

MEDICAL SCHOOL AND RESIDENCY PROGRAM  
CURRICULUM RESOURCES ON DRUG ABUSE AND ADDICTION

# Methamphetamine

Creighton University

Eugene J. Barone, M.D. \* Syed Pirzada Sattar, M.D.  
Kathryn N. Huggett, Ph.D. \* Amanda S. Lofgreen, M.S.

*These curriculum resources from the NIDA Centers of Excellence for Physician Information have been posted on the NIDA Web site as a service to academic medical centers seeking scientifically accurate instructional information on substance abuse. Questions about curriculum specifics can be sent to the Centers of Excellence directly. <http://www.drugabuse.gov/coe>*

November 5, 2010

# Objectives

1. Prevalence data
2. Diagnostic criteria
3. Review of methods of abuse
4. Review of mechanism of action
5. Review of effects of use on the brain
6. Review of symptoms of intoxication and withdrawal
7. Review of short- and long-term effects of use
8. Review of treatment principles
9. Review of pharmacological and non-pharmacological treatments and treatment outcomes data
10. Discussion of clinical vignettes

# Methamphetamine Abuse Overview

- Initially limited to Hawaii and western parts of the United States, methamphetamine abuse continues to spread eastward.
- Methamphetamine abused in the United States comes from:
  - Small, illegal laboratories, where its production endangers the people in the labs and neighbors, as well as the environment.
  - Foreign or domestic superlabs (most comes from here).
- Methamphetamine abuse leads to devastating medical, psychological, and social consequences and contributes to increased transmission of infectious diseases.
- Methamphetamine abuse can be prevented and methamphetamine addiction can be treated.

# Prevalence Data

[www.drugabuse.gov/coe](http://www.drugabuse.gov/coe)

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## **Prevalence:**

The number of people that have a condition at any given time.

## **Lifetime Prevalence:**

The number of people who will have the condition at some point in their lives.

# Methamphetamine Prevalence (2008)

- Lifetime prevalence of methamphetamine use is approximately 5.0 percent.
- 12.5 million Americans ages 12 and over have used methamphetamine.

# Methamphetamine: Epidemiology

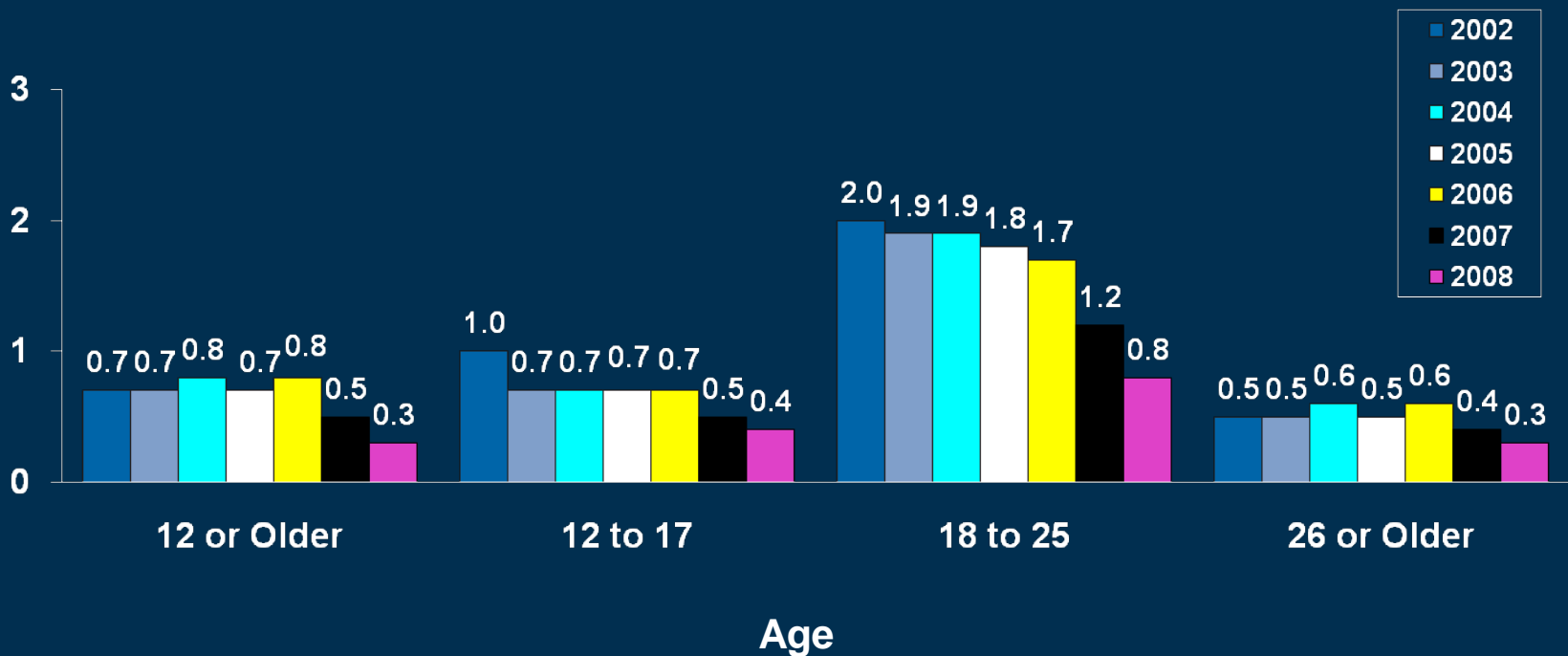
## Percentage of Individuals Reporting Methamphetamine Use, by Age Group, 2008

Age Group	Lifetime	Annual	Last 30 days
12–17	0.8%	0.7%	0.2%
18–25	4.7%	0.8%	0.2%
26–34	7.2%	0.6%	0.3%
> 34	5.3%	0.2%	0.1%
> 12 (Total)	5.0%	0.3%	0.1%

2008 National Survey on Drug Use and Health.

# Past-year Methamphetamine Use

## Percentage of Individuals Reporting Methamphetamine Use in the Past Year, by Age Group, 2002–2008



Note: Estimates are based on new 2006 questions. The 2002-2005 estimates are adjusted for comparability.

2008 National Survey on Drug Use and Health.



# Methamphetamine: Epidemiology

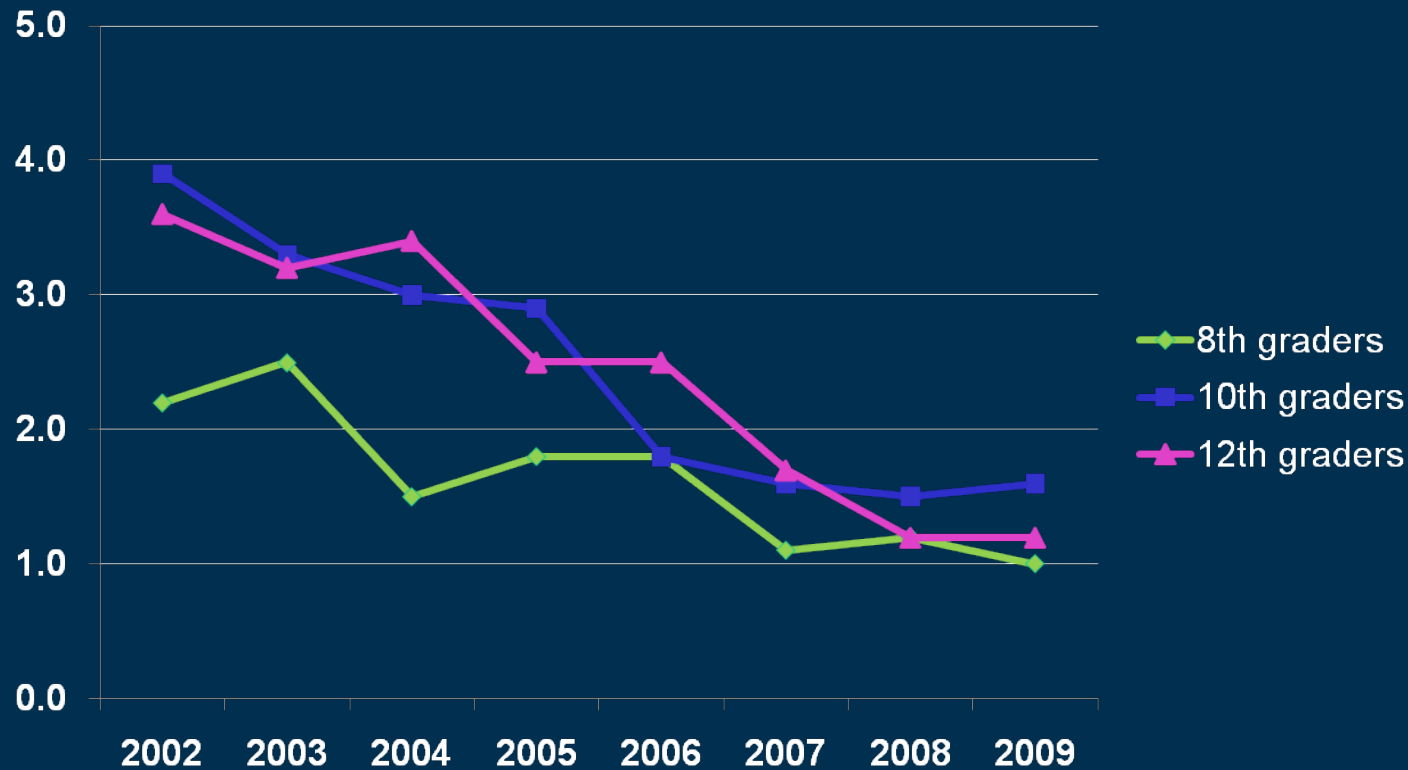
## High School Students Reporting Methamphetamine Use, 2009

Grade	Lifetime	Annual	Last 30 days
8 <sup>th</sup>	1.6%	1.0%	0.5%
10 <sup>th</sup>	2.8%	1.6%	0.6%
12 <sup>th</sup>	2.4%	1.2%	0.5%

Johnston, 2009.

