

Growing a Grown-up Brain

Scientists have long thought that the human brain was formed in early childhood. But by scanning children's brains with an MRI year after year, they discovered that the brain undergoes radical changes in adolescence. Excess gray matter is pruned out, making brain connections more specialized and efficient. The parts of the brain that control physical movement, vision, and the senses mature first, while the regions in the front that control higher thinking don't finish the pruning process until the early 20s.

Gray matter: Nerve cell bodies and fibers that make up the bulk of the brain's computing power.

Parietal lobe: Spatial perception

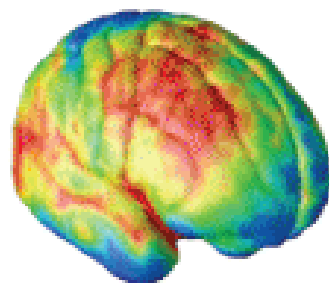
Occipital lobe: Vision

Temporal lobe: Memory, hearing, language

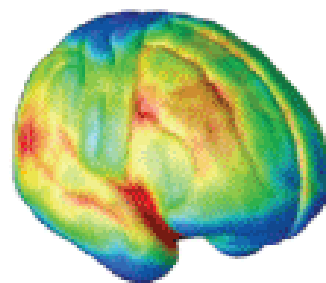
Frontal lobe: Planning, emotional control, problem solving

Gray matter density

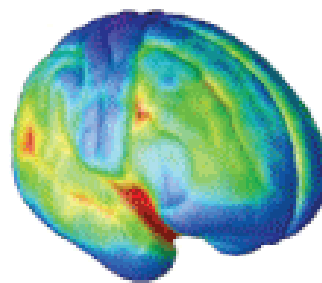
Gray matter becomes less dense as the brain matures.



Age: 5



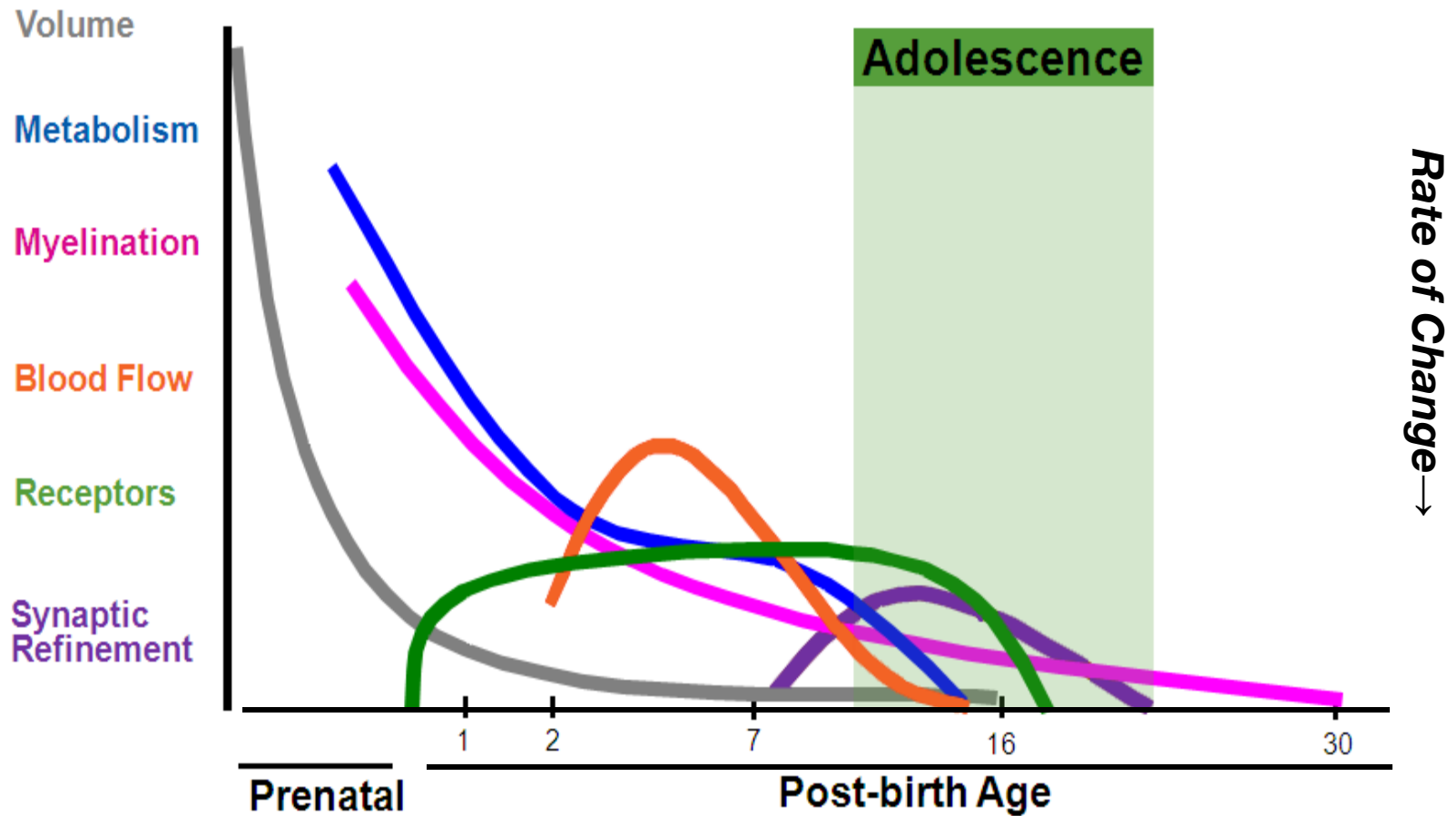
Adolescence



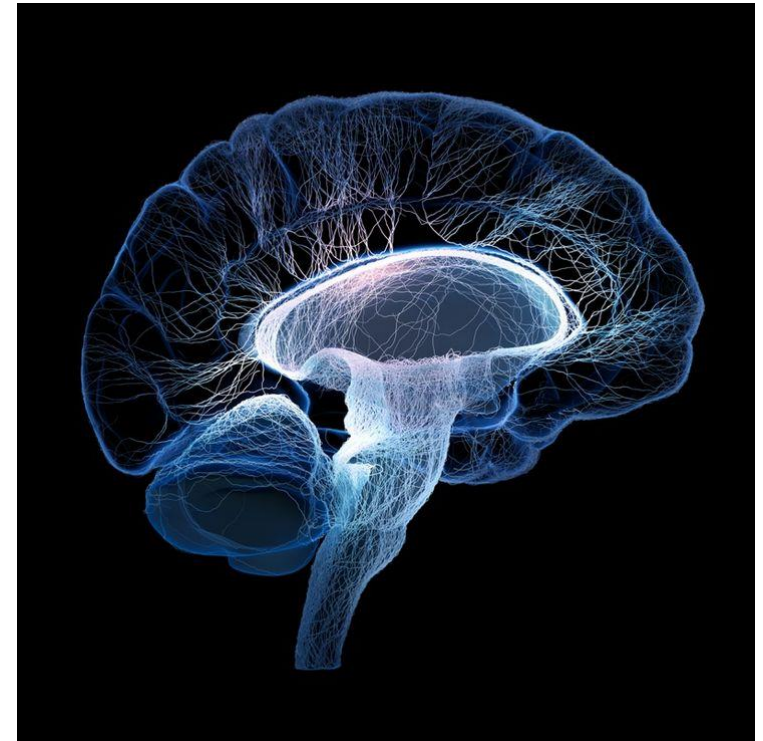
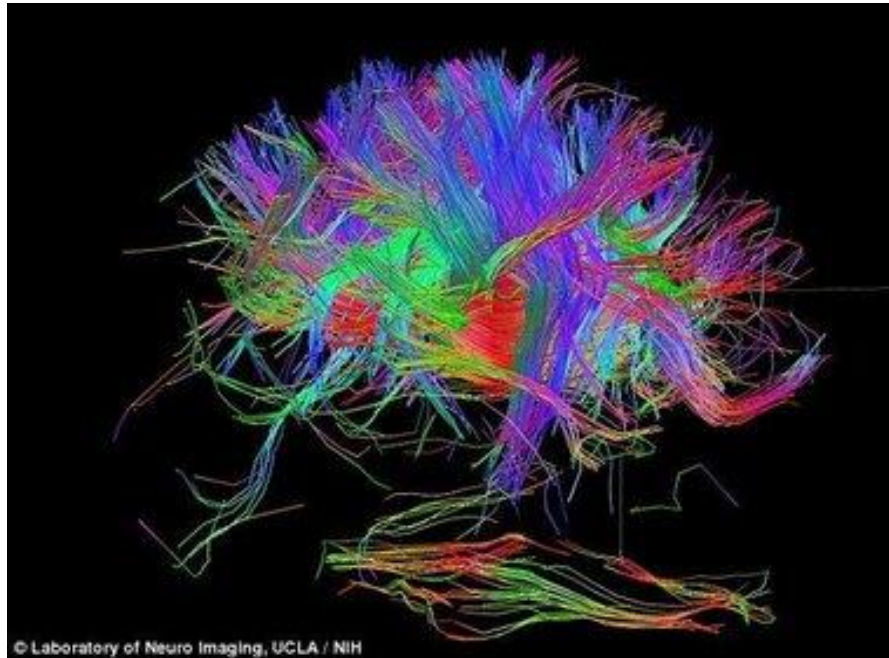
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Source: "Dynamic mapping of human cortical development during childhood through early adulthood," Nitin Gogtay et al., *Proceedings of the National Academy of Sciences*, May 25, 2004; California Institute of Technology

