

# The Downsides of Colorado's “Social Experiment”



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# Disclosures

- No relationship with any pharmaceutical or marijuana company
- The Circle Program, of which I am the medical director, receives funding, in part, from medical marijuana tax proceeds



As a result of proceeding to legalize a substance that we really know very little about and did not prepare for adequately, there have been many

## **UNINTENDED CONSEQUENCES**

# The Primary Problem

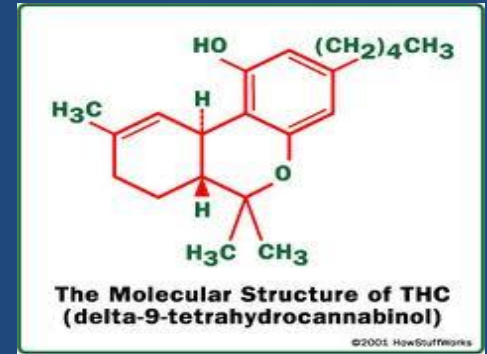
- Advocates for the legalization of medical and retail marijuana – are quick to point out all possible benefits – money, jobs, medical benefits
- But they use the words “cannabis” or “marijuana” for everything
- And we have to be clear what they are talking about

# These are all “cannabis” but have very different effects on the mind/body

- Hemp – “green” plant with multiple uses (variety of Cannabis sativa plant < 1% THC)
- CBD – the non-psychoactive component – medicinal benefits – perhaps even low dose THC has medicinal benefits - but more research needed
- High Potency THC – the psychoactive component that is much higher concentration than what was available in the past

# Cannabis

- Complex alkaloid mixture of more than 400 compounds
- At least 60 different compounds described with activity on the cannabinergic system in the body
- Most abundant cannabinoids are
  - Delta-9 tetrahydrocannabinol (most psychoactive)
  - Cannabidiol
  - Cannabinol
- Effect first discovered in 1963 by Raphael Mechoulam in Israel
  - he injected THC into aggressive rhesus monkeys – they became calm and sedated



# Cannabis Sativa versus Indica



# Difference

- In General: Cannabis indica strains have higher THC:CBD ratio and Cannabis sativa have higher CBD:THC ratios
- However there is huge variability and multiple hybrids
- And both strains have THC, with a seeming goal of growers to continually increase the potency of the THC

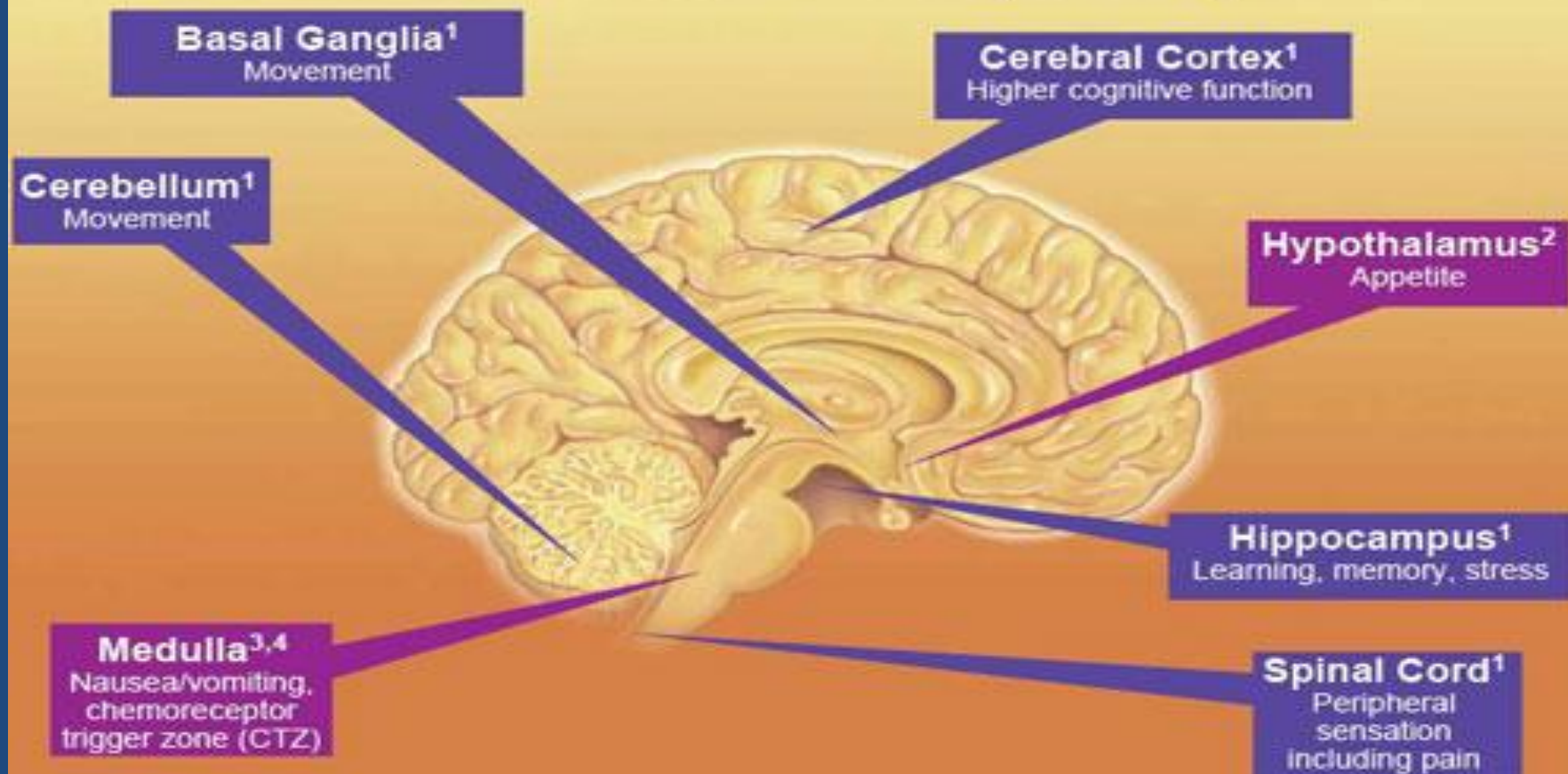
# Cannabinergic system

- Two main cannabis receptors
- CB1—present throughout CNS
  - Hippocampus
  - Cortex
  - Olfactory areas
  - Basal ganglia
  - Cerebellum
  - Spinal cord
- CB2 — located peripherally, linked with immune system
  - Spleen
  - Macrophages



Anandamides discovered in 1992 – “supreme joy”

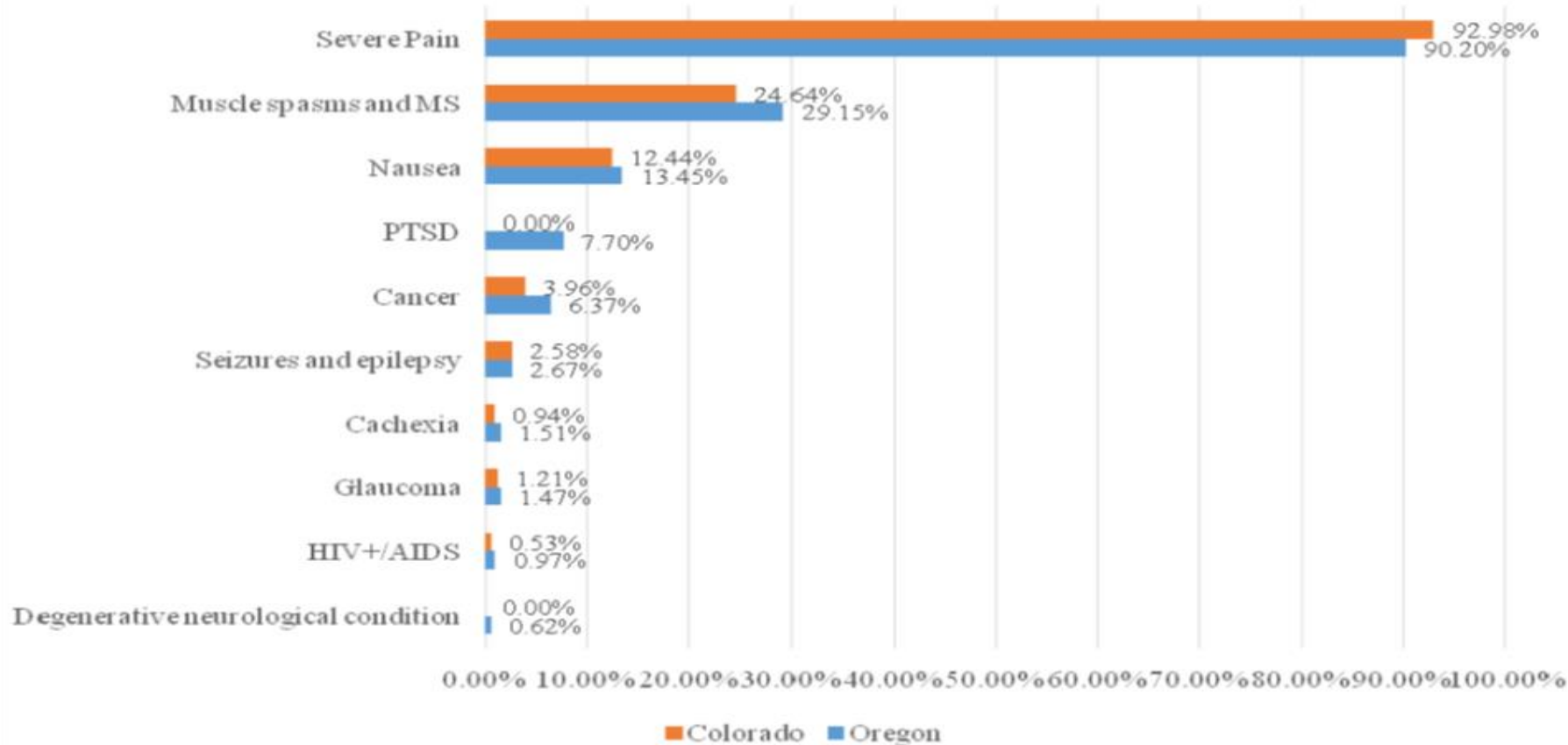
# Concentrations of CB<sub>1</sub> receptors



1. Joy JE, et al, eds. *Marijuana and Medicine: Assessing the Science Base*. Washington, DC: National Academy Press, 1998:33-81. 2. Martin BR, et al. *J Support Oncol*. 2004;2(4):305-316. 3. Grotenherven F. *Curr Drug Targets CNS Neurol Disord*. 2005;4(5):507-530. 4. Navari RM, et al. *Expert Opin Emerg Drugs*. 2006;11(1):137-151.

# Colorado History with Marijuana

- **November 2000**
  - Coloradoans passed Amendment 20 legalizing medical marijuana
- **September 2009**
  - 19,691 new patient applications received since June 2001, 17,356 patients with valid ID cards
- **October 2009 – Flood Gates Opened**
  - Obama administration “will not seek to arrest medical marijuana users and suppliers as long as they conform to state laws “
  - December 2009 – 41,039 valid licenses
  - December 2013 – 110,979 valid licenses
- **November 2012 – voters passed amendment 64**
- **January 2014 – Doors opened for recreational marijuana (First State in the US)**
  - - December 2014 – 115,467 valid licenses for medical marijuana



Number of medical cannabis patients in Colorado and Oregon in July 2016.

NOTE: Patients may report multiple qualifying ailments

SOURCES: Adapted from CDPHE, 2016; OHA, 2016.

This is in spite of the fact that:

There is a dearth of rigorous research on the effects of marijuana for the most common conditions for which it is recommended

# Cannabinoids for Medical Use

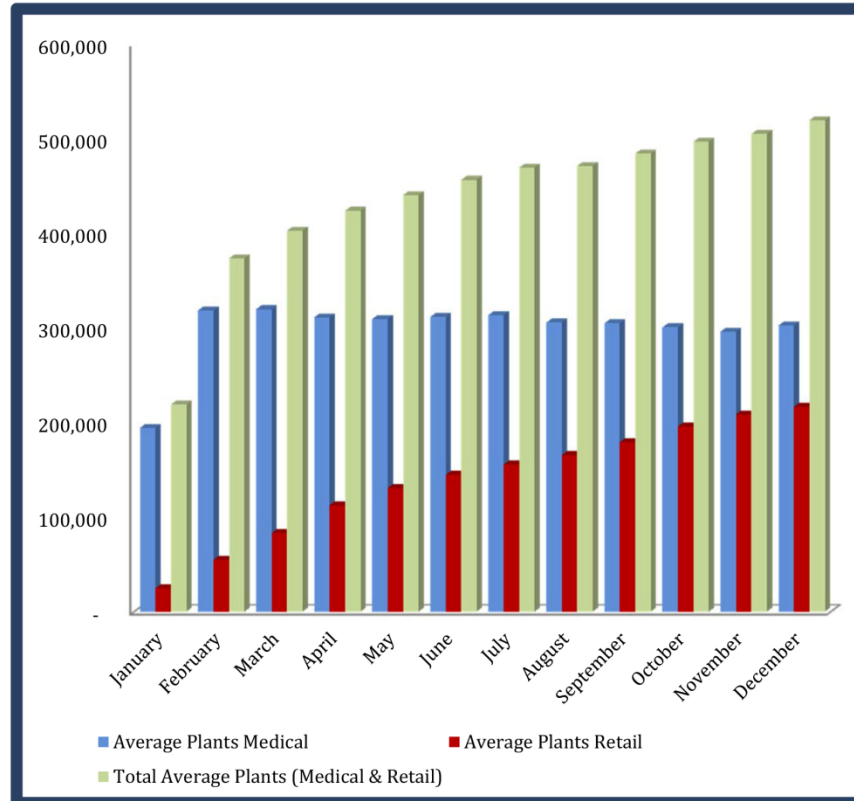
A systematic review and meta-analysis

Whiting et al. JAMA 2015;313:2456-2473

- 79 trials (6462 participants) only 4 judged at low risk of bias, 55 high risk of bias (incomplete outcome data, substantial withdrawals)
- Compared with placebo, cannabinoids were associated with greater response for
  - Nausea/vomiting (47% vs 20%)
  - Reduction in pain (37% vs 31%)
  - Reduction in spasticity
  - Most all trials not reaching statistical significance