# Methamphetamine Use is Not Increasing, According to the Monitoring the Future Study

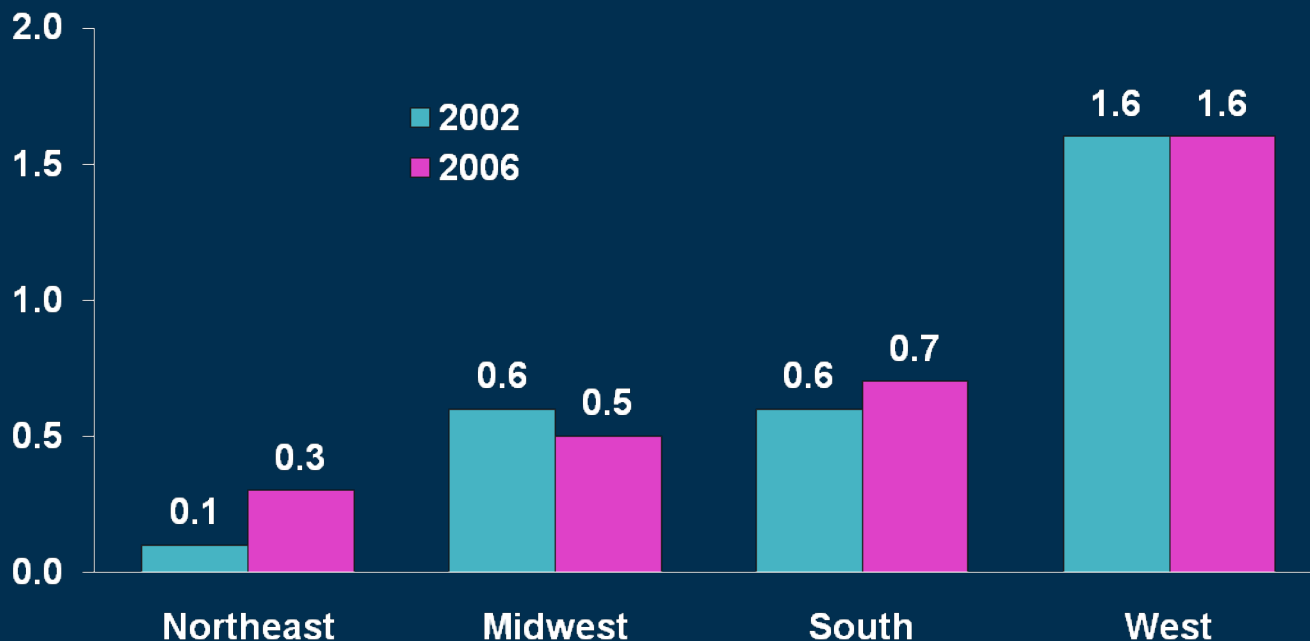
## Percentage of Students Reporting Use of Methamphetamine in the Past Year, by Grade, 2002–2009



Johnston, 2009.

# Past-year Methamphetamine Use Among Persons Age 12 Years and Over, by Region

## Percentage Using in Past Year, 2002 and 2006

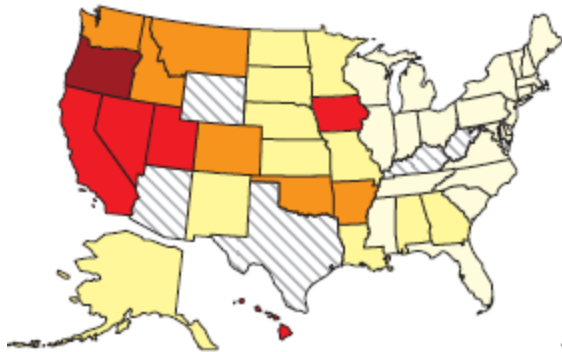


**Note:** Estimates are based on new 2006 questions; 2002 estimates are adjusted for comparability.

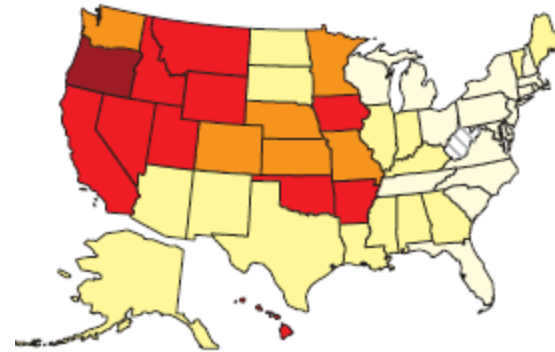
+ Difference between this estimate and the 2006 estimate is statistically significant at the .05 level.

# Primary Methamphetamine/Amphetamine Admission Rates

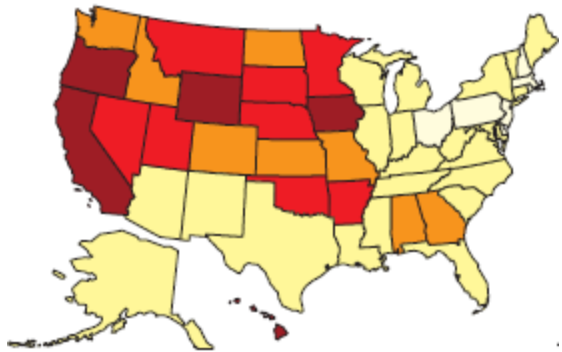
(per 100,000 population, aged 12 and over)



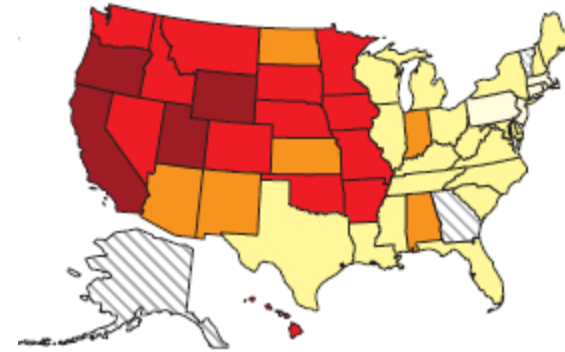
**1996**  
(range <1 – 225)



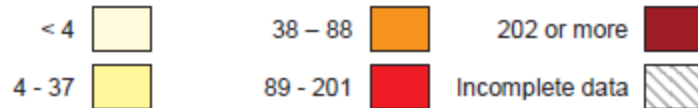
**2000**  
(range 1 – 266)



**2003**  
(range 1 – 251)

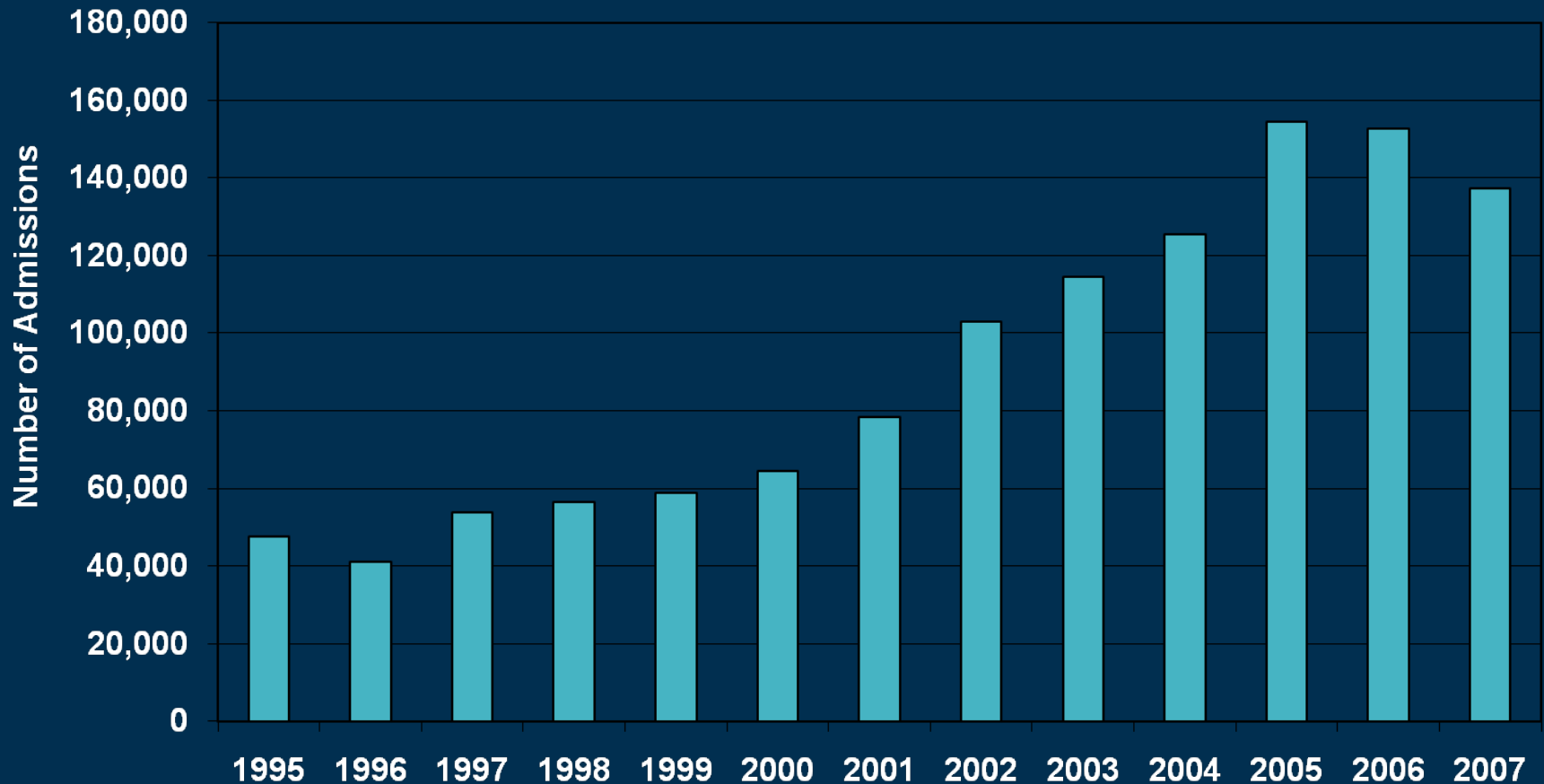


**2006**  
(range 3 – 282)



Substance Abuse and Mental Health Services Administration (SAMHSA), 2008.