Brain Development

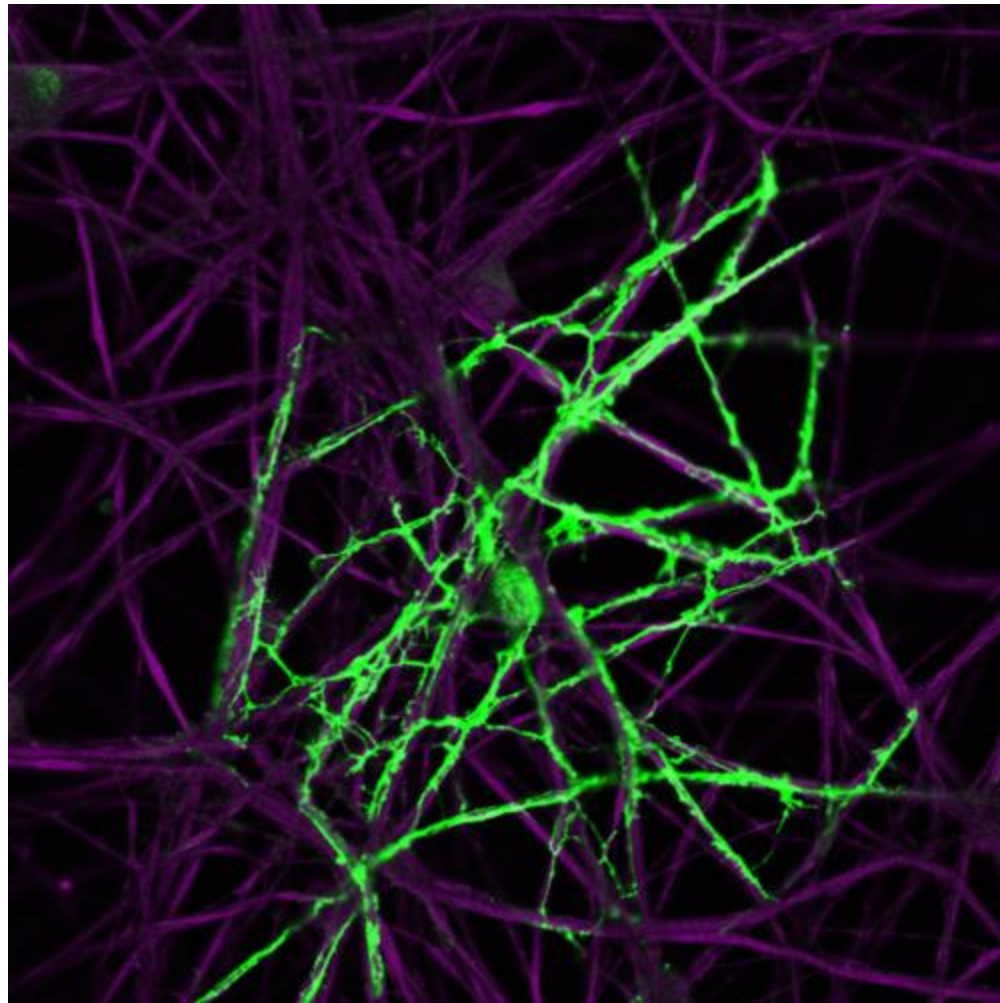


Source: Tapert & Schweinsburg, 2005



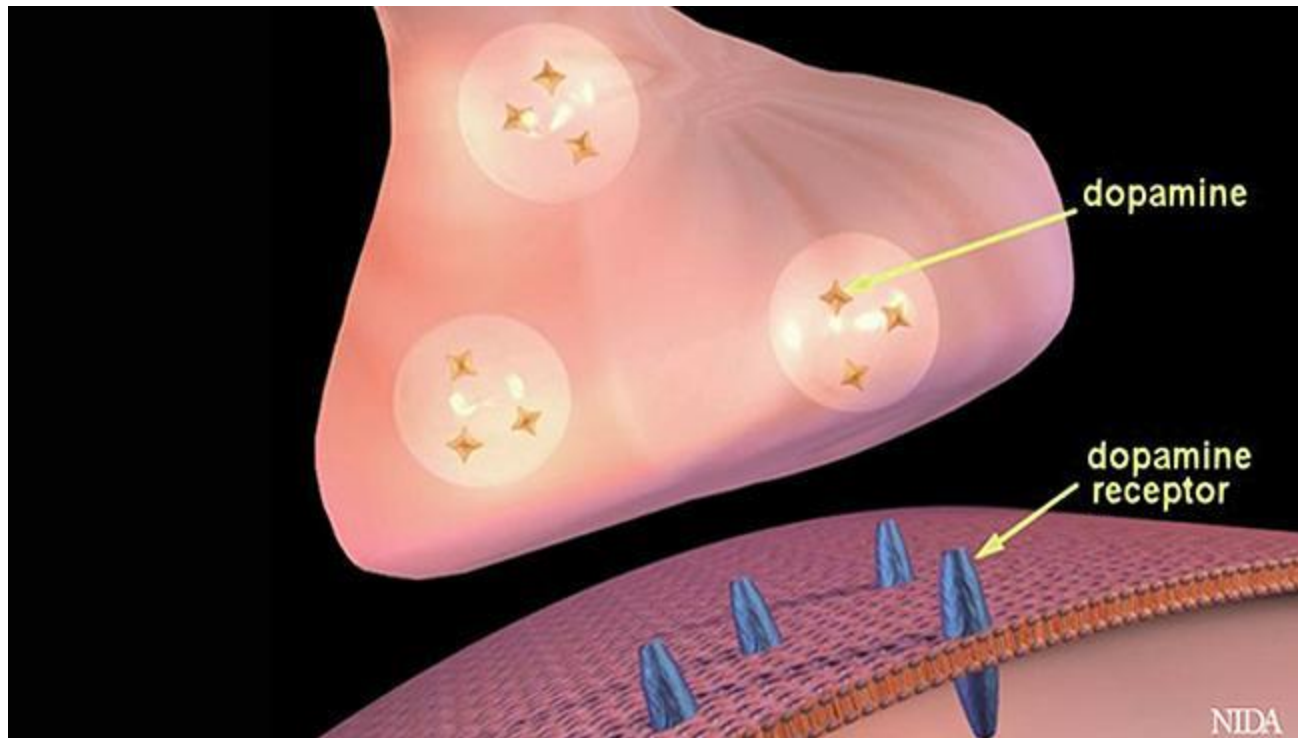
Synaptic Refinement



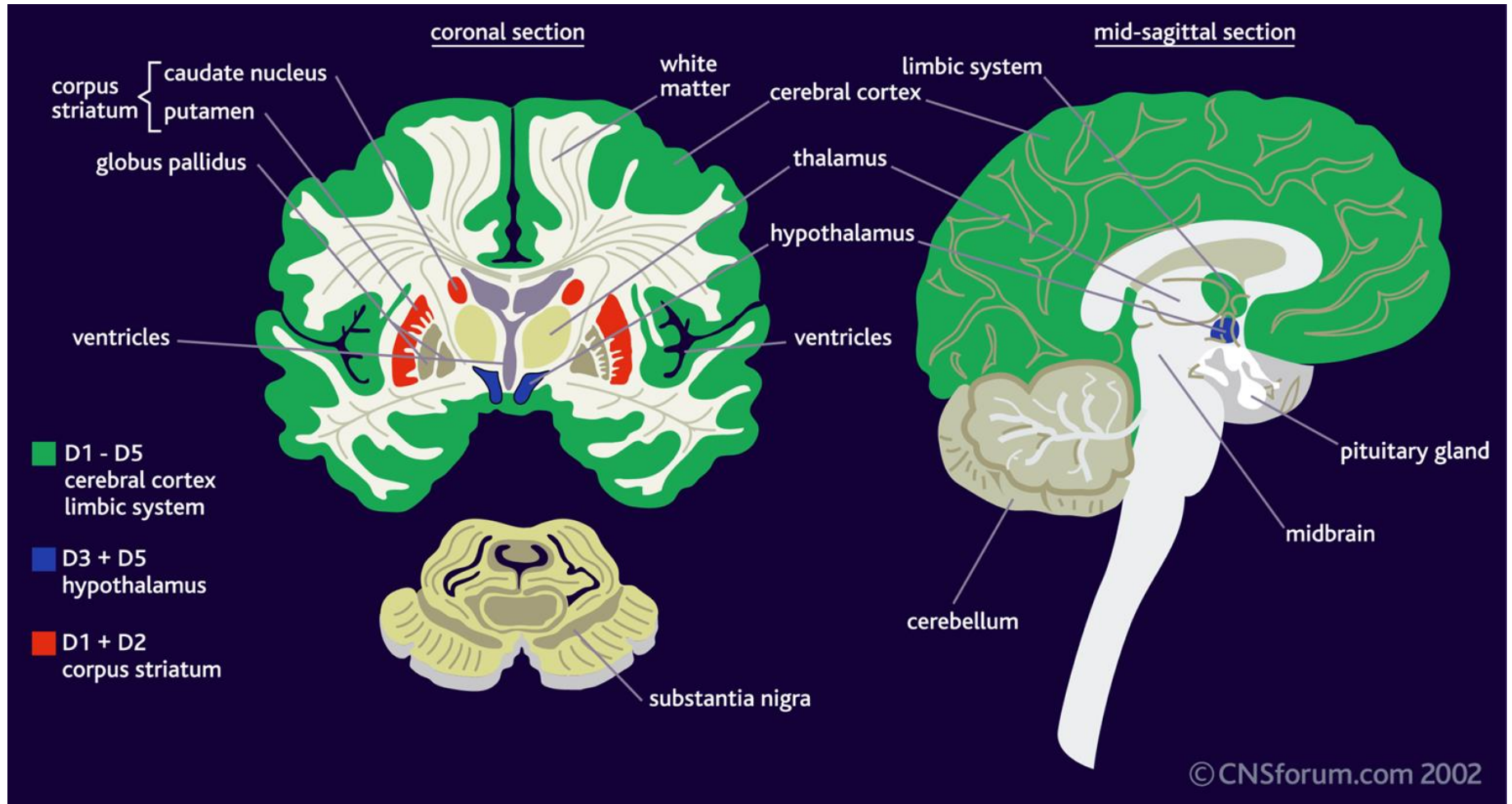


Myelination





Dopamine Receptors



Dopamine Receptors



Act First,
Think Later

This is Normal Development

Preference
for Physical
Activity and
Sensation
Seeking

More Risky
Impulsive
Behavior



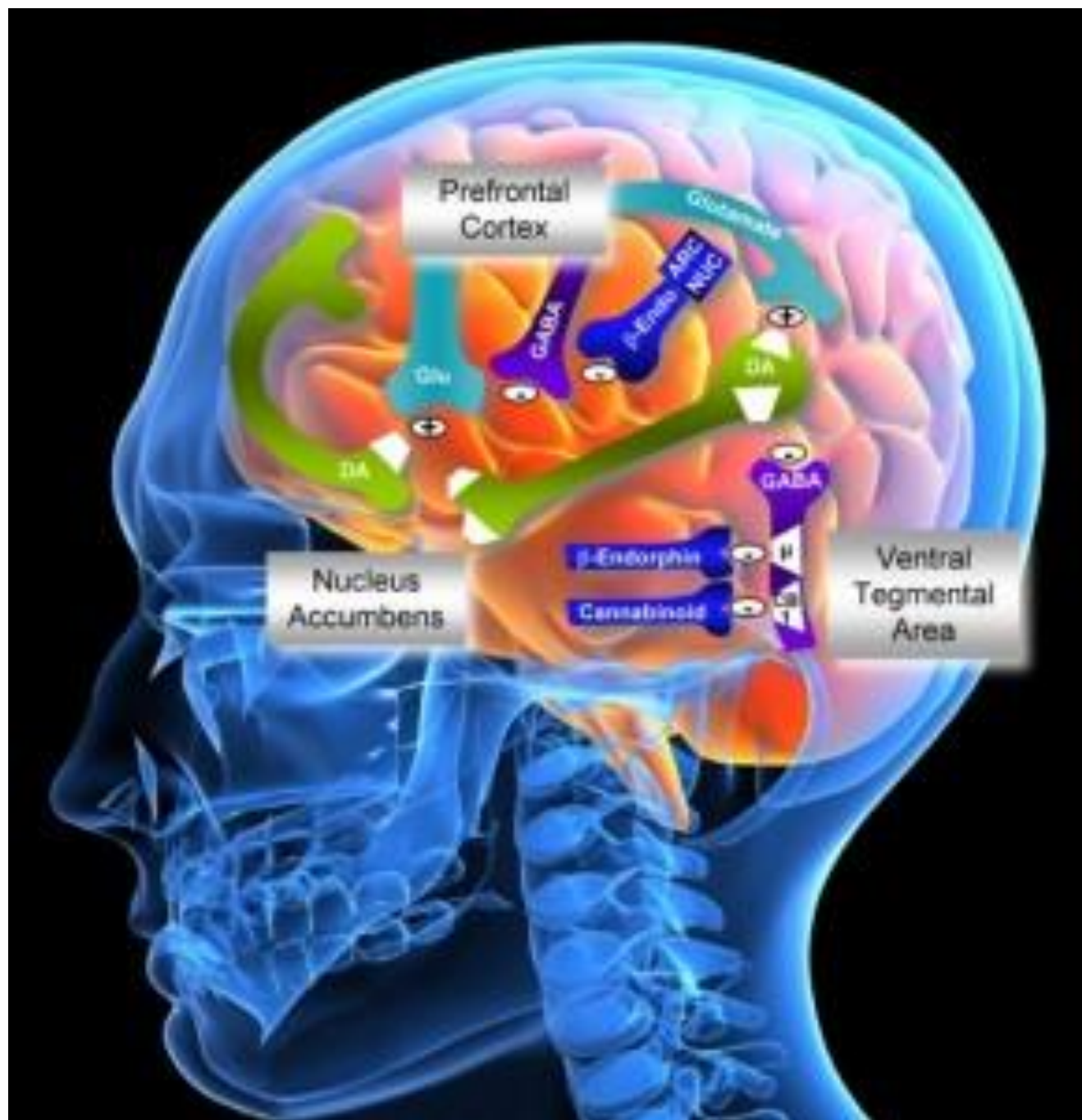
Emotions Felt
Very
Intensely

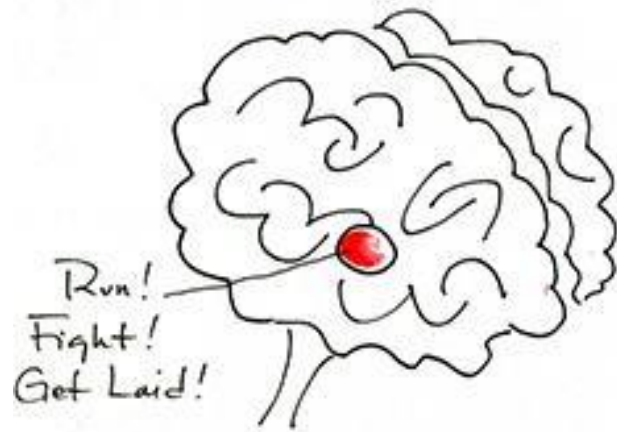
Less than
Optimal
Planning

Less
Consideration
of Negative
Consequences

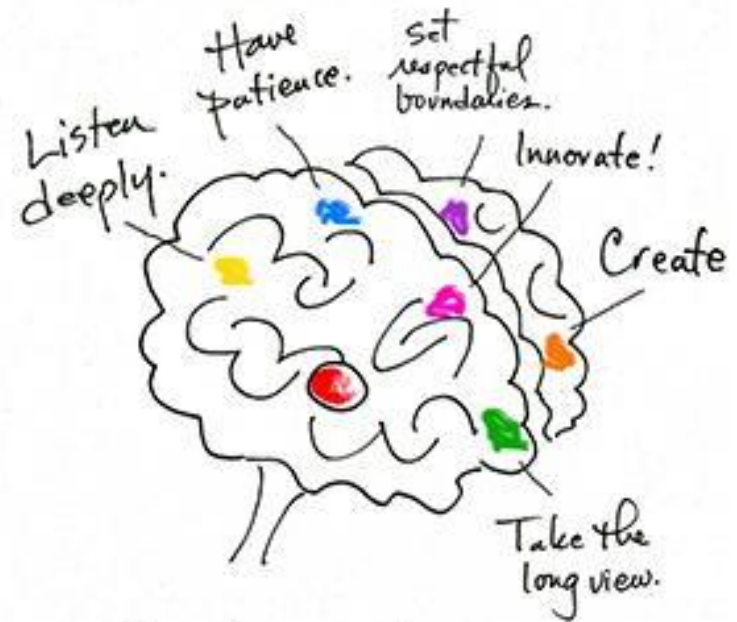
Strongly
Influenced by
Friends and
Peers







Lizard brain advice



Cortex advice

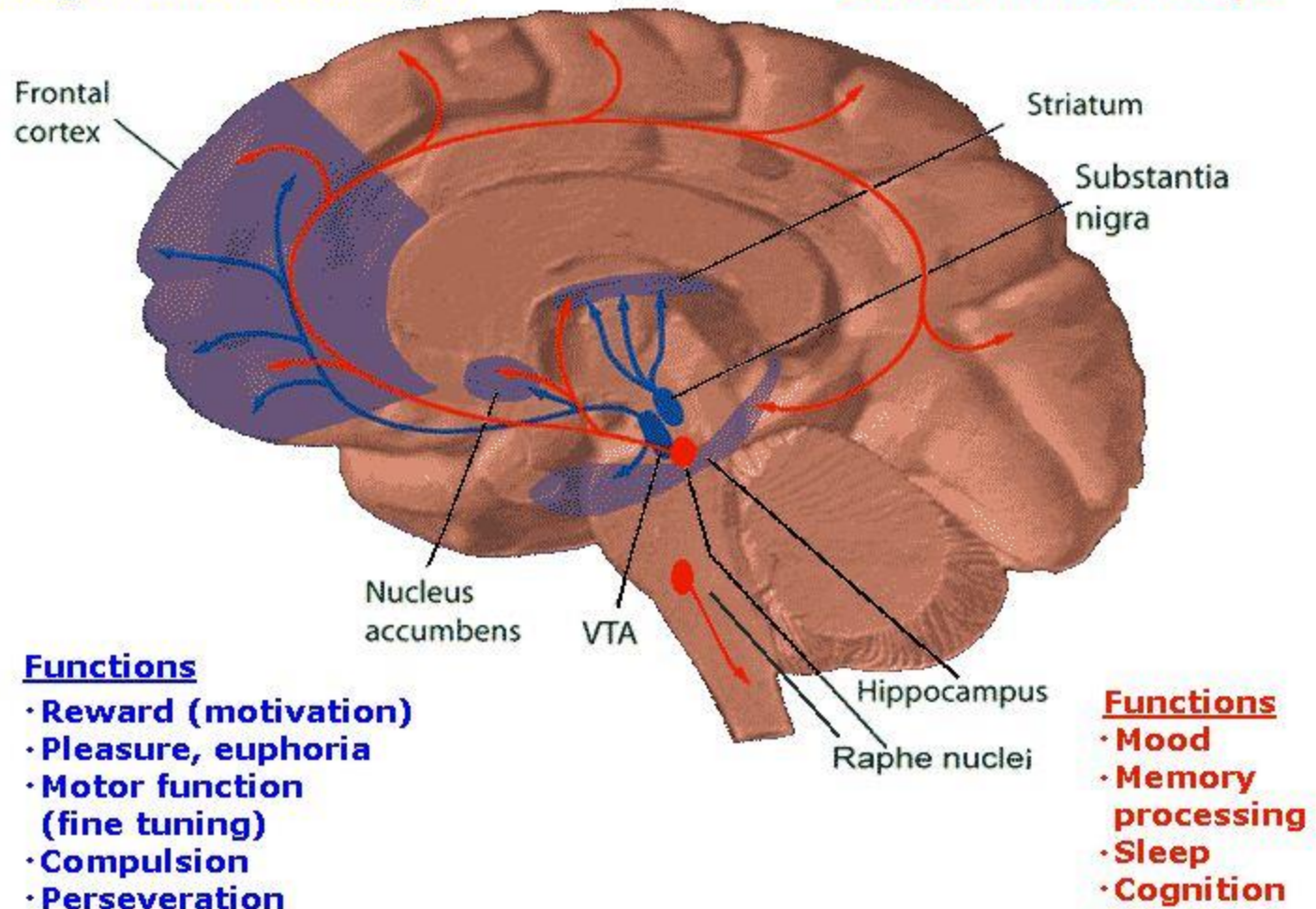
Eat, Drink, Connect

Brain Changes

The brain undergoes changes throughout life (Eriksson et al., 1998), with intervals of modest change punctuated by periods of more rapid transformation (Spear, 2000). Periods of more dramatic change include not only pre- and early postnatal eras but also adolescence (Spear, 2000). Rakic, Bourgeois, and Goldman-Rakic (1994) estimate that up to 30,000 cortical synapses are lost every second during portions of the pubertal period in nonhuman primates, resulting in a decline of nearly 50% in the average number of synaptic contacts per neuron, compared with the number prior to puberty. There is a similar loss of synapses in the human brain between 7 and 16 years of age (Huttenlocher, 1979), but the scarcity of human postmortem tissue makes it difficult to provide a more detailed description of this phenomenon. Although the implications of the massive pruning remain speculative, it is likely that it reflects active restructuring of connections and the promotion of more mature patterns. Some forms of mental retardation are associated with unusually high density of synapses (Goldman-Rakic, Isseroff, Schwartz, & Bugbee, 1983).

Dopamine Pathways

Serotonin Pathways



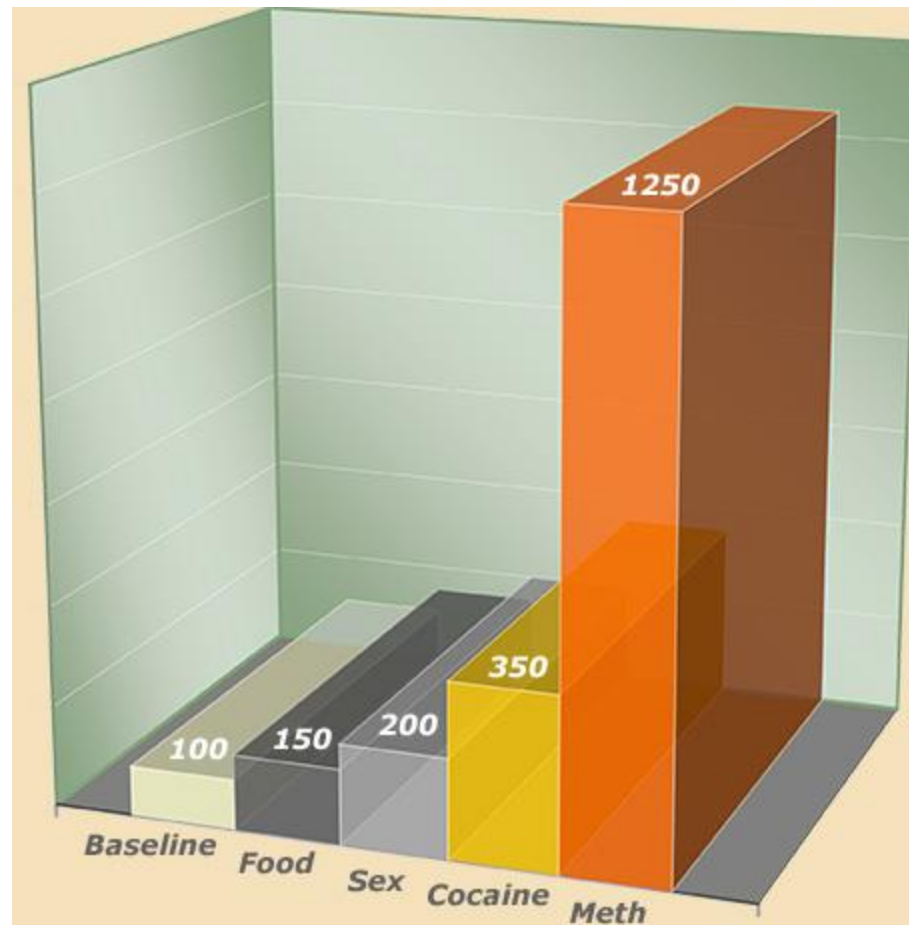


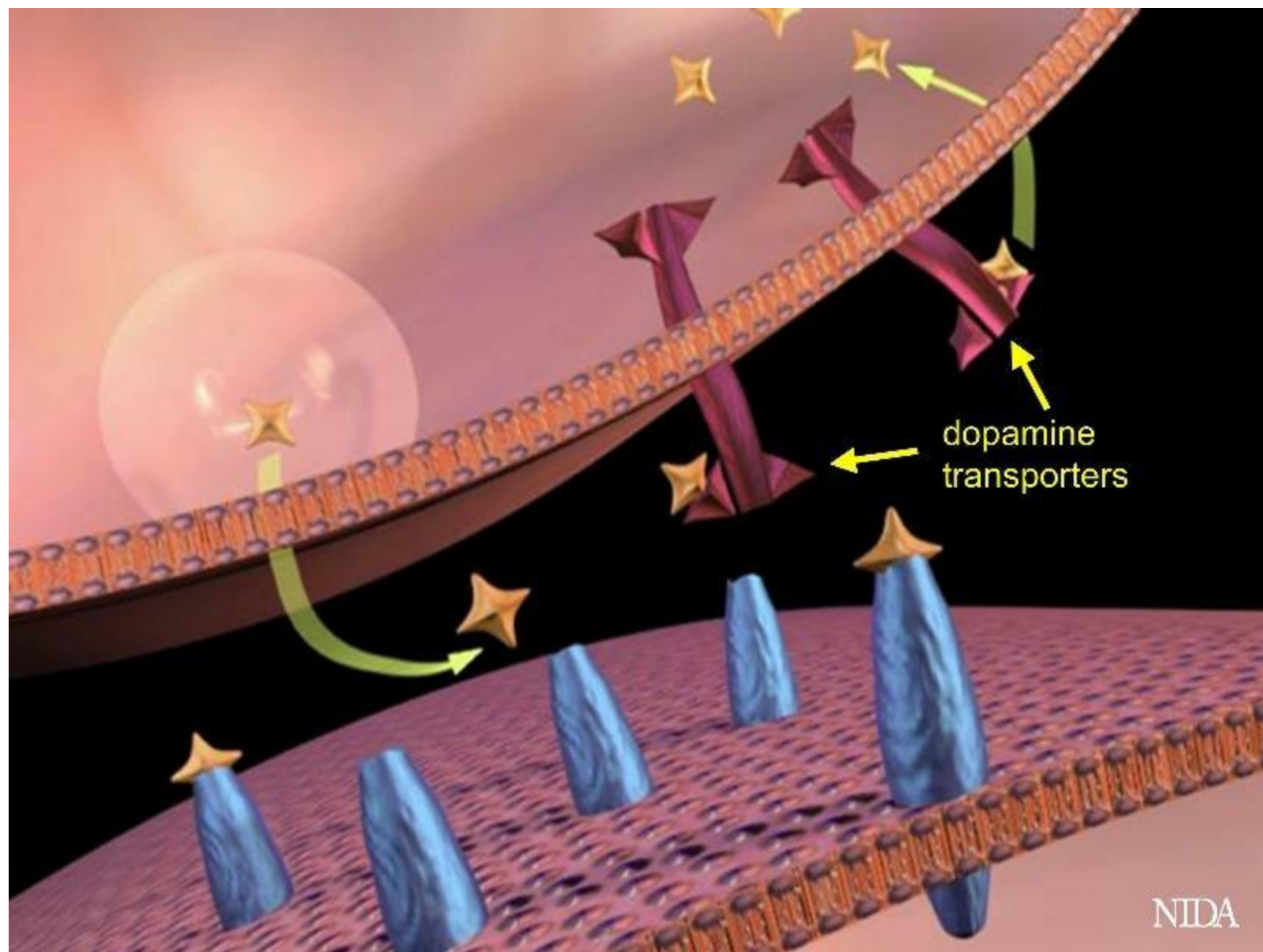
IT IS SAD
TODAY.