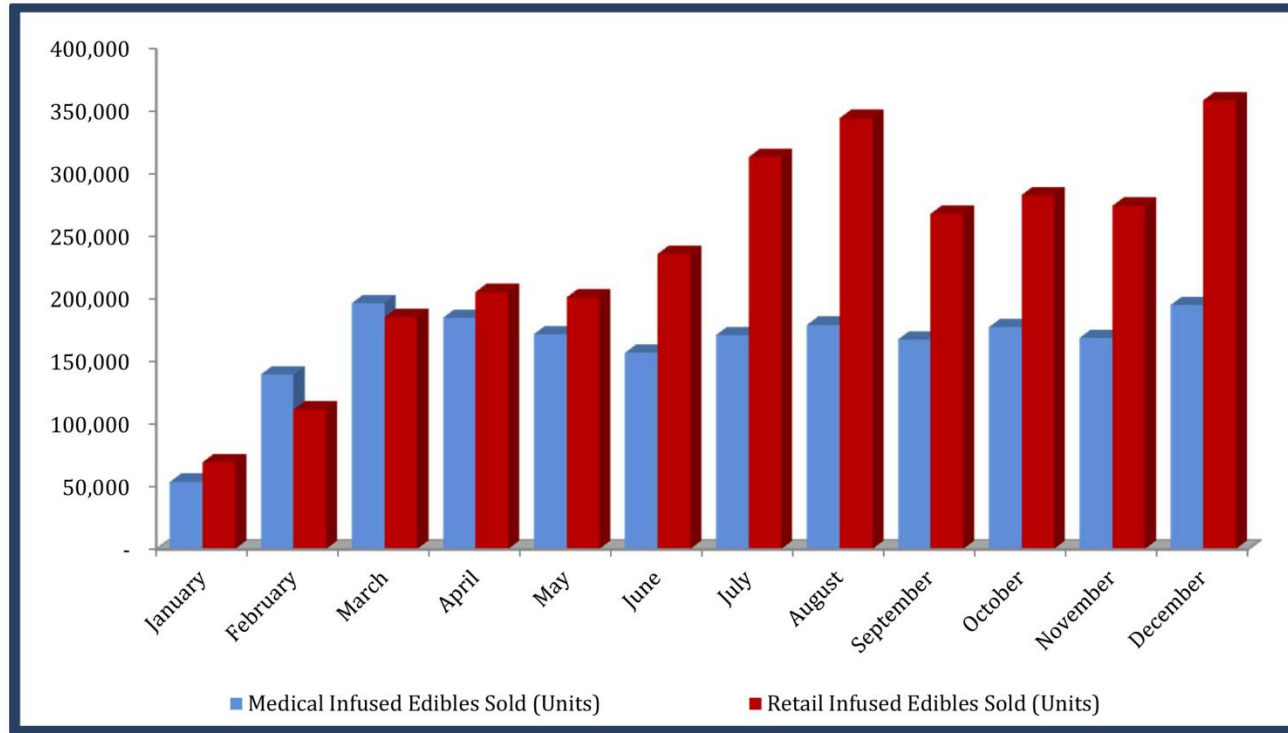
# Increase in MJ plants in Colorado in 2014

Table 6



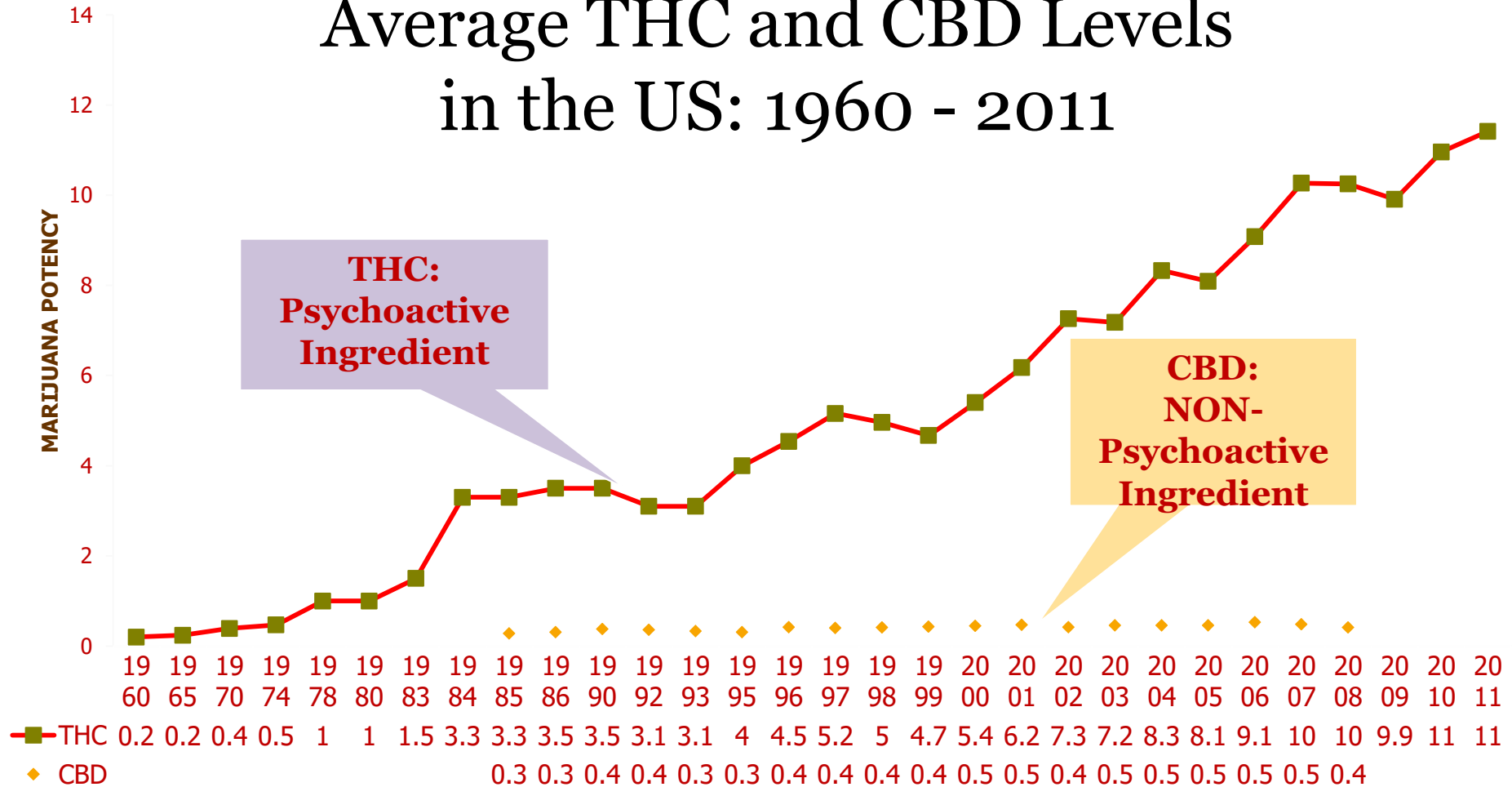
**Colorado  
Department  
of Revenue**

# Increase in Edibles in 2014



“For entry-level stoners, buying something that looks like a gummy bear or chocolate bar is a lot less of a psychological barrier than choosing between jars of bud with names like Raskal’s White Super Chunk and Fort Collins Cough.”  
[www.wired.com](http://www.wired.com)

# Average THC and CBD Levels in the US: 1960 - 2011



# THC Content- Not Like It Used to Be...

- 1980 THC content was less than 2%
- 1997- 4.5%
- 2006- 8.5%
- 2015- 20% or more
- MassRoots.com advertises their shatter has over 80% THC
- Dabbing concentrates this even further, sometimes inhaling near 90% THC

[http://www.who.int/substance\\_abuse/publications/msb\\_cannabis\\_report.pdf?ua=1](http://www.who.int/substance_abuse/publications/msb_cannabis_report.pdf?ua=1)

Also from MassRoots.com

# Rising THC levels turns MJ into a hard drug

Nationally, the potency of marijuana has more than tripled since the mid-1990s.

Average potency of marijuana flowers/buds in Colorado is now 17.1% THC while the average potency for concentrates is 62.1%. Potency rates of up to 95% have been recorded. [Smartcolorado.org](http://Smartcolorado.org)

After the Dutch observed negative impacts from rising THC potencies, a team of health experts concluded that THC potencies above 15% should be considered a hard drug.

Laar, Margriet van, Guus Cruts, Marianne van Ooyen-Houben, Esther Croes, Peggy van der Pol, Ronald Meijer, and Toine Ketelaars. "The Netherlands Drug Situation 2014." Reitorx National Focal Point, n.d. [http://specialtydiagnostix.de/wp-content/uploads/ti/en/trimbos\\_2014.pdf](http://specialtydiagnostix.de/wp-content/uploads/ti/en/trimbos_2014.pdf).

# Most Potent in the World

“Law enforcement from neighboring states agree, Colorado has strongest marijuana in the world.”

By [Garrison Wells](#) April 14, 2014

<http://gazette.com/law-enforcement-from-neighboring-states-agree-colorado-has-strongest-marijuana-in-the-world/article/1518194#TxA0JLQJs0k7wobD.99>

# Formulations

Joint



Bong



Oil



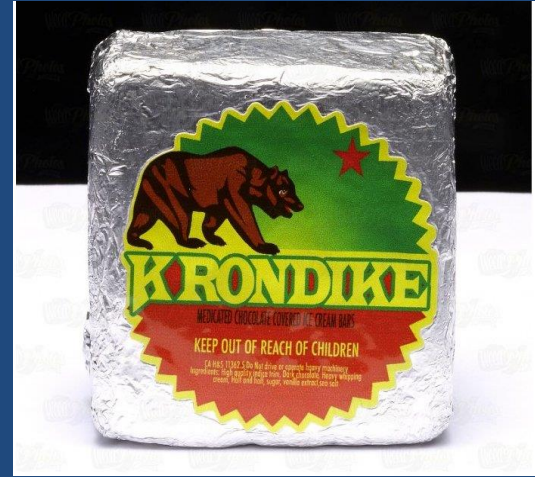
Shatter



Dabbing

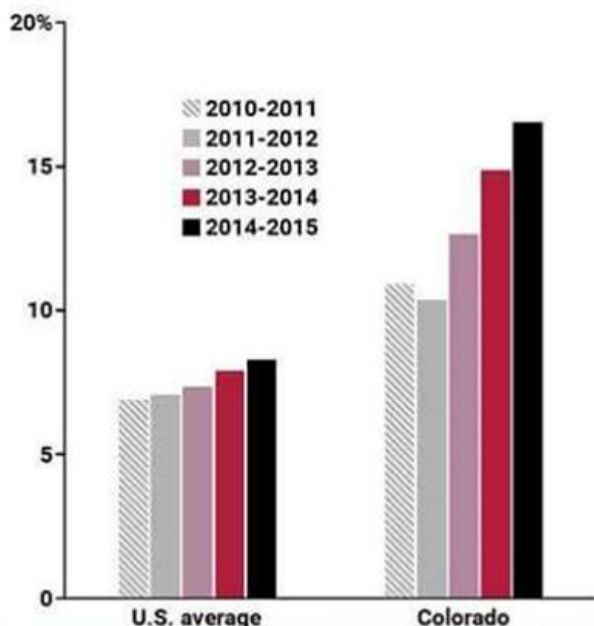


# Edibles



# Since legalization, pot use in Colorado has steadily climbed, well outpacing the national average

Percentage of population ages 12 and up who used marijuana in the past month

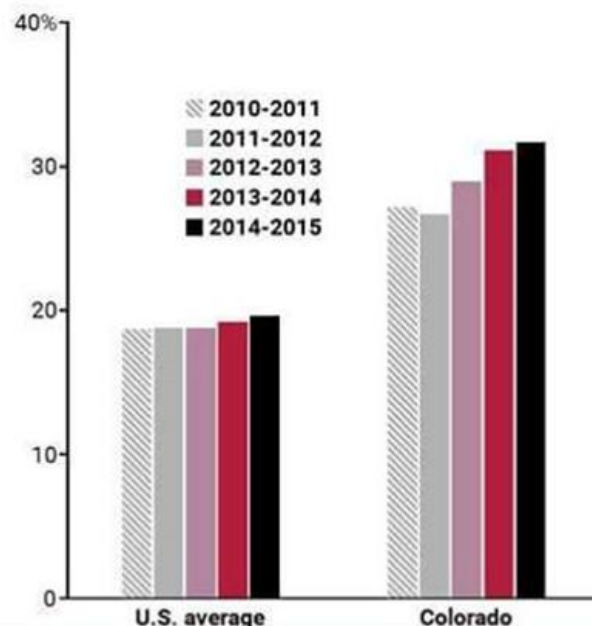


Avg.  
change  
per period

4.7%

10.8%

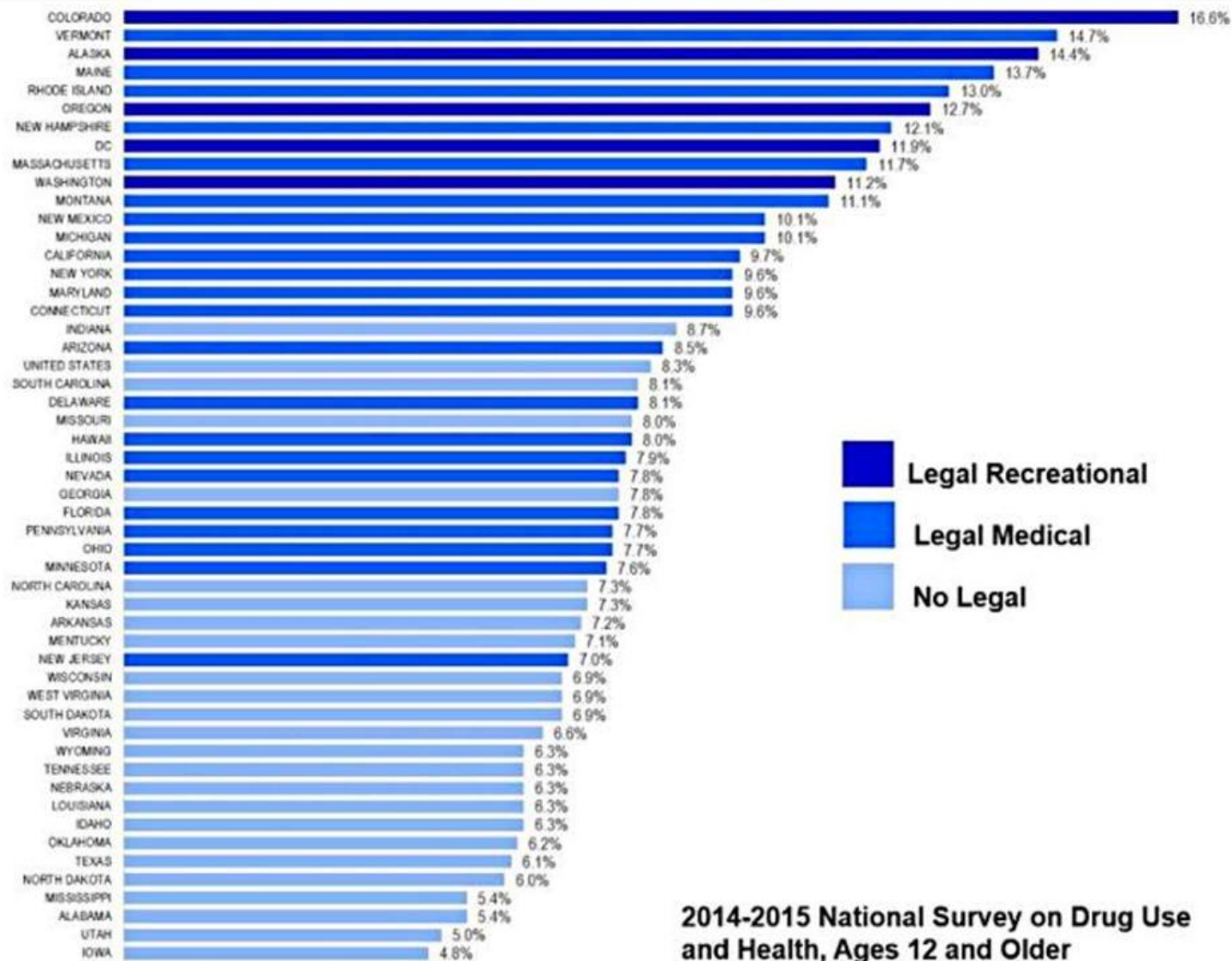
Percentage of population ages 18 to 25 who used marijuana in the past month