# Methamphetamine Treatment Admissions



SAMHSA, 2009b.

# Methods of Abuse

[www.drugabuse.gov/coe](http://www.drugabuse.gov/coe)

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# Methods of Abusing Methamphetamine

- Ingesting
- Snorting
- Smoking
- Injecting
- Skin popping

# Mechanism of Action

[www.drugabuse.gov/coe](http://www.drugabuse.gov/coe)

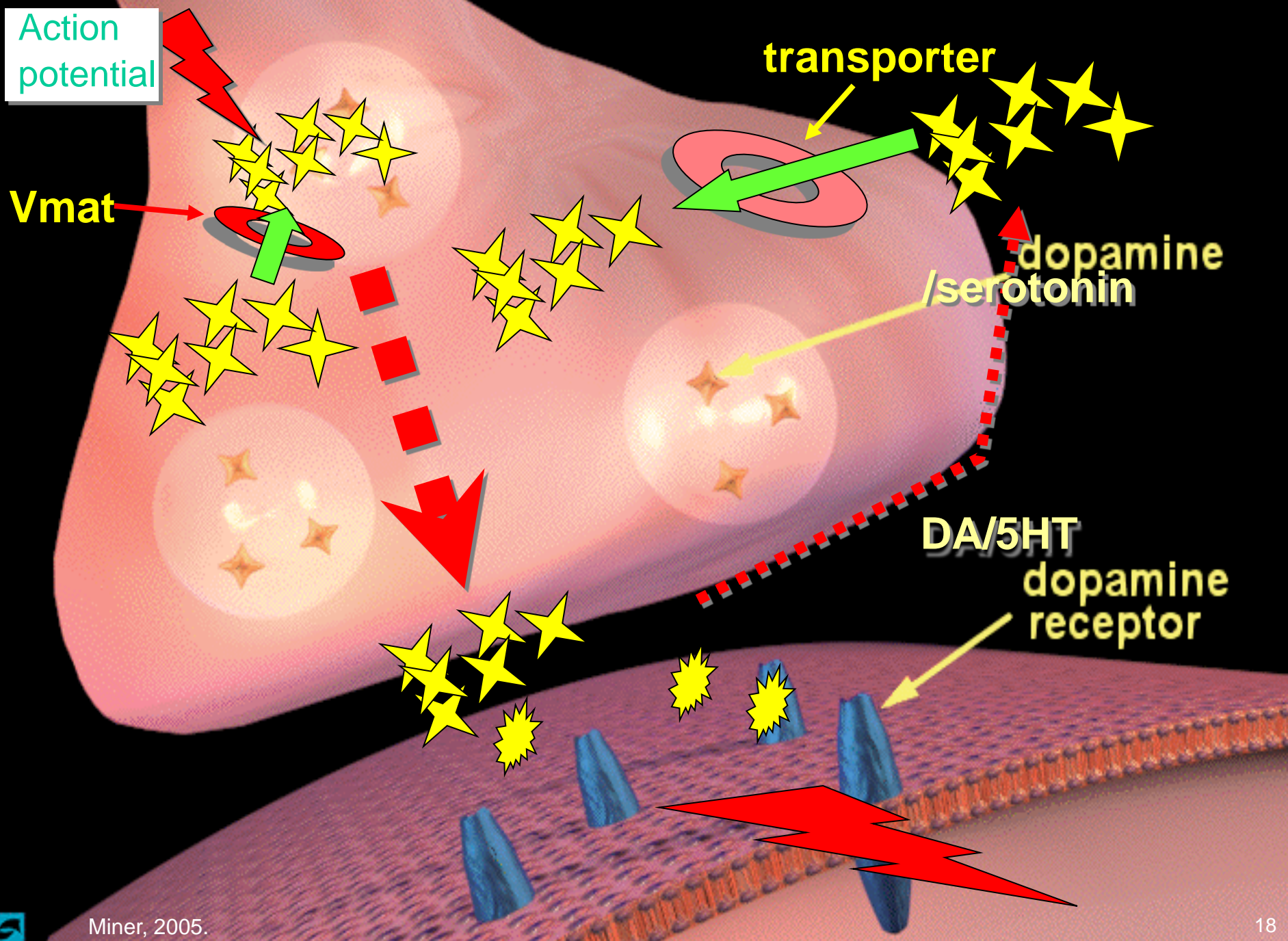
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# Mechanism of Action

- Increased activity of serotonin
- Increased activity of norepinephrine
- Increased activity of dopamine  
(primary mechanism of euphoria)