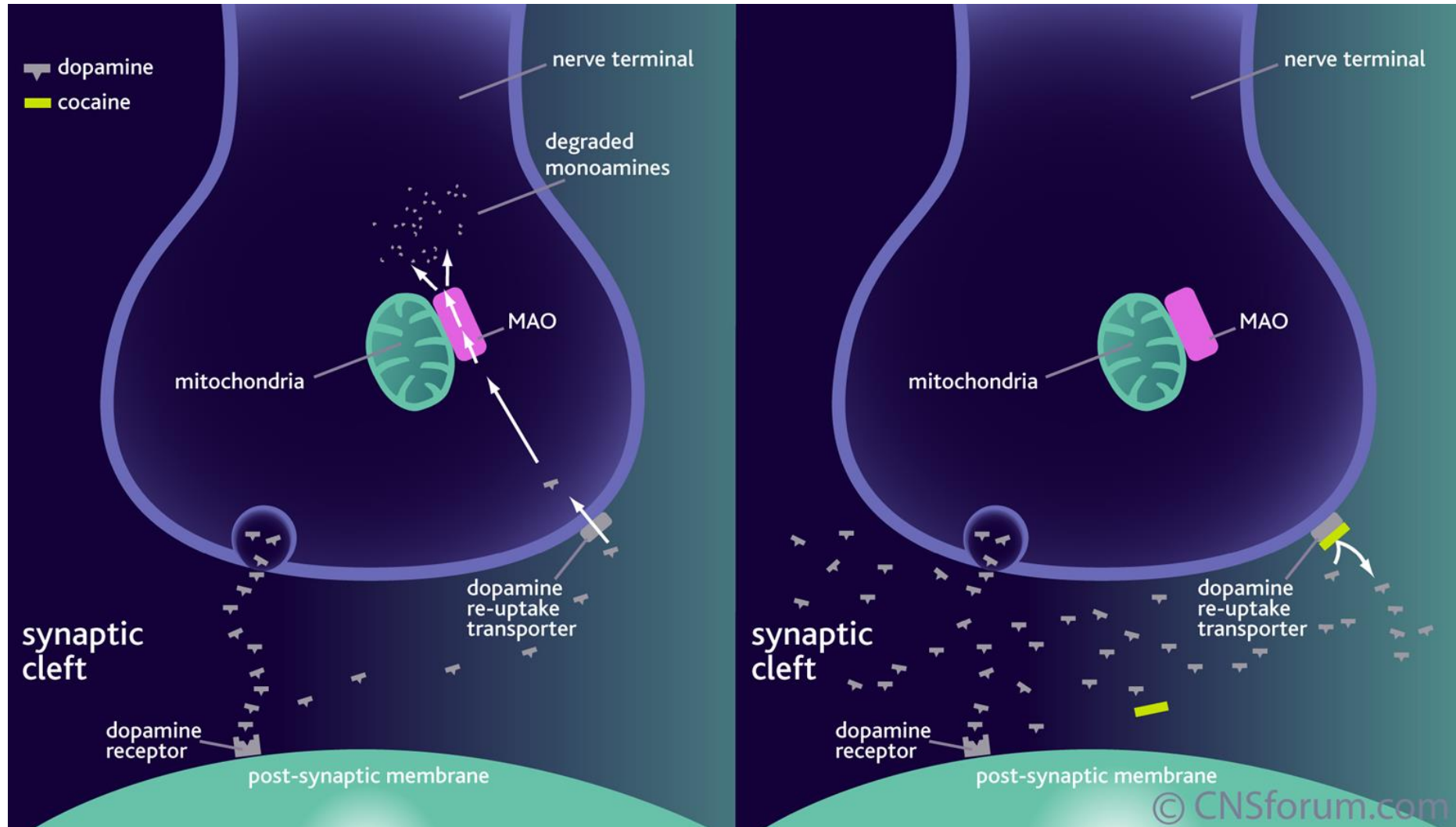
Gjo
5-05



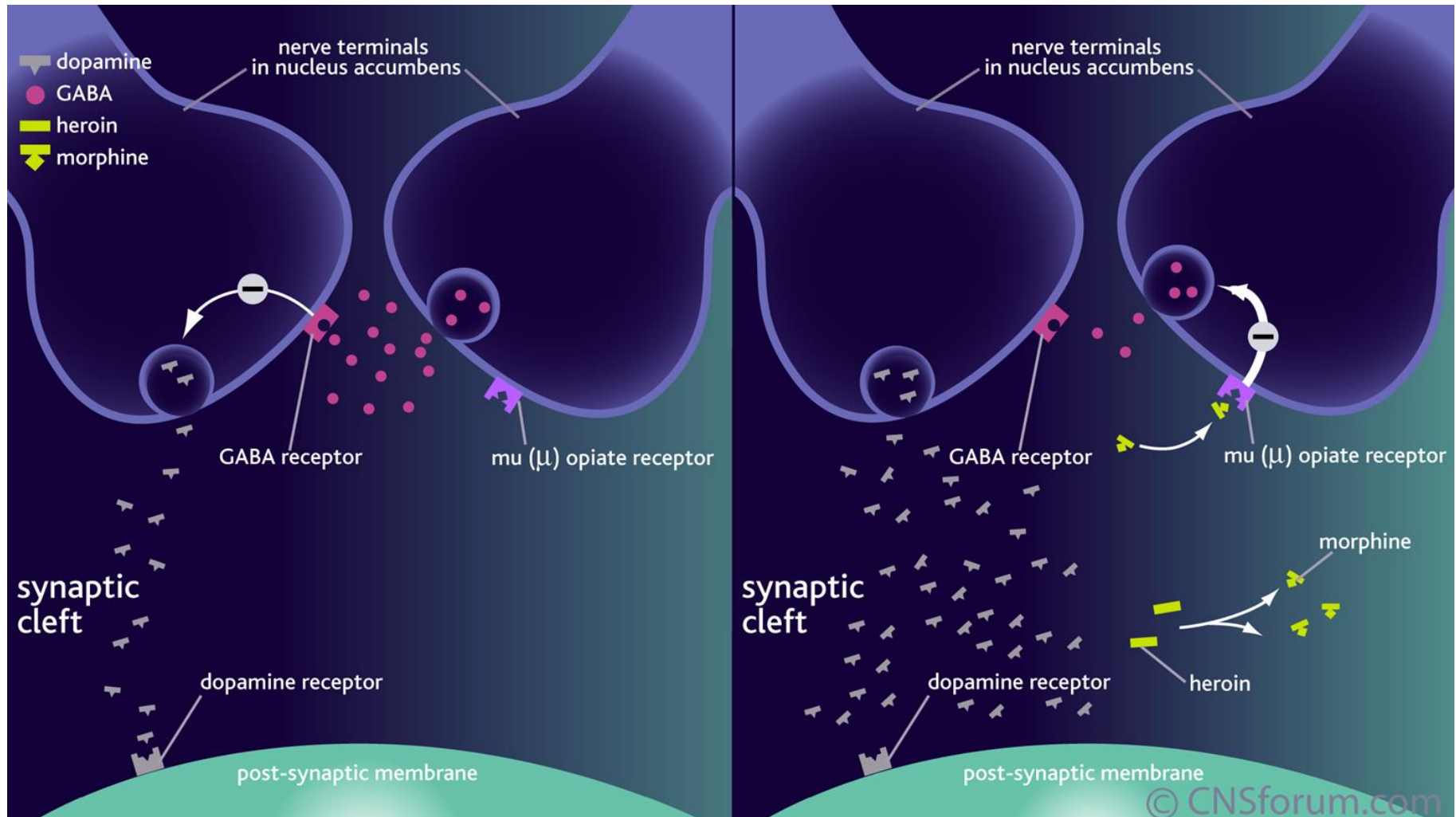


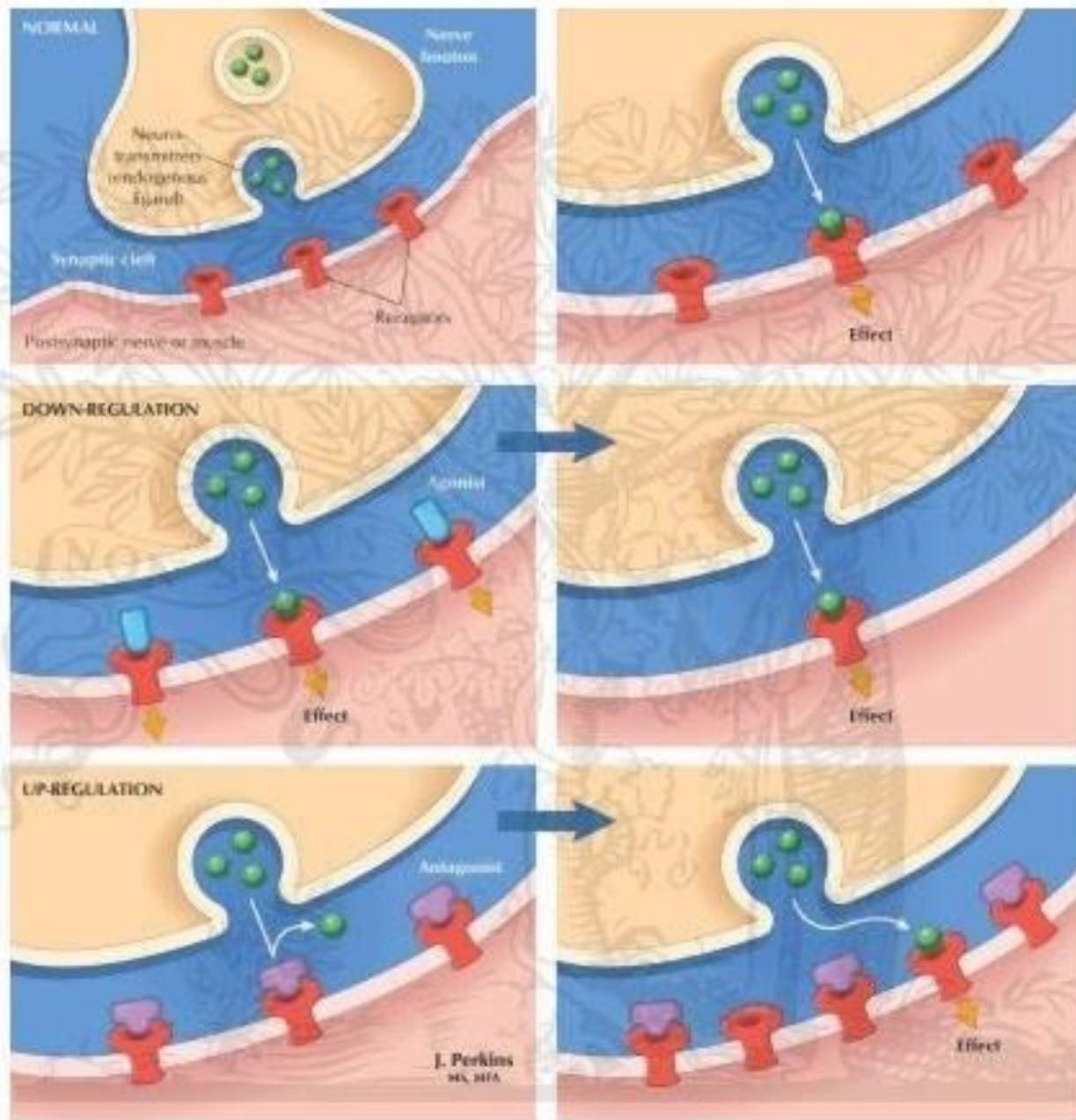


How Cocaine Works

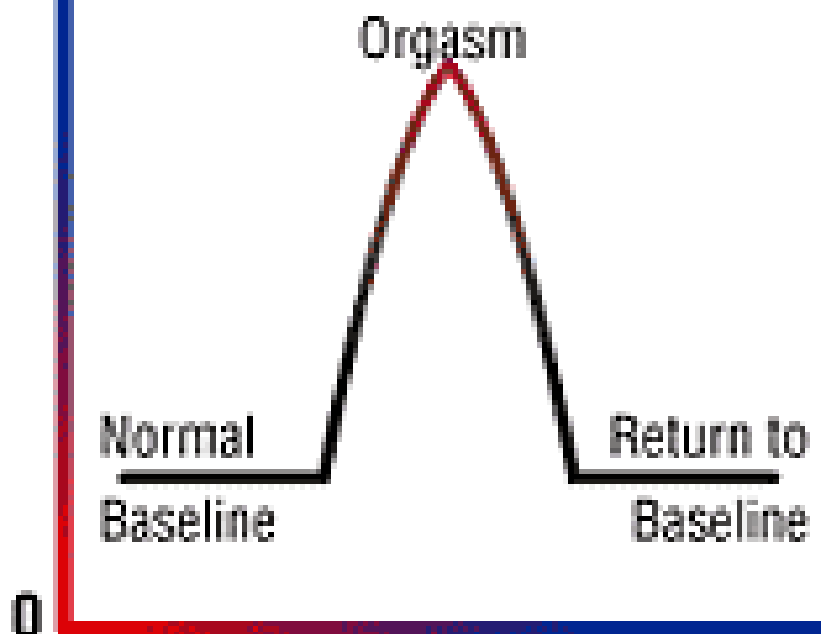


How Heroin Works

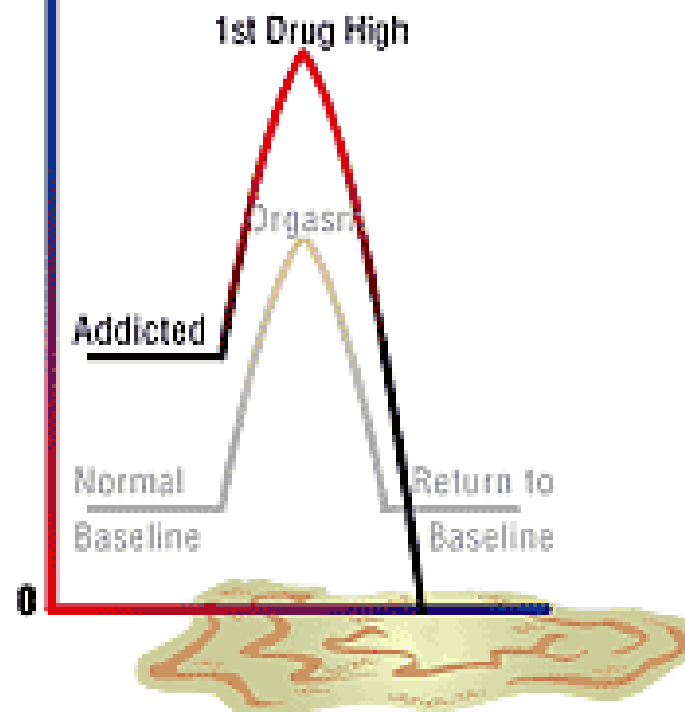


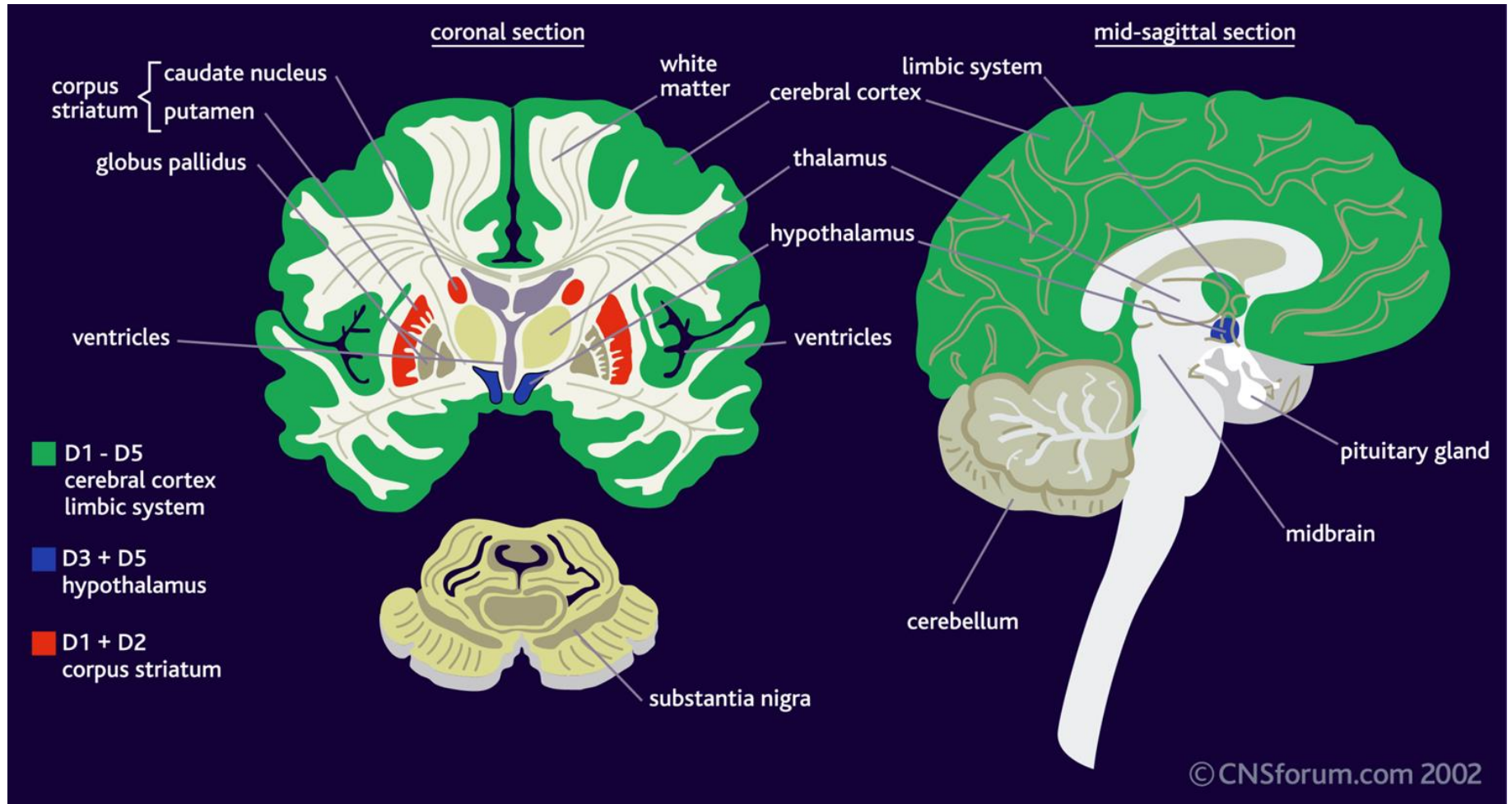


Dopamine Level - Normal Brain



Dopamine Level - Addicted Brain





Dopamine Receptors



Early Use



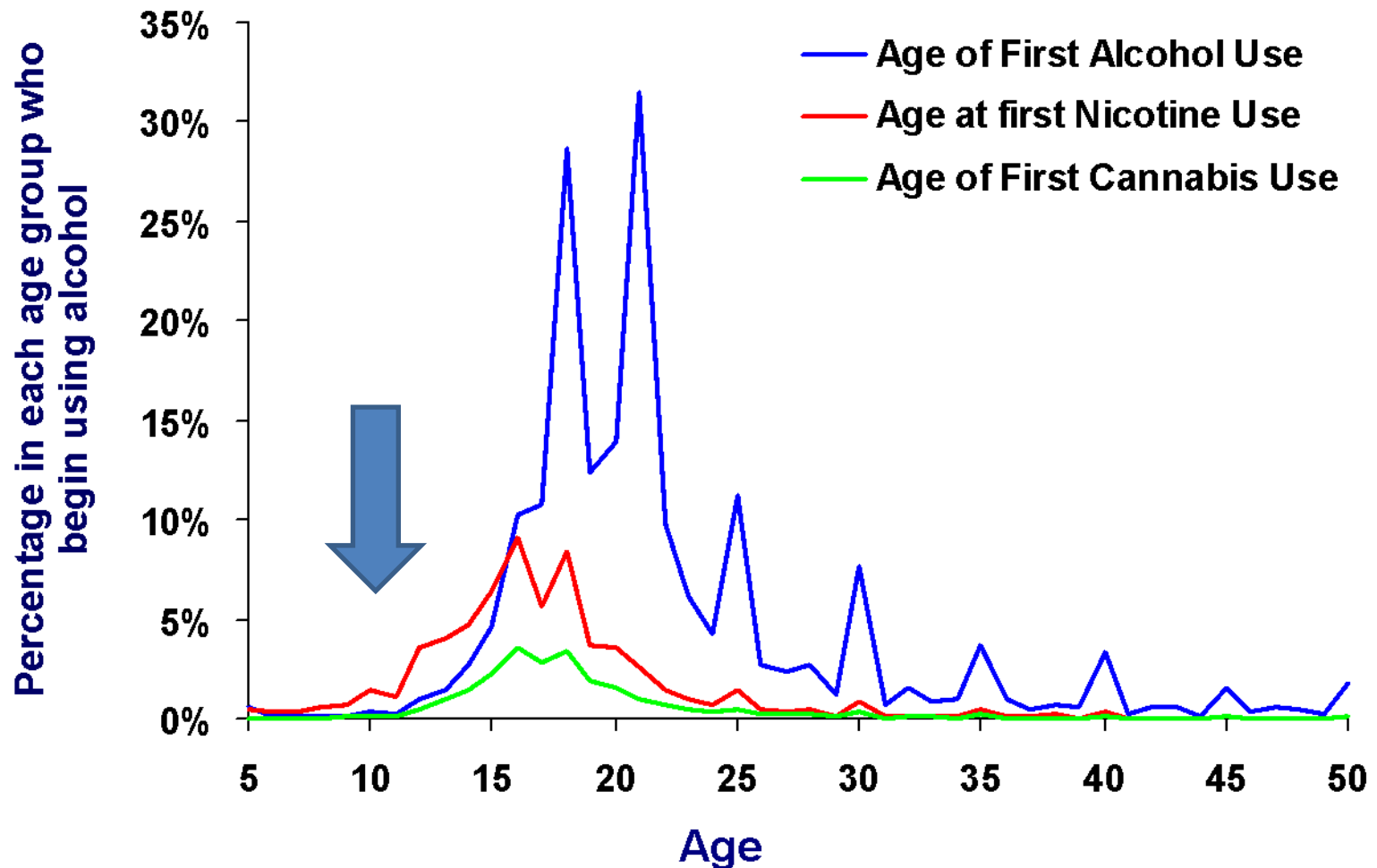
Genetics



Trauma

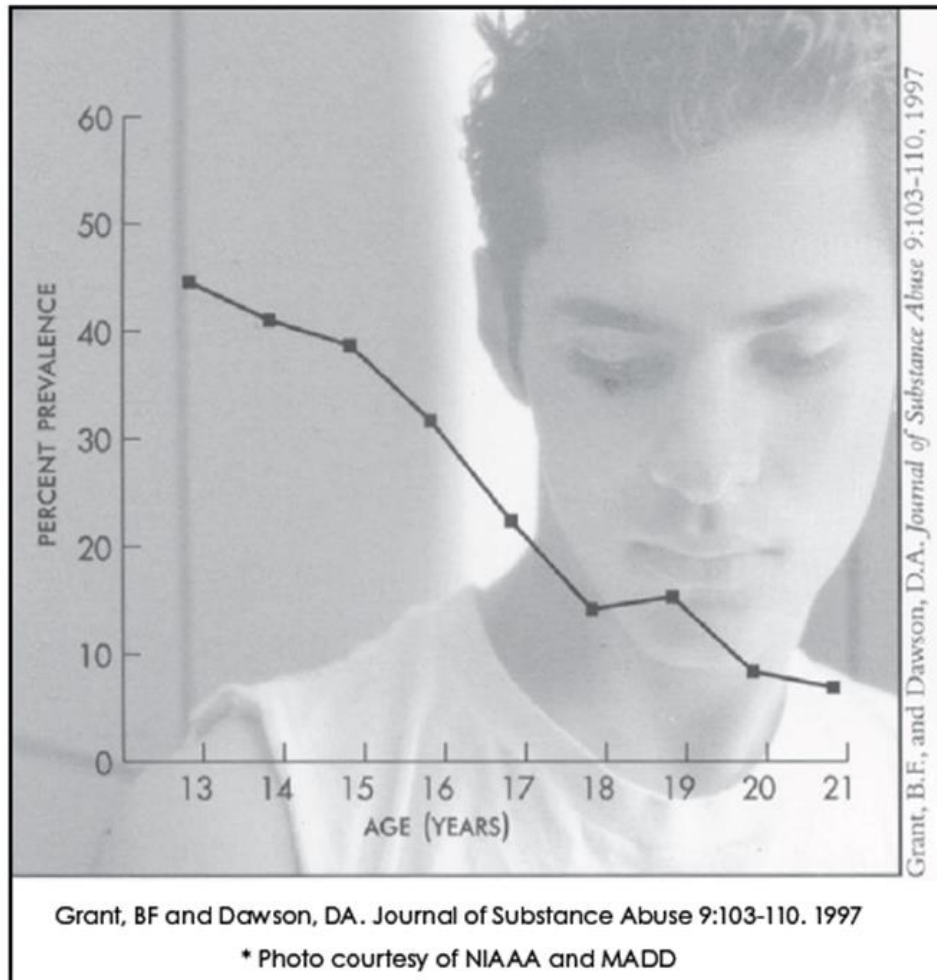


Addiction is a Developmental Pediatric Disease



Source: NIAAA National Epidemiologic Survey on Alcohol and Related Conditions, 2003

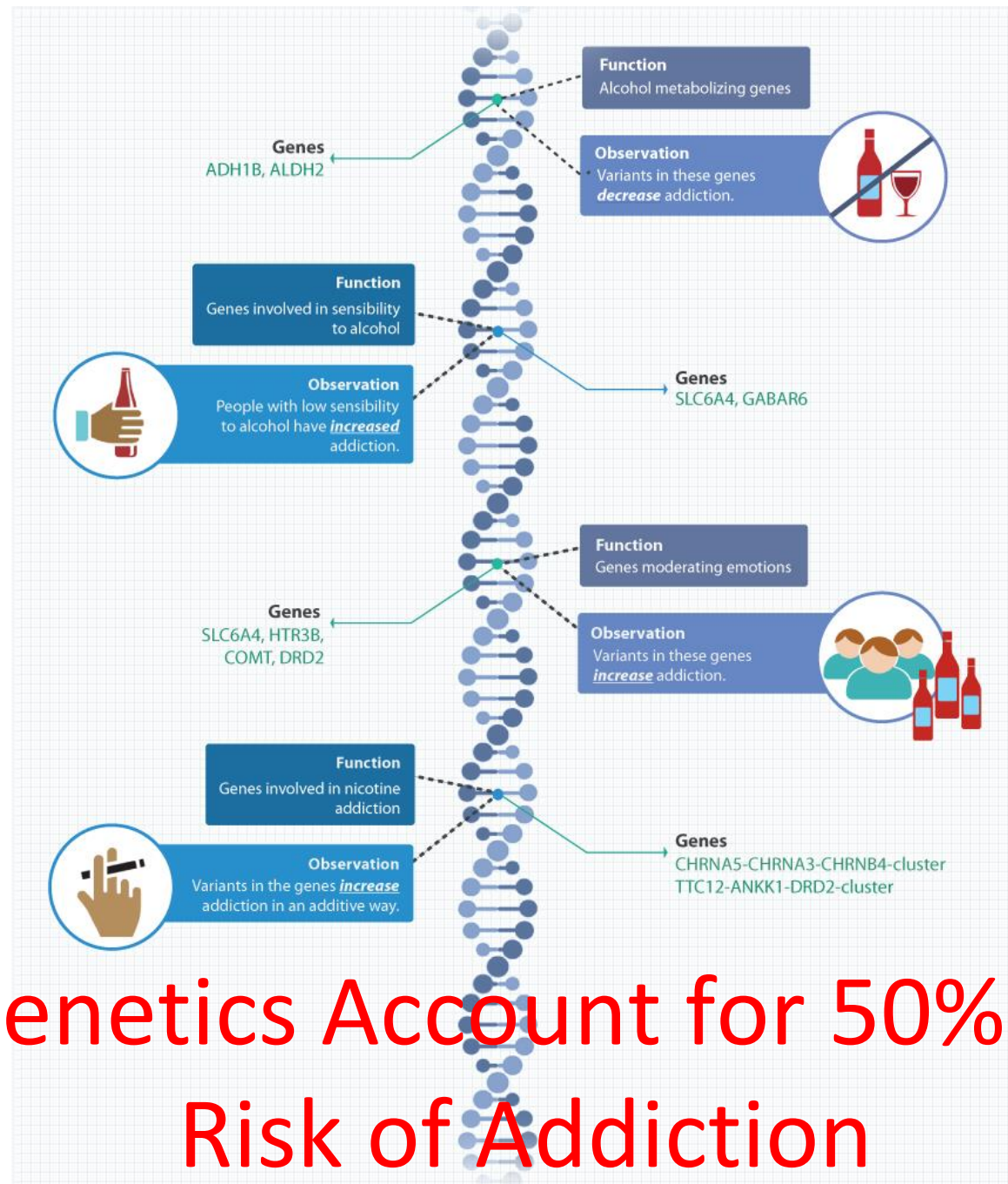
Teen Alcohol Use Wires The Brain For Addiction



40% of kids who begin drinking at age 15 will become alcoholics.

Only 7% of those who begin drinking at age 21 become alcoholics.







Adverse Childhood Experiences
Emotional Neglect
Abuse
Household Dysfunction

Relationship of Childhood Abuse and Household Dysfunction to Many of the Leading Causes of Death in Adults

The Adverse Childhood Experiences (ACE) Study

Vincent J. Felitti, MD, FACP, Robert F. Anda, MD, MS, Dale Nordenberg, MD, David F. Williamson, MS, PhD, Alison M. Spitz, MS, MPH, Valerie Edwards, BA, Mary P. Koss, PhD, James S. Marks, MD, MPH

Background: The relationship of health risk behavior and disease in adulthood to the breadth of exposure to childhood emotional, physical, or sexual abuse, and household dysfunction during childhood has not previously been described.

Methods: A questionnaire about adverse childhood experiences was mailed to 13,494 adults who had completed a standardized medical evaluation at a large HMO; 9,508 (70.5%) responded. Seven categories of adverse childhood experiences were studied: psychological, physical, or sexual abuse; violence against mother; or living with household members who were substance abusers, mentally ill or suicidal, or ever imprisoned. The number of categories of these adverse childhood experiences was then compared to measures of adult risk behavior, health status, and disease. Logistic regression was used to adjust for effects of demographic factors on the association between the cumulative number of categories of childhood exposures (range: 0–7) and risk factors for the leading causes of death in adult life.

Results: More than half of respondents reported at least one, and one-fourth reported ≥ 2 categories of childhood exposures. We found a graded relationship between the number of categories of childhood exposure and each of the adult health risk behaviors and diseases that were studied ($P < .001$). Persons who had experienced four or more categories of childhood exposure, compared to those who had experienced none, had 4- to 12-fold increased health risks for alcoholism, drug abuse, depression, and suicide attempt; a 2- to 4-fold increase in smoking, poor self-rated health, ≥ 50 sexual intercourse partners, and sexually transmitted disease; and a 1.4- to 1.6-fold increase in physical inactivity and severe obesity. The number of categories of adverse childhood exposures showed a graded relationship to the presence of adult diseases including ischemic heart disease, cancer, chronic lung disease, skeletal fractures, and liver disease. The seven categories of adverse childhood experiences were strongly interrelated and persons with multiple categories of childhood exposure were likely to have multiple health risk factors later in life.

Conclusions: We found a strong graded relationship between the breadth of exposure to abuse or household dysfunction during childhood and multiple risk factors for several of the leading causes of death in adults.

Medical Subject Headings (MeSH): child abuse, sexual, domestic violence, spouse abuse, children of impaired parents, substance abuse, alcoholism, smoking, obesity, physical activity, depression, suicide, sexual behavior, sexually transmitted diseases, chronic obstructive pulmonary disease, ischemic heart disease. (Am J Prev Med 1998;14:245–258) © 1998 American Journal of Preventive Medicine