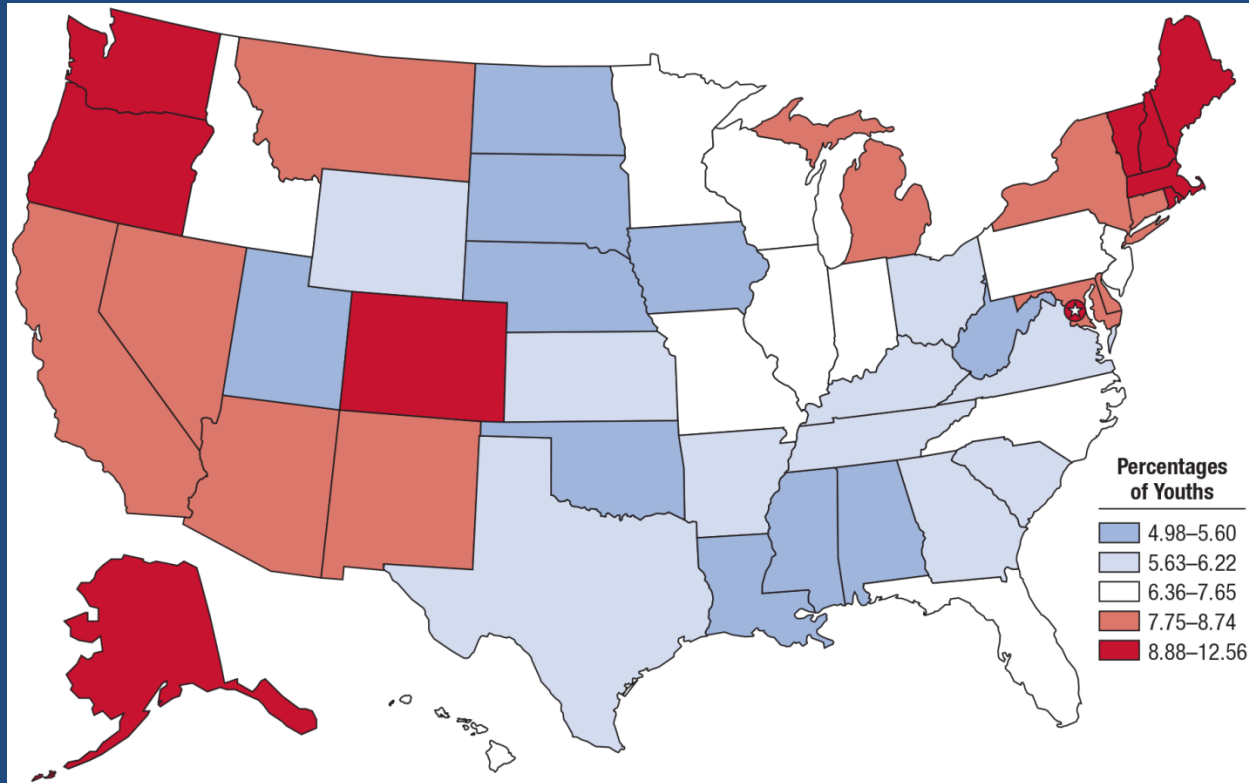
Avg.  
change  
per period

1.2%

3.9%



# Marijuana use in the past month among youths aged 12 to 17, by state: percentages, annual averages, 2013-2014



Source: SAMHSA, Center for Behavioral Health Statistics and Quality, National Surveys on Drug Use and Health (NSDUHs), 2013 and 2014.

# Colorado ranks 1st in the nation for youth (12+) use of marijuana use

“The Legalization of Marijuana in Colorado: The Impact.” Youth and Adult Marijuana Use. Rocky Mountain High Intensity Drug Trafficking Area, January 2016. <http://www.rmhidta.org/html/FINAL%20NSDUH%20Results-%20Jan%202016%20Release.pdf>.



# Increasing adolescent emergency room visits in Colorado's Children Hospital System

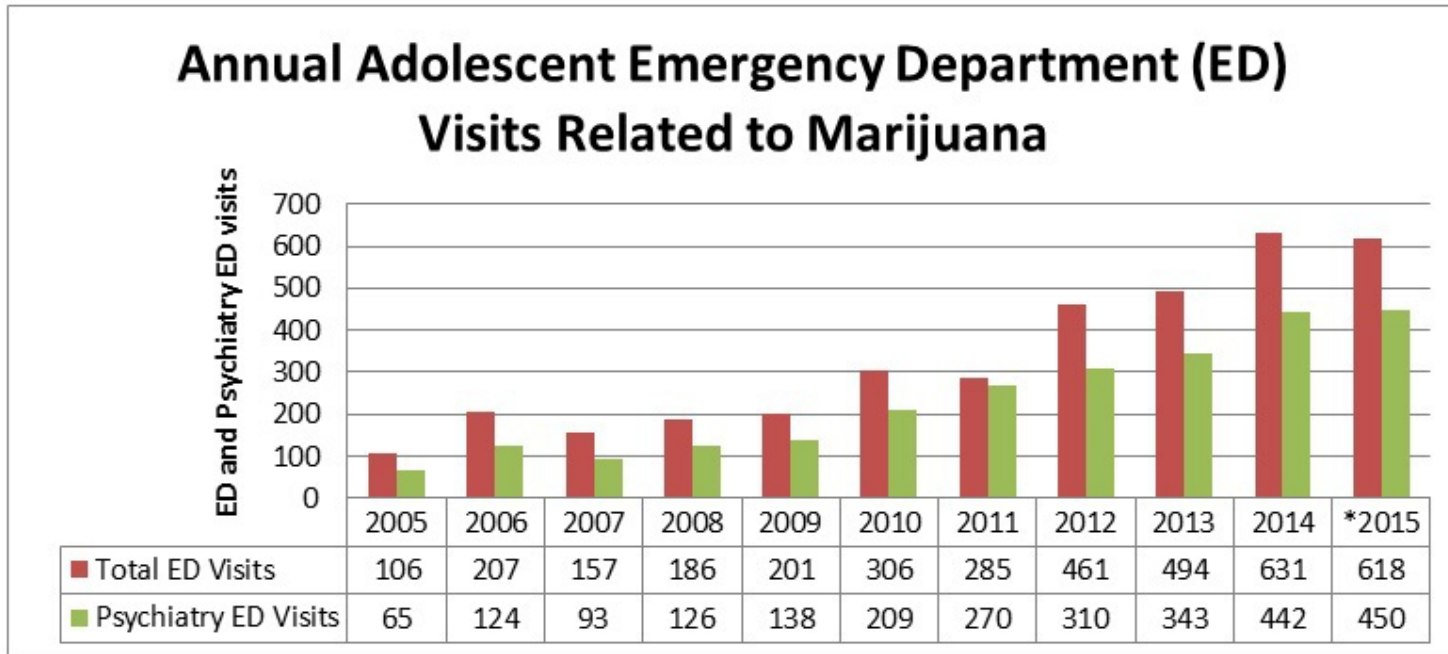


Figure 1. Annual adolescent emergency department visits related to marijuana. \*2015 full year estimated based on extrapolated data through June 2015. **George Sam Wang, MD, University of Colorado**

# Medical Consequences

- Multiple children have been treated in Colorado hospitals after becoming critically ill from edible marijuana
- Marijuana-related calls to poison-control centers have spiked
  - Rocky Mountain Poison and Drug Center received calls for marijuana exposure
  - 61 in 2012
  - 88 in 2013
  - 151 in 2014 – 45 were age 8 or younger

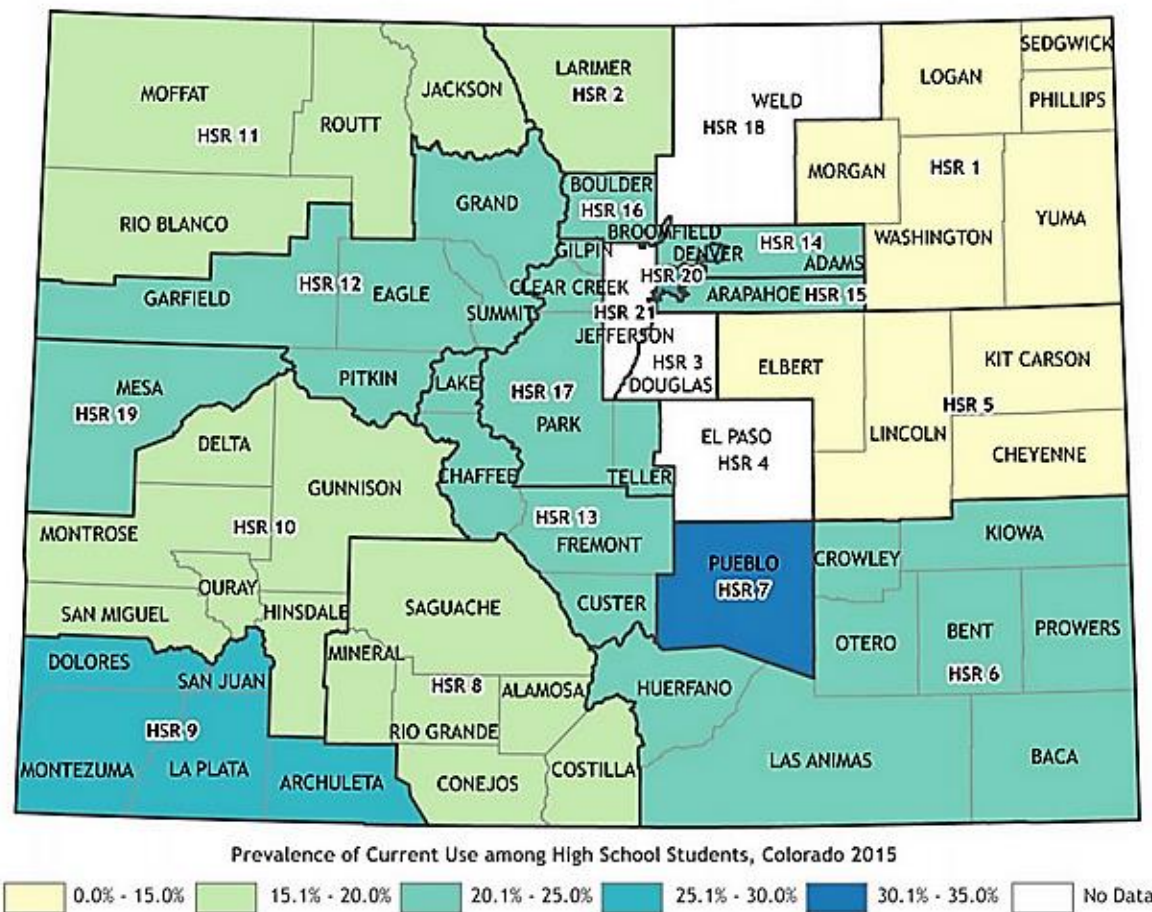
# 2015 Healthy Kids Colorado Survey

(only 46% response rate, not 60% expected by CDC)

Percentage of kids who	Pueblo County	Colorado Overall
Tried Marijuana for the first time before age 13	15.8 %	9.2 %
Used heroin one or more times	6.3 %	2.0 %
Used methamphetamines one or more times	6.6 %	2.4 %
Taken Rx drug without Rx one or more times	16.0 %	13.7 %
Used Rx drugs in last 30 days without a Rx	11.9 %	6.7 %

**Source: Colorado Department of Public Health and Environment**

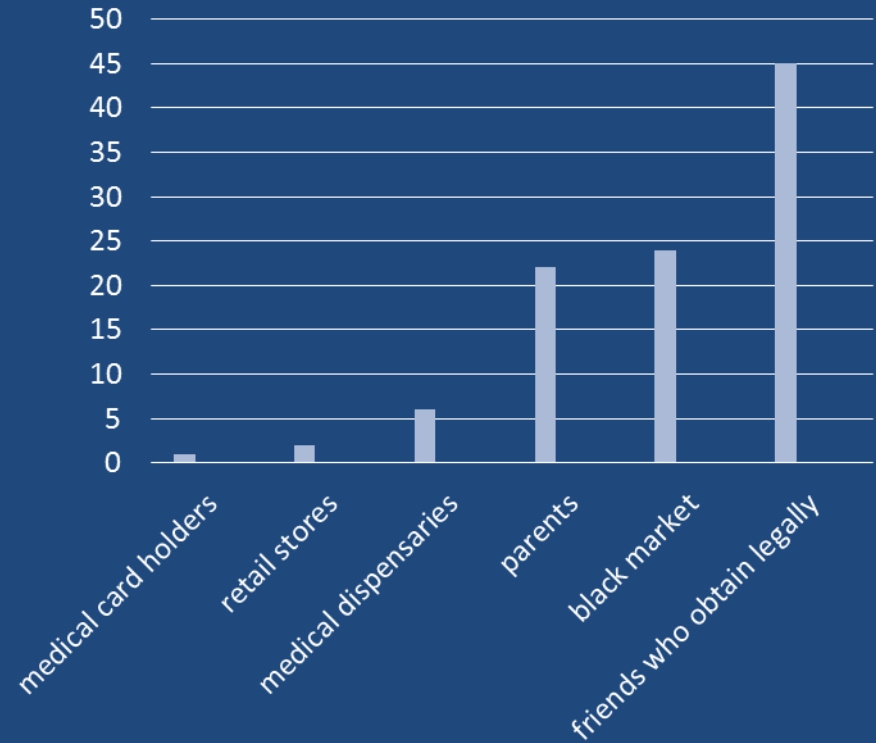
Map 2. Prevalence of Current Marijuana Use among High School Students in Colorado, 2015



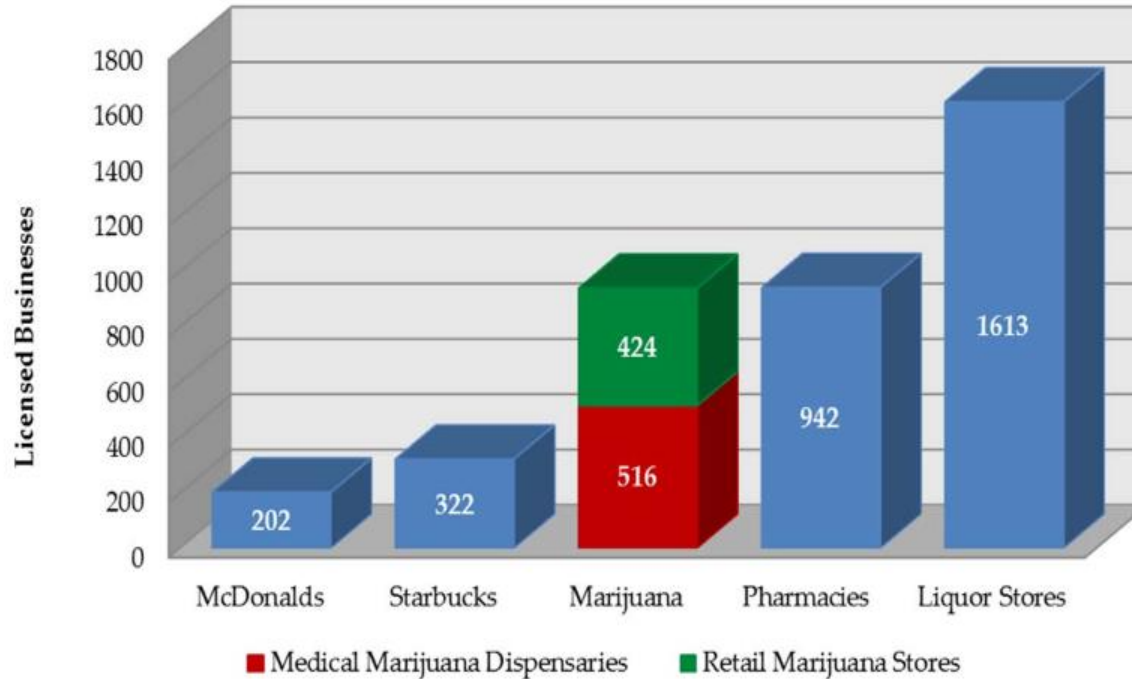
# Where do the kids get their marijuana?

