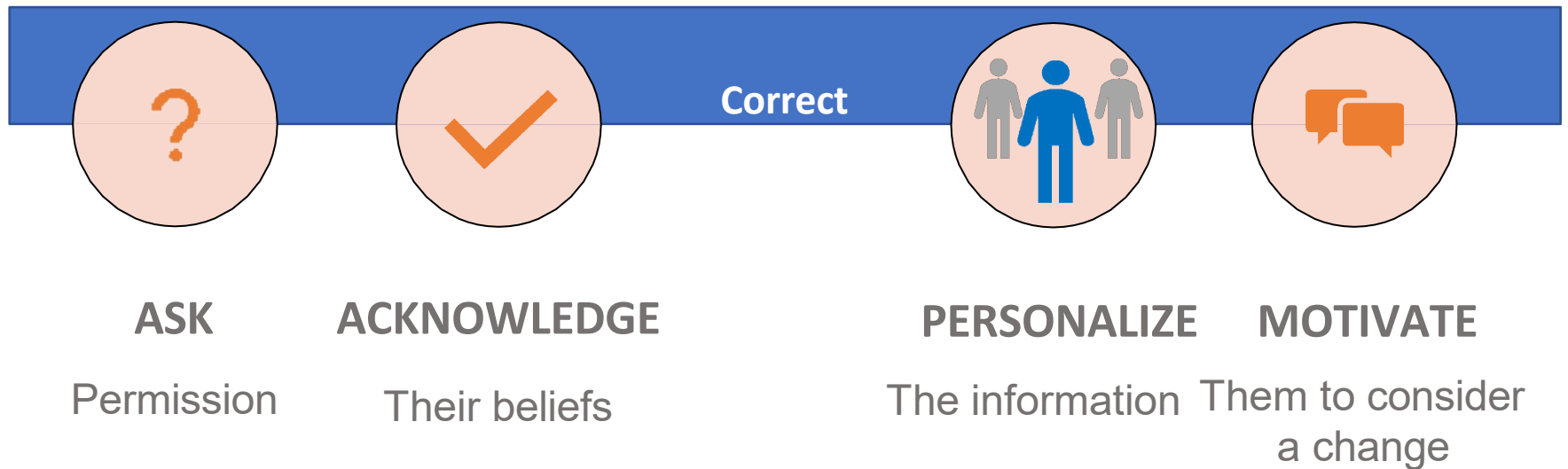
Story by Hannah Yasharoff, USA TODAY • 6mo • ⌚ 3 min read



How to quit vaping
 @marthas10 Getty Images



Strategies for Effective Counseling



WHAT TO SAY

- “Quitting is hard, and sometimes people don’t succeed on their first try. I want you to know that I’m here for you, and can help you set yourself up for success.”



MOTIVATIONAL INTERVIEWING¹⁰

- Pediatricians can use Motivational Interviewing to promote change by collaborating with adolescent patients
- Using Motivational Interviewing, pediatricians can:
 - Guide patients to find their own motivation to change
 - Help to resolve ambivalence
 - Support patients in setting their own goals for change



MOTIVATIONAL INTERVIEWING¹⁰

- Patient-focused
 - Ask open-ended questions
 - Find common ground
- Non-judgmental
 - Express empathy
- Define motivation, confidence, and commitment for change



IMPORTANCE AND CONFIDENCE

- How important is it for you to quit using e-cigarettes?
- How confident are you that you can make a change?
 - Why did you pick a low/high number?
 - What would it take to move you to a higher number?



REFLECTIVE LISTENING

- Understand meaning rather than collect facts
- “How” and “what” not “why”
 - “It sounds like you...”
 - “So you feel...”
 - “You’re wondering if...”
 - “So you...”



American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN®





Old West Designated Driver



What is Substance Use Harm Reduction?

- Substance use harm reduction is an approach to serving people who use drugs to
- prevent overdose and infectious disease transmission,
- improve their physical, mental, and social wellbeing, and
- offer low-threshold options for accessing substance use disorder treatment and other health care services.