Finding Your ACE Score

While you were growing up, during your first 18 years of life:

1. Did a parent or other adult in the household **often or very often**...
Swear at you, insult you, put you down, or humiliate you?
or
Act in a way that made you afraid that you might be physically hurt?
Yes No If yes enter 1 _____
2. Did a parent or other adult in the household **often or very often**...
Push, grab, slap, or throw something at you?
or
Ever hit you so hard that you had marks or were injured?
Yes No If yes enter 1 _____
3. Did an adult or person at least 5 years older than you **ever**...
Touch or fondle you or have you touch their body in a sexual way?
or
Attempt or actually have oral, anal, or vaginal intercourse with you?
Yes No If yes enter 1 _____
4. Did you **often or very often** feel that ...
No one in your family loved you or thought you were important or special?
or
Your family didn't look out for each other, feel close to each other, or support each other?
Yes No If yes enter 1 _____
5. Did you **often or very often** feel that ...
You didn't have enough to eat, had to wear dirty clothes, and had no one to protect you?
or
Your parents were too drunk or high to take care of you or take you to the doctor if you needed it?
Yes No If yes enter 1 _____
6. Were your parents **ever** separated or divorced?
Yes No If yes enter 1 _____
7. Was your mother or stepmother:
Often or very often pushed, grabbed, slapped, or had something thrown at her?
or
Sometimes, often, or very often kicked, bitten, hit with a fist, or hit with something hard?
or
Ever repeatedly hit at least a few minutes or threatened with a gun or knife?
Yes No If yes enter 1 _____
8. Did you live with anyone who was a problem drinker or alcoholic or who used street drugs?
Yes No If yes enter 1 _____
9. Was a household member depressed or mentally ill, or did a household member attempt suicide?
Yes No If yes enter 1 _____
10. Did a household member go to prison?
Yes No If yes enter 1 _____

Now add up your "Yes" answers: _____ This is your ACE Score.

ABUSE



Physical



Emotional



Sexual

NEGLECT



Physical



Emotional

HOUSEHOLD DYSFUNCTION



Mental Illness



Incarcerated Relative



Mother treated violently



Substance Abuse



Divorce

Table 1. Prevalence of childhood exposure to abuse and household dysfunction

Category of childhood exposure ^a	Prevalence (%)	Prevalence (%)
Abuse by category		
Psychological		11.1
<i>(Did a parent or other adult in the household . . .)</i>		
Often or very often swear at, insult, or put you down?	10.0	
Often or very often act in a way that made you afraid that you would be physically hurt?	4.8	
Physical		10.8
<i>(Did a parent or other adult in the household . . .)</i>		
Often or very often push, grab, shove, or slap you?	4.9	
Often or very often hit you so hard that you had marks or were injured?	9.6	
Sexual		22.0
<i>(Did an adult or person at least 5 years older ever . . .)</i>		
Touch or fondle you in a sexual way?	19.3	
Have you touch their body in a sexual way?	8.7	
Attempt oral, anal, or vaginal intercourse with you?	8.9	
Actually have oral, anal, or vaginal intercourse with you?	6.9	
Household dysfunction by category		
Substance abuse		25.6
Live with anyone who was a problem drinker or alcoholic?	23.5	
Live with anyone who used street drugs?	4.9	
Mental illness		18.8
Was a household member depressed or mentally ill?	17.5	
Did a household member attempt suicide?	4.0	
Mother treated violently		12.5
<i>Was your mother (or stepmother)</i>		
Sometimes, often, or very often pushed, grabbed, slapped, or had something thrown at her?	11.9	
Sometimes, often, or very often kicked, bitten, hit with a fist, or hit with something hard?	6.3	
Ever repeatedly hit over at least a few minutes?	6.6	
Ever threatened with, or hurt by, a knife or gun?	3.0	
Criminal behavior in household		
Did a household member go to prison?	3.4	3.4
Any category reported		52.1%

^aAn exposure to one or more items listed under the set of questions for each category.