45 percent reported friends who obtain it legally  
24 percent reported from the black market  
22 percent reported from their parents  
6 percent reported from medical marijuana dispensaries  
2 percent reported from retail marijuana stores  
1 percent reported from medical marijuana cardholders

SOURCE: Colorado Association of School Resource Officers (CASRO) and Rocky Mountain HIDTA



## Colorado Business Comparisons, January 2016



SOURCE: Colorado Department of Revenue; Starbucks Coffee Company, Corporate Office Headquarters; McDonalds Corporation, Corporate Office Headquarters

# Marijuana Laws Have Contributed to Illicit Use – Rather Than Decreasing Illicit Use

- Overall, from 1991-1992 to 2012-2013, illicit cannabis use increased significantly more in states that passed medical marijuana laws than in other states, as did cannabis use disorders Hasin et al. JAMA Psychiatry 2017
- Crime due to marijuana has definitely not gone away in Colorado - We still have illegal pot and legal weed costs 3 times as much as black-market weed

# Explosion of people coming to Pueblo from out of state for Marijuana – ending up homeless

- In 2013 Posada served 2,444 unduplicated men, women and children
- In 2014 – 3,767
- In 2015 – 4,946
- In 2016 – 7,800
- There are an increase in homeless camps and an increase in violence

# Consequences of Long-term or Heavy Marijuana Use Beginning in Adolescence

- Increased risk of Addiction
- Altered Brain Development
- Poor Educational Outcome with Increased Likelihood of Dropping Out
- Permanent Cognitive Impairment with Lower IQ
- Diminished Life Satisfaction
- Chronic Bronchitis
- Increased Risk of Psychosis Disorders. Especially in Persons with Genetic Predisposition.

Data is supported by NEJM, Adverse Health Effects of Marijuana (June 5, 2014). National Institute of Health. American Academy of Pediatrics, The Impact of Marijuana Policies on Youth Clinical Research and Legal Update (2015). As well as numerous other resources.

# Addiction

Also referred to as Marijuana Use Disorder

- 9% of those who experiment with marijuana will become addicted
- 17% of those who start using as teenagers will become addicted
- 25-50% of those who are daily users will become addicted

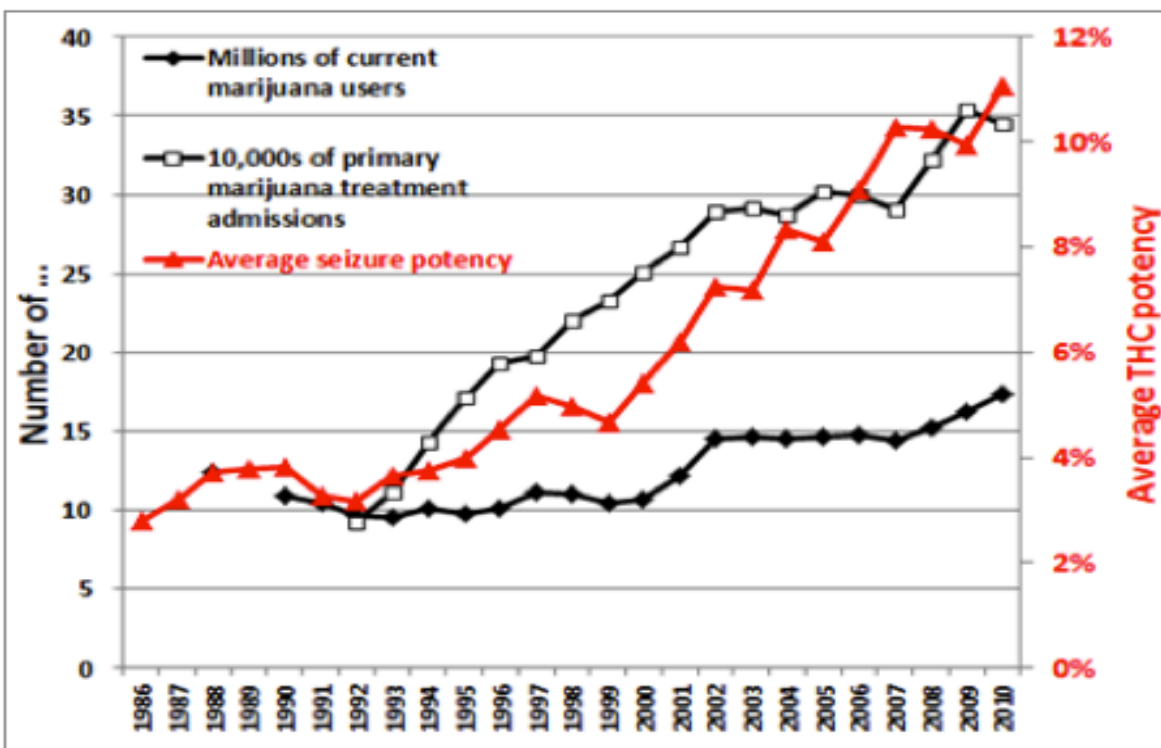
Data from NEJM, Adverse Health Effects of Marijuana Use.

Nora Volkow. June 5<sup>th</sup> 2014

# MJ Withdrawal Syndrome

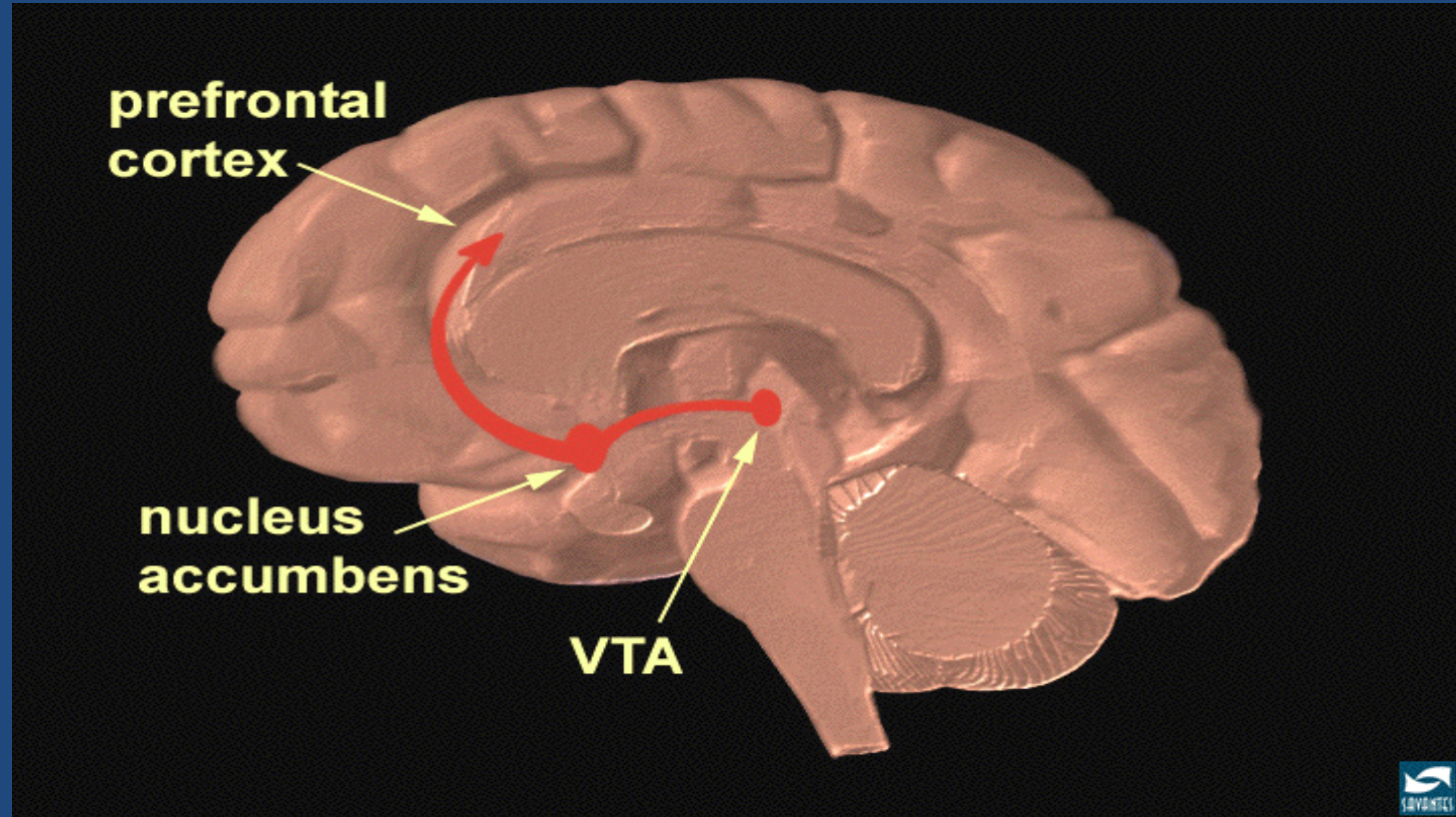
- Increased anger
- Irritability
- Depression
- Restlessness
- Headache
- Loss of appetite
- Insomnia
- Severe cravings for marijuana

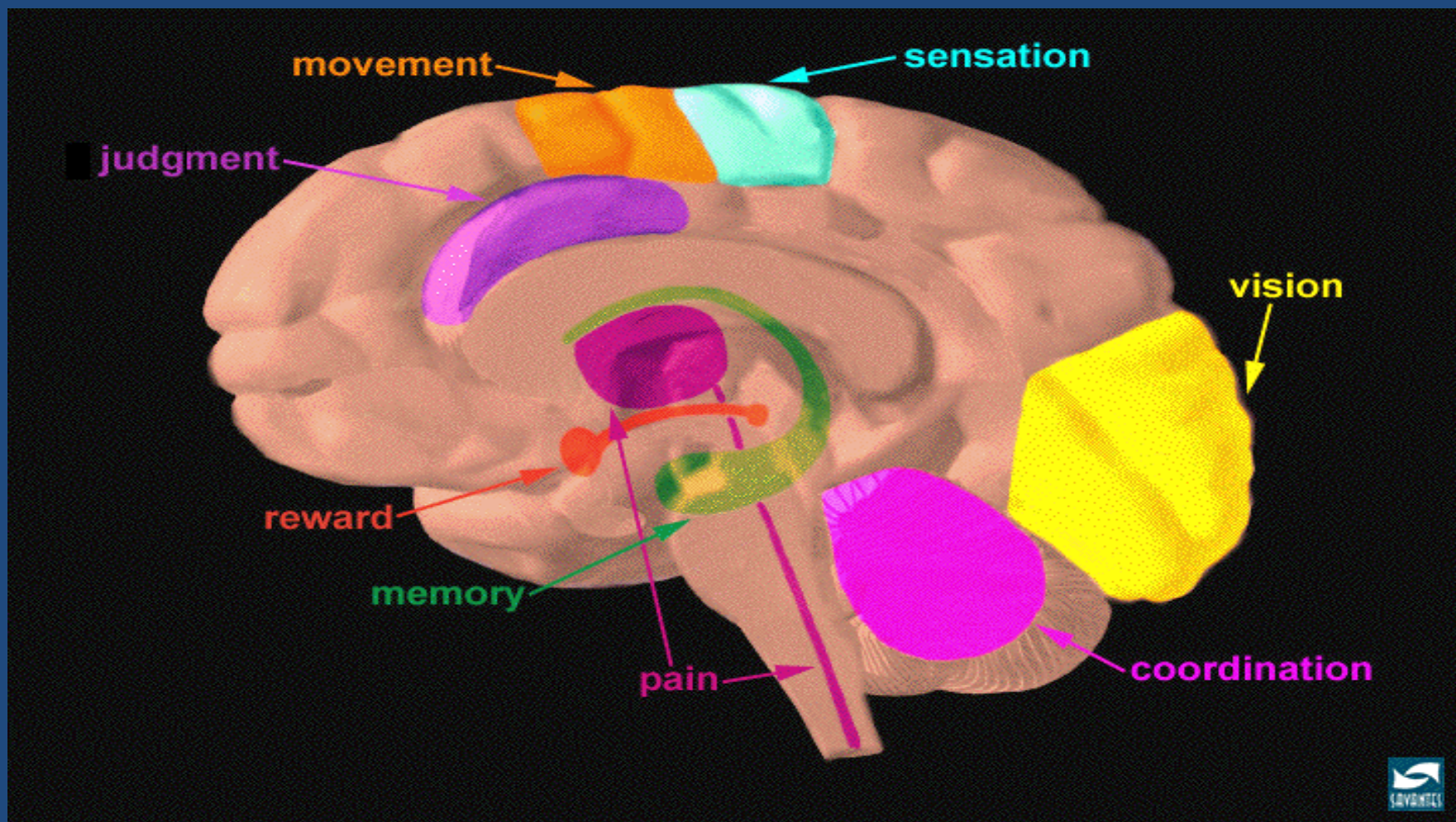
## MARIJUANA USERS, TREATMENT ADMISSIONS, AND AVERAGE POTENCY: 1986-2010



Sources: [NSDUH](#), [TEDS](#), National Seizure System

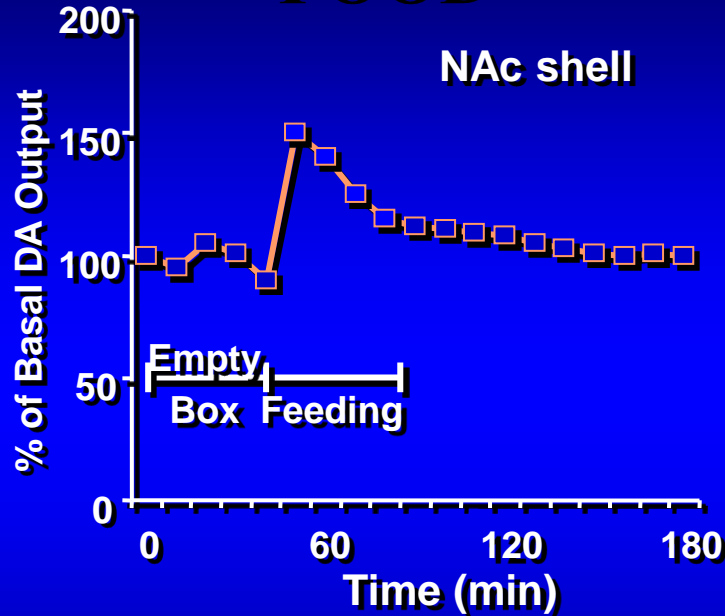
# How Drugs of Abuse affect the Learning and Memory part of the Brain