Action potential

Vmat

transporter

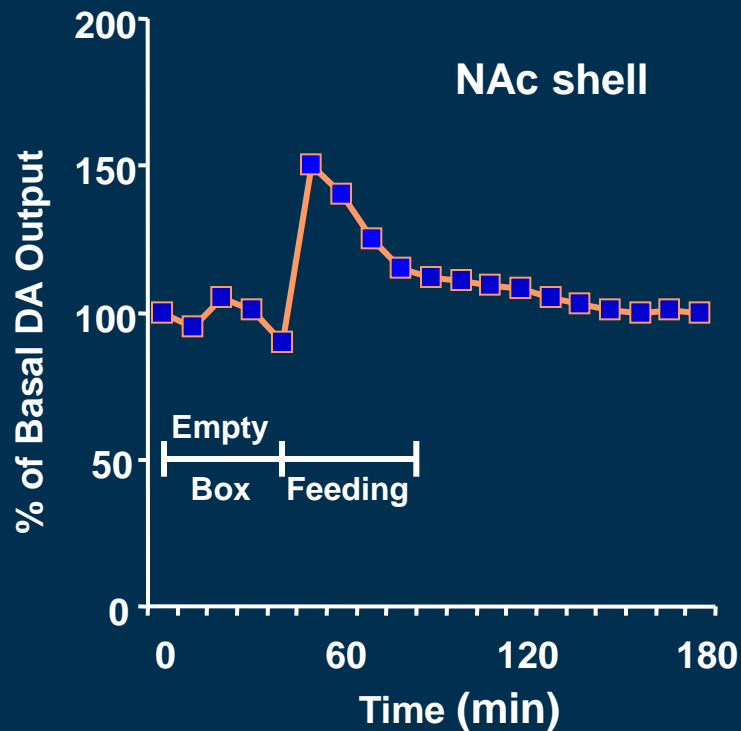
dopamine /serotonin

DA/5HT

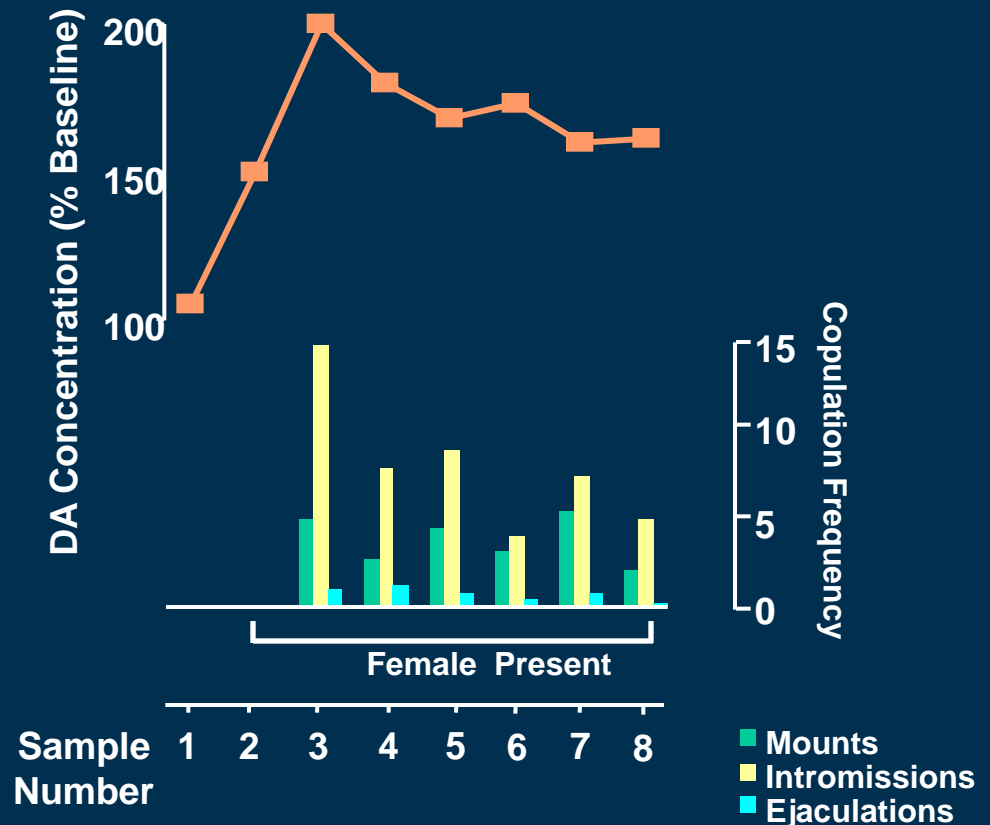
dopamine receptor

# Natural Rewards Elevate Dopamine Levels

## FOOD

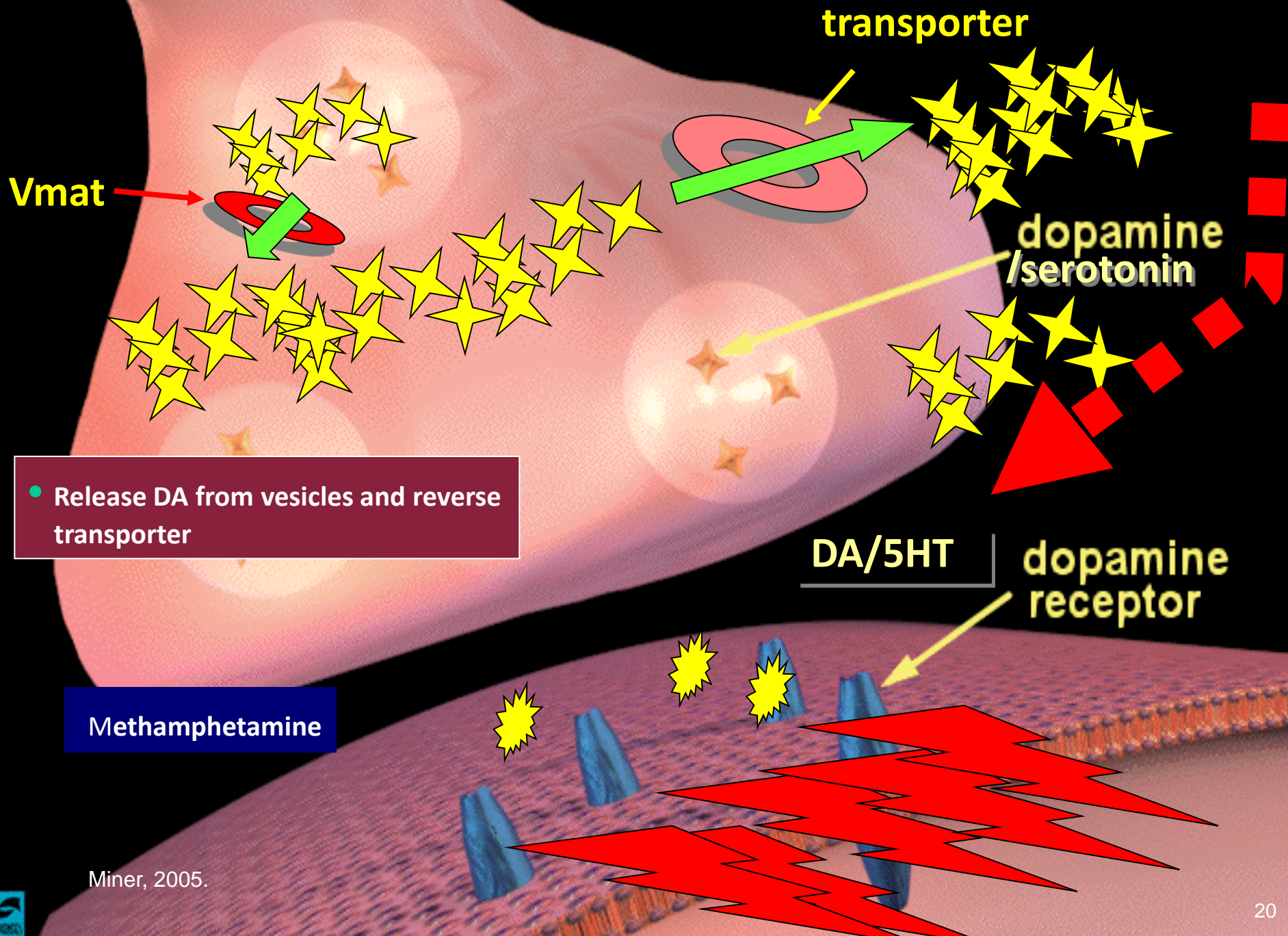


## SEX



Di Chiara et al., Neuroscience, 1999.

Fiorino and Phillips, J. Neuroscience, 1997.



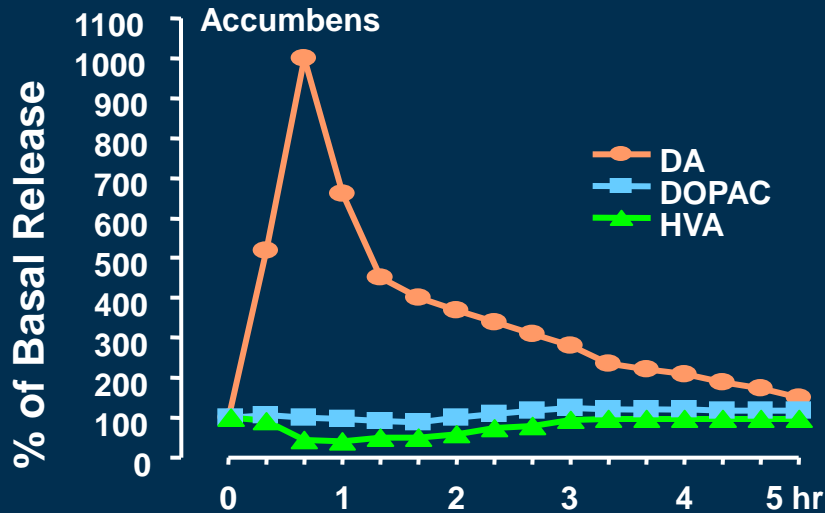
• Release DA from vesicles and reverse transporter

Methamphetamine

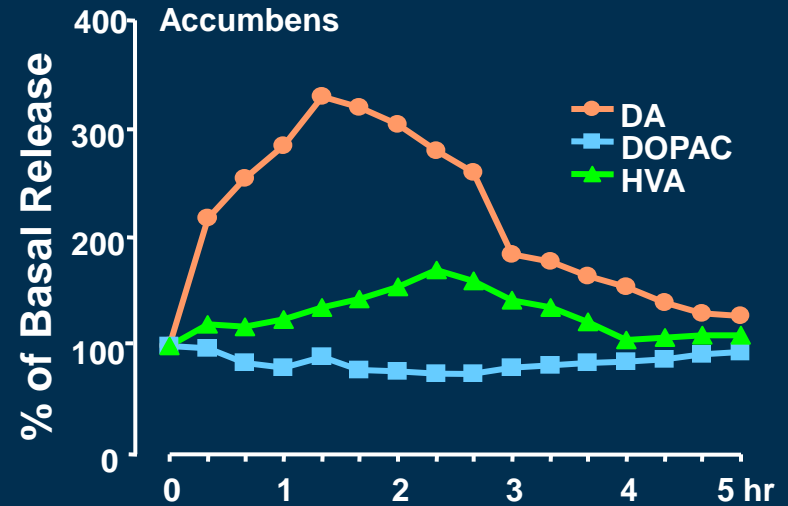
Miner, 2005.

# Effects of Drugs on Dopamine Release

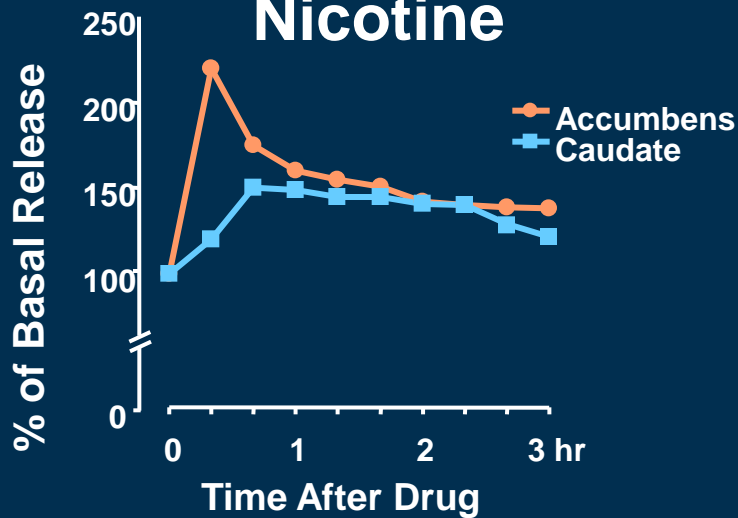
## Amphetamine



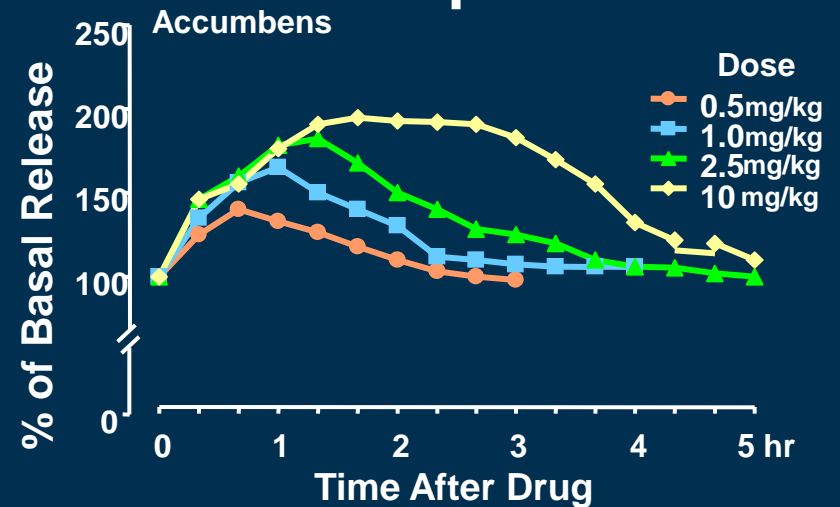
## Cocaine



## Nicotine



## Morphine



# Effects of Use on the Brain

[www.drugabuse.gov/coe](http://www.drugabuse.gov/coe)