Injury Prevention & Control : Division of Violence Prevention

Violence Prevention

About Us +

Child Maltreatment -

Definition

Data Sources

Risk and Protective Factors

Essentials for Childhood

ACE Study -

About the Study

The ACE Pyramid

Major Findings

Questionnaires

Data and Statistics

Related Links

Publications

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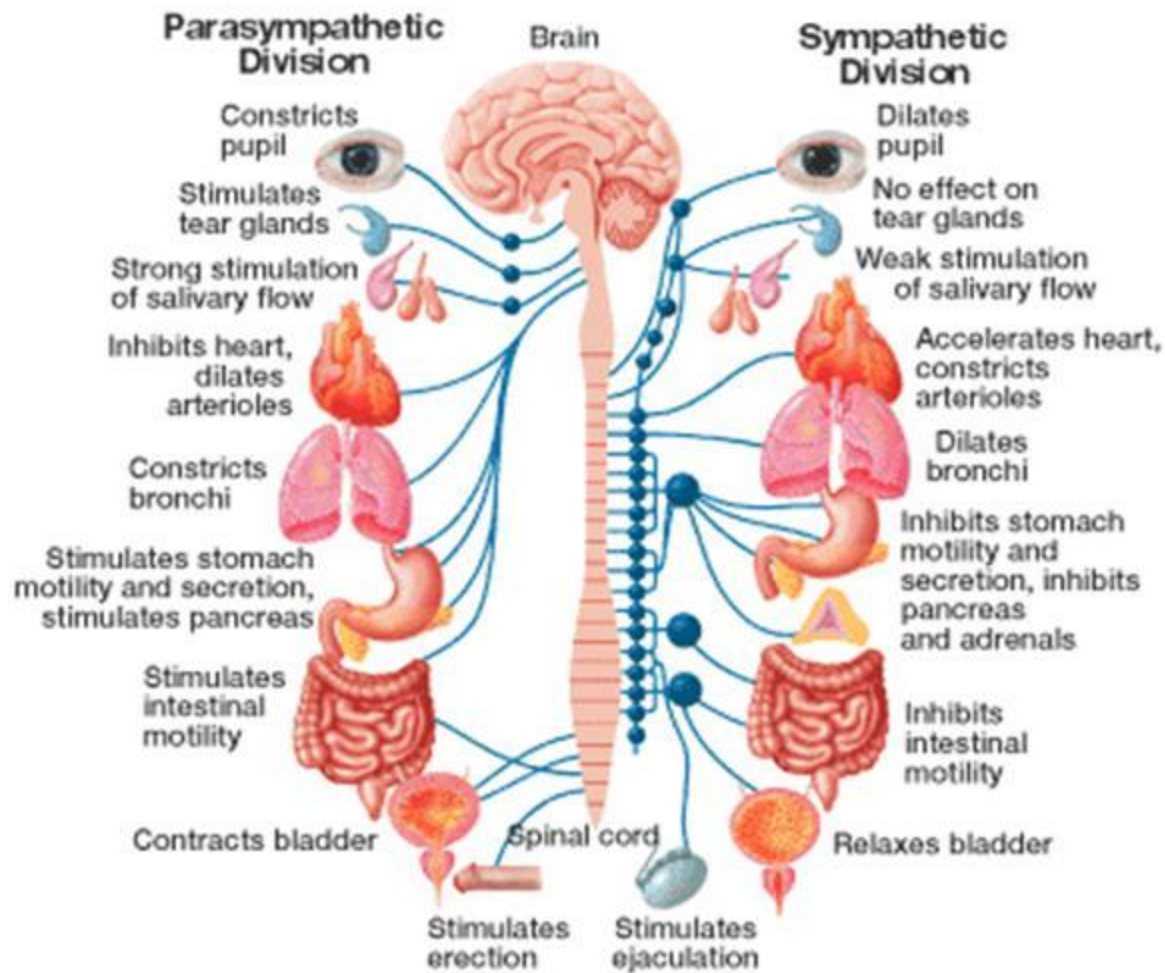
Major Findings



Childhood abuse, neglect, and exposure to other traumatic stressors which we term *adverse childhood experiences* (ACE) are common. Almost two-thirds of our study participants reported at least one ACE, and more than one of five reported three or more ACE. The short- and long-term outcomes of these childhood exposures include a multitude of health and social problems.

The ACE Study uses the ACE Score, which is a total count of the number of ACEs reported by respondents. The ACE Score is used to assess the total amount of stress during childhood and has demonstrated that as the number of ACE increase, the risk for the following health problems increases in a strong and graded fashion:

- Alcoholism and alcohol abuse
- Chronic obstructive pulmonary disease (COPD)
- Depression
- Fetal death
- Health-related quality of life
- Illicit drug use
- Ischemic heart disease (IHD)
- Liver disease
- Risk for intimate partner violence
- Multiple sexual partners
- Sexually transmitted diseases (STDs)
- Smoking
- Suicide attempts
- Unintended pregnancies
- Early initiation of smoking
- Early initiation of sexual activity
- Adolescent pregnancy



FREEZE & SURRENDER

Fight or Flight

Complex Childhood Trauma

Behaviors

Aggression

Disproportionate Reactiveness

Impulsivity

Distractibility

Withdrawal and Avoidance

Three or More Traumatic Events

Two-and-half times more likely to repeat a grade than are children who have experienced none

Five times more likely to have severe attendance issues

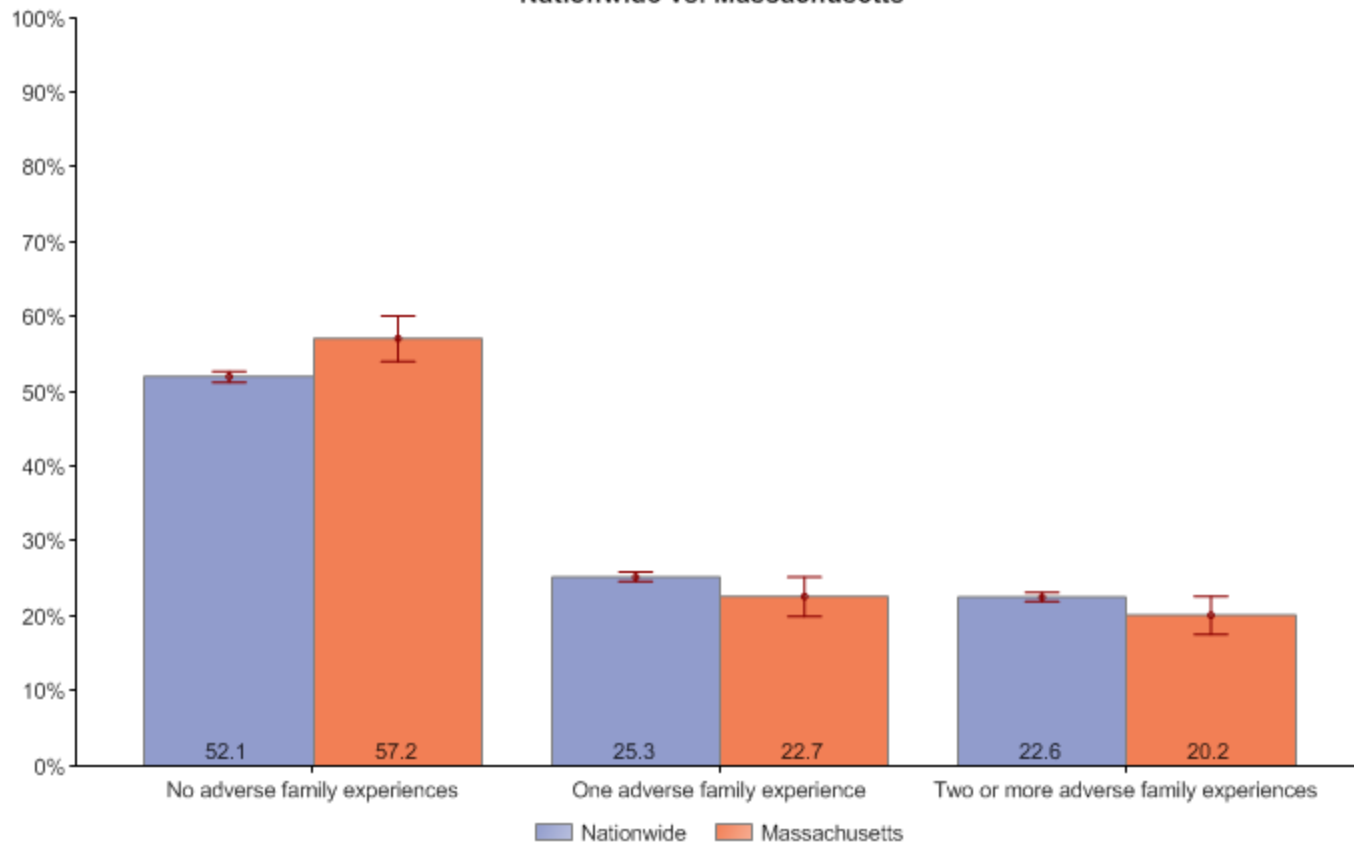
Six times more likely to experience behavioral problems

More than **twice** as likely to be suspended from school

How many children have experience two or more adverse experiences?
(details)

		No adverse family experiences	One adverse family experience	Two or more adverse family experiences	Total %
Nationwide	%	52.1	25.3	22.6	100.0
	C.I.	(51.3 - 52.8)	(24.7 - 26.0)	(22.0 - 23.2)	
	n	53,528	21,877	19,115	
	Pop. Est.	37,833,101	18,395,284	16,430,694	
Massachusetts	%	57.2	22.7	20.2	100.0
	C.I.	(54.1 - 60.2)	(20.0 - 25.3)	(17.6 - 22.7)	
	n	1,175	363	298	
	Pop. Est.	783,536	310,450	276,113	
C.I. = 95% Confidence Interval. Percentages are weighted to population characteristics. n = Cell size. Use caution in interpreting Cell sizes less than 50.					

Adverse family experiences
Children age 0-17 years
Nationwide vs. Massachusetts



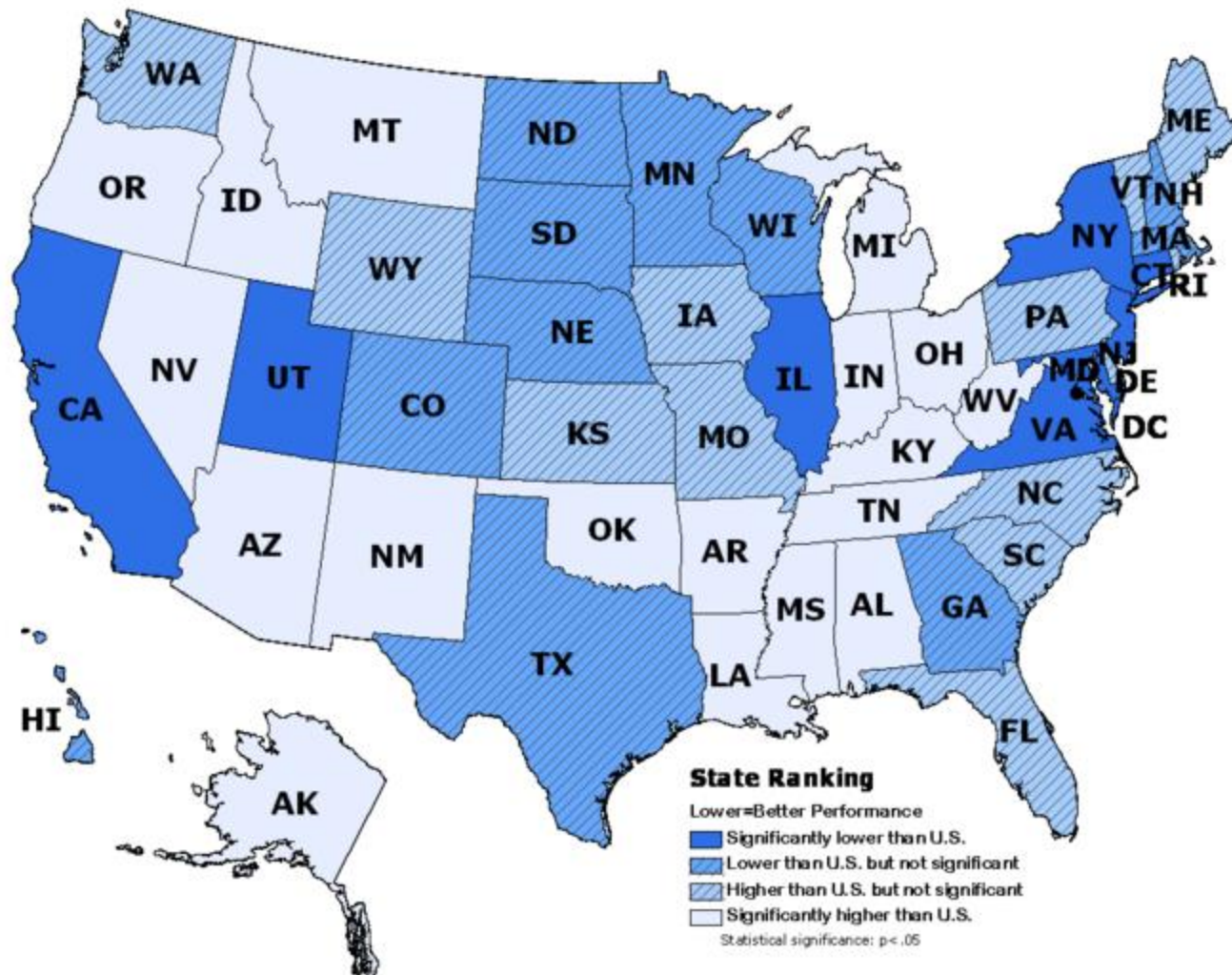
Adverse Childhood Experiences

Percent of children who have had two or more adverse childhood experiences

2011/12 National Survey of Children's Health

Nationwide: 22.6% of children met indicator

Range Across States: 16.3% to 32.9%



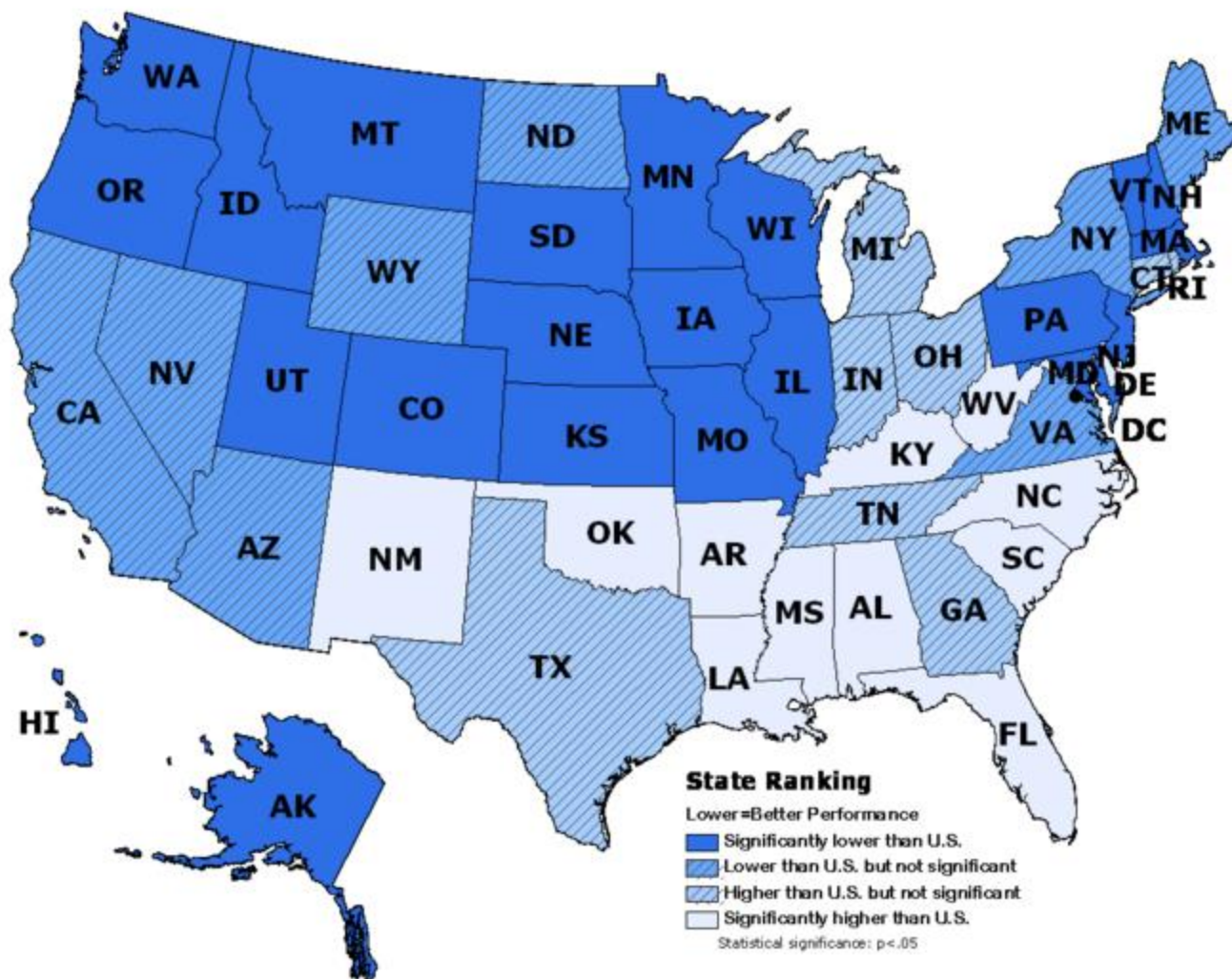
Repeating a Grade

Percent of children who have repeated at least one grade (age 6-17)

2011/12 National Survey of Children's Health

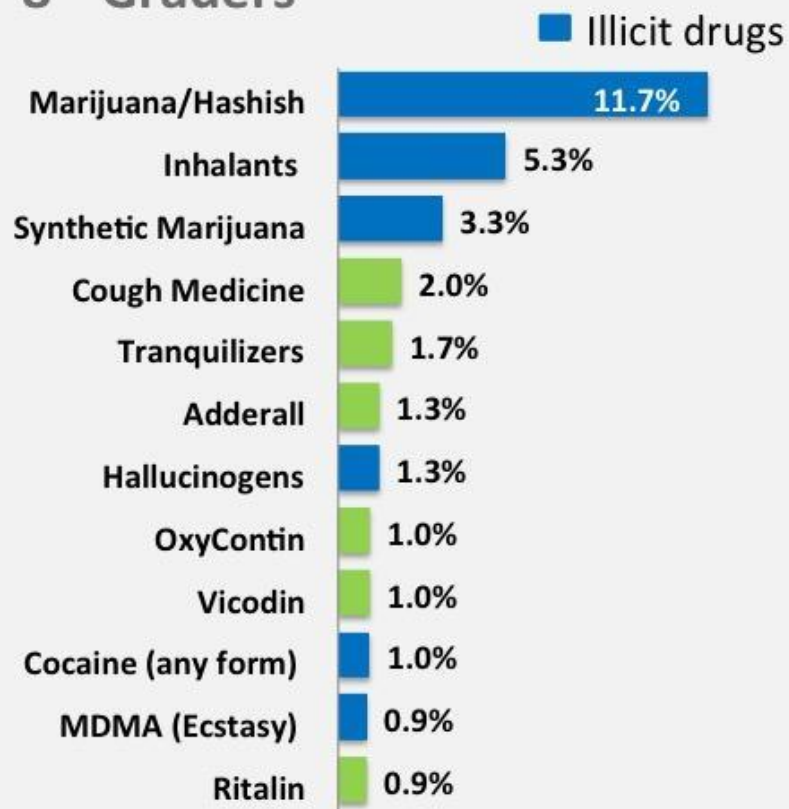
Nationwide: 9.1% of children met indicator

