National Institute on Drug Abuse (NIDA)

Understanding Drug Abuse and Addiction: What Science Says

Last Updated February 2016



https://www.drugabuse.gov

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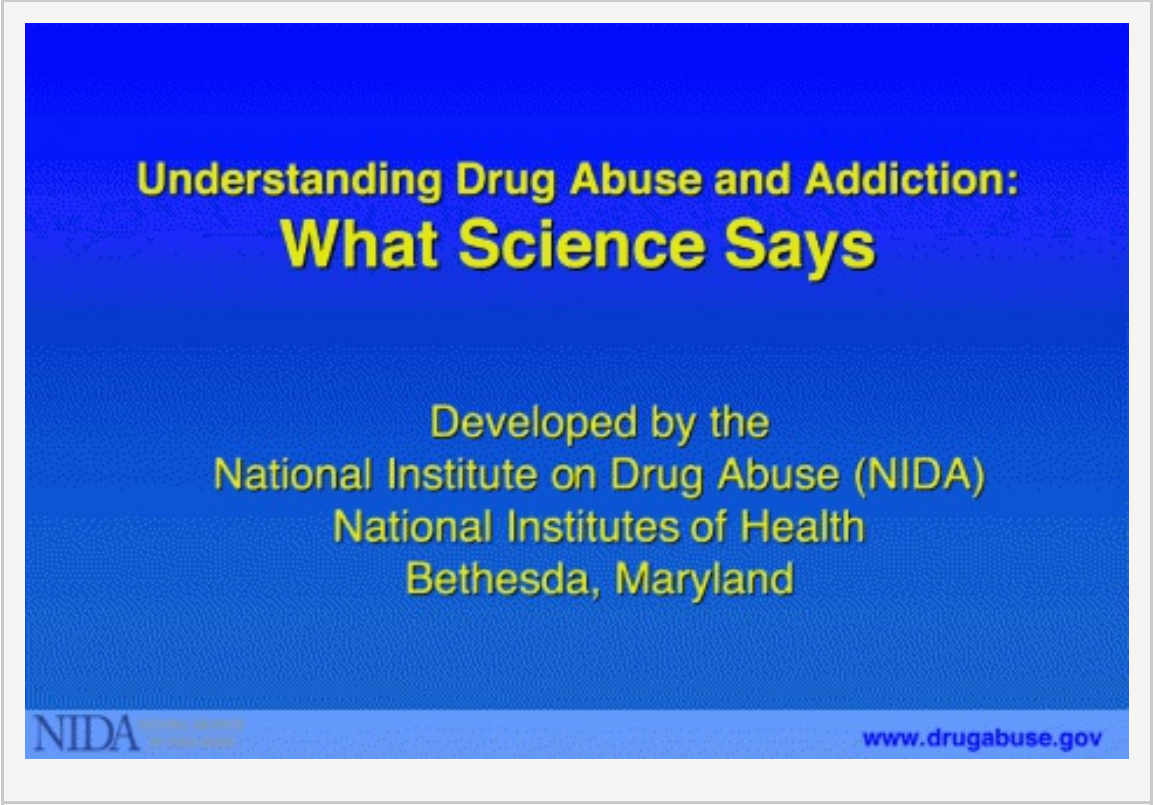
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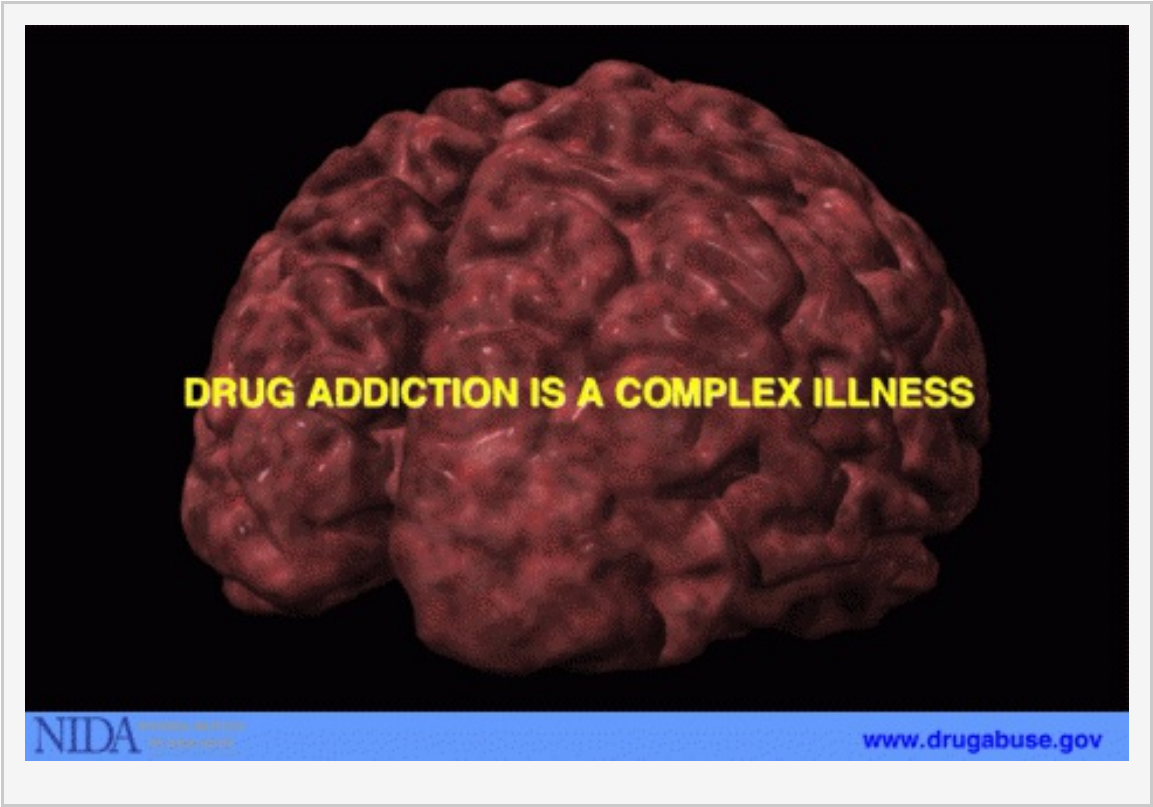
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Section I