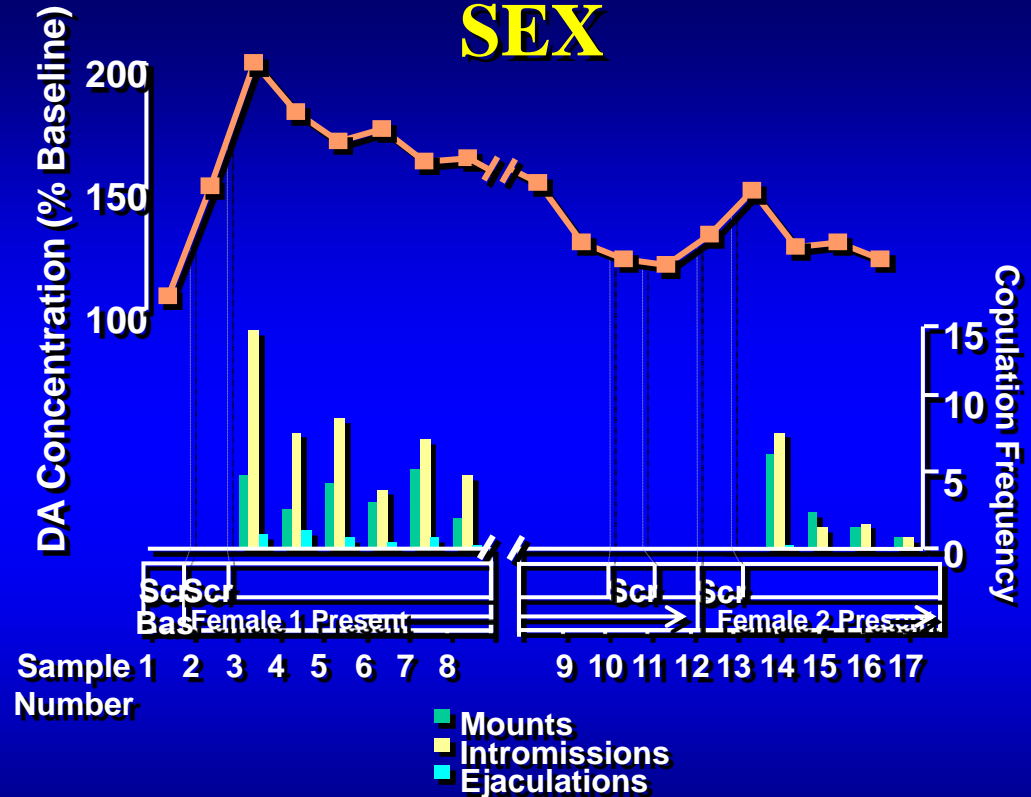
# Natural Rewards Elevate Dopamine Levels

## FOOD



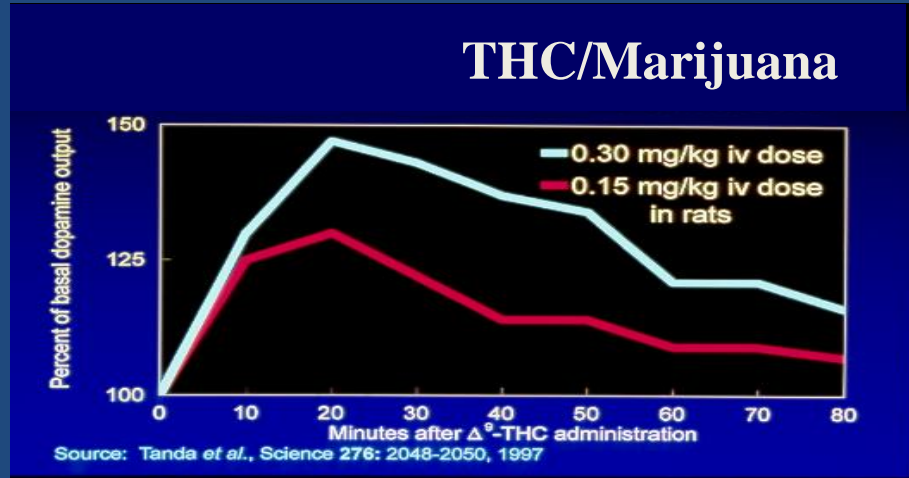
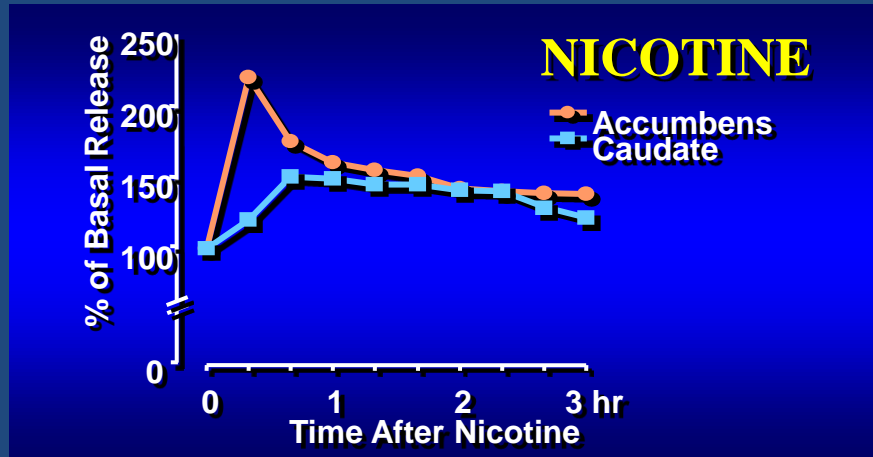
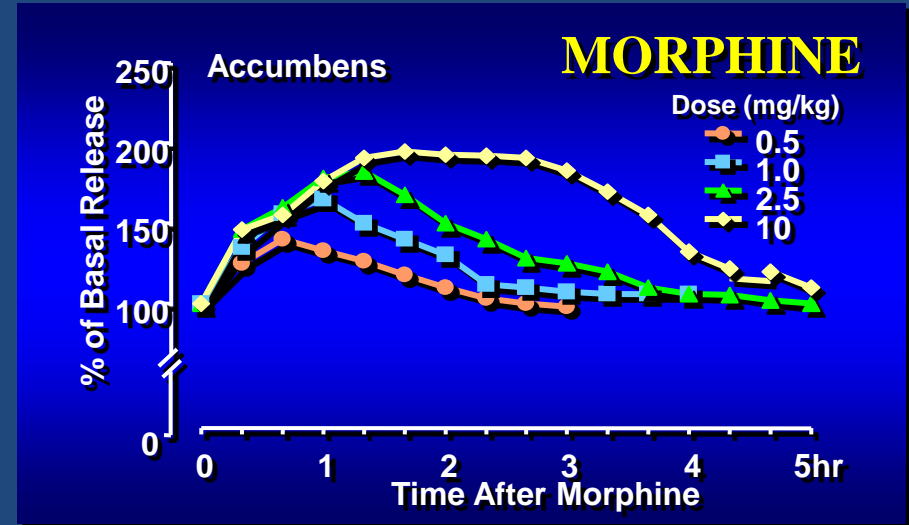
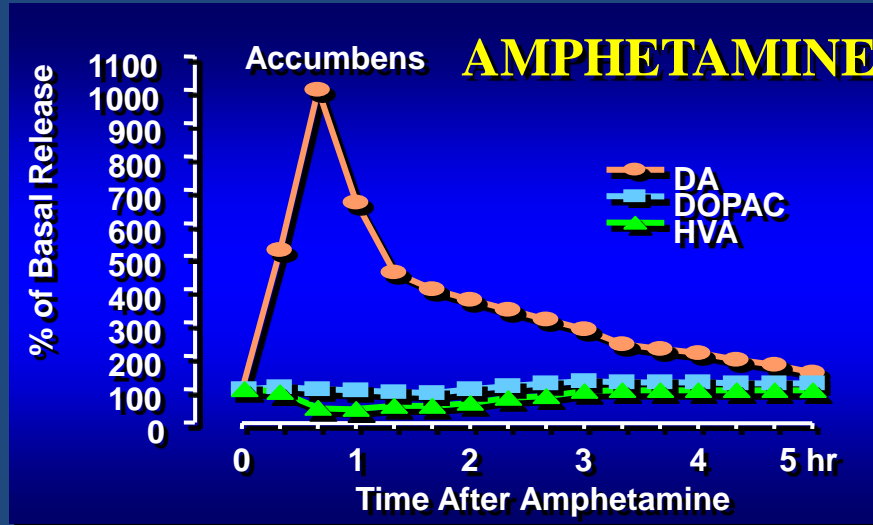
Source: Di Chiara et al.

## SEX



Source: Fiorino and Phillips

# Effects of Drugs on Dopamine Levels



Source: Di Chiara and Imperato

# Effects of Drug Use on the Hippocampus

- Drugs of abuse are potent negative regulators of adult neurogenesis in the hippocampus
- Chronic administration of opiates, THC, ethanol or nicotine decreases hippocampal function, decreasing ability of adult brain to adapt to new information

# Normal Brain Development during Adolescence

## - Neurotransmitter Development



- Lots of Dopamine and Glutamate - stimulatory neurotransmitters – “stepping on the gas” – go,go,go – learn, explore, do
- Decreased Serotonin and GABA – suppressive neurotransmitters – “stepping on the brake” located in the prefrontal motor cortex – the last part of the brain to fully develop

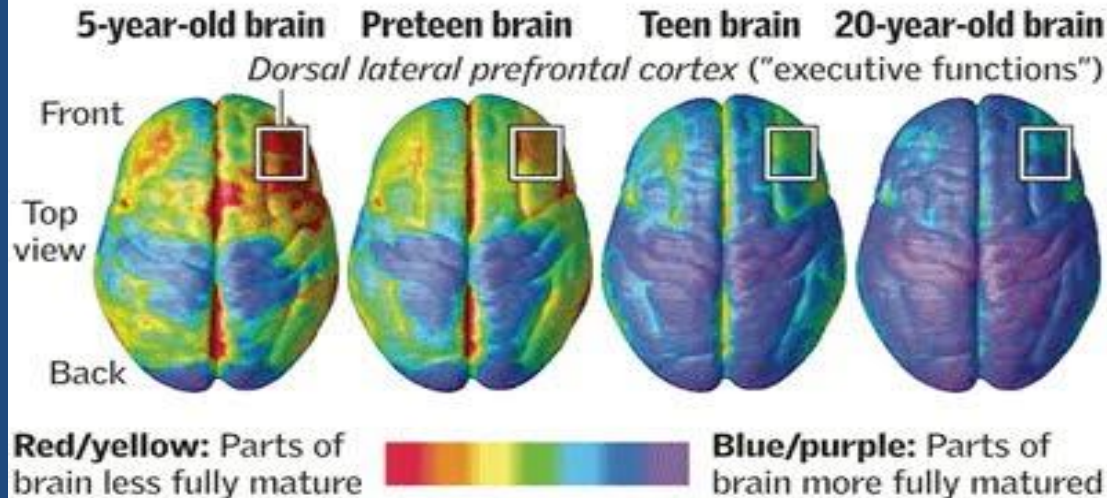


Schepis et al. Neurobiological Processes in Adolescent Addictive Disorders. Am J Addictions. 2008;17:6-23

# Brain Development

## Judgment last to develop

The area of the brain that controls “executive functions” — including weighing long-term consequences and controlling impulses — is among the last to fully mature. Brain development from childhood to adulthood:



Sources: National Institute of Mental Health;  
Paul Thompson, Ph.D., UCLA Laboratory of  
Neuro Imaging

Thomas McKay | The Denver Post

# Behavioral Factors Relating to Substance Abuse in Adolescents

- ↑ neurobiological based tendencies for risk-taking with decreased suppressive and regulatory control
- lots of Go, go, go
- very little ability to put on the brakes
- ↓ in parental monitoring
- ↑ in peer affiliation

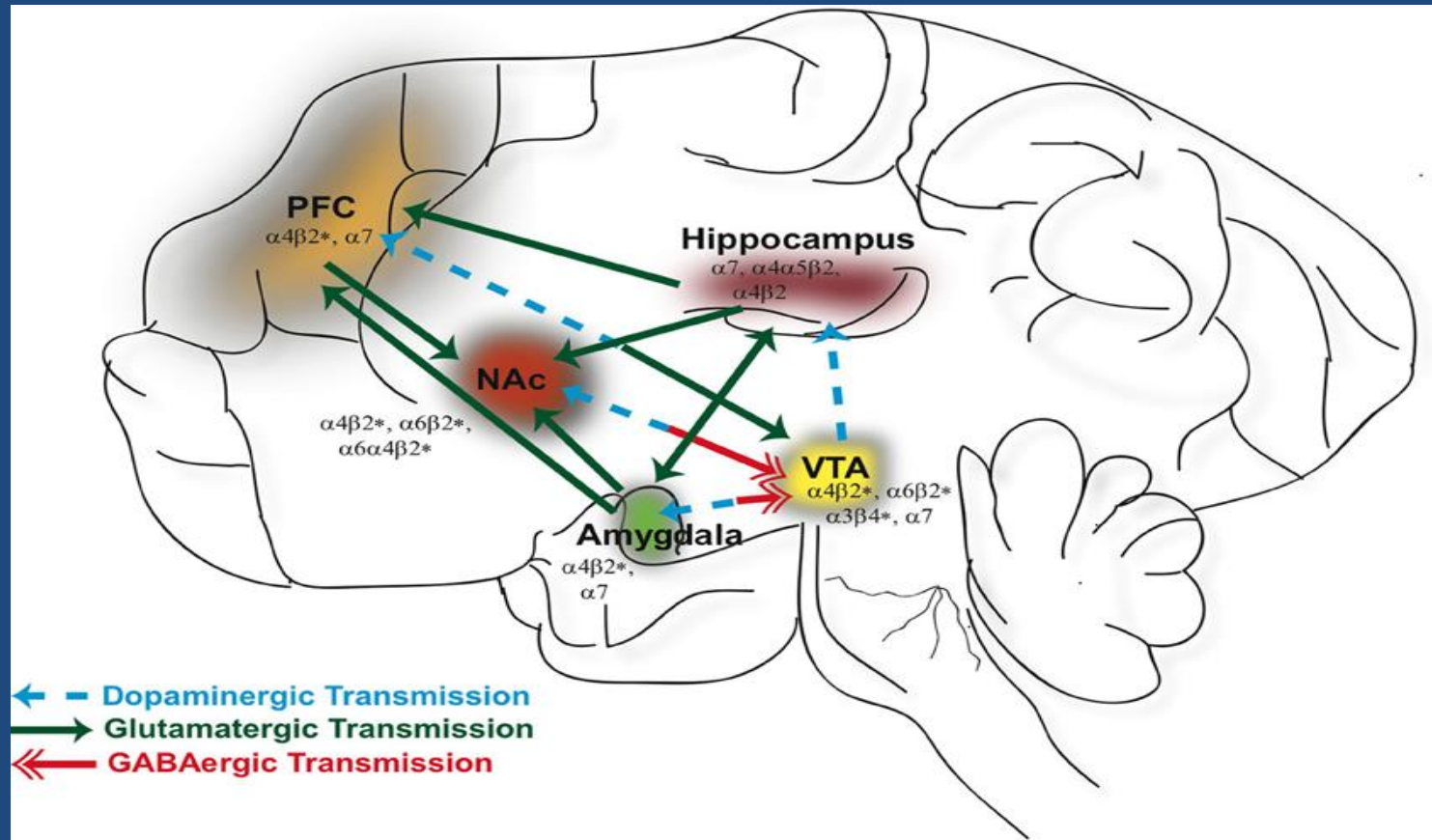


# Acetylcholine - ACH

- Another important brain neurotransmitter – helps us focus and concentrate
- ACH innervation of the PFC reaches mature levels during adolescence – receptors = nAChRs
- Involved in promoting or preventing neuronal cell death – depending on developmental stage
- Nicotine works on these receptors and can mess up the fine tuning of the brain during adolescence



# Nicotinic Cholinergic Neurons



# Endocannabinoid Receptors

- Are all over the brain – receptors for anandamides - “supreme joy”
- CB1 receptors regulate the balance between excitatory and inhibitory neuronal activity
- Exposure to cannabis during adolescence disrupts glutamate which plays an important role in synaptic pruning in PFC – disrupting normal brain development
- Lubman et al. Cannabis and adolescent brain development. Pharmacology and Therapeutics 2015;148:1-16



# Regional Brain Abnormalities Associated with Long-term heavy Cannabis Use

Arch Gen Psychiatry

2008;65:694-701

- 15 long term (>10 years) and heavy (>5 joints daily) cannabis using men compared with 16 age matched non using controls by MRIs of brains
- Cannabis users had bilaterally reduced hippocampal and amygdala volumes  $p=.001$
- Increase in positive symptoms (psychotic)  $p<.001$
- Significantly worse performance on measures of verbal learning  $p<.001$

# The Good News:

## There can be Recovery

- Yucel et al. Hippocampal harms, protection and recovery following regular cannabis use. Transl Psychiatry 2016;6:e710
- 74 subjects 40 males, 34 females, long-term (@ 15 yrs) regular cannabis users vs 37 non-users healthy controls
- Cannabis subgroups
  - Exposed predominantly to THC – past 3 months
  - Exposed to THC and CBD – past 3 months
  - Former users with sustained abstinence – 29 months

# MRI studies of hippocampal integrity

- Cannabis users had smaller hippocampal volumes relative to controls
- Users not exposed to CBD had even greater (11%) reduced volumes – CBD appears to be protective
- In former users, hippocampal integrity was comparable to controls
- Functional deficits may persist in spite of this apparent recovery as reported in other studies – but not tested here

# IQ and Brain Development Studies

Study in New Zealand with a 20 year follow-up showed IQ decrease by 8 points with early persistent teen use. Published in the proceedings of the National Academy of Sciences

In Utero exposure (light to moderate marijuana users, approx. 3xweek) has a significant effect on school-age intellectual development. J Am Acad Child Adolesc Psychiatry, 2008.