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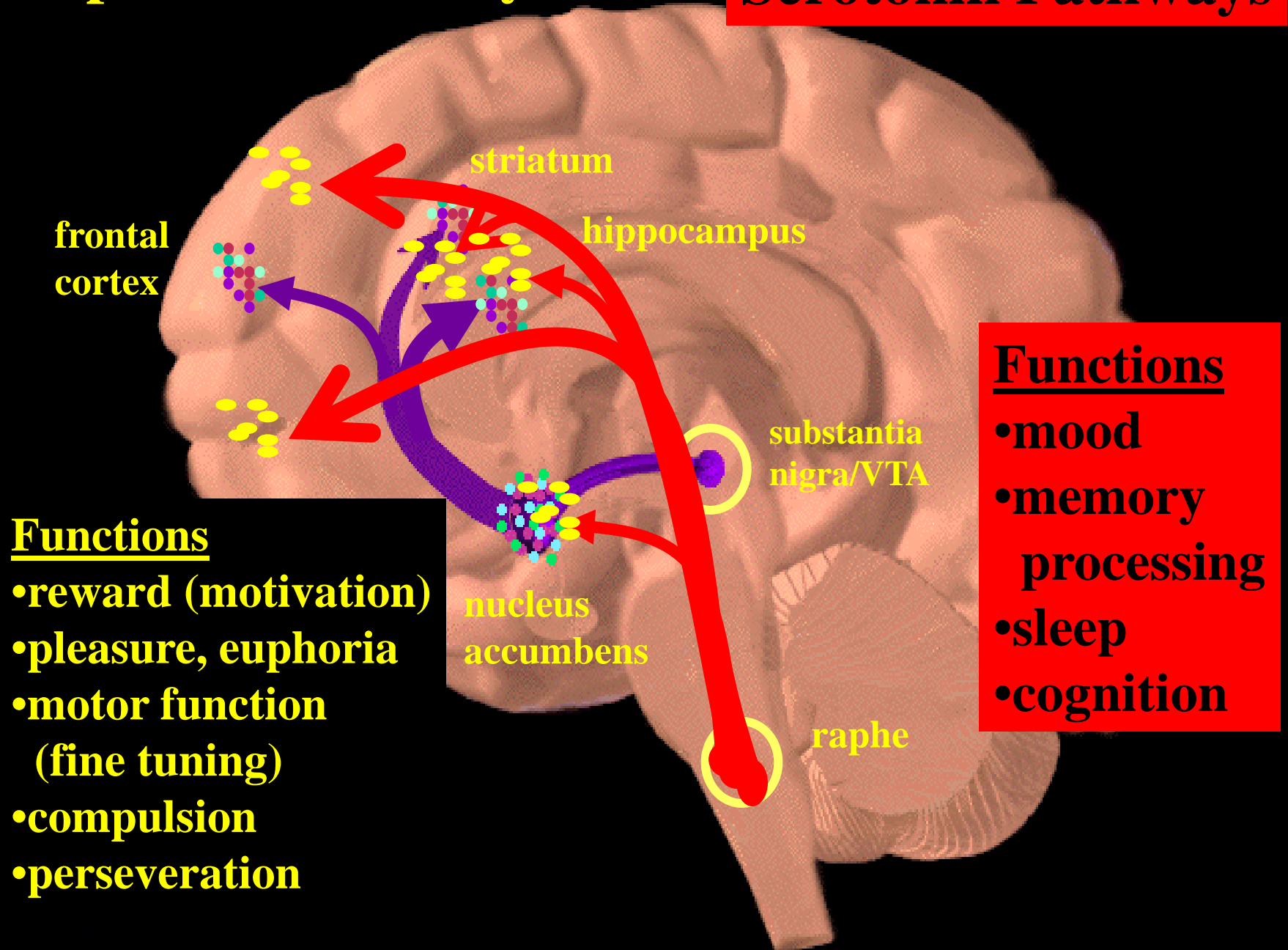


# How Do Drugs Work in the Brain?

We know that despite their many differences, most abused substances enhance the dopamine and serotonin pathways.

# Dopamine Pathways

# Serotonin Pathways



## Functions

- reward (motivation)
- pleasure, euphoria
- motor function (fine tuning)
- compulsion
- perseveration

## Functions

- mood
- memory processing
- sleep
- cognition



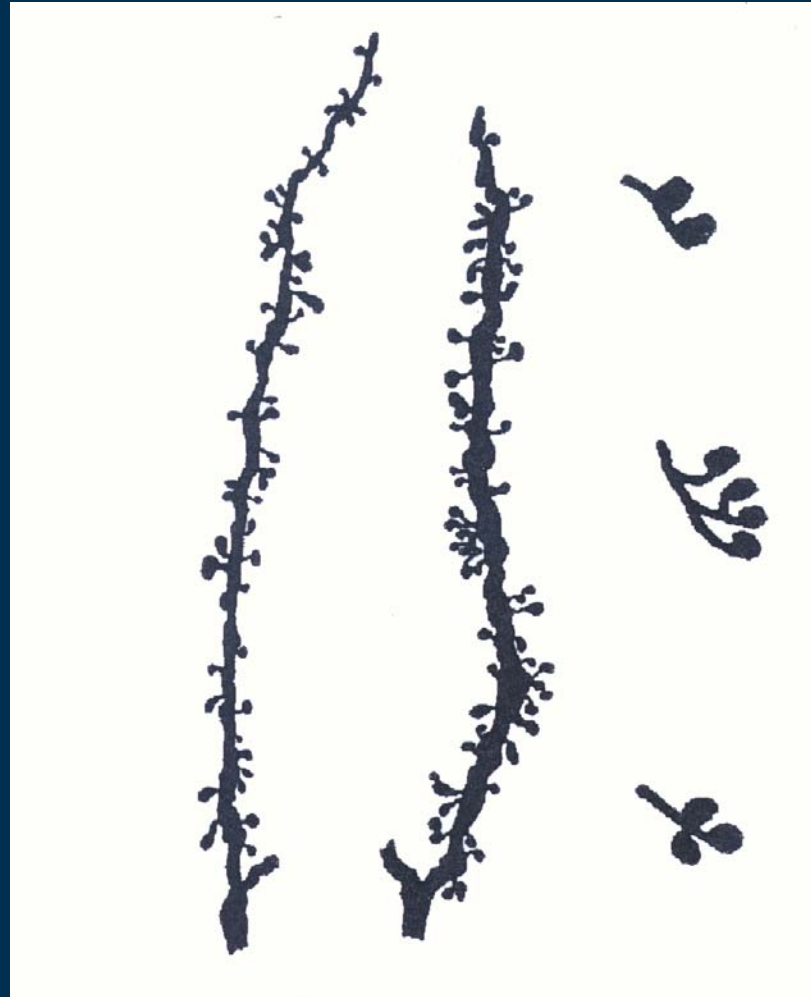
# Science Has Generated a Lot of Evidence Showing...

Prolonged drug use changes the brain in fundamental and long-lasting ways.

AND . . .

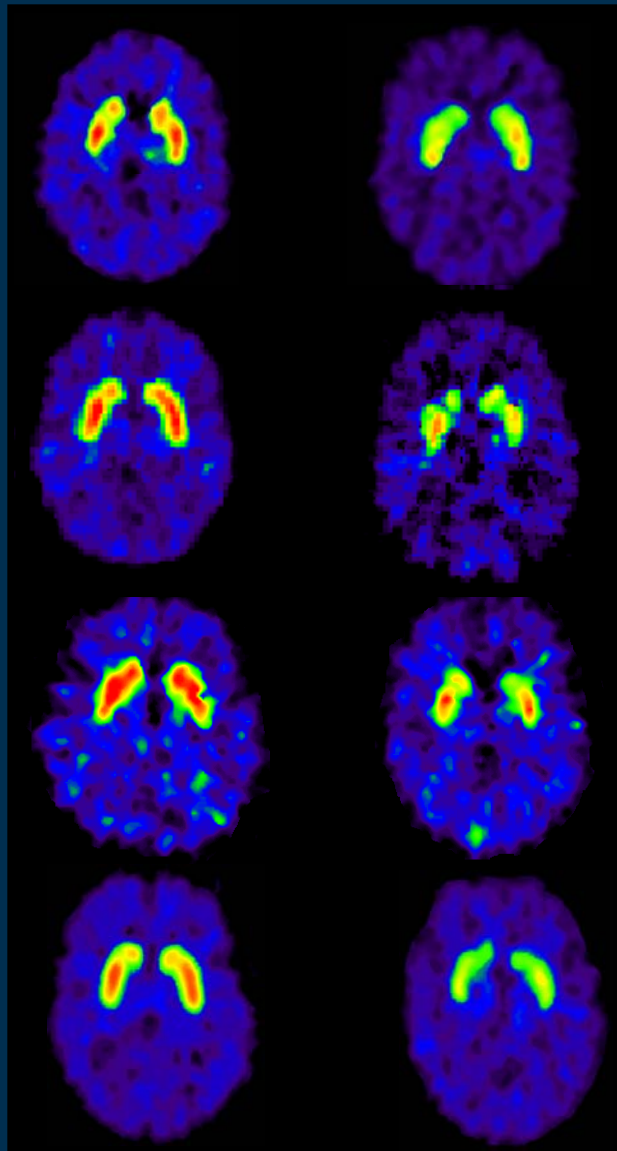
We have evidence that these changes can be both **structural** and **functional**.

# Structurally . . . $\text{NA}_c$



Saline      Amph

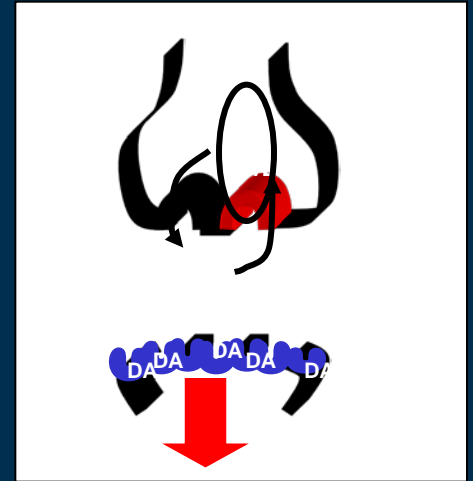
# Functionally, Dopamine D2 Receptors Are Lower in Addiction