1: Understanding Drug Abuse and Addiction: What Science Says

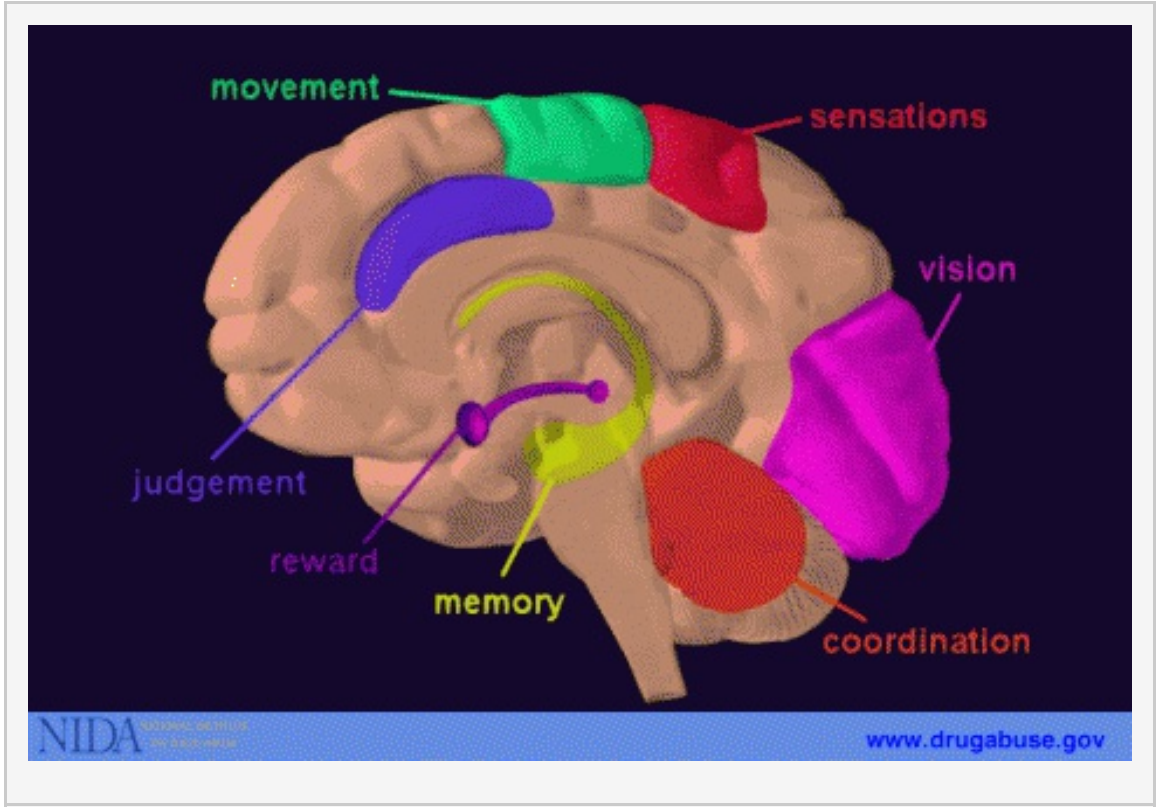


2: Drug addiction: a complex illness



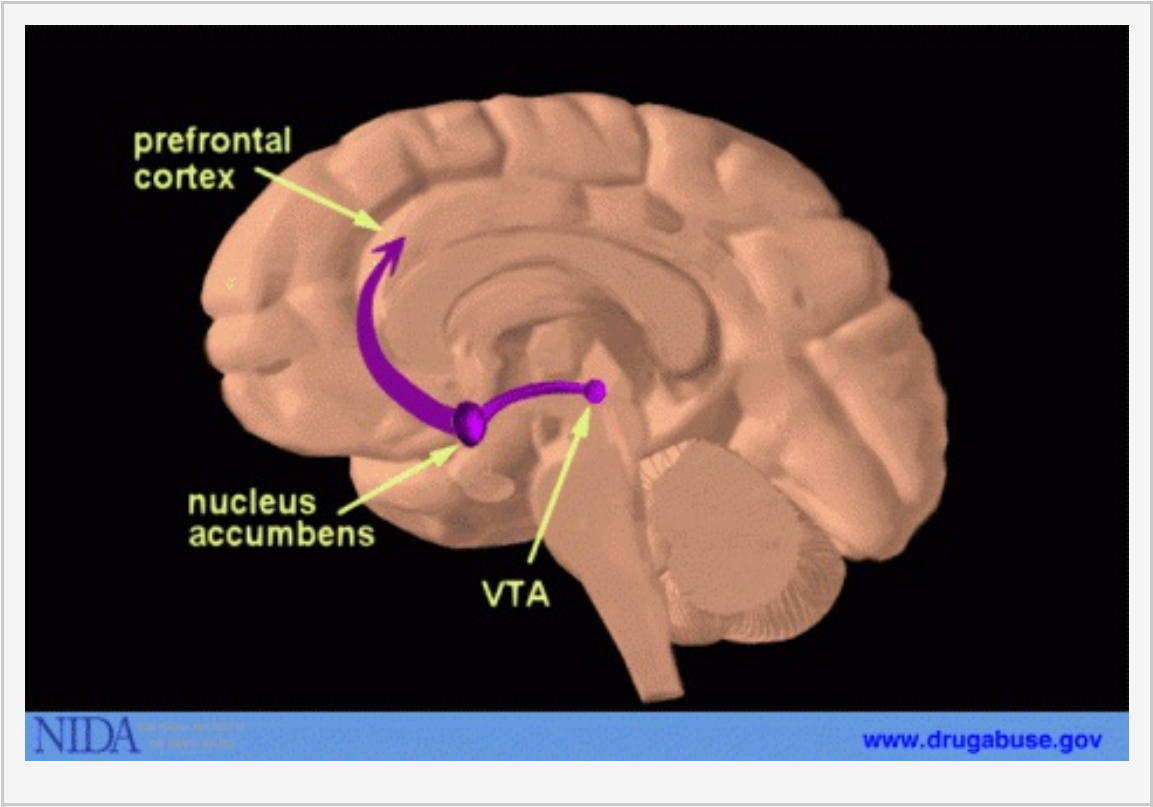
Drug addiction is a complex illness. The path to drug addiction begins with the act of taking drugs. Over time, a person's ability to choose not to take drugs is compromised. This, in large part, is a result of the effects of prolonged drug use on brain functioning, and thus on behavior. Addiction, therefore, is characterized by *compulsive drug craving, seeking, and use that persists even in the face of negative consequences*.