(SAMHSA, 2022)



Role of Prevention in Harm Reduction

- Harm reduction supports people, helping prevent injury, infectious disease transmission, and death.
- Harm reduction meets people where they are and helps them move forward.
- Harm reduction supports multiple pathways to recovery.
- Harm reduction addresses social determinants of health and focuses on increasing protective factors

See - <https://www.samhsa.gov/find-help/harm-reduction>



Harm Reduction
Saves Lives



NICOTINE REPLACEMENT THERAPY (NRT)

- NRT addresses nicotine withdrawal symptoms by providing the user with a controlled amount of nicotine, thus helping reduce the urge to smoke or vape⁵
- NRT is safe and effective in helping adult tobacco users quit, and works best when paired with behavioral counseling interventions⁵⁻⁶
- NRT comes in several forms, including the nicotine patch, gum, lozenge, inhaler, and nasal spray
- NRT is safer than cigarettes, e-cigarettes, and other tobacco products because it delivers nicotine to the user without exposing them to the toxic chemicals and carcinogens in tobacco and e-cigarette products



Image Source: J Gorzkowski (personal photo). Used with permission.



Become a quitter

Get more info on quitting
at www.richmondcenter.org

AMERICAN ACADEMY OF PEDIATRICS
Julius B. Richmond
Center of Excellence
www.richmondcenter.org

Why quit?

- Lower risk of disease and death
- Save money- the average pack of cigarettes now costs \$7
- Healthier family- less exposure to secondhand smoke
- Better role model for the children in your life



Ways to quit

- Talk to your doctor
- Telephone quitline: 1-800-QUIT NOW
- Text-based programs: text the word 'quit' to the number 47848
- Online programs: Become an Ex, Quit for Life, Freedom from Smoking
- In-person programs: Offered by hospitals, health departments, and community organizations

Nicotine Replacement Therapy

Nicotine replacement therapy helps by treating the body's dependence on nicotine by gradually reducing the amount consumed. Some require a prescription, noted by the asterisks.

Types of nicotine replacement therapy include:

- | | |
|-----------|-------------------|
| -patches | -inhaler* |
| -lozenges | -nasal spray* |
| -gum | -oral medication* |



Remember!

- Set a quit date and be prepared.
- Get rid of triggers like ashtrays, lighters, spit bottles
- Change your routine to replace tobacco use with another task or hobby
- Do not use electronic devices like e-cigarettes to quit. They are not proven to be safe or effective to help you quit.

January 2020





Smartphone App Resources for Youth and Young Adults

- 🕒 **Program Name:** QuitSTART
Creator: National Cancer Institute
Youth/Young Adult: Youth and young adults who want to quit smoking
Ages: 13+

Program Details:

- 🕒 Personalized quit support and tips
- 🕒 Support to manage cravings and withdrawal
- 🕒 Encouragement after relapse

Available in: USA

How to Connect:

[Download from](#)

[Google Play](#)

[Download from](#)

[Apple Store](#)

Resources for Parents to Help their Youth/Young Adults Quit

- 🕒 **Program Name:** Helping a Child Quit Vaping/BecomeAnEX
Creator: Truth Initiative, Mayo Clinic
Designed for: Parents who want to help their child quit vaping
Program Length: 21 days
Available in: USA

How to Connect: Text “QUIT” to 202-899-7550



Program Name:

[SmokefreeTXT](#)