Range Across States: 2.9% to 23.0%

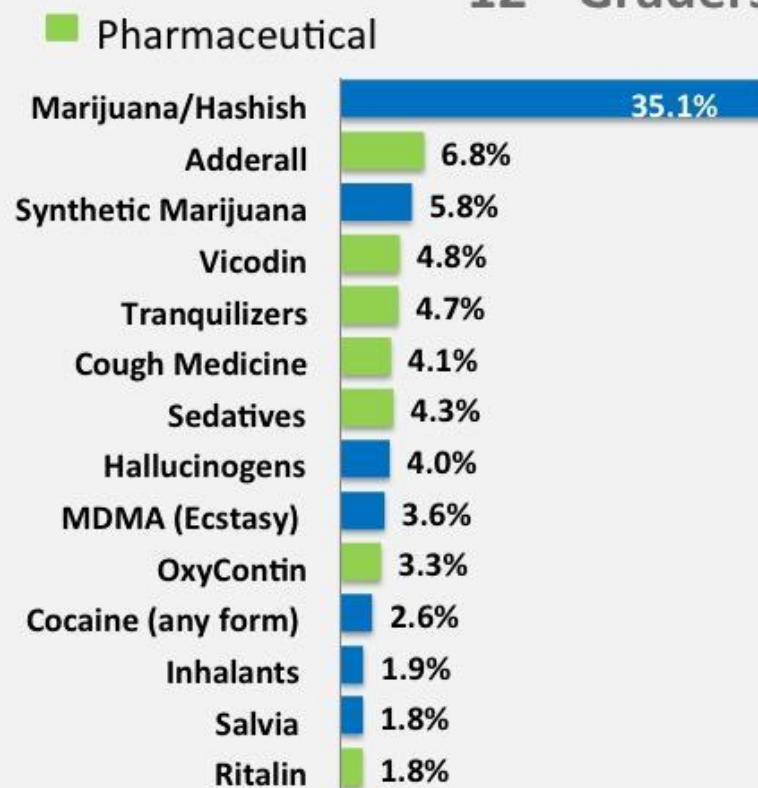


Top Drugs among 8th and 12th Graders, Past Year Use

8th Graders



12th Graders



* Only 12th graders surveyed about sedatives use

Source: University of Michigan, 2014 Monitoring the Future Study

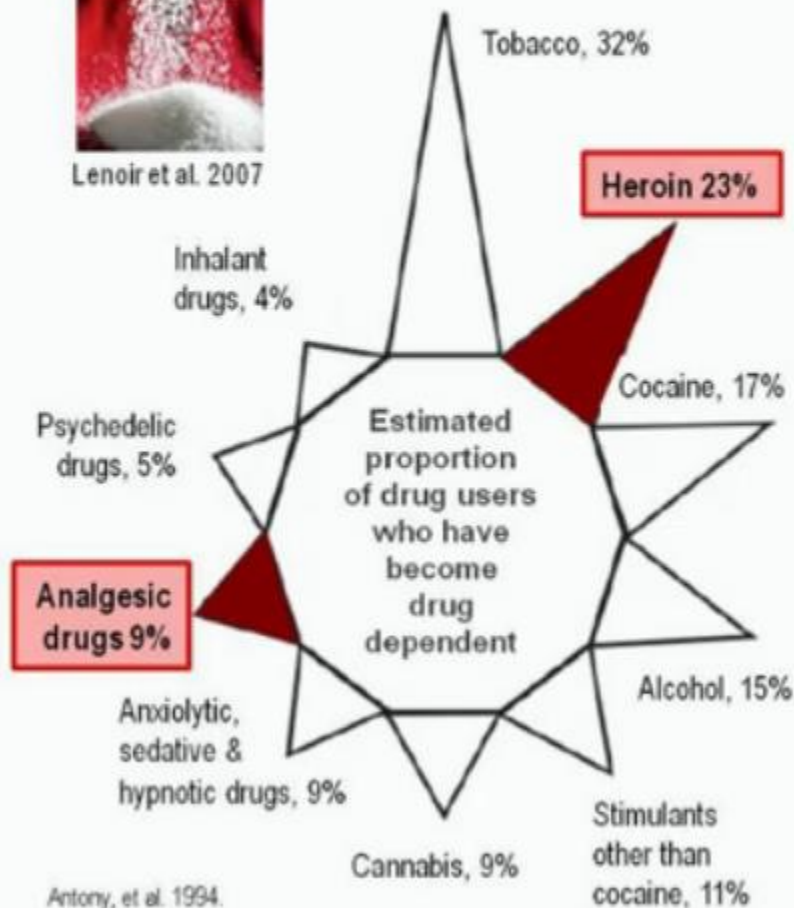
Who will develop aberrant behaviour?



Sugar, rats, 94%



Lenoir et al. 2007



Addiction: interaction GxExS

Opoid painkillers

US: **16% of non-medical users become dependent**

Norway, weak opiod: **0.3%** and **0.08–0.5%** of new users develop prescription patterns indicating persistent opiod use and problematic opiod use

Vulnerability

For all prescription drugs

- Higher risk if starts at an **early age**
- 42% (< 13 years) vs 17% (> 21 years)

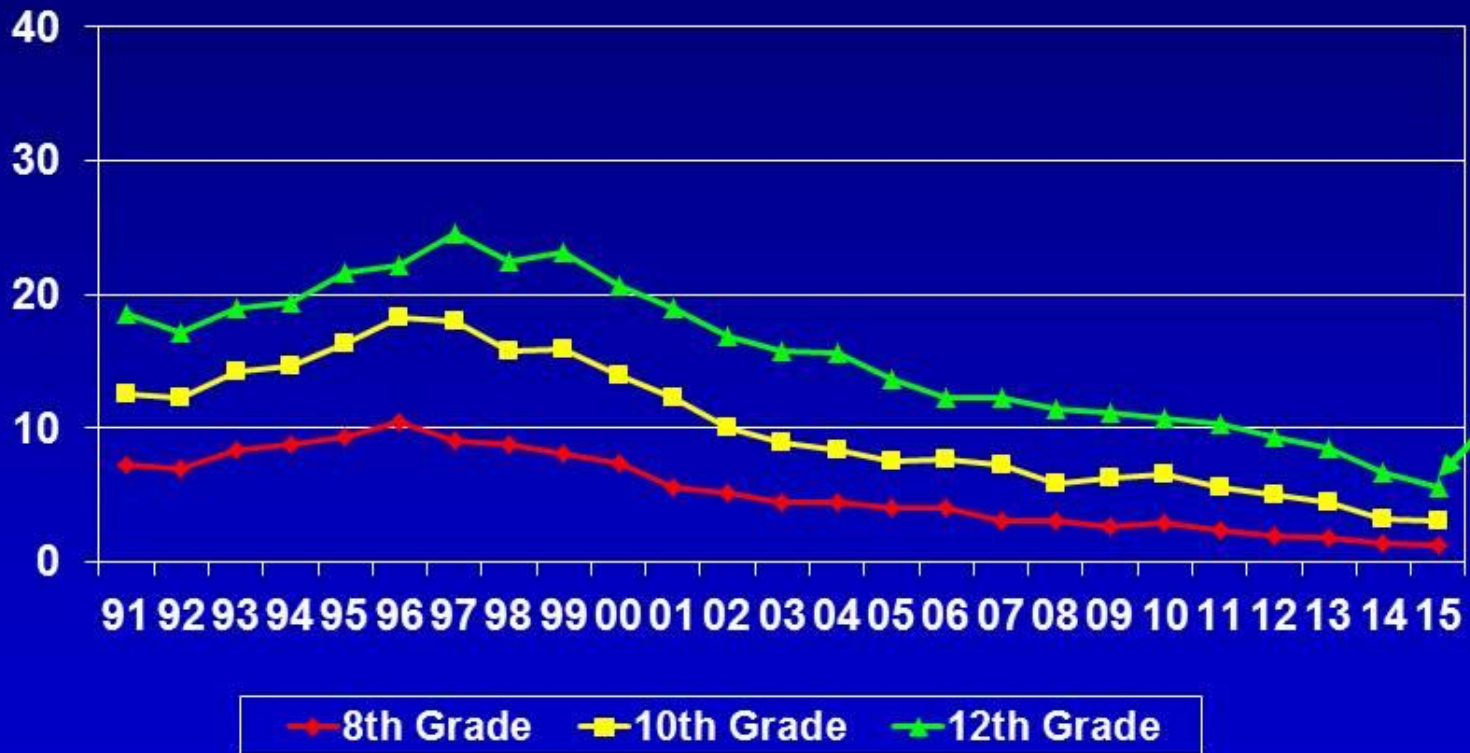
Genetics, comorbidities:

- other addictions, psychiatric, pain, and sleep disorders

E

Role of the environment

Percent of Students Reporting Daily Cigarette Use, by Grade

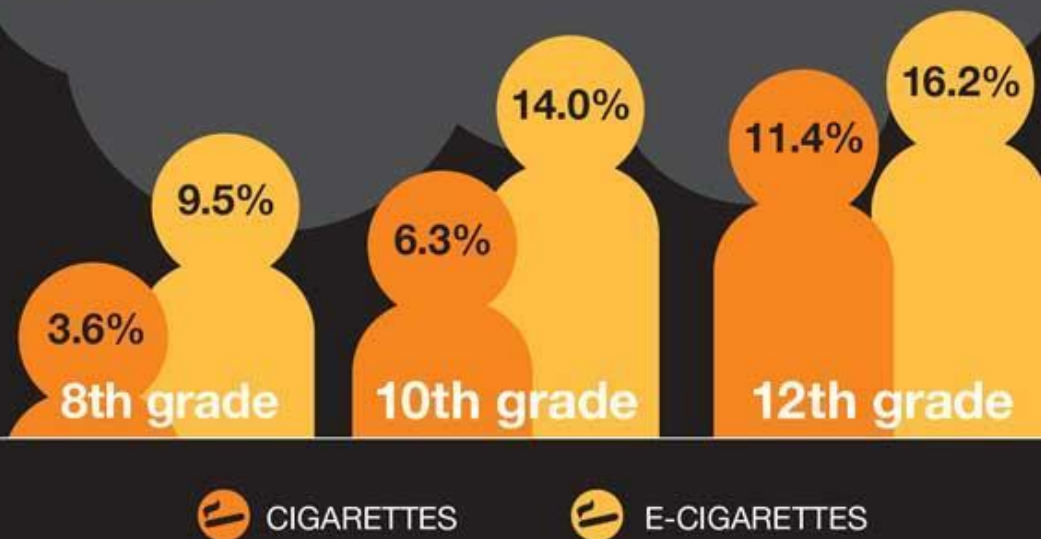


↑ Denotes significant difference between 2014 and 2015

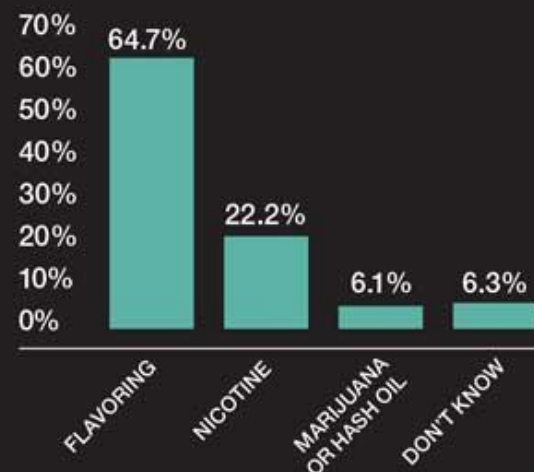
SOURCE: University of Michigan, 2015 Monitoring the Future Study

TEENS ARE MORE LIKELY TO USE E-CIGARETTES THAN CIGARETTES

*Past-month use



64.7% of 12th graders reported vaporizing “just flavoring” in their last e-cigarette; some didn’t know what they inhaled. E-cigs are unregulated so flavored liquid might actually contain nicotine.

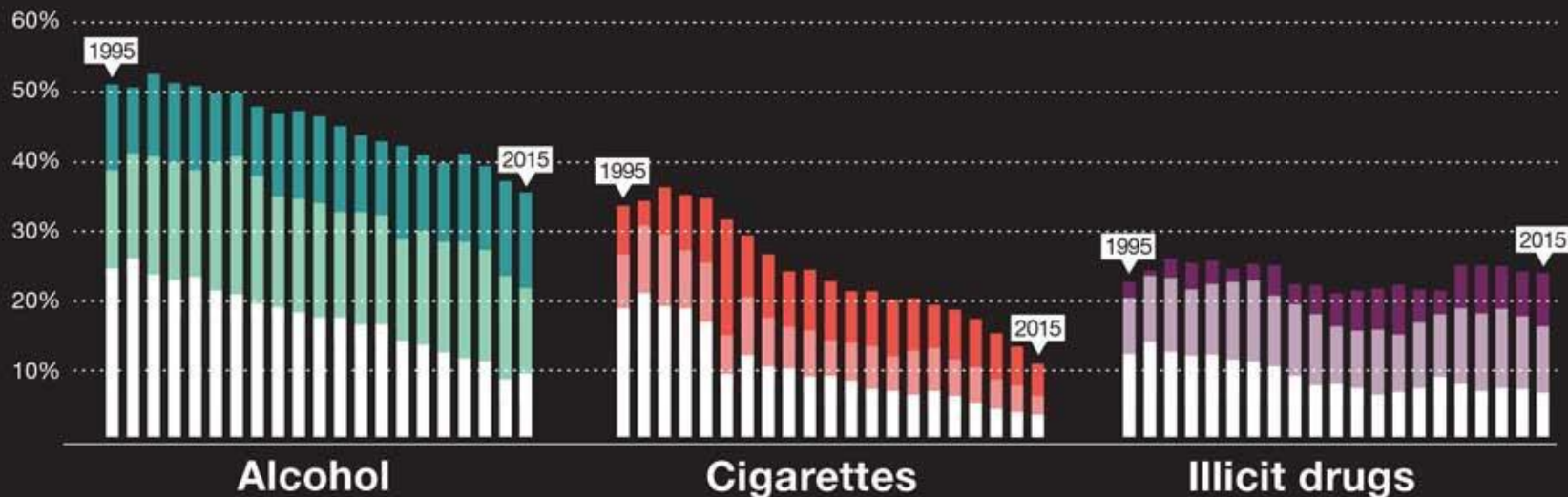


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LAST TWO DECADES OF ALCOHOL, CIGARETTE, AND ILLICIT DRUG USE*




*Past-month use



2015

 35.3% OF 12TH GRADERS
 21.5% OF 10TH GRADERS
 9.7% OF 8TH GRADERS

 11.4% OF 12TH GRADERS
 6.3% OF 10TH GRADERS
 3.6% OF 8TH GRADERS

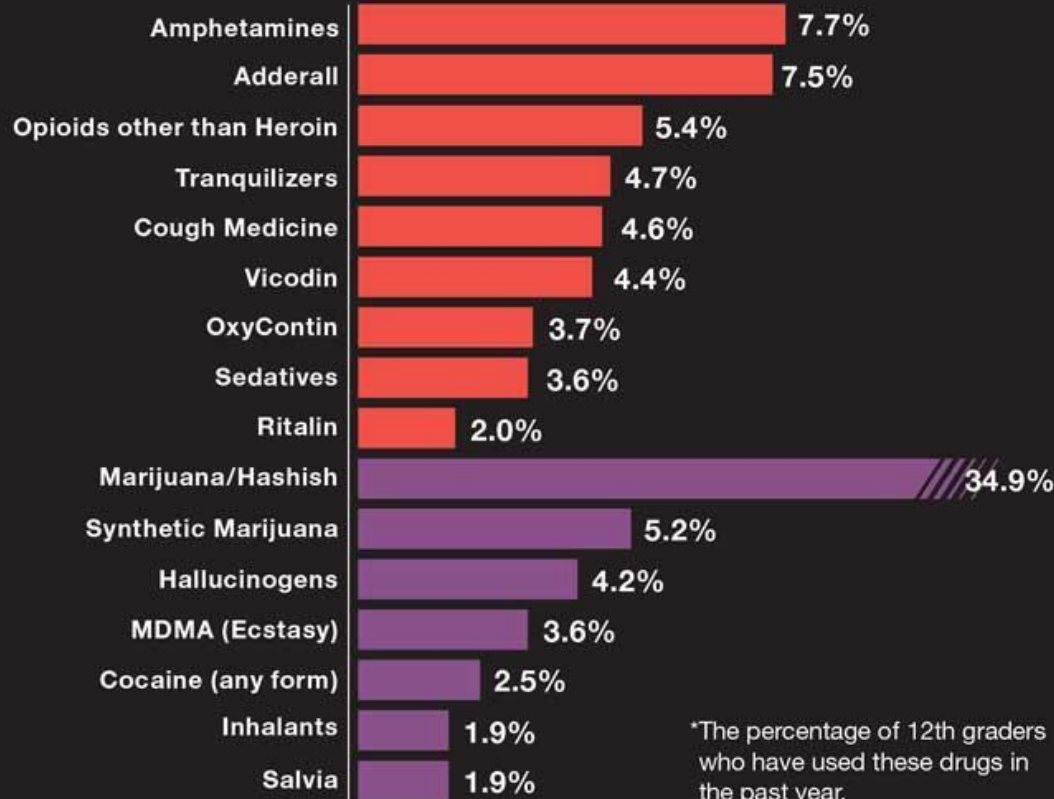
 23.6% OF 12TH GRADERS
 16.5% OF 10TH GRADERS
 8.1% OF 8TH GRADERS



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PRESCRIPTION/OVER-THE-COUNTER VS. ILLICIT DRUGS*



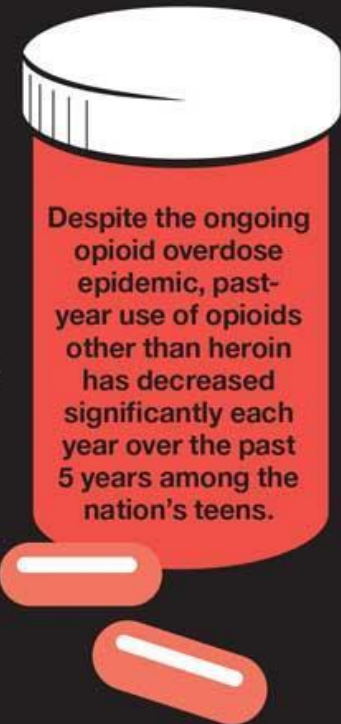
*The percentage of 12th graders who have used these drugs in the past year.



PRESCRIPTION/OTC



ILLICIT DRUGS



Despite the ongoing opioid overdose epidemic, past-year use of opioids other than heroin has decreased significantly each year over the past 5 years among the nation's teens.

Heroin use has also decreased over the past 5 years and is at the lowest rate since the MTF survey began.