3: Brain regions and their functions



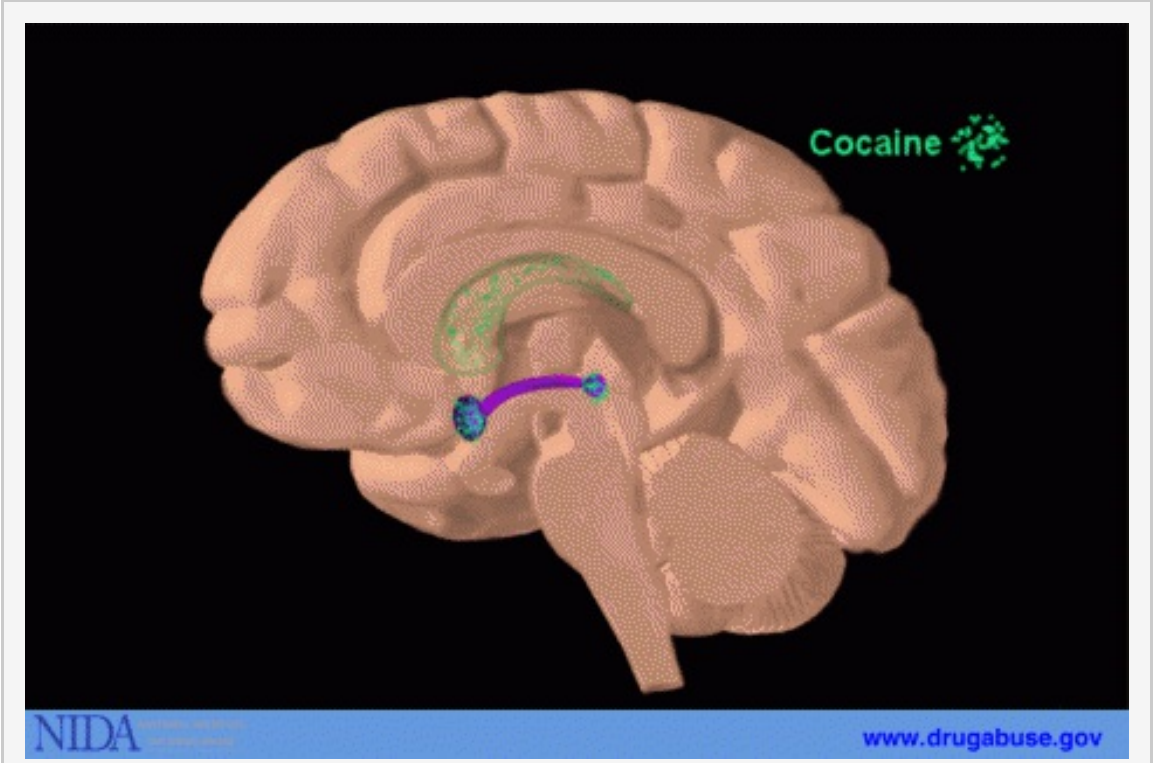
Certain parts of the brain govern specific functions. For example, the cerebellum is involved with coordination; the hippocampus with memory. Nerve cells (neurons) are the basic unit of communication in the brain. Information is relayed from one area of the brain to other areas through complex circuits of interconnected neurons. Information via electrical impulses transmitted from one neuron to many others is done through a process called "neurotransmission."