# What Does it Mean to Have a Decreased IQ?

- First, loss of 8 points will bring an average (50%) IQ of 100 down to the 29%.
- Less likely to get the “ideal” job
- Less likely to get a good score on SAT
- Decreased overall satisfaction in life
- Less likely to go to college
- Less likely to get married
- Less likely to stay married

# Marijuana and Mental Illness

- Study in Australia tracked 1600 girls for 7 years  
Arseneault et al. BMJ 2002;325:1212
- Those who used marijuana every day were 5 times more likely to suffer from depression and anxiety than non-users
- Teenage girls who used the drug at least once a week were twice as likely to develop depression than those who did not use
- Cannabis use increased the risk of developing schizophrenia symptoms – specific to cannabis and early onset – prior to age 15

# Marijuana and Depression

Bahorik AL et al. *J Affect Disord.* March 15, 2017

- Participants were 307 patients with depression assessed at baseline, 3- and 6-months on symptoms, functioning and marijuana use – 40.7% used marijuana within 30 days of start
- Marijuana use was associated with poor recovery
- Those aged 50+ ( $B=0.44$ ,  $p<.001$ ) increased their marijuana use compared to the youngest age group
- Marijuana use worsened depression ( $B=1.24$ ,  $p<.001$ ) and anxiety ( $B=0.80$ ,  $p=.025$ ) symptoms
- Marijuana use led to poorer mental health ( $B=-2.03$ ,  $p=.010$ ) functioning (study from UCSF Department of Psychiatry)

# Risk of Psychosis

- Using cannabis at a young age (<15-18) increases the risk of developing a psychotic disorder
- Risk is dose dependent and increases with greater frequency of use and with higher potency THC
- Pierre JM Risks of increasingly potent Cannabis: the joint effects of potency and frequency. *Current Psychiatry* 2017;16:14-20

# High Potency Cannabis associated with a tripled risk for Psychosis

- DiForti et al. Lancet Psychiatry, 2015
- London – analyzed 780 people ages 18-65, 410 with first episode psychosis and 370 healthy controls
- High potency – THC > 15% - 3X increased risk of psychosis
- Daily use – 5X increased risk
- Psychosis not associated with Hash < 5% THC

# Genetic Variants may Identify those at risk of psychosis and dependence

- Sherva R et al. Genome-wide association study of cannabis dependence severity, novel risk variants, and shared genetic risks. JAMA Psychiatry 2016
- People with a variation in the AKT1 gene are more susceptible to the mind altering effects of cannabis
- Morgan CJA et al. AKT1 genotype moderates the acute psychotomimetic effects of naturalistically smoked cannabis in young cannabis smokers. Transl Psychiatry 2016

# Attempts to add PTSD

- A growing number of states have identified PTSD as an approved condition for medical marijuana
- Observational study of 2276 Veterans treated in VA PTSD treatment programs
  - Never used marijuana – significantly lower symptom severity 4 months later
  - “Starters” – highest levels of violent behavior and PTSD symptoms 4 months after treatment
  - “Stoppers” – lowest level of PTSD symptoms at 4 months after treatment
- Wilkinson et al. J Clin Psychology 2015

# Why Marijuana (THC) is probably not the answer for PTSD

- Similar as to why benzodiazepines are not the answer
- Temporary relief – numbing, disconnecting from the trauma emotions
- Cognitive impairment, a-motivational syndrome, potential for psychosis or worsening psychosis from PTSD
- Addiction potential and vicious cycle
- False memories

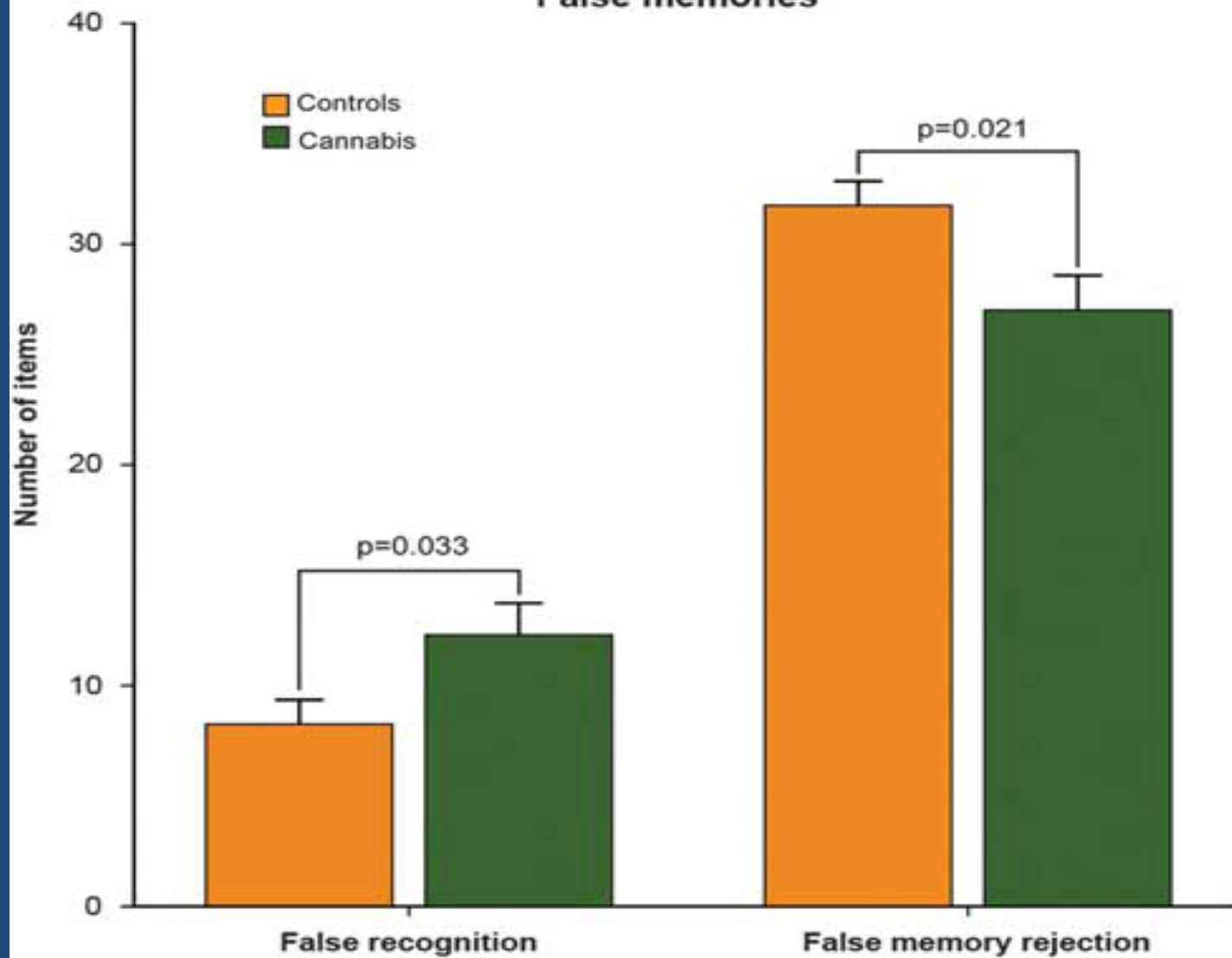
# False Memories

- Working and declarative memory deficits result from marijuana use and are thought to normalize with abstinence
- However, cannabis users have an increase susceptibility to memory distortions even when abstinent and drug free – compromising reality monitoring
- Riba et al. Telling true from false: cannabis users show increased susceptibility to false memories. *Molecular Psychiatry* 2015;20:772-777.

# Cannabis and False Memories

- 16 heavy cannabis users (daily for last 2 years – average 21 years (3-39))
- 16 matched cannabis naïve controls
- Cannabis users abstained from cannabis use for 4 weeks prior to the study
- Memory paradigm included a study phase and a testing phase with participant in MRI scanner – 20 lists of 4 words

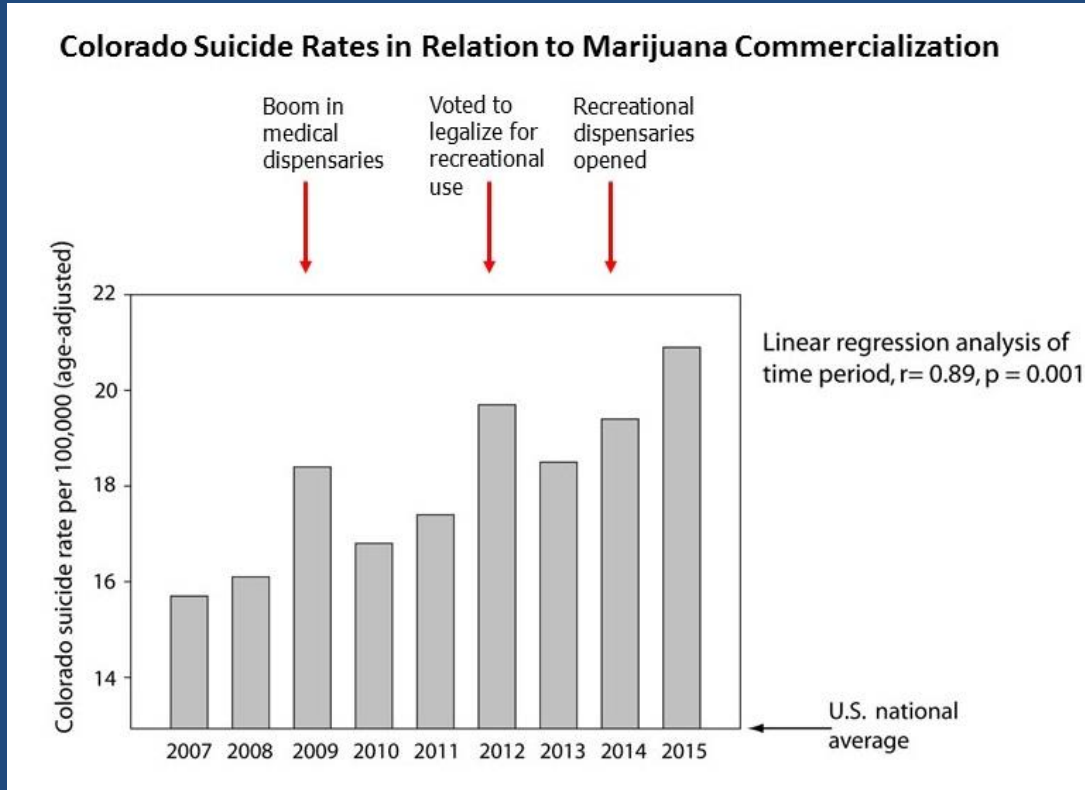
## False memories



# Marijuana and Suicide

- Multiple studies have documented a relationship between cannabis use and suicidality — Buckner et al Psych Res 2017;253:256-259 — tested the utility of the interpersonal-psychological theory of suicide
- Large longitudinal study in Australia and New Zealand of over 2000 adolescents and maximum frequency of marijuana use found almost 7X increase in suicide attempts in daily marijuana users compared with non-users — Silins E et al. The Lancet psychiatry Vol 1 September 2014

# Correlation of Marijuana and Suicide



**In fact veteran suicides have not decreased. Instead, they are up 32% since 2001, compared to a national increase of 23% during the same period – Congressional Hearing 4/27/27**

# Medical Consequences due to increasing risk of psychosis

- We can no longer say marijuana is not associated with death
  - April 2014 – Wyoming college student jumped to his death from a Denver hotel balcony after eating more than the recommended serving of a marijuana cookie
  - April 2014 – Man shot and killed his wife in front of their three children after consuming edibles
  - Sept 2012 – 18 yo male smoked marijuana and then stabbed himself 20 times – THC 38.2 ng (8 times the legal limit)

# Marijuana and Violence

- “Marijuana Violence and Law” Miller N, Oberbarnscheidt T. J Addict Res Ther 2017
- Case reports of 12 highly popularized storylines in which marijuana use led to unnecessary violence and health risks
- Reviewing their symptoms consistent with their reported marijuana use – paranoia, psychosis, aggressiveness, personality change

**“THOSE WHO CANNOT REMEMBER  
THE PAST ARE CONDEMNED TO  
REPEAT IT.”**

George Santayana

# Brief History of Marijuana

- 6000 BC – Cannabis seeds used as food in China
- 4000 BC – Textiles made of hemp in China
- 2727 BC – first recorded medicinal use in Chinese Pharmacopoeia
- 1400 BC to AD – trade moves product through India, Mediterranean countries, Europe – numerous medicinal uses reported

# Curious Facts about Marijuana

- 1378 – Emir of the Ottoman Empire makes the first edict against eating hashish or smoking cannabis – 1<sup>st</sup> “War on Drugs”
- 1798 – Napoleon declared total prohibition on marijuana after realizing much of the Egyptian lower class were habitual smokers
- 1868 – Egypt – 1<sup>st</sup> modern country to outlaw cannabis ingestion
- 1890 – Hashish made illegal in Turkey



# History of Marijuana

- Introduced to North America in 1600s by Puritans – Hemp for ropes, sails, clothing; cannabis a common ingredient in medicines, sold openly in pharmacies
- 1937 – Marijuana Tax Act – transfer of cannabis illegal throughout US except for medicinal and industrial use, expensive excise tax and detailed logs required
- 1969 – found to be unconstitutional since it violated 5<sup>th</sup> Amendment privilege against self-recrimination