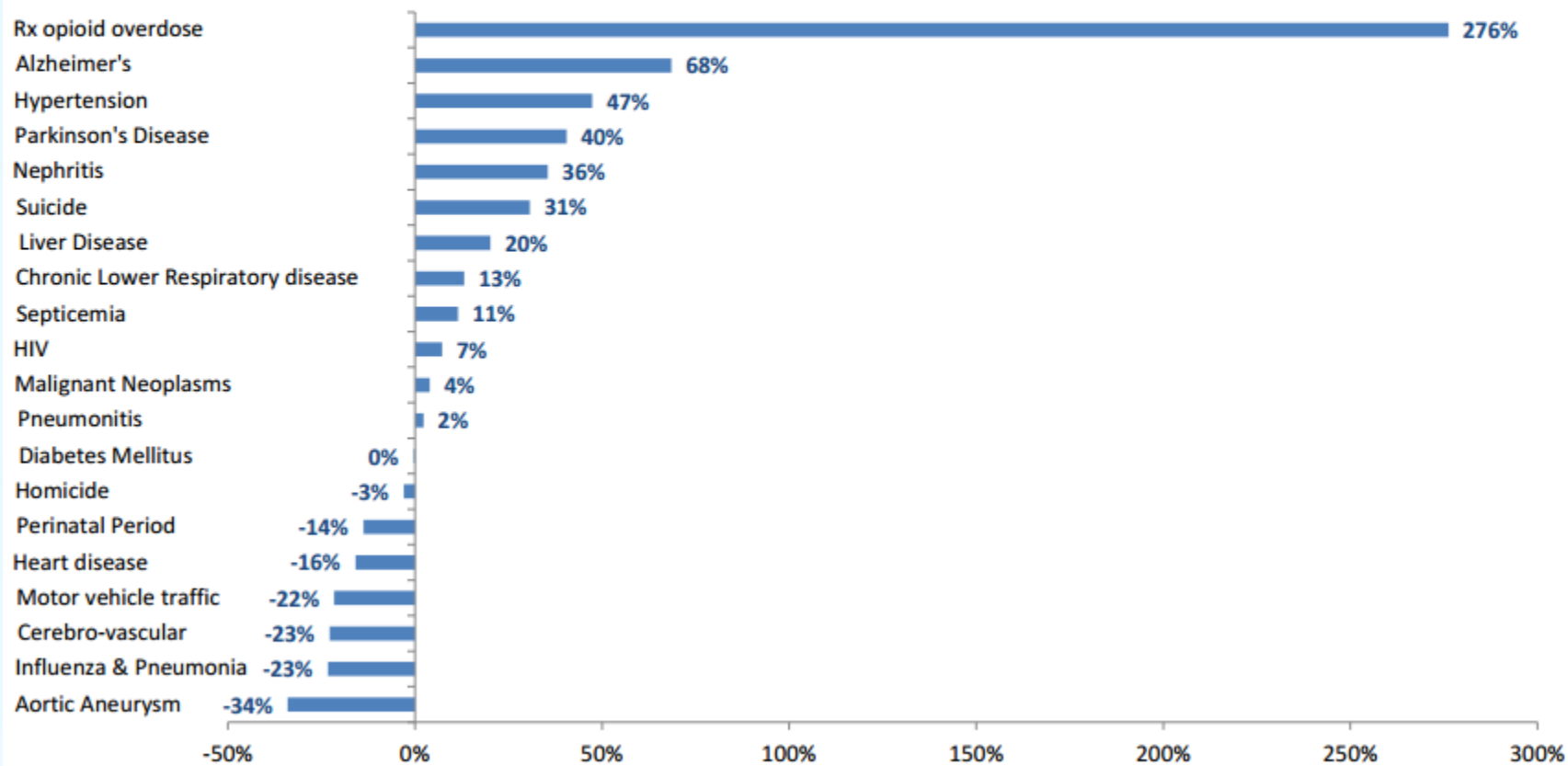


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Opioid pain reliever-related overdose deaths increasing at a faster rate than deaths from any major cause

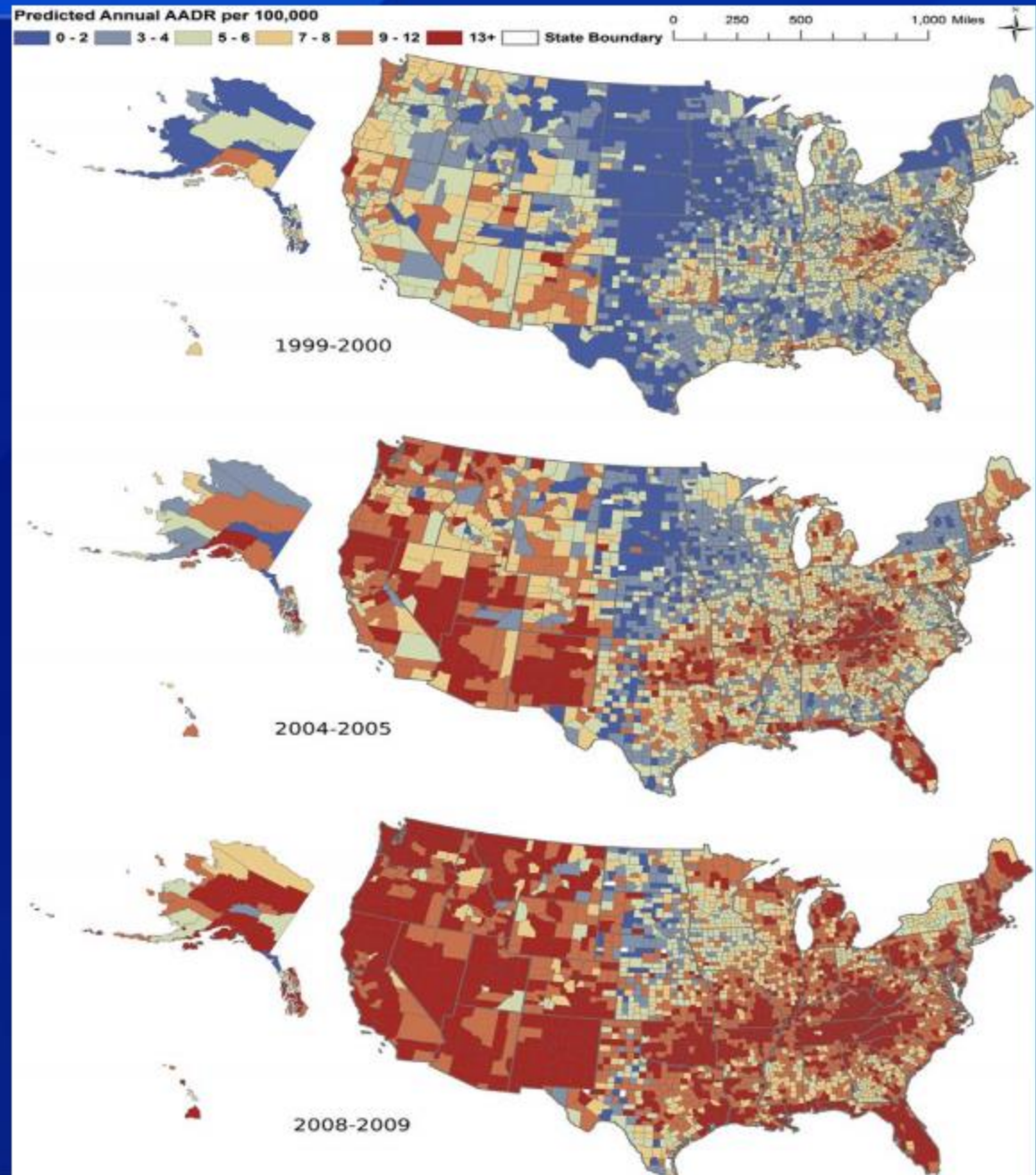
% change in number of deaths, United States, 2000-2010



Predicted Age-Adjusted Death Rates due to Drug Poisoning:

1999-2000
2004-2005
2008-2009

Source: Rossen et al,
2013 , AJPM

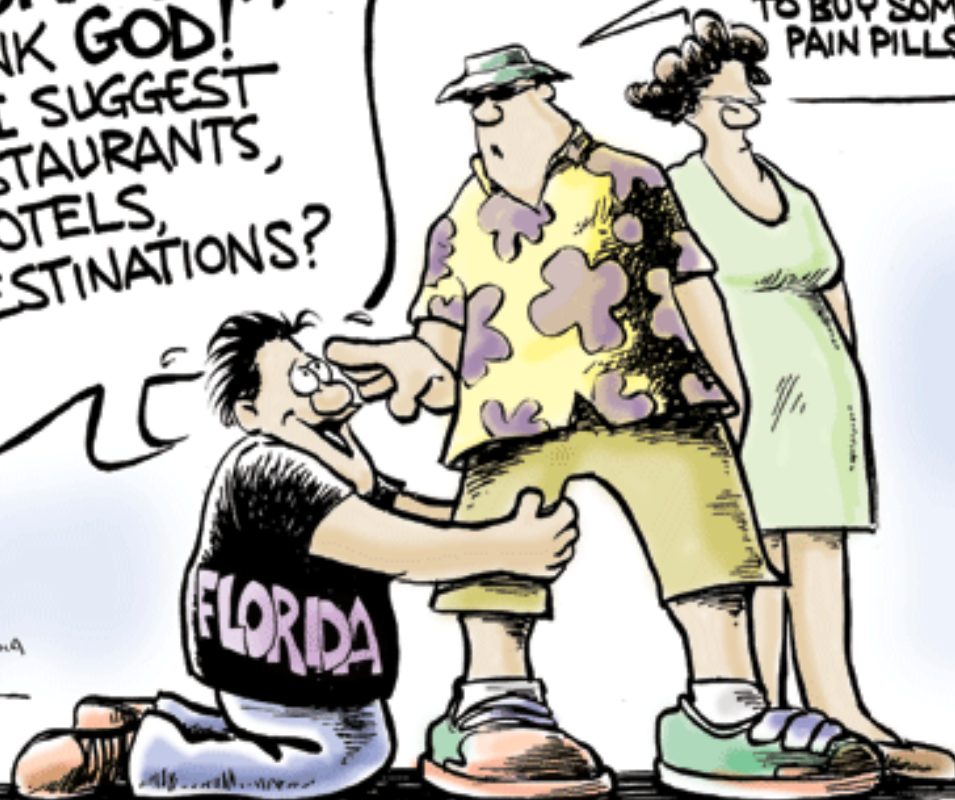




TOURISTS!!
THANK GOD!!
MAY I SUGGEST
RESTAURANTS,
HOTELS,
DESTINATIONS?

WE'RE
JUST HERE
TO BUY SOME
PAIN PILLS.

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SOUTH FLORIDA
SUN-SENTINEL



Florida Shutting 'Pill Mill' Clinics



Tim Chapman/Miami Herald, via Associated Press

At an Aug. 15 news conference, Florida officials displayed prescription drugs that were surrendered to the state by pain clinics.

By LIZETTE ALVAREZ

Published: August 31, 2011

WEST PALM BEACH, Fla. — Florida has long been the nation's center of the illegal sale of prescription drugs: Doctors here bought 89 percent of all the Oxycodone sold in the country last year. At its peak, so many out-of-staters flocked to Florida to buy drugs at more than 1,000 pain clinics that the state earned the nickname "Oxy Express."

Related

Times Topics: OxyContin (Drug)
| Prescription Drug Abuse

[Enlarge This Image](#)



Joe Raedle/Getty Images

Florida Gov. Rick Scott attends a

But with the help of tougher laws, officials have moved aggressively this year to shut down so-called pill mills and disrupt the pipeline that moves the drugs north. In the past year, more than 400 clinics were either shut down or closed their doors.

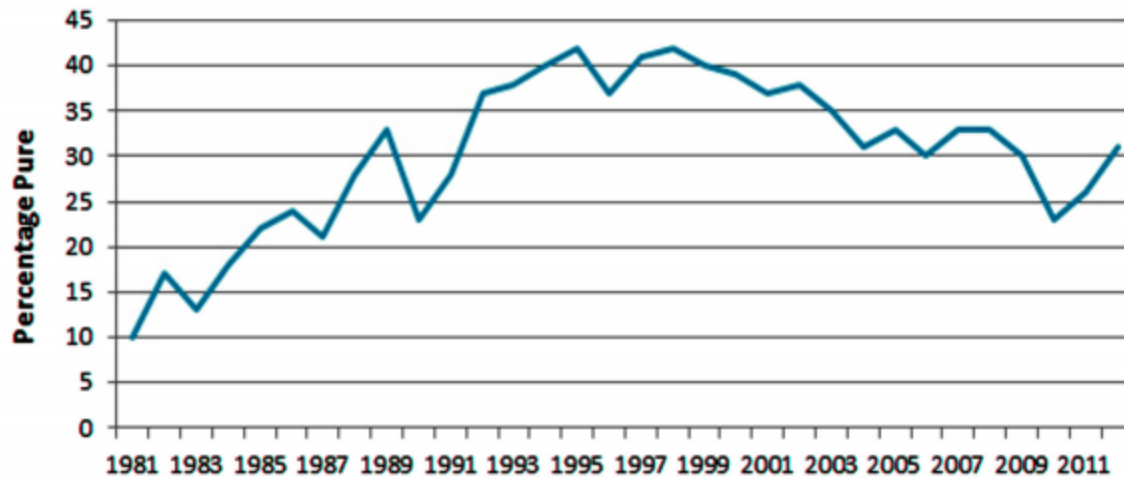
Prosecutors have indicted dozens of pill mill operators, and nearly 80 doctors have seen their licenses suspended for prescribing mass quantities of pills without clear medical need.

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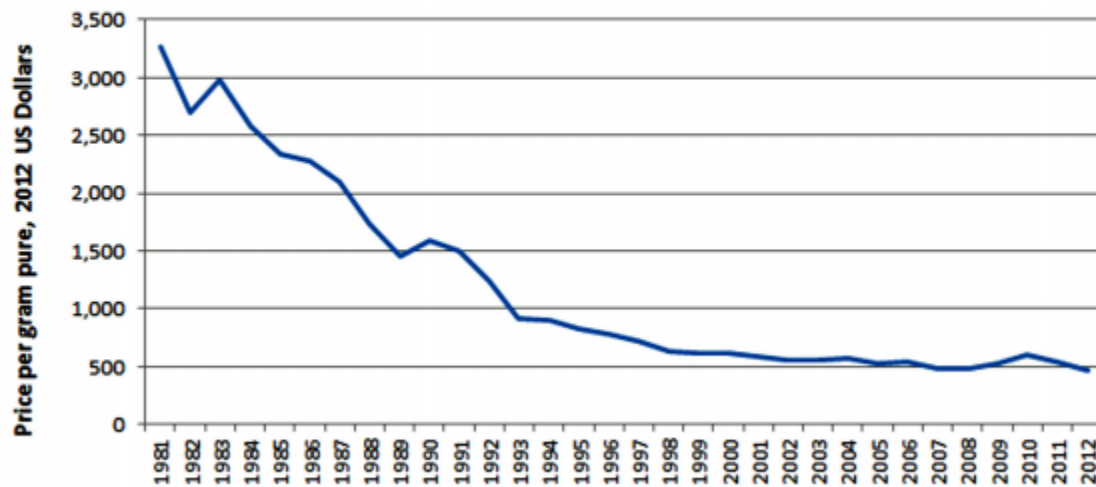


(U) Chart 5. Retail-level Average Purity of Heroin in the United States, 1981 to 2012



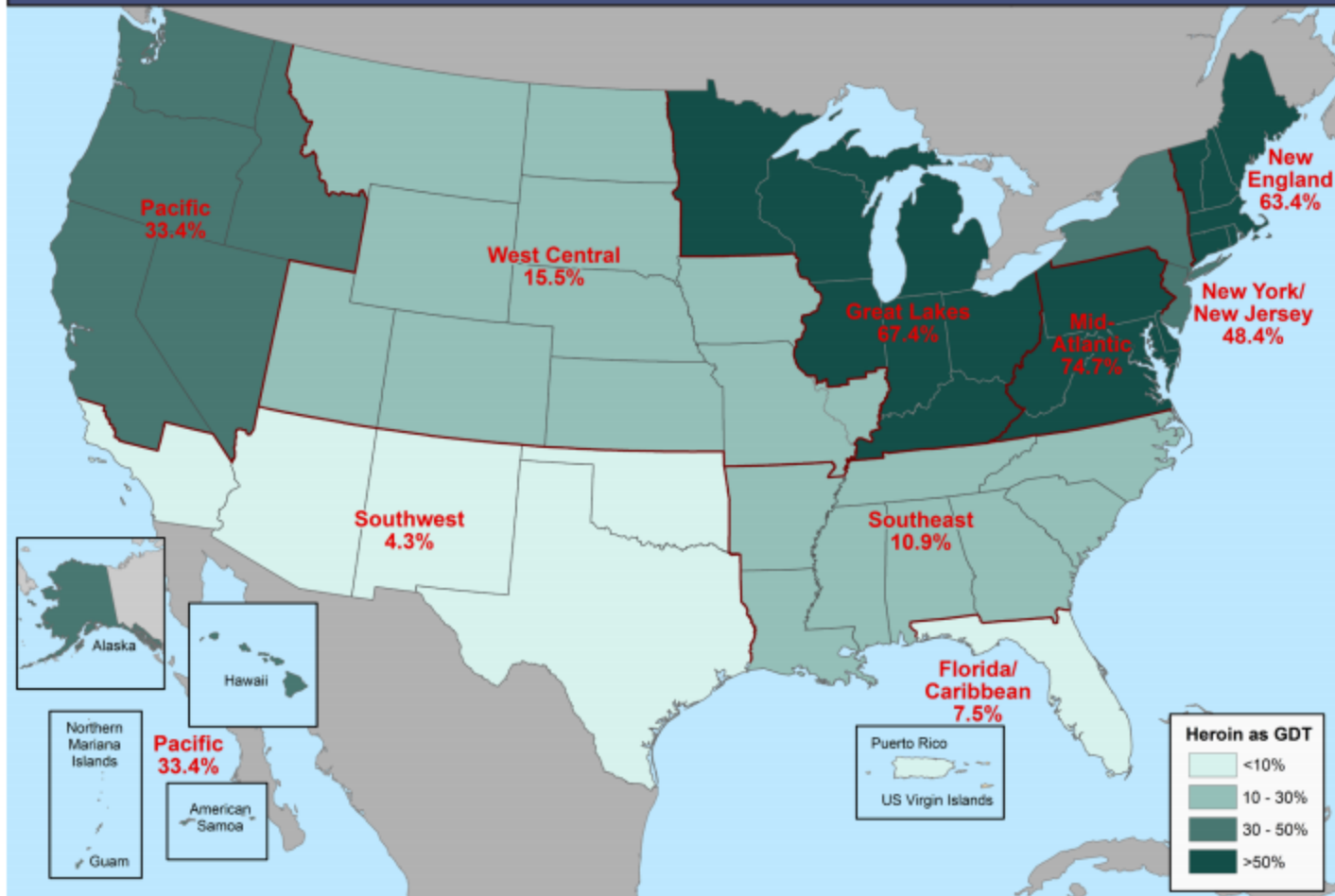
Source: Institute for Defense Analyses and ONDCP