4: The reward pathway



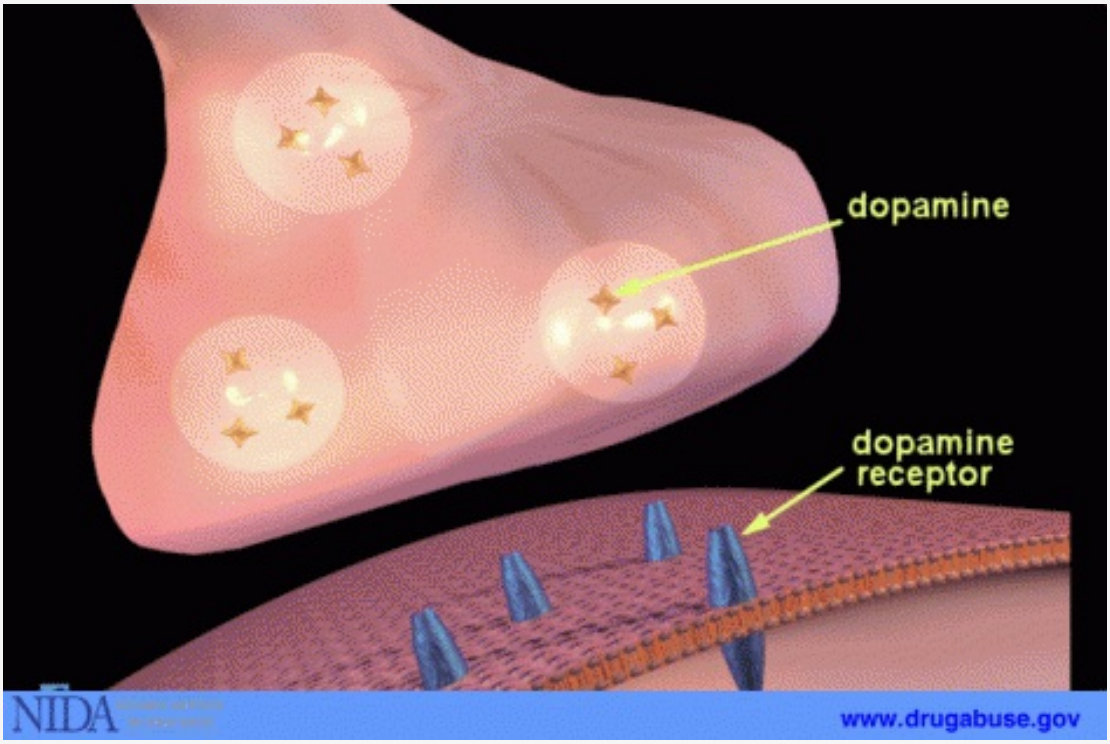
One pathway important to understanding the effects of drugs on the brain is called the reward pathway. The reward pathway involves several parts of the brain, some of which are highlighted in this image: the ventral tegmental area (VTA), the nucleus accumbens, and the prefrontal cortex. When activated by a rewarding stimulus (e.g., food, water, sex), information travels from the VTA to the nucleus accumbens and then up to the prefrontal cortex.

5: Where cocaine has its effects in the brain



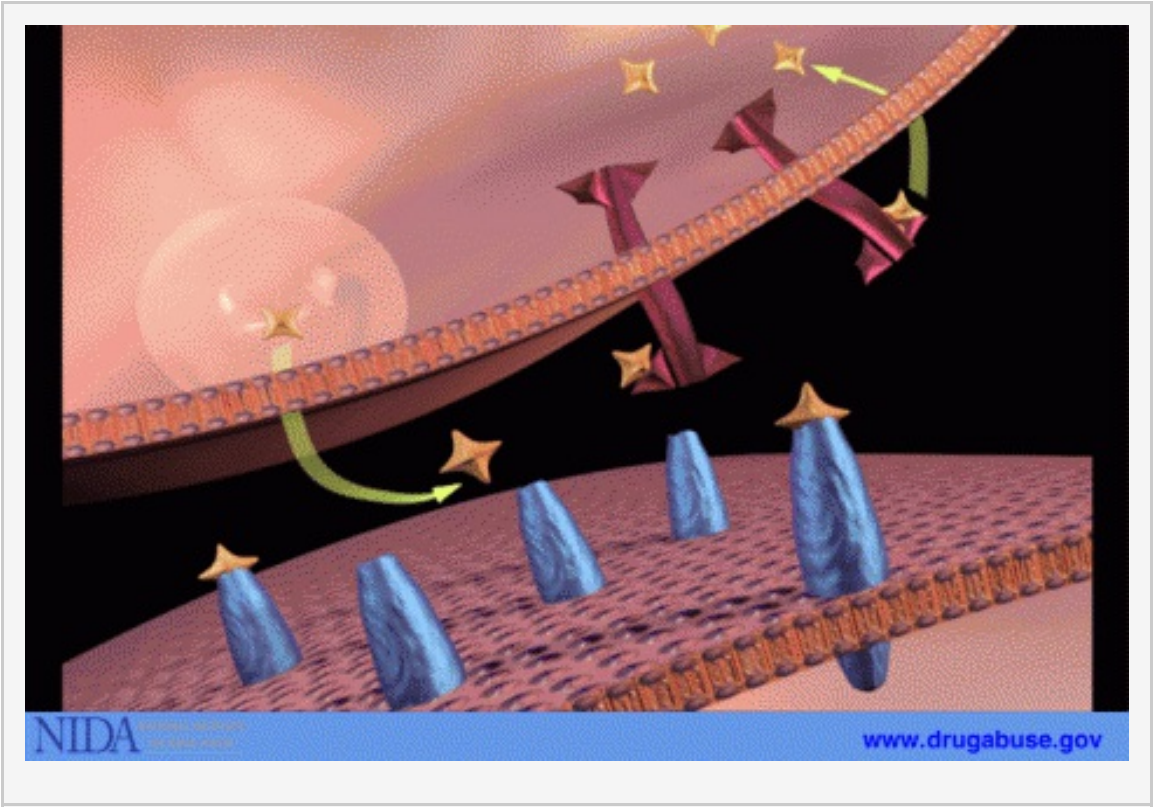
Using cocaine as an example, we can describe how drugs interfere with brain functioning. When a person snorts, smokes, or injects cocaine, it travels to the brain via the bloodstream. Although it reaches all areas of the brain, its euphoric effects are mediated in a few specific areas, especially those associated with the reward pathway discussed in the previous image.