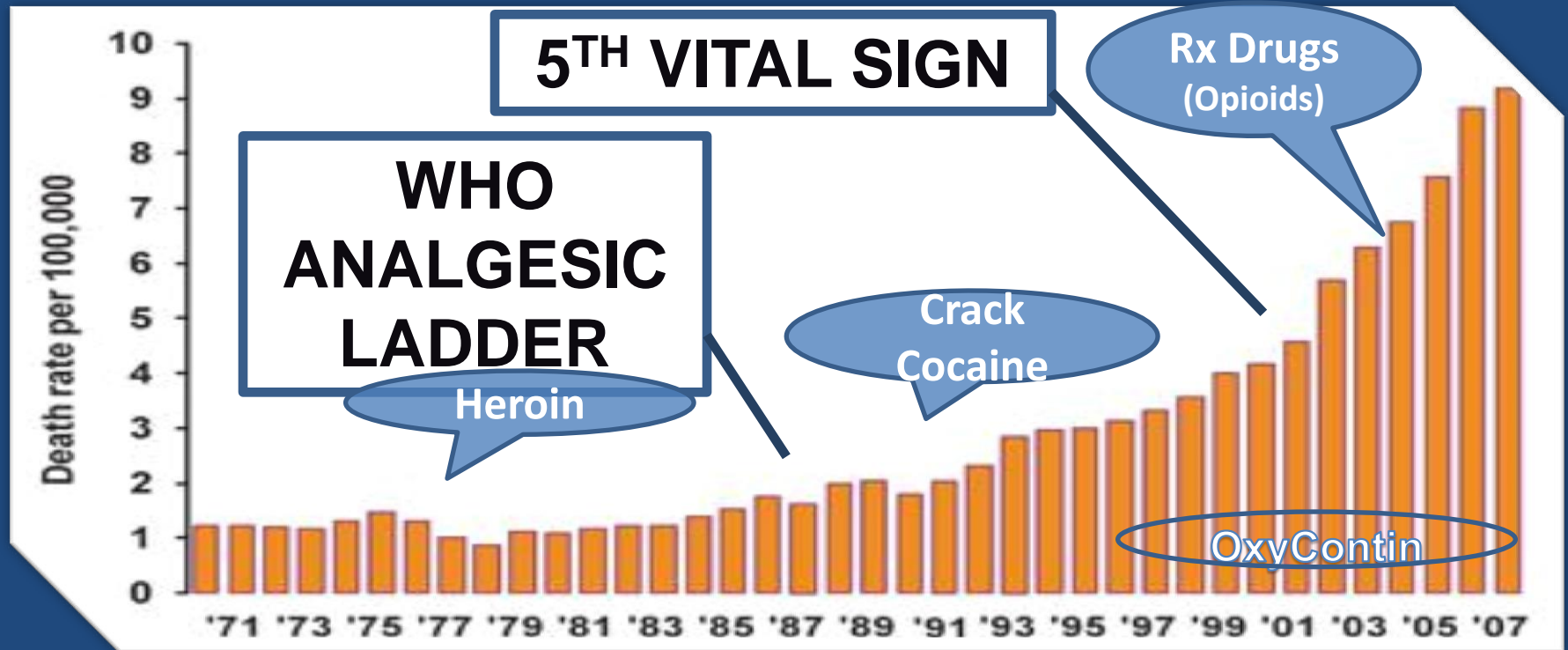
# History continued

- 1970 – Controlled Substance Act – classified cannabis as having:
  - High abuse potential
  - No medical use
  - Not safe to use under medical supervision
- 1975 – FDA establishes Compassionate Use Program for Medical Marijuana – Glaucoma, Multiple Sclerosis, Cancer
- 1986 – Dronabinol placed into Schedule II by DEA

# What does MJ have to do with Opiates?



# Unintended outcome of Pain as the 5<sup>th</sup> Vital Sign Epidemic of Unintentional Rx Drug Overdose and Death

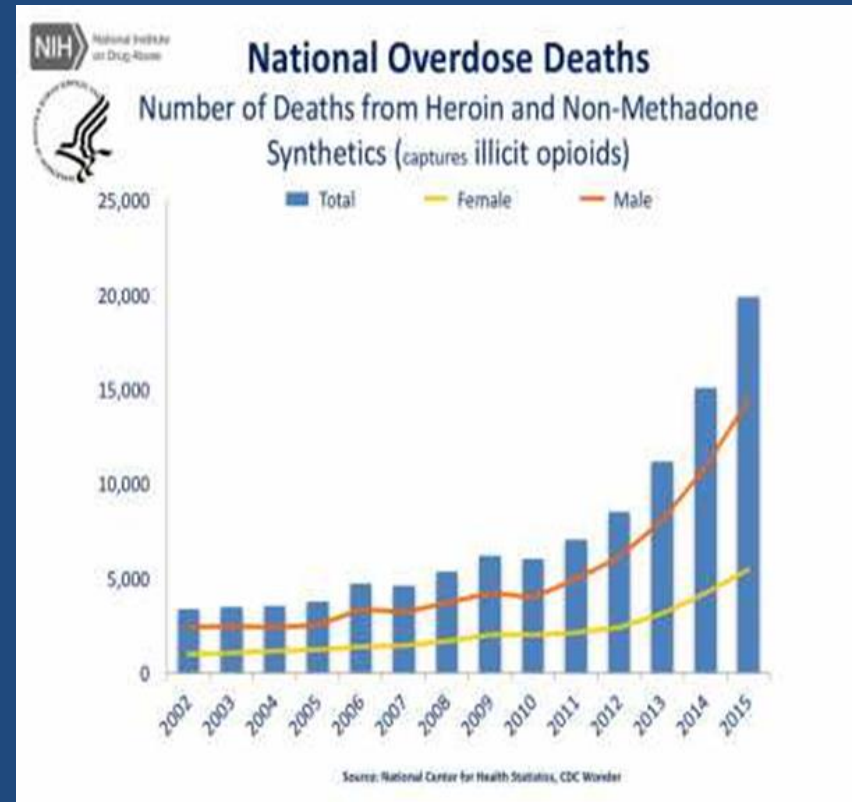
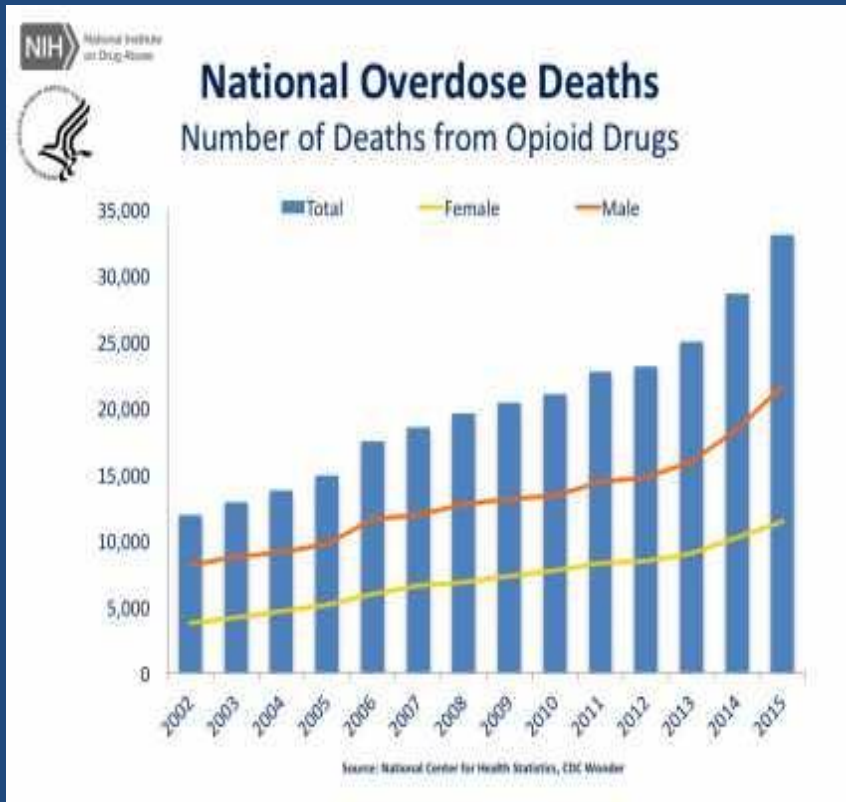


CDC's Issue Brief: Unintentional drug poisoning in the United States. Unintentional drug poisoning includes drug overdoses resulting from drug misuse, drug abuse, and taking too much of a drug for medical reasons.

Marijuana advocates like to cite this study that found opioid overdoses were lower in states that had a medical marijuana law to support legalization of recreational marijuana

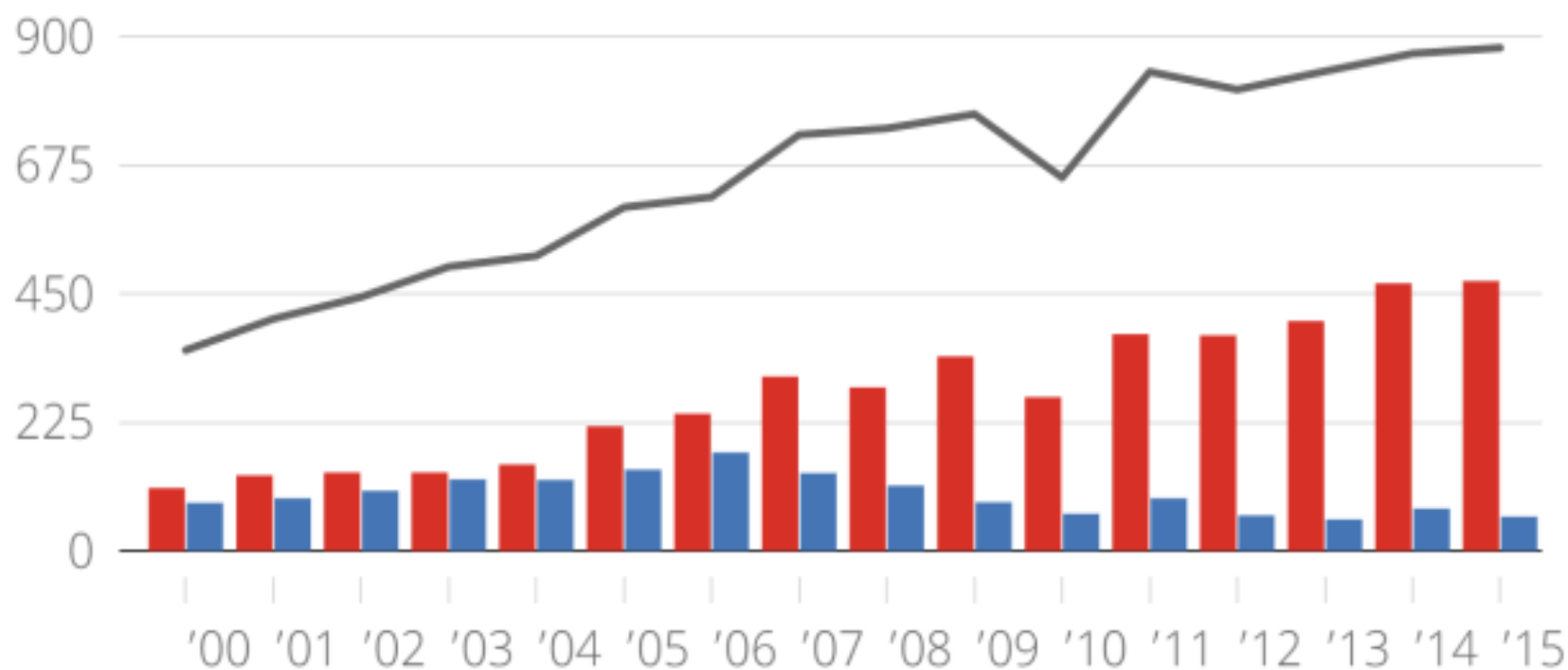
- JAMA intern Med 2014;174:1668-1673
- However, this data was from 1999-2010 and was about patients using medical marijuana for chronic pain
- They reported a 25% lower rate of Rx painkiller overdose deaths in 13 states that had a medical marijuana law
- We are seeing very different outcomes since 2010

# Deaths from opioid overdoses continue to sky rocket



## Drug poisoning deaths in Colorado

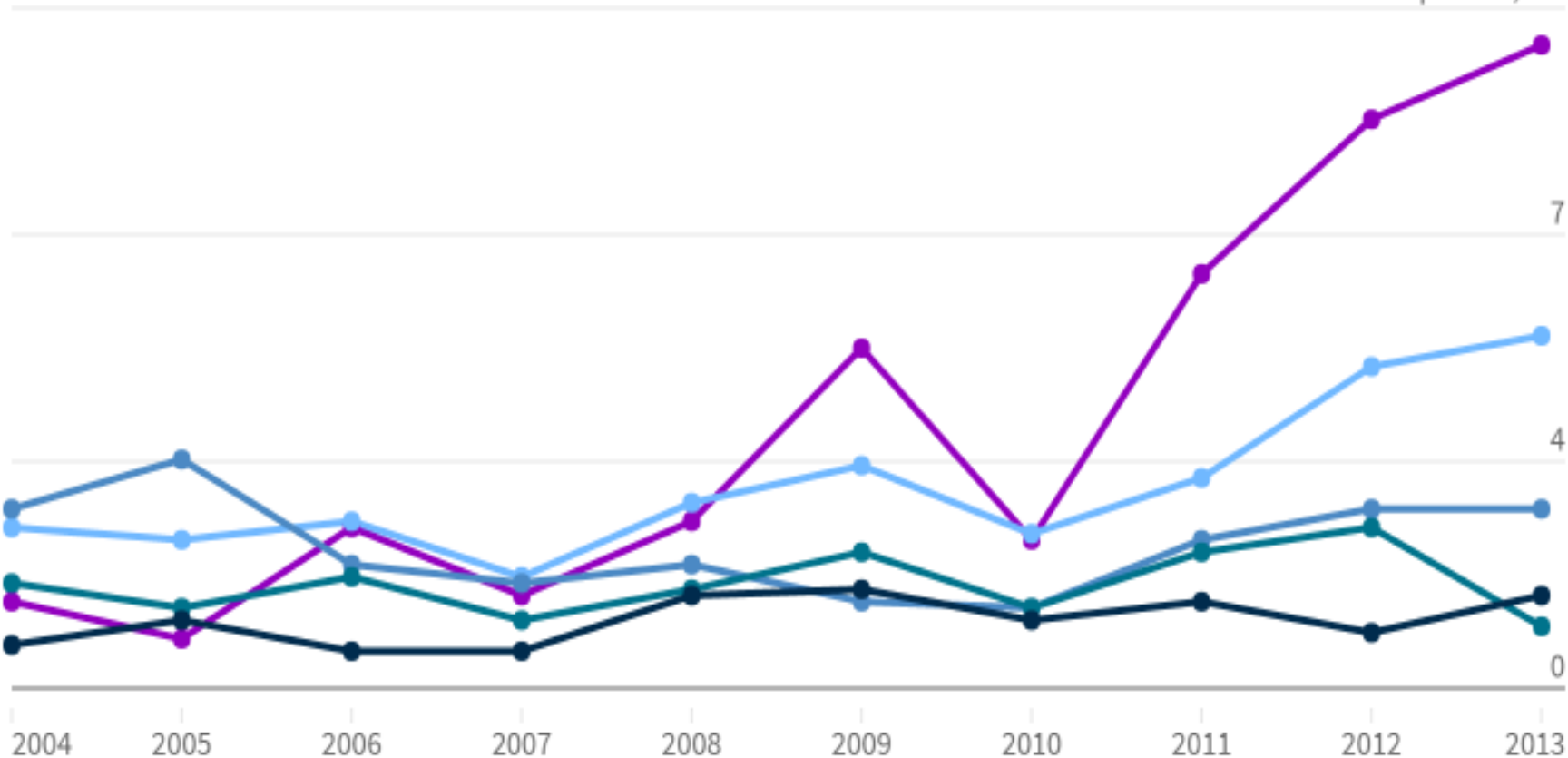
■ Opiates ■ Cocaine ■ All Drug Poisoning