(U) Chart 6. Retail-level Average Price Per Gram Pure, for Heroin in the United States, 1981 to 2012



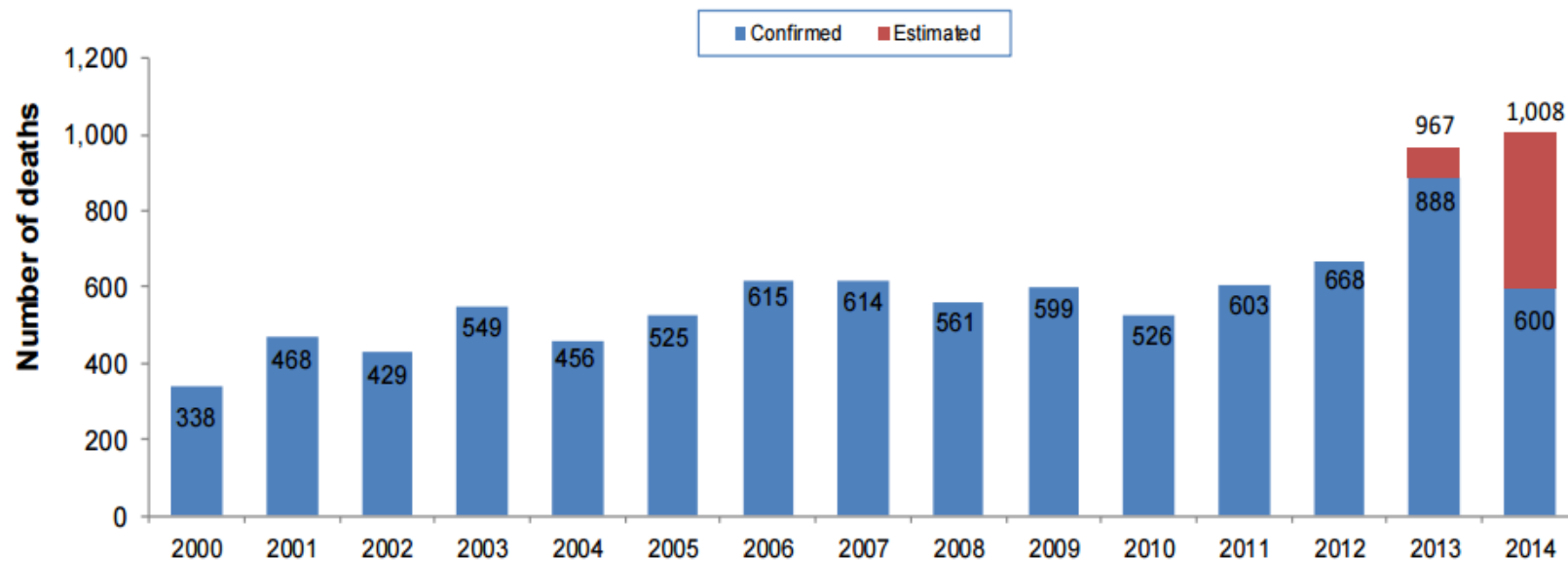
Source: Institute for Defense Analyses and ONDCP

(U) Map 2. Percentage of 2015 NDTs Respondents Reporting Heroin as Greatest Drug Threat, by OCDETF Region

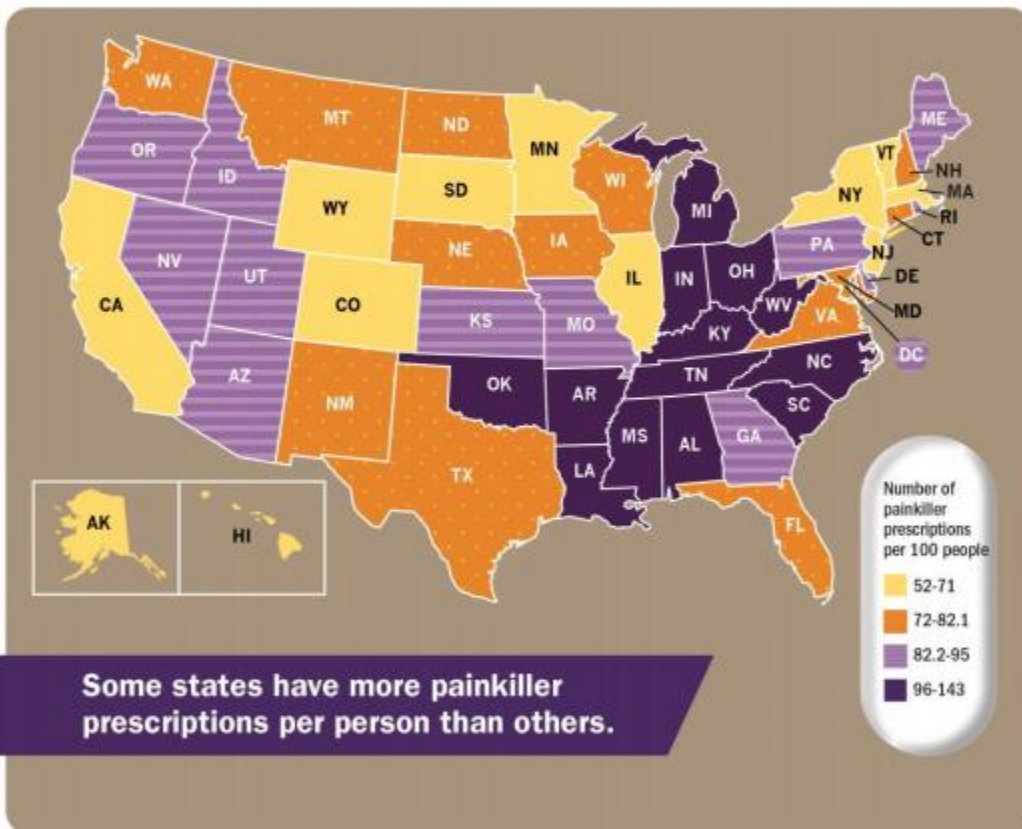


Source: 2015 National Drug Threat Survey

Opioid-Related Deaths, Unintentional/Undetermined Massachusetts: 2000-2014



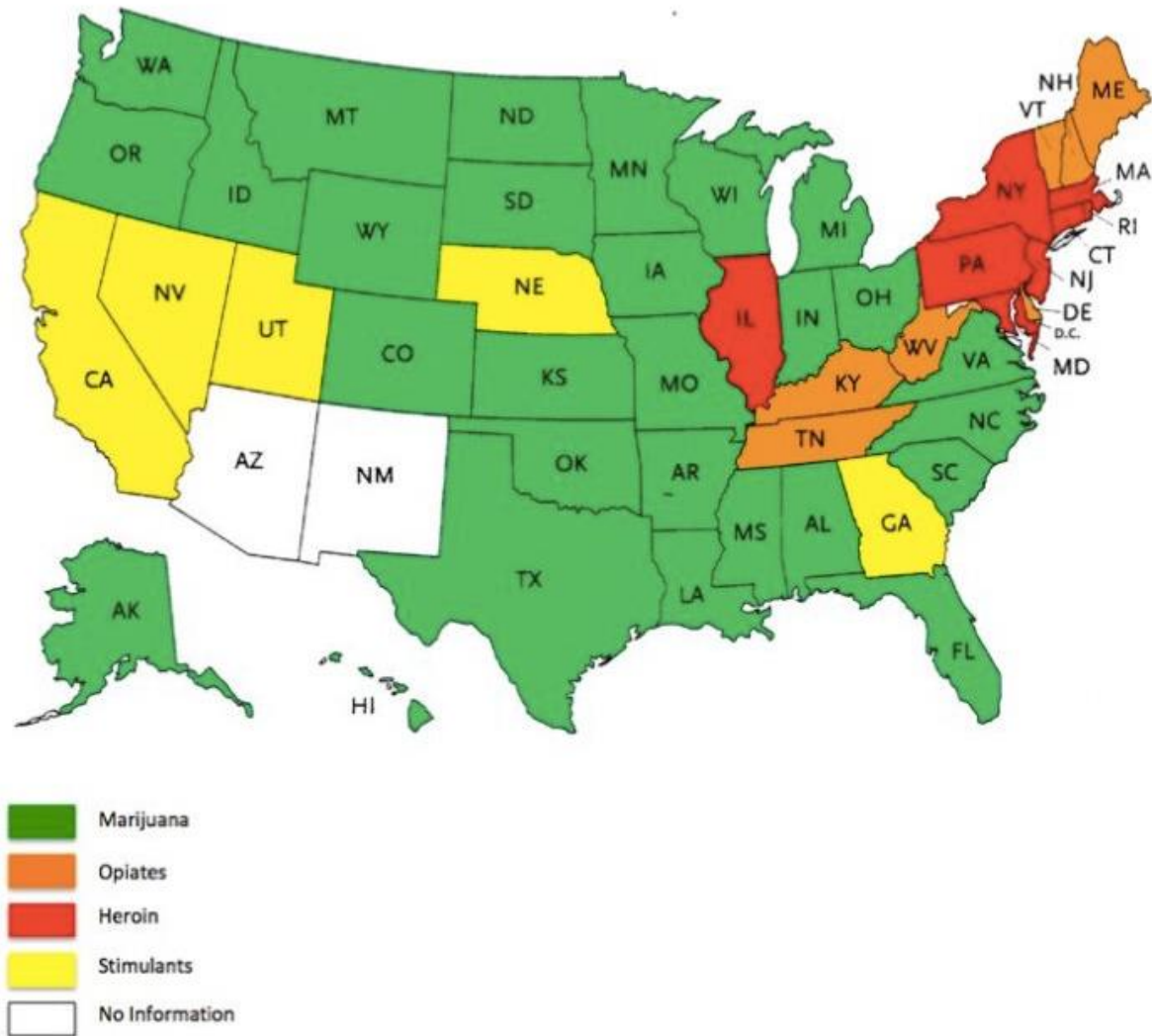
Opioid pain reliever prescribing rates vary by state



SOURCE: CDC Vital Signs, July 2014. cdc.gov/vitalsigns.

6. A large part of the problem has been the rise of of painkillers and heroin, especially in the Northeast.

(Map shows the drug most commonly cited in drug treatment admissions in each state)



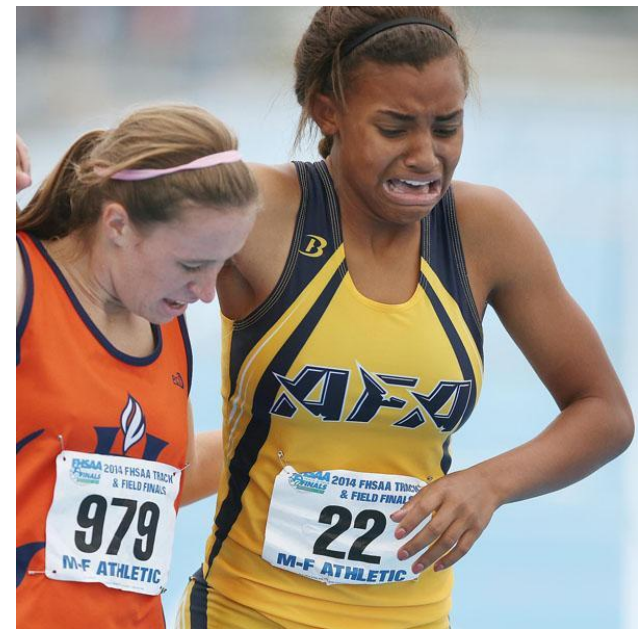
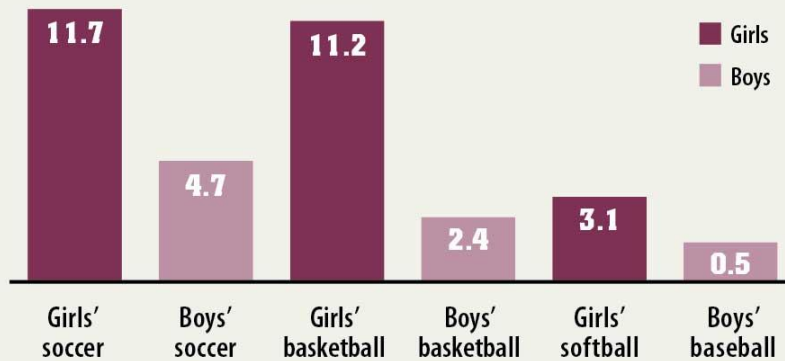


FIGURE 2 High school ACL injury rates

High school anterior cruciate ligament (ACL) injury rates per 100,000 athlete exposures (AEs) by sport and sex. (An athlete exposure is 1 athlete participating in 1 practice or competition.)



Adapted from Comstock RD, et al.³



Signs and Symptoms at School

Small or “pinpoint” pupils

An overall unhealthy look

Weight loss

Vomiting

Constipation

“Nodding off” to sleep

Laxative use

In females, not getting a period

Depression

Signs at Home

More time spent away from home

Frequent, secret phone calls

Trouble with the police

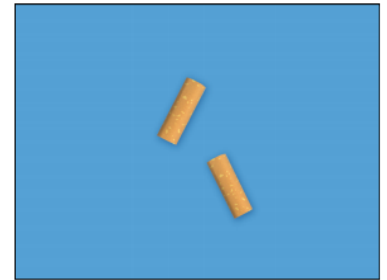
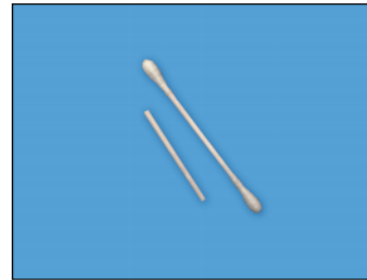
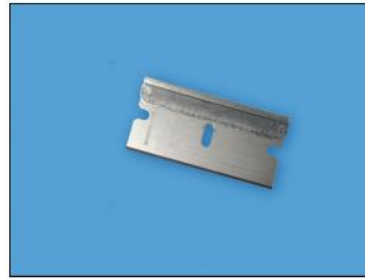
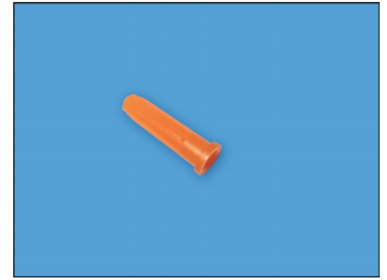
Missing money, credit cards, and/or valuables

Pawn slips

Purchases returned for refunds

Small plastic Ziploc bags

Bottles of vinegar and bleach and cotton balls



Patient Education Videos

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Welcome to PrescribeToPrevent.org

Here you will find information you need to start prescribing and dispensing naloxone (Narcan) rescue kits, including some useful resources containing further information about this life-saving medicine. We are prescribers, pharmacists, public health workers, lawyers, and researchers working on overdose prevention and naloxone access. We compiled these resources to help health care providers educate their patients to reduce overdose risk and provide naloxone rescue kits to patients.

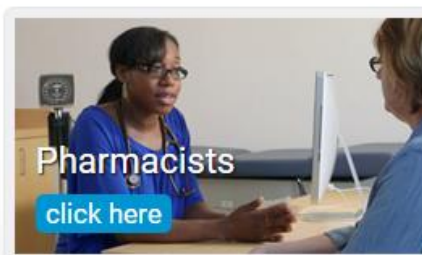
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OVERDOSE PREVENTION PROGRAMS

Find the nearest overdose prevention and naloxone program.

Find a program

[click here](#)



Opioid Safety and How to Use Naloxone



Overdose prevention and response instructions



Overdose prevention and response instructions-
American Society of Anesthesiologists



NYC Dept. of Health, "Take Care, Take Charge", Safety
Tips for People Who Use or Inject Drugs

SAMHSA



SAMHSA Opioid Overdose Toolkit

Facts for Community Members; Five Essential Steps
for First Responders; Information for Prescribers;
Safety Advice for Patients & Family Members;
Recovering from Opioid Overdose- updated 2014



Federal Guidelines for Opioid Treatment Programs

NEW AMERICAN EDITION OF THE
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"A riveting account of human cravings, this book needs to get into as many hands as possible. Maté's resonant, unflinching analysis of addiction today shatters the assumptions underlying our War on Drugs."

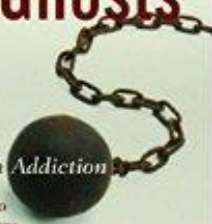
—Nora Stanger, former Seattle Chief of Police and author of *Breaking Bonds: A Top Cop's Exposé of the Dark Side of American Policing*

GABOR MATÉ, MD

In the Realm of Hungry Ghosts

Close Encounters with Addiction

Foreword by PETER A. LEVINE, PhD
author of *Waking the Tiger: Healing Trauma*



THE BODY KEEPS THE SCORE

BRAIN, MIND, AND BODY
IN THE HEALING OF TRAUMA



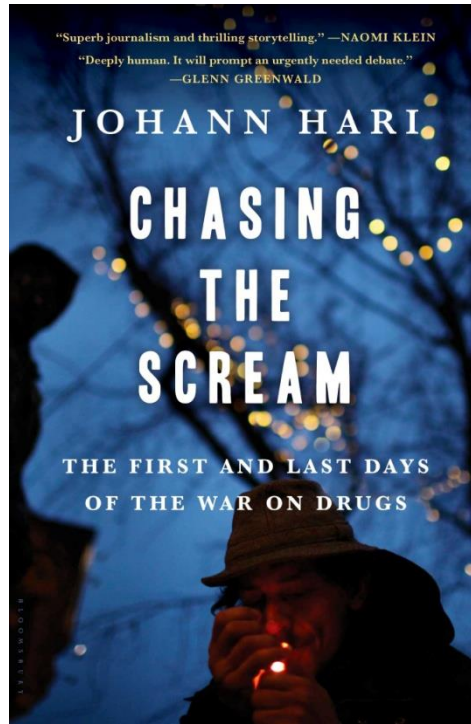
BESSEL VAN DER KOLK, MD

"Superb journalism and thrilling storytelling." —NAOMI KLEIN
"Deeply human. It will prompt an urgently needed debate."
—GLENN GREENWALD

JOHANN HARI

CHASING THE SCREAM

THE FIRST AND LAST DAYS
OF THE WAR ON DRUGS



The relentless marketing of pain pills.
Crews from one small Mexican town
selling heroin like pizza. The collision has
led to America's greatest drug scourge.

The True Tale of America's Opiate Epidemic

DREAM LAND



SAM QUINONES