6: Neurotransmission



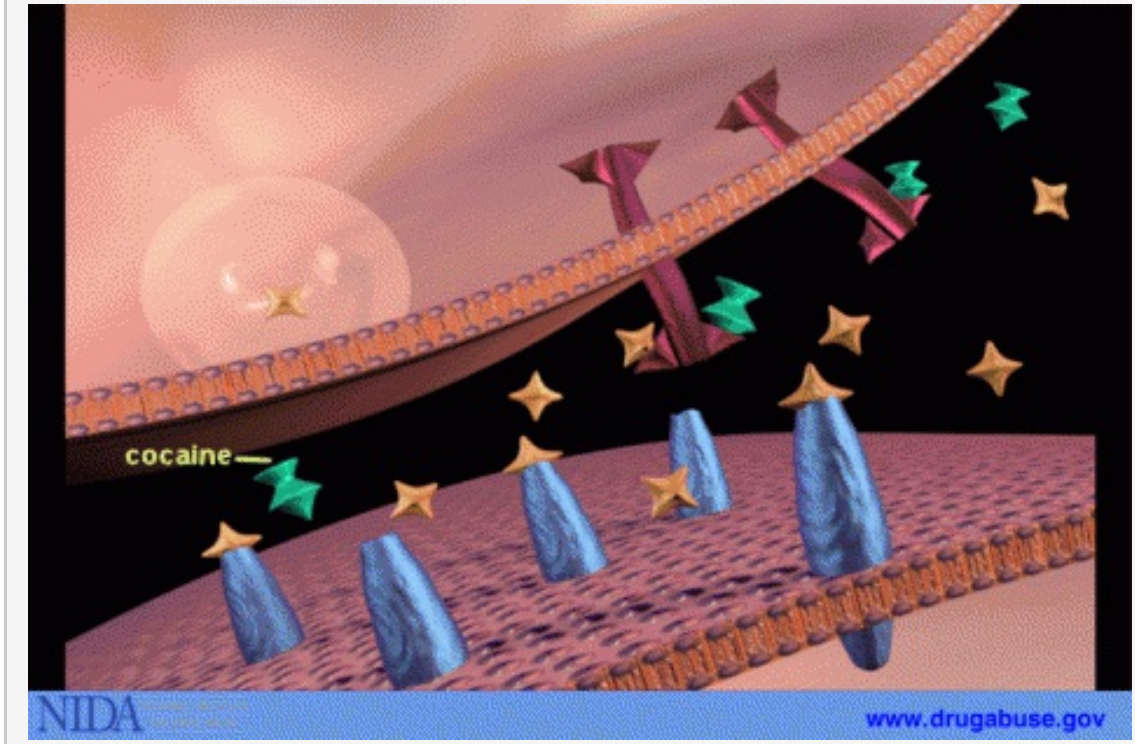
As mentioned earlier (image 3), information is communicated in the brain via a process called neurotransmission. Neurotransmission involves a variety of chemical substances called "neurotransmitters." One such neurotransmitter is called "dopamine." In the normal communication process, dopamine is released by a neuron into the synapse (the small gap between neurons). The dopamine then binds with specialized proteins called "dopamine receptors" (see image) on the neighboring neuron, thereby sending a signal to that neuron.

7: Neurotransmission (continued)



After the signal is sent to the neighboring neuron, dopamine is transported back to the neuron from which it was released by another specialized protein, the "dopamine transporter".