## Colorado Hospital Discharges That Mention Heroin or Opium

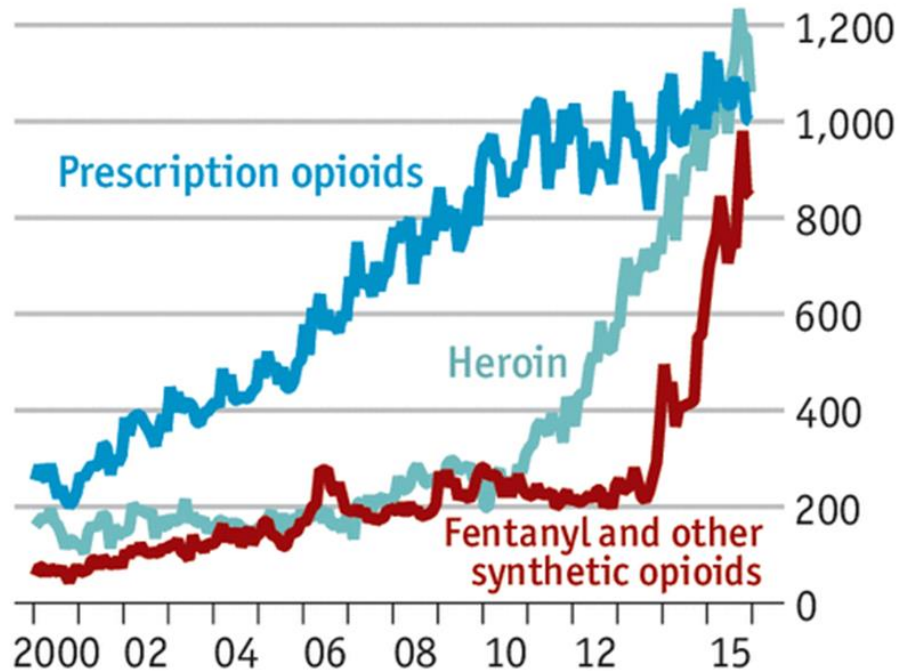
18-25 years 26-34 years 35-44 years 45-54 years 55-64 years

11 per 100,000



## New highs

United States, drug overdose deaths\*, monthly



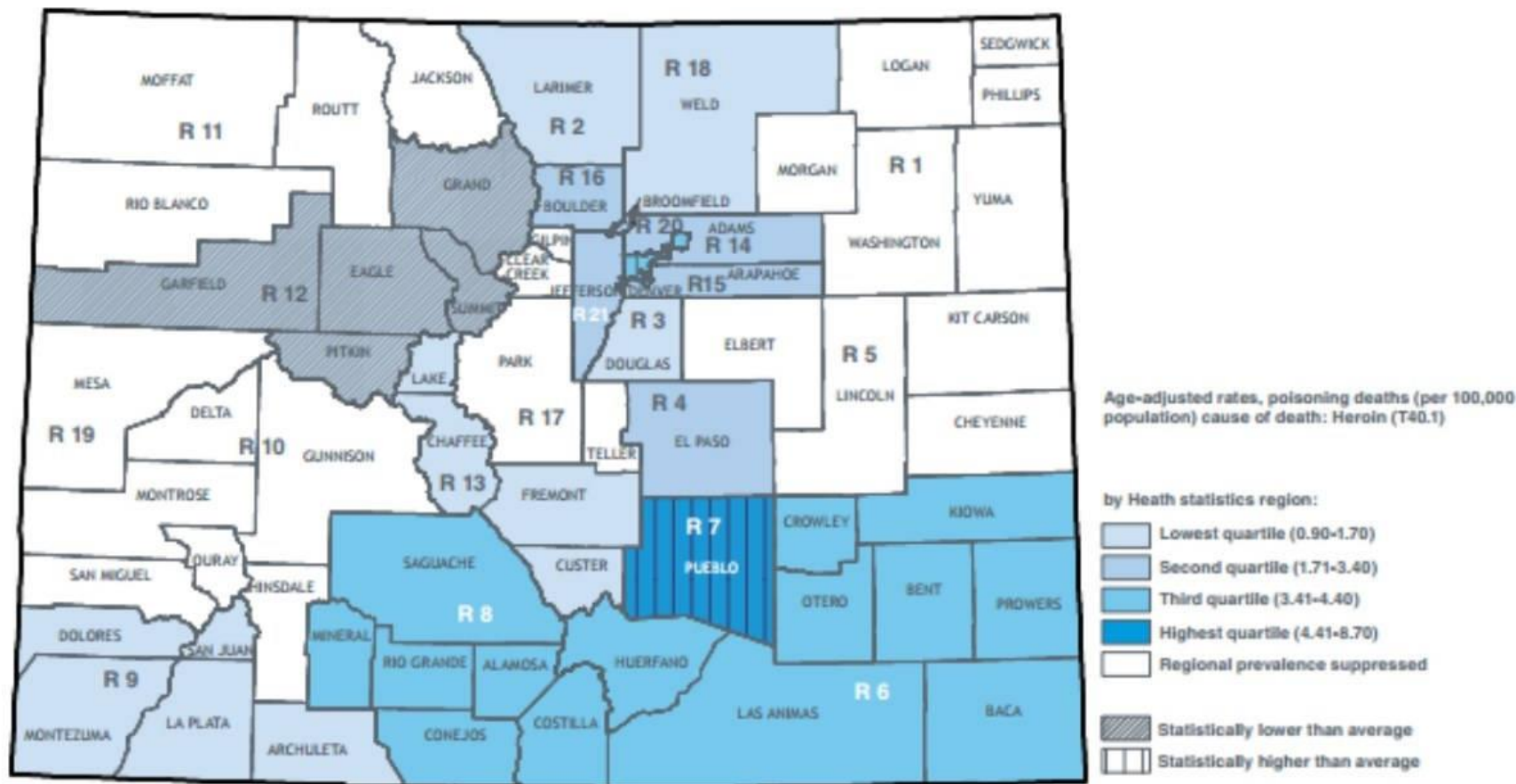
Source: Centres for Disease Control and Prevention

\*Deaths involving more than one drug are counted multiple times

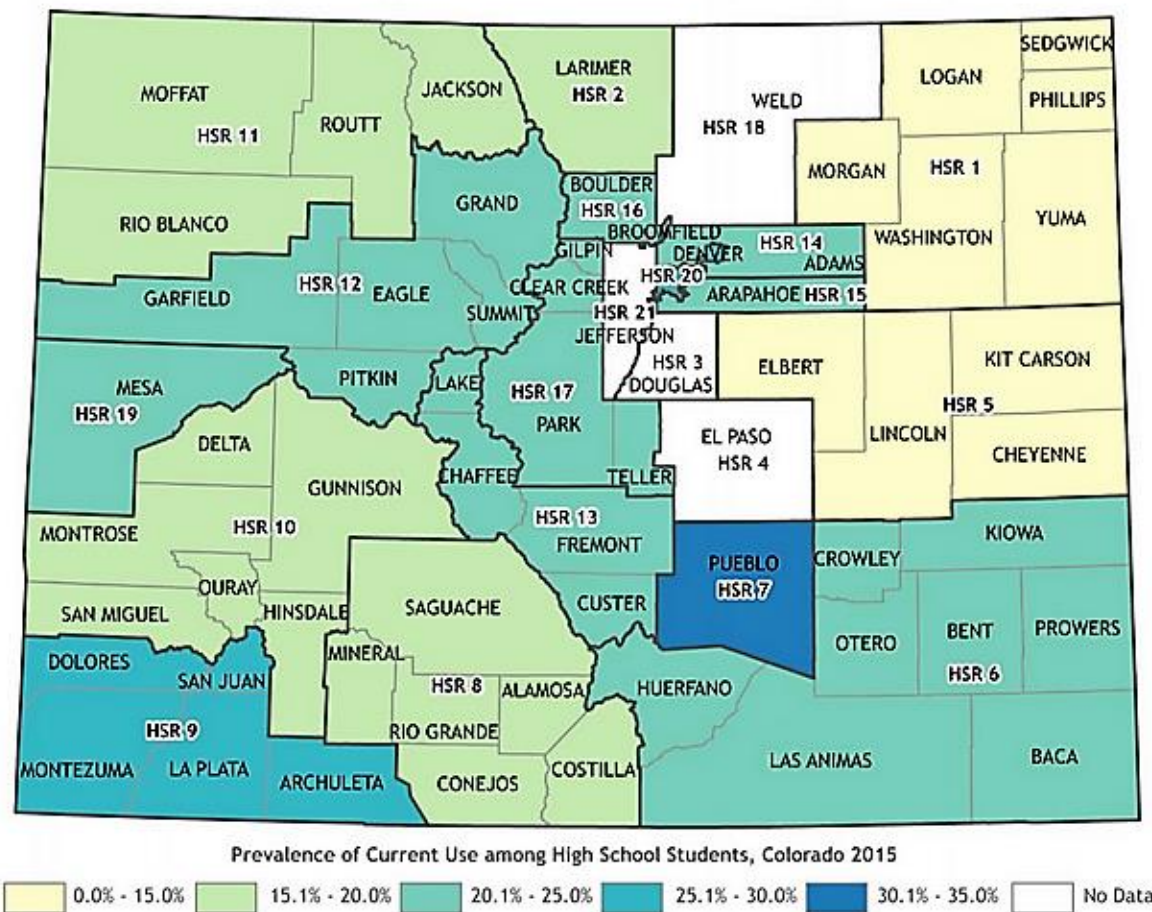
# In Colorado Heroin related deaths are doubling

- In 2011, statewide there were 79 heroin-related deaths. By 2015 that number doubled to 160.
- In 2011, 16 pounds of the drug were seized and just four years later nearly 270 pounds were taken.
- Pueblo County was in the highest percentile of heroin use by county and also ranked as having statistically higher use.
- <http://www.corxconsortium.org/heroin-response-work-group/>

### Figure 2.4 Colorado Heroin Use by County



Map 2. Prevalence of Current Marijuana Use among High School Students in Colorado, 2015



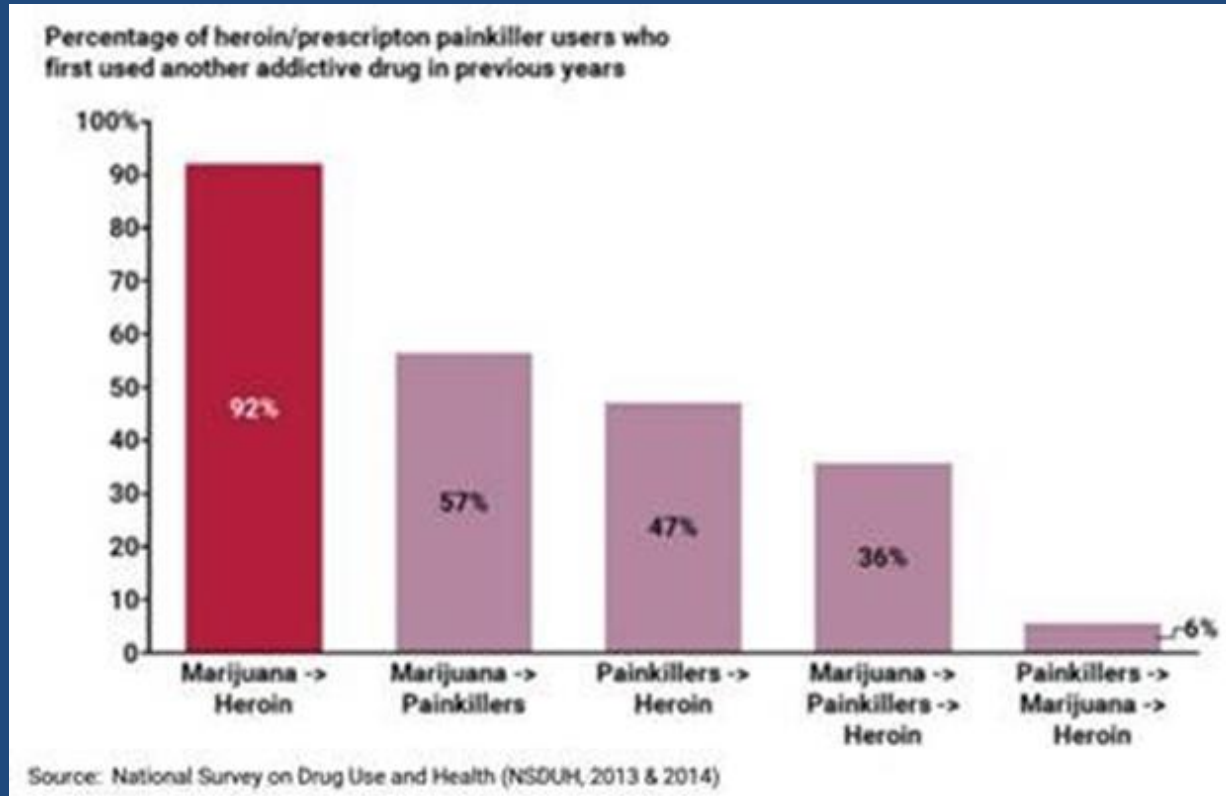
### Major findings

- In 2015, health statistics regions 7 (Pueblo County, 30.1%) and 9 (Dolores, San Juan, Montezuma, La

# One Hospital in Pueblo

- 2016 – 84,316 patients seen in the ER
- 2.15% tested positive for opiates – 1,812
- 730 opioid overdoses – 2 per day
- 7-15 patients admitted to the ICU with opioid OD per week – average 2 per day
- 73 admitted with severe abscesses
- 37 admitted with endocarditis

# Marijuana can be the gateway to opiates/heroin



# Strong Evidence Marijuana is a Gateway Drug

- UK Birth Cohort – 5315 adolescents with 3 or more measures of cannabis use from age 13-18
- 80.1% non-users, 14.2% late onset occasional use, 2.3% early onset occasional use and 3.4% regular users
- Dose-response relationship between cannabis use trajectories in adolescence and nicotine dependence, harmful alcohol consumption and other illicit drug use by 21
- Taylor M et al. J Epidemiol Community Health. 2017

# Prenatal exposure of cannabis alters opioid gene function in humans

- Aborted fetus brains from women using marijuana compared to those from women not using marijuana during pregnancy
- Discovered impaired opioid-related genes in distinct brain circuits that may have long term effects on cognitive and emotional behaviors
- Wang et al. Pharmacogenomics J, 2006;6:255-264

# Prenatal cannabis exposure increases heroin seeking in adult rats

- THC exposed rats exhibited shorter latency to the first active lever press for heroin and had higher heroin-seeking during mild stress and drug extinction than animals not exposed to THC – and exhibited allostatic changes in limbic enkephalin systems in adulthood
- Sapano et al. Biol Psychiatry 2007;61:554-563

# Naltrexone maintenance decreases cannabis self-administration and subjective effects of daily cannabis use

- Randomized double-blind, placebo controlled trial of naltrexone in non-treatment seeking cannabis smokers
- In a laboratory setting those receiving the placebo had 7.6 times the odds of self-administering active cannabis compared with those receiving daily naltrexone
- Haney et al. Neuropsychopharmacology 2015

# Solutions/Recommendations

- Educate, educate, educate
- Eliminate MMJ, just have regulated retail MJ
- Decriminalize possession of small amounts of MJ, increase the availability of drug courts and treatment
- Limit THC concentrations to <5%
- Increase prevention and early intervention efforts
- Increase research on CBD and lower doses of THC
- Strong ban on any advertising, especially that which appears to be directed toward youth – for all drugs including marijuana, tobacco and alcohol