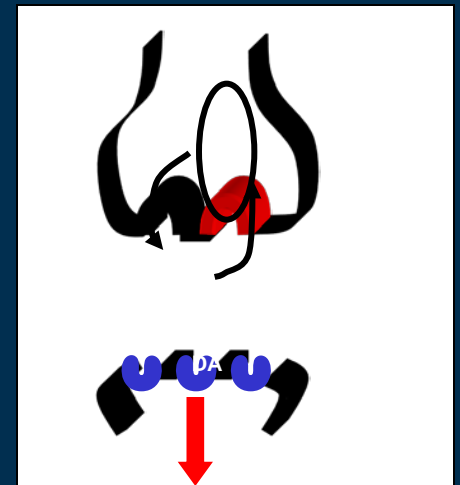
Control

Addicted

## Reward Circuits



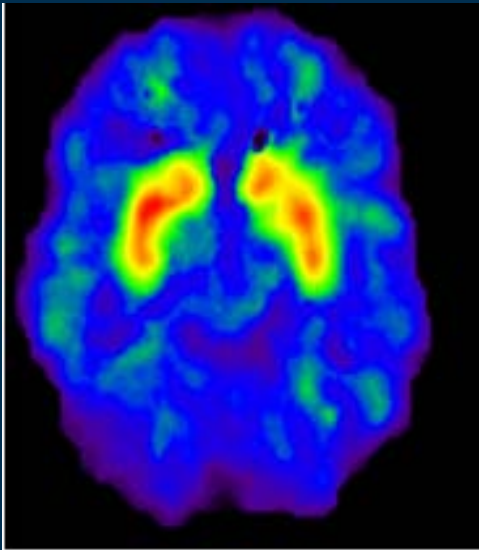
Non-Drug Abuser



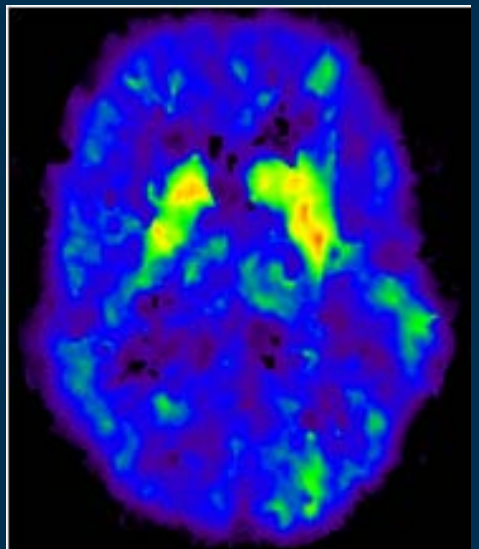
Drug Abuser

DA D2 Receptor Availability

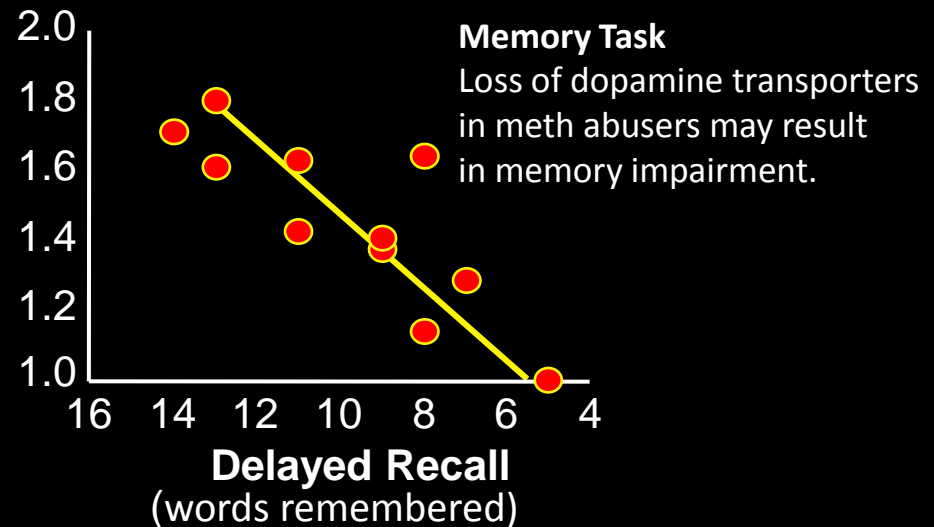
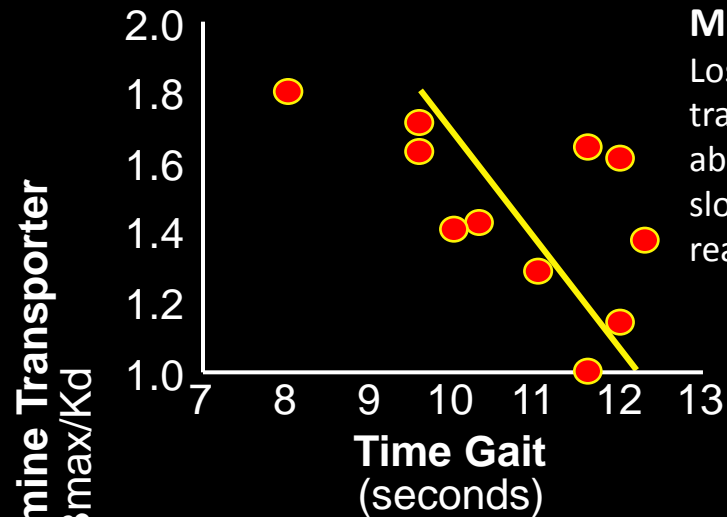
# Dopamine Transporters in Methamphetamine Abusers



Normal Control

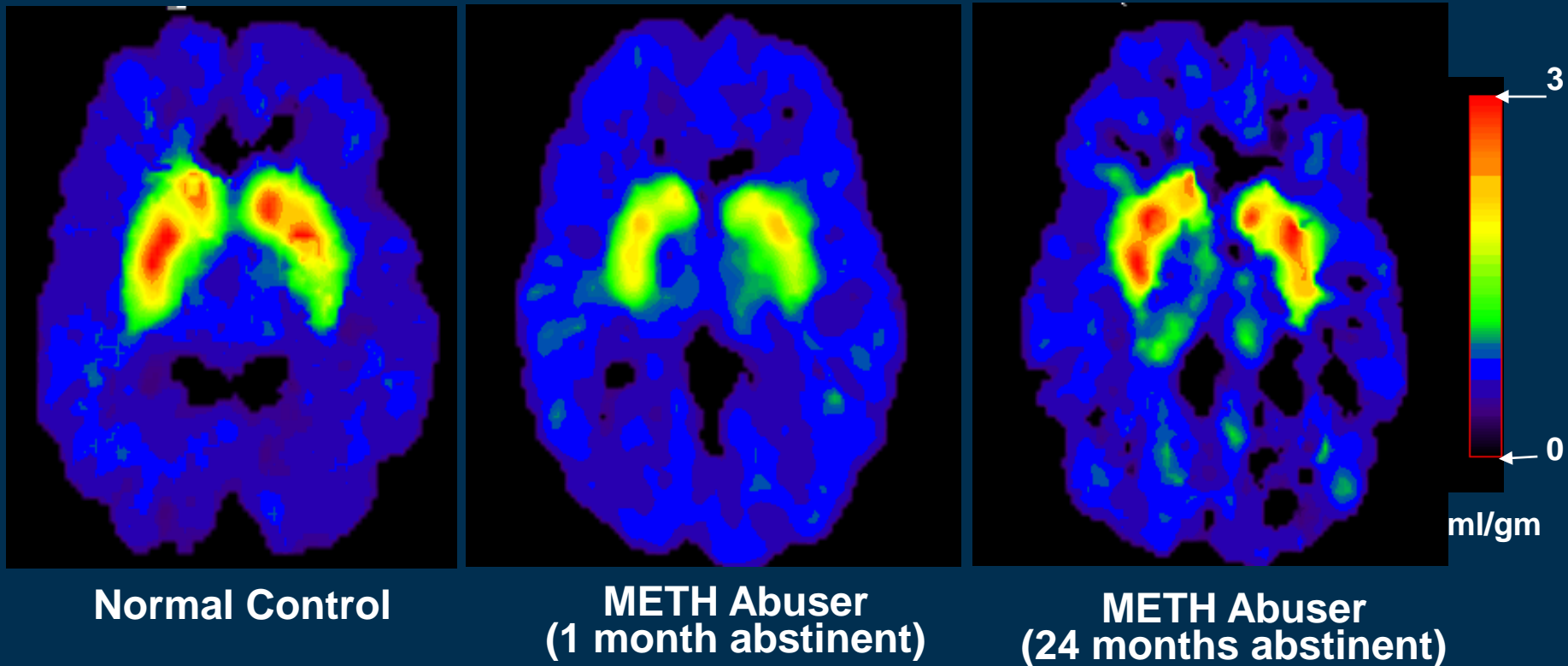


Methamphetamine Abuser



Source: Volkow et al., 2001.

# Partial Recovery of Brain Dopamine Transporters in Methamphetamine (METH) Abuser After Protracted Abstinence



NIDA, 2007..

# Diagnostic Criteria

[www.drugabuse.gov/coe](http://www.drugabuse.gov/coe)

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# Diagnostic Criteria

**Based on the Diagnostic and Statistical Manual of Psychiatric Diseases IV Edition (DSM-IV)**

- Abuse
- Dependence

American Psychiatric Association (APA), 2000.



# Diagnostic Criteria: Methamphetamine *Abuse*

A maladaptive pattern of substance use leading to clinically significant impairment or distress, as manifested by one (or more) of the following, occurring within a 12-month period:

1. Recurrent substance use resulting in a failure to fulfill major role obligations at work, school, home (e.g., repeated absences or poor work performance related to substance use; substance-related absences, suspensions, or expulsions from school; neglect of children or household).
2. Recurrent substance use in physically hazardous situations (e.g., driving an automobile when impaired by substance use).
3. Recurrent substance-related legal problems (e.g., arrests for substance-related disorderly conduct).
4. Continued substance use despite persistent or recurrent social or inter-personal problems caused or exacerbated by the effects of the substance (e.g., arguments with spouse about consequences of intoxication).

The symptoms have never met the criteria for Substance Dependence for this class of substances.

# Diagnostic Criteria: Methamphetamine *Dependence*

A maladaptive pattern of substance use, leading to clinically significant impairment or distress, as manifested by three (or more) of the following, occurring at any time in the same 12-month period:

1. Tolerance, as defined by either of the following:
  - A need for markedly increased amounts of the substance to achieve intoxication or desired effect.
  - A markedly diminished effect with continued use of the same amount of substance.
2. Withdrawal, as manifested by either of the following:
  - The characteristic withdrawal syndrome for the substance.
  - The same (or a closely related) substance is taken to relieve or avoid withdrawal symptoms.
3. The substance is often taken in larger amounts or over a longer period than was intended.