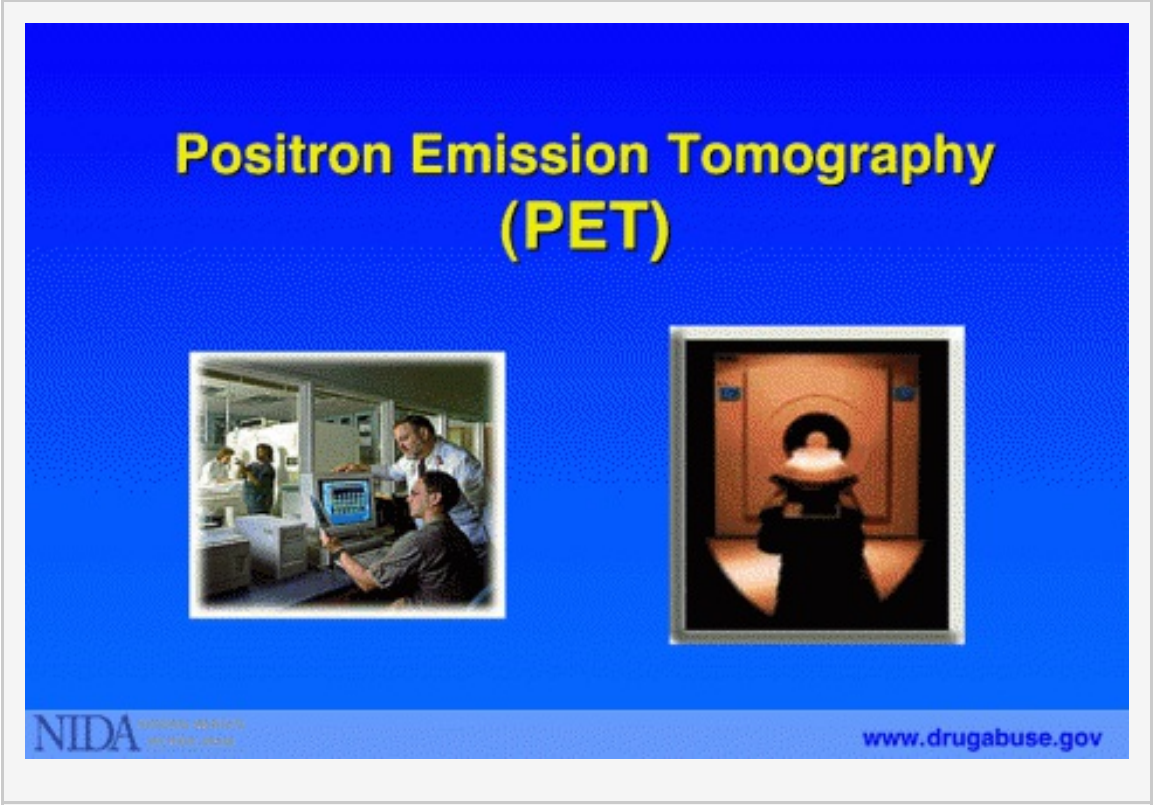
8: Cocaine and neurotransmission



Drugs of abuse are able to interfere with this normal communication process in the brain. Cocaine, for example, blocks the removal of dopamine from the synapse by binding to the dopamine transporters. As shown in this image, this results in a buildup of dopamine in the synapse. In turn, this causes a continuous stimulation of receiving neurons, probably responsible for the euphoria reported by cocaine abusers.

Section II

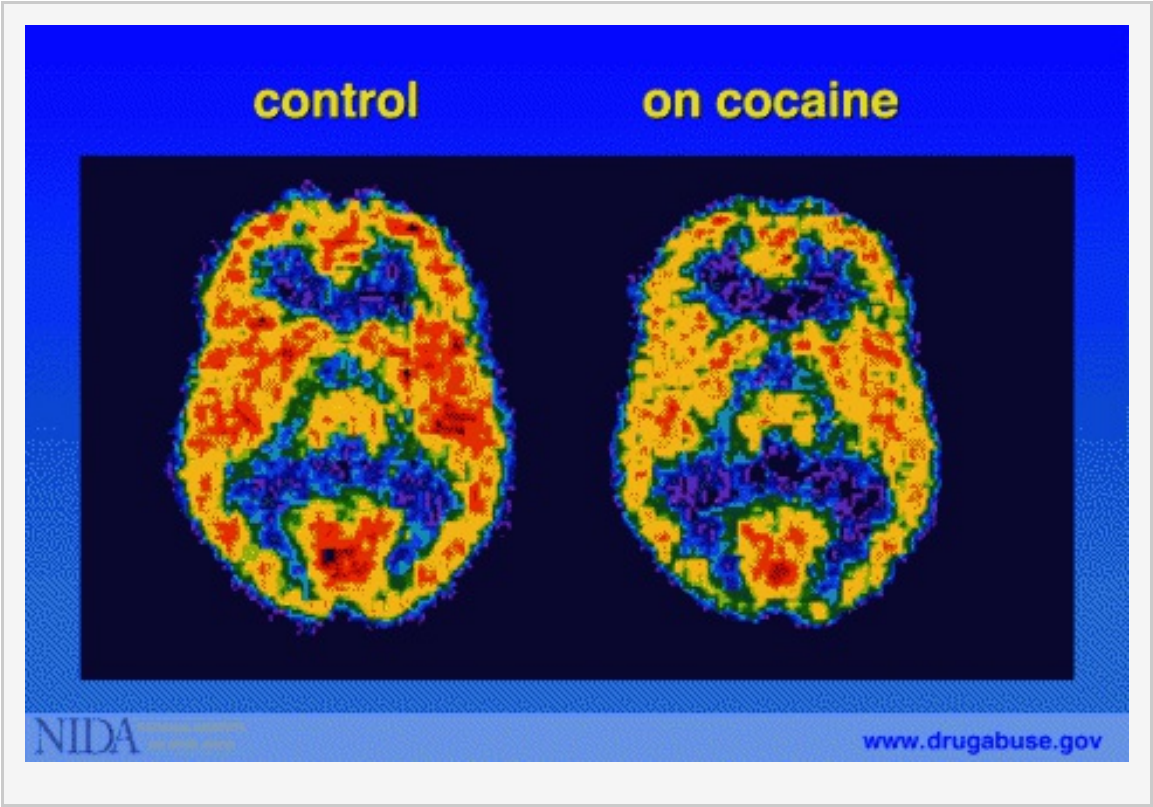
1: Measuring brain activity in response to drug use



Position Emission Tomography (PET) measures emissions from radioactively-labeled chemicals that have been injected into the bloodstream, and uses the data to produce images of the distribution of the chemicals in the body.

In drug abuse research, PET is being used for a variety of reasons including: to identify the brain sites where drugs and naturally occurring neurotransmitters act; to show how quickly drugs reach and activate receptors; to determine how long drugs occupy these receptors; and to find out how long they take to leave the brain. PET is also being used to show brain changes following chronic drug abuse, during withdrawal from drug use, and during the experience of drug craving. In addition, PET can be used to assess the effects of pharmacological and behavioral therapies for drug addiction on the brain.

2: Positron emission tomography (PET) scan of a person using cocaine



Cocaine has other actions in the brain in addition to activating the brain's reward circuitry. Using brain imaging technologies, such as PET scans, scientists can see how cocaine actually affects brain function in people. PET allows scientists to see which areas of the brain are more or less active by measuring the amount of glucose that is used by different brain regions. Glucose is the main energy source for the brain. When brain regions are more active, they will use more glucose and when they are less active they will use less. The amount of glucose that is used by the brain can be measured with PET scans. The left scan is taken from a normal, awake person. The red color shows the highest level of glucose utilization (yellow represents less utilization and blue indicated the least). The right scan is taken from someone who is on cocaine. The loss of red areas in the right scan compared to the left (normal) scan indicates that the brain is using less glucose and therefore is less active. This reduction in activity results in disruption of many brain functions.