[for Teens](#) Housed

by: National

Cancer Institute

Youth/Young Adult: Youth who want to quit smoking

Ages: 13-17

Program Length: 6-8 weeks, 3-5 texts per day

Available in: USA

How to Connect: Text “QUIT” to 47848



Text-Based Tobacco Cessation Resources for Teen and Adults

- **Program Name:** [SmokefreeTXT for Teens](#)
Housed by: National Cancer Institute
Youth/Young Adult: Youth who want to quit smoking
Ages: 13-17
Program Length: 6-8 weeks, 3-5 texts per day
Available in: USA
How to Connect: Text “QUIT” to 47848
- **Program Name:** [SmokefreeTXT](#)
Housed by: National Cancer Institute
Youth/Young Adult: Young adults who want to quit smoking
Ages: 18+
Program Length: 6-8 weeks, 3-5 texts per day
Available in: USA
How to Connect: Text “QUIT” to 47848
- **Program Name:** [DipfreeTXT](#)
Housed by: National Cancer Institute
Youth/Young Adult: Youth and young adults who want to quit dip or chewing tobacco
Ages: 13+
Program Length: 6-8 weeks, 3-5 texts per day
Available in: USA
How to Connect: Text “SPIT” to 222888
- **Program Name:** SmokefreeTXT en Español
Housed by: National Cancer Institute
Youth/Young Adult: Youth and young adults who want to quit smoking
Ages: 13+
Program Length: 6-8 weeks, 3-5 texts per day
Available in: USA
How to Connect: Text “LIBRE” to 47848
- **Program Name:** This is Quitting
Housed by: Truth Initiative
Youth/Young Adult: Youth and young adults who want to quit vaping or e-cigarette use
Ages: 13-24
Program Length: 4+ weeks, 1 message per day
Available in: USA
How to Connect: Text “DITCHJUUL” to 8870



Web-Based Resources for Youth and Young Adults

- **Program Name:** Smokefree Teen
Creator: National Cancer Institute
Youth/Young Adult: Youth who want to quit smoking, vaping, or other tobacco use
Ages: 13-17
Program Details:
 - Tools and tips
 - Online chat support (LiveHelp)
 - Quit plans for smoking and vaping**Available in:** USA
How to Connect: <https://teen.smokefree.gov/>
- **Program Name:** [Smokefree Espanol](https://espanol.smokefree.gov/)
Creator: National Cancer Institute
Youth/Young Adult: Young adults who want to quit smoking
Ages: 18+
Program Details:
 - Tools and tips
 - Online chat support (LiveHelp)
 - Quit plans for smoking**Available in:** USA
How to Connect: <https://espanol.smokefree.gov/>
- **Program Name:** Smokefree.gov
Creator: National Cancer Institute
Youth/Young Adult: Young adults who want to quit smoking
Ages: 18+
Program Details:
 - Tools and tips
 - Online chat support (LiveHelp)
 - Quit plans for smoking**Available in:** USA
How to Connect: <https://smokefree.gov/>
- **Program Name:** My Life, My Quit
Creator: National Jewish Health
Youth/Young Adult: Youth who want to quit smoking or vaping
Ages: 13-17 (up to 18 in some states)
Program Details:
 - Teen-focused education
 - Five one-on-one coaching sessions, scheduled every 7-10 days
 - Support for quitting and stress relief**Available in:** CO, HI, ID, IA, KS, KY, MA, MI, MN, MO, NV, NH, ND, OH, OK, PA, RI, UT, VT, WY
How to Connect: <https://mylifemyquit.com>



🕒 **Program Name:** American Indian Commercial Tobacco Program

Creator: National Jewish Health

Youth/Young Adult: Members of American Indian communities who want to quit smoking, vaping or using other tobacco products

Ages: All ages

Program Details:

- 🕒 Free and confidential
- 🕒 Speak with trained health professionals
- 🕒 Tailored support to individual patient needs
- 🕒 Phone support with optional email and text support

How to Connect: <https://aiquitline.com>

🕒 **Program Name:** NOT for Me

Creator: American Lung Association

Youth/Young Adult: Youth who want to quit smoking, vaping, or other tobacco use

Ages: 13-19

Program Details:

- 🕒 6-week program
- 🕒 8 self-paced sessions with:
 - 🕒 Educational videos
 - 🕒 Quit plan development tool: “Journey Journal”
 - 🕒 Tools and tips for quitting

Available in: USA

How to Connect: www.NOTforMe.org

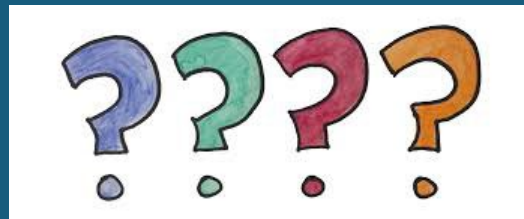


Please Fill Out Survey



<https://lanitek.com/P?s=866659>

Questions ???



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Opioid
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