# Diagnostic Criteria: Methamphetamine *Dependence* (cont.)

4. There is a persistent desire or unsuccessful efforts to cut down or control substance use.
5. A great deal of time is spent in activities to obtain the substance, use the substance, or recover from its effects.
6. Important social, occupational, or recreational activities are given up or reduced because of substance use.
7. The substance use is continued despite knowledge of having a persistent or recurrent physical or psychological problem that is likely to have been caused or exacerbated by the substance (e.g., continued drinking despite recognition that an ulcer was made worse by alcohol consumption).

# Symptoms of Intoxication and Withdrawal

[www.drugabuse.gov/coe](http://www.drugabuse.gov/coe)

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# Clinical Presentation: Intoxication

- **Rush** (5 to 30 min)
  - Adrenal gland release of epinephrine
  - Rapid release of dopamine
  - Intensely euphoric
  - Tachycardia, BP spike, heart rhythm abnormalities

# Clinical Presentation: Intoxication

- **High** (4 to 16 hours)
  - Continuation of the physical and mental hyperactivity
- **Binge** (3 to 15 days)
  - Larger doses required to achieve same intensity
  - Little or no rush or high felt
  - Physical and mental hyperactivity

# Clinical Presentation: Withdrawal

- **“Crash” (1 to 3 days)**
  - Follows a binge
  - Tired, lifeless, and sleepy
  - Feelings of emptiness and dysphoria
  - Often repeat use of this drug or alcohol/other drugs to self-medicate withdrawal symptoms
- **Withdrawal (several days to several weeks)**
  - Depressive symptoms, lethargy, cravings, and suicidal thoughts

# Short- and Long-term Effects of Use

[www.drugabuse.gov/coe](http://www.drugabuse.gov/coe)

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# Short-term Effects

- Increased attention and decreased fatigue
- Increased activity and wakefulness
- Decreased appetite
- Euphoria and rush
- Increased respiration
- Rapid/irregular heartbeat
- Hyperthermia
- A distorted sense of well-being
- Effects that can last 8 to 24 hours

# Long-term Effects

- Addiction
- Psychosis, including:
  - Paranoia and delusions
  - Hallucinations
  - Repetitive motor activity
- Changes in brain structure and function
- Memory loss
- Aggressive or violent behavior
- Anxiety and mood disturbances
- Fatigue
- Severe dental problems
- High blood pressure
- Tachycardia
- Tachypnea
- Myocardial infarctions
- Skin lesions
- Stroke
- Dehydration
- Weight loss
- Death

# Fetal Effects of Methamphetamine

Preliminary evidence suggests that prenatal methamphetamine exposure is associated with subtle physical and neurobehavioral effects, including:

- Lower arousal
- Poorer self-regulation
- Poorer quality of movement
- Increased central nervous system stress
- Small for gestational age

# Drug Use Has Played a Prominent Role in the HIV/AIDS Epidemic in Several Ways

- Disease transmission
  - IV drug use
  - Drug user disinhibition leading to high-risk sexual behaviors
- Progression of disease

# Treatment Principles

[www.drugabuse.gov/coe](http://www.drugabuse.gov/coe)

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# Basic Principles of Treatment

1. Addiction is a complex but treatable disease that affects brain function and behavior.
2. No single treatment is appropriate for all individuals.
3. Treatment needs to be readily available.
4. Effective treatment attends to the individual's multiple needs, not just his or her drug use.
5. Remaining in treatment for an adequate period of time is critical for treatment effectiveness.
6. Counseling (individual and/or group) and other behavioral therapies are critical components of effective treatment for addiction.
7. Medications are an important element of treatment for many patients, especially when combined with counseling and other behavioral therapies.

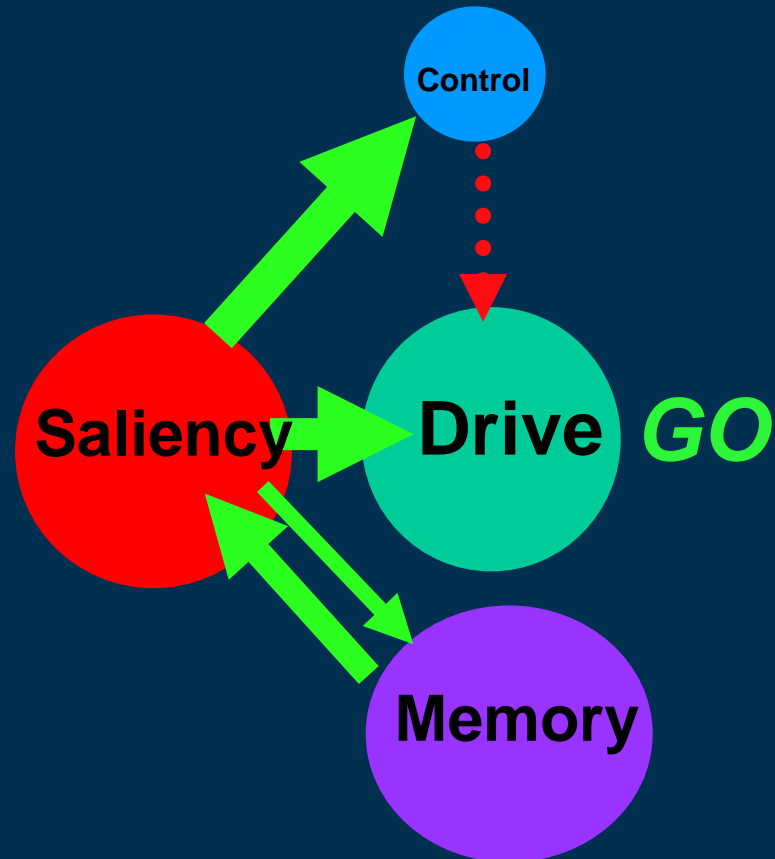
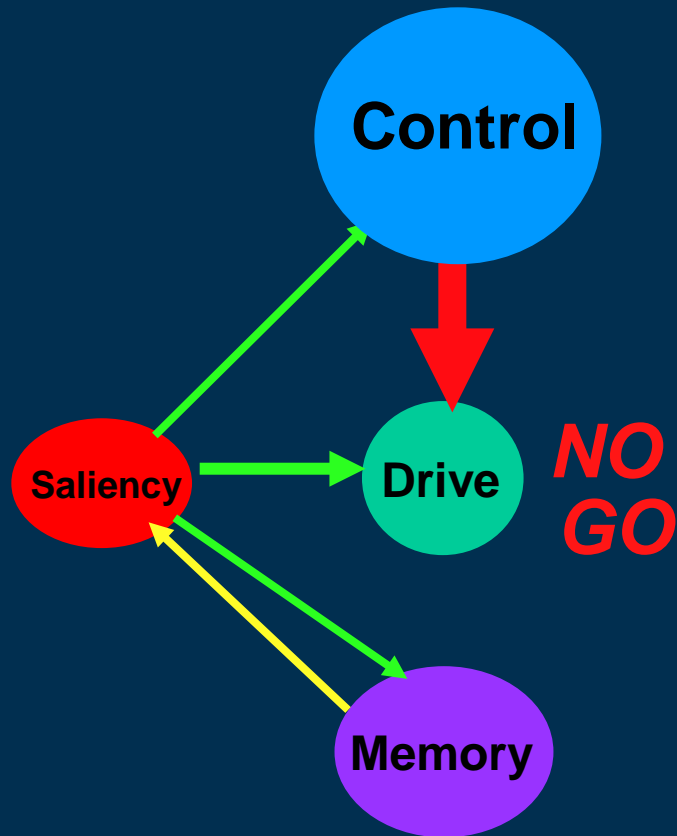
# Basic Principles of Treatment (Cont.)

8. An individual's treatment and services plan must be assessed continually and modified as necessary to ensure that it meets the person's changing needs.
9. Addicted or drug-abusing individuals with coexisting mental disorders should have both disorders treated in an integrated way.
10. Medical detoxification is only the first stage of addiction treatment and by itself does little to change long-term drug use.
11. Treatment does not need to be voluntary to be effective.
12. Possible drug use during treatment must be monitored continuously.
13. Treatment programs should provide assessment for HIV/AIDS, hepatitis B and C, tuberculosis and other infectious diseases, and counseling to help patients modify or change behaviors that place themselves or others at risk of infection.

# Why Can't Addicts Just Quit?

Non-Addicted Brain

Addicted Brain



**Because addiction changes brain circuits.**



# Treatments Types

[www.drugabuse.gov/coe](http://www.drugabuse.gov/coe)

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# Pharmacological Treatments

- No approved medications
- Off label use/treatment of co-morbid conditions
  - Antidepressants
  - Mood stabilizers
  - Antipsychotic medications
- Symptomatic treatment

# Non-pharmacological Treatments

- Motivation Enhancement Therapy (MET)
- Cognitive behavioral therapy
- Contingency management
- Matrix Model
- Family education
- Group therapy
- Self-help groups (12-step program)

# Motivational Enhancement Therapy (MET)

- MET seeks to evoke from clients their own motivation for change and to consolidate a personal decision and plan for change.
- MET is primarily client centered, although planned and directed.
- The content of an MET session depends on the client's stage of motivation. Prochaska and colleagues (1992) have described five stages of readiness:
  - **Precontemplation:** the patient is not considering change.
  - **Contemplation:** patient is ambivalent, weighing the pros and cons of change.
  - **Preparation:** the balance tips in favor of change and the patient begins considering options.
  - **Action:** the patient taking specific steps to accomplish change.
  - **Maintenance:** the patient focuses on preventing relapse.

# Negotiating Behavior Change Based on an MET Approach



# Assess Importance, Confidence, and Readiness

## Examples:

- “How important is it to you to stop smoking?”
- “If you decided right now to change your smoking behavior, how confident do you feel about succeeding with this?”
- “People differ quite a lot in how ready they are to change their smoking behavior. What about you?”