3: Principles of drug abuse prevention



In 1997, NIDA published the first research-based guide on preventing drug use among children and adolescents. Using a question-and-answer format, this guide presents an overview of the research about the origins and pathways of drug abuse, the basic principles derived from effective drug abuse prevention research, and the application of these research findings. Key components of this publication are presented in the following images.

The guide is available for viewing online.

4: Risk and Protective Factors



- Risk factors: Challenge an individual's emotional, social and academic development
- Protective factors: Can lessen the impact of risk factors. Their impact varies along the developmental process.
- Common risk factors are found for multiple adolescent problem behaviors – e.g., substance use, teen pregnancy, delinquency, school drop out, violence

Evidence-based prevention interventions may target risk and protective factors in the individual, family, peer, school and community domains.

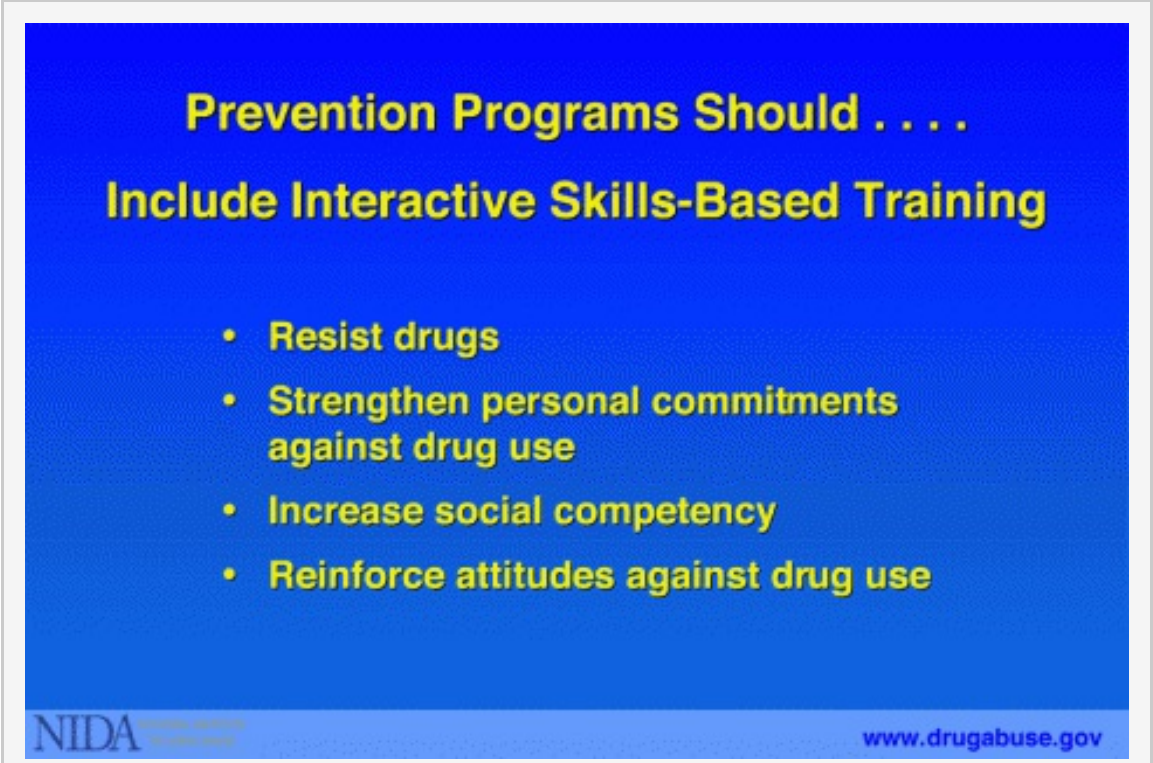
The Aim of Prevention Approaches is to reduce risk factors and enhance protective factors.

5: Targets all forms of drug use



Prevention programs should target all forms of drug use including the use of tobacco, alcohol, marijuana, and inhalants. In addition, prevention programs should be culturally sensitive to the context and needs of the individual, the family, and the community.