# Physician Tasks Based in Patient Readiness to Change

<b>PRECONTEMPLATION</b>	Raise doubt—increase the patient's perception of risks and problems with current behavior.
<b>CONTEMPLATION</b>	Tip the decisional balance—evoke reasons for Change and risks of not changing; strengthen patient's self-efficacy for change of current behavior.
<b>PREPARATION</b>	Help the patient determine the best course of action to take in seeking change; develop a plan.
<b>ACTION</b>	Help the patient implement the plan; use skills; problem solve; support self-efficacy.
<b>MAINTENANCE</b>	Help the patient identify and use strategies to prevent relapse; resolve associated problems.

# Outcomes

[www.drugabuse.gov/coe](http://www.drugabuse.gov/coe)

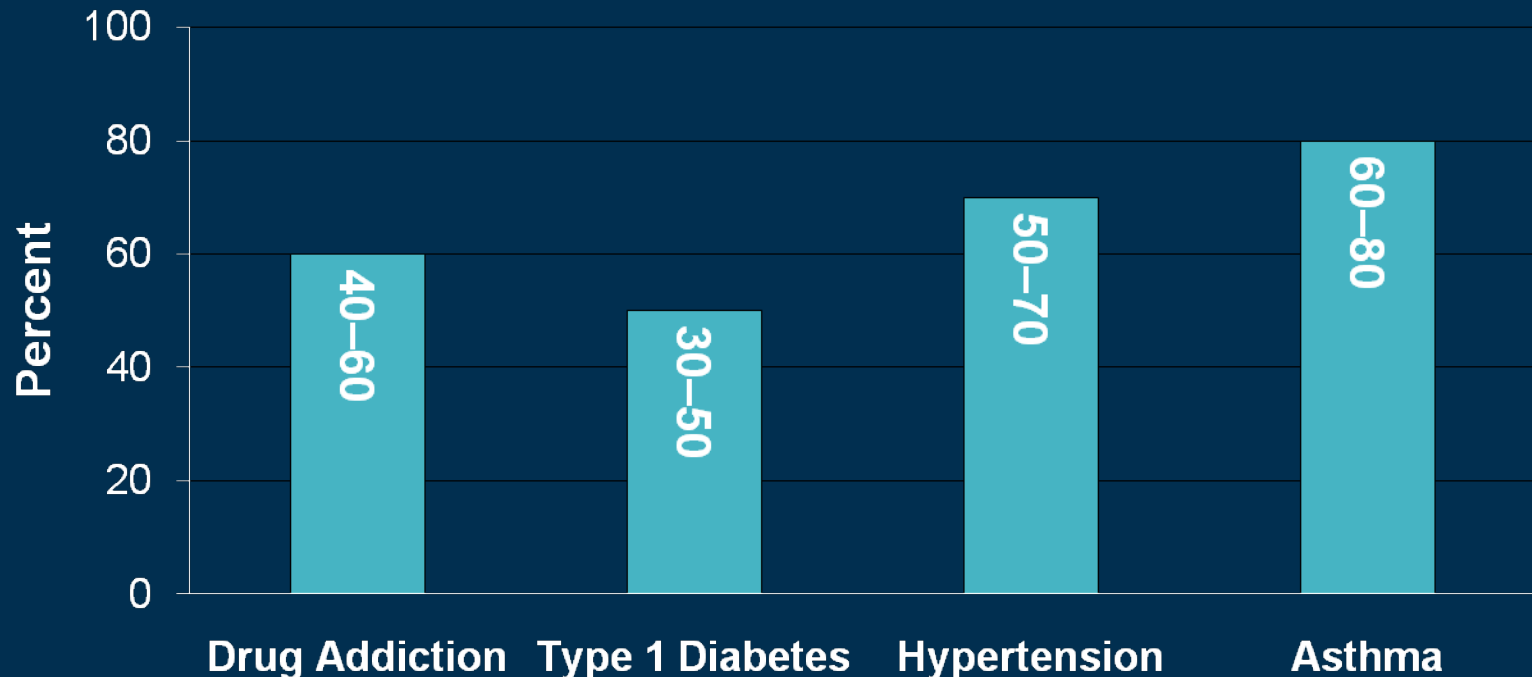
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# Relapse Rates Are Similar for Drug Addiction and Other Chronic Illnesses

## Percentage of Patients Who Relapse



McLellan, et al., 2000.

# Clinical Vignettes

[www.drugabuse.gov/coe](http://www.drugabuse.gov/coe)

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# Clinical Vignette # 1

A 22-year-old white male is admitted to the ER with paranoia; olfactory, tactile, auditory and visual hallucinations; agitation; and behavior disturbances. This is atypical behavior for him. Acute management should include:

- Medical assessment, including CT of head, EEG
- Urine drug screen
- Pharmacotherapy with tranquilizers (benzodiazepines and antipsychotics), IV fluids, and general supportive treatment

## Clinical Vignette # 2

A 62-year-old white male is admitted to the ER with history of alcohol and IV drug use. He is very depressed, tired, and suicidal with some paranoia. His ADL are poor. Acute management should include:

- Medical assessment, blood workup, and CT of head
- Urine drug screen
- Pharmacotherapy with tranquilizers (benzodiazepines and antipsychotics), IV fluids, and general supportive treatment

## Clinical Vignette # 3

A 32-year-old, 30 weeks pregnant white female, with a previous history of bipolar disorder, presents to the obstetric clinic for a routine well check. She has facial sores that she says are acne related to her pregnancy. She is also presenting with symptoms of hypomania. She is denying any alcohol or drug use. Her grooming and hygiene are poor. Acute management should include:

- Medical/Obstetric assessment, blood workup
- Urine drug screen
- IV fluids and general supportive treatment
- Benzodiazepine treatment to control agitation
- Social work consult

# Assessment Questions

[www.drugabuse.gov/coe](http://www.drugabuse.gov/coe)

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# Preclinical Learner Assessment Questions

[www.drugabuse.gov/coe](http://www.drugabuse.gov/coe)

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# Preclinical Learner Assessment Questions

1. For a diagnosis of methamphetamine abuse, a maladaptive pattern of abuse needs to be present over a period of:
  - a. One month
  - b. One year
  - c. One week
  - d. One decade



# Preclinical Learner Assessment Questions

2. **Diagnosis of methamphetamine dependence requires the presence of the following number of criteria out of the possible seven:**
  - a. Three
  - b. Four
  - c. Five
  - d. Seven

# Preclinical Learner Assessment Questions

- 3. Methamphetamine is a potent stimulant drug that works primarily by increasing:**
- a. Dopamine breakdown
  - b. Dopamine release
  - c. Acetylcholine blockade
  - d. Norepinephrine synthesis

# Preclinical Learner Assessment Questions

- 4. Methamphetamine can cause death by:**
- a. Respiratory depression
  - b. Hyperthermia
  - c. Metabolic acidosis
  - d. Metabolic alkalosis

# Preclinical Learner Assessment Questions

- 5. The fastest way to get a high from methamphetamine use is:**
- a. Skin popping
  - b. Ingesting
  - c. Snorting
  - d. Smoking

# Preclinical Learner Assessment Questions

- 6. Approximately the following percentage of people can be expected to have used methamphetamine in the United States:**
- a. 10%
  - b. 5%
  - c. 2%
  - d. 1%

# Preclinical Learner Assessment Questions

- 7. The effects of methamphetamine can generally last for:**
- a. 60 seconds or less
  - b. 1 hour
  - c. 2 hours
  - d. 24 hours

# Assessment Questions

- 11. Methamphetamine use most commonly presents with another co-morbid condition, which is:**
- a. Bipolar disorder
  - b. Hypertension
  - c. Suicidal disorder
  - d. Another substance use disorder

# Clinical Learner Assessment Questions

[www.drugabuse.gov/coe](http://www.drugabuse.gov/coe)

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# Clinical Learner Assessment Questions

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# Clinical Learner Assessment Questions

- 7. The effects of methamphetamine can generally last for:**
- a. 60 seconds or less
  - b. 1 hour
  - c. 2 hours
  - d. 24 hours

# Clinical Learner Assessment Questions

- 8. Methamphetamine dependence can be successfully treated with:**
- a. Naltrexone
  - b. Disulfiram
  - c. Acamprosate
  - d. Behavioral therapies



# Clinical Learner Assessment Questions

## **10. Relapse rates for substance use disorders are:**

- a. Higher than for other chronic diseases
- b. Lower than for other chronic diseases
- c. Similar to other chronic diseases

# Clinical Learner Assessment Questions

- 11. Methamphetamine use most commonly presents with another co-morbid condition, which is:**
- a. Bipolar disorder
  - b. Hypertension
  - c. Suicidal disorder
  - d. Another substance use disorder

# Clinical Learner Assessment Questions

## 12. In the treatment of methamphetamine use disorders:

- a. A high-stimulus environment is required to ensure the patient stays awake
- b. Hydralazine treatment is often required
- c. Haloperidol treatment is contraindicated as it can lower the seizure threshold
- d. Antidepressants may be prescribed to decrease a patient's depression

# Interclerkship Assessment Questions

[www.drugabuse.gov/coe](http://www.drugabuse.gov/coe)

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# Interclerkship Assessment Questions

1. For a diagnosis of methamphetamine abuse, a maladaptive pattern of abuse needs to be present over a period of:
  - a. One month
  - b. One year
  - c. One week
  - d. One decade

# Interclerkship Assessment Questions

2. **Diagnosis of methamphetamine dependence requires the presence of the following number of criteria out of the possible seven:**
  - a. Three
  - b. Four
  - c. Five
  - d. Seven

# Interclerkship Assessment Questions

- 6. Approximately the following percentage of people can be expected to have used methamphetamine in the United States:**
- a. 10%
  - b. 5%
  - c. 2%
  - d. 1%

# Interclerkship Assessment Questions

- 8. Methamphetamine dependence can be successfully treated with:**
- a. Naltrexone
  - b. Disulfiram
  - c. Acamprosate
  - d. Behavioral therapies



# Interclerkship Assessment Questions

## 10. Relapse rates for substance use disorders are:

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