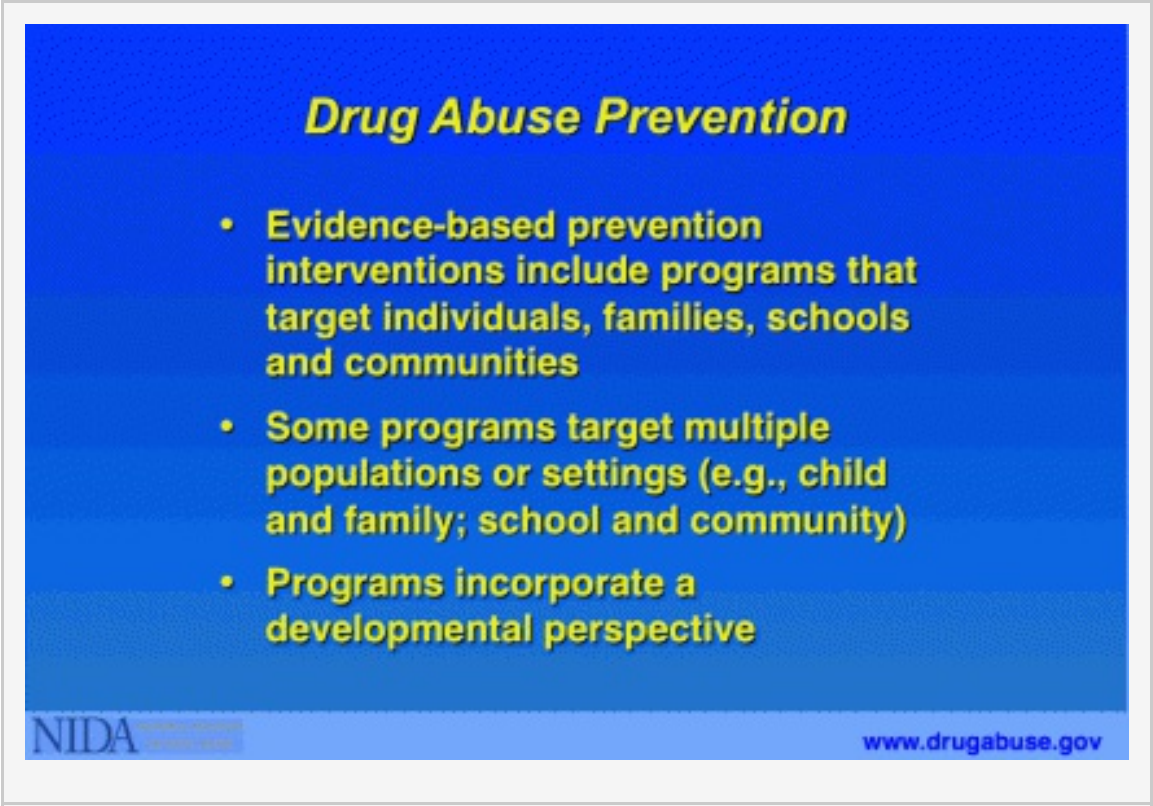
6: Skills-based training



Prevention programs should include skills training to help children and adolescents resist drugs, strengthen personal commitments against drug use, increase social competency (e.g., communications, peer relationships, self efficacy, and assertiveness), and reinforce attitudes against drug use. Programs should use interactive methods (e.g., group discussion) rather than didactic teaching methods alone.

Section III

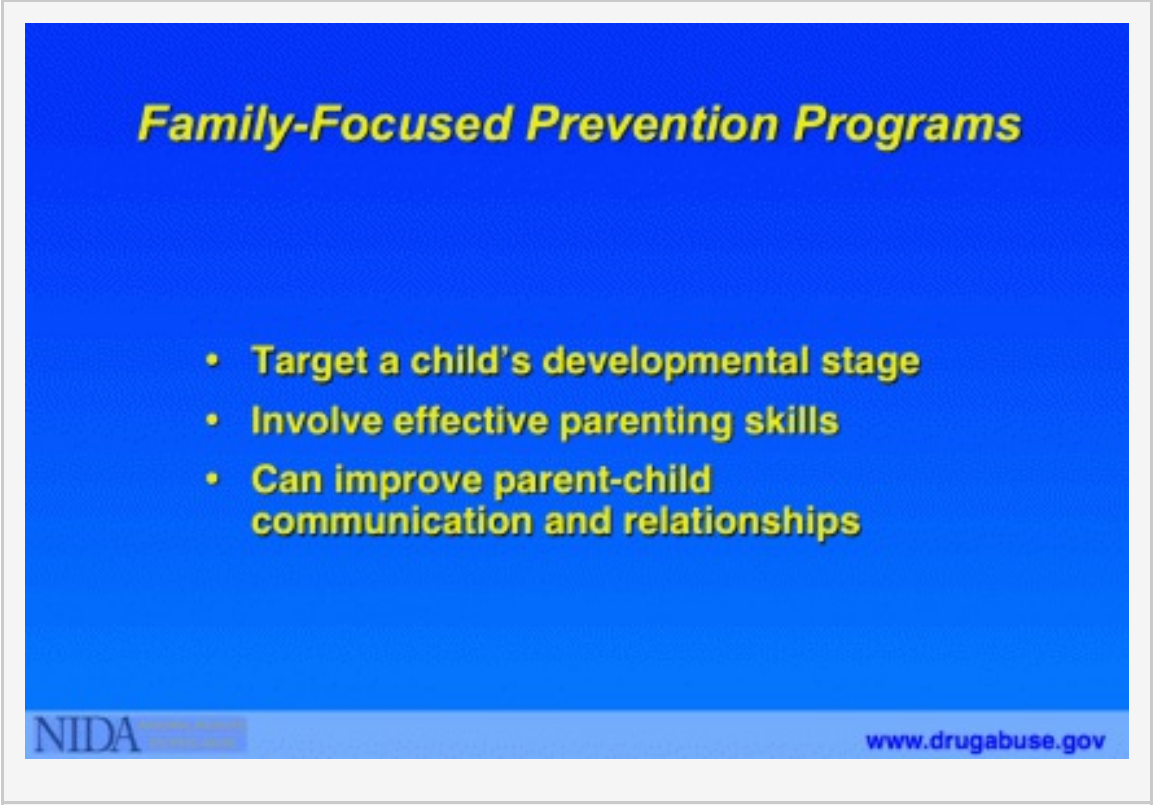
1: Drug Abuse Prevention



Evidence-based prevention programs target individuals, families, schools, communities, or multiple targets.

Evidence-based drug abuse prevention programs often incorporate a developmental perspective.

2: Family-Focused Prevention Programs



Family-focused prevention programs target parents or the families, taking into consideration the stage of the child's development. Programs may provide training on effective parenting skills and monitoring to help reduce conduct problems and other risk factors for drug abuse, and improve parent-child communication and relationships.

3: Community and School Prevention Programs



Community programs that include media campaigns and policy changes, such as new regulations that restrict access to alcohol, tobacco, or other drugs, are more effective when they are accompanied by school or family interventions. Community programs need to strengthen norms against drug use in all drug abuse prevention settings, including the family and the school. In addition, prevention programming should be adapted to address the specific nature of the drug abuse problem in the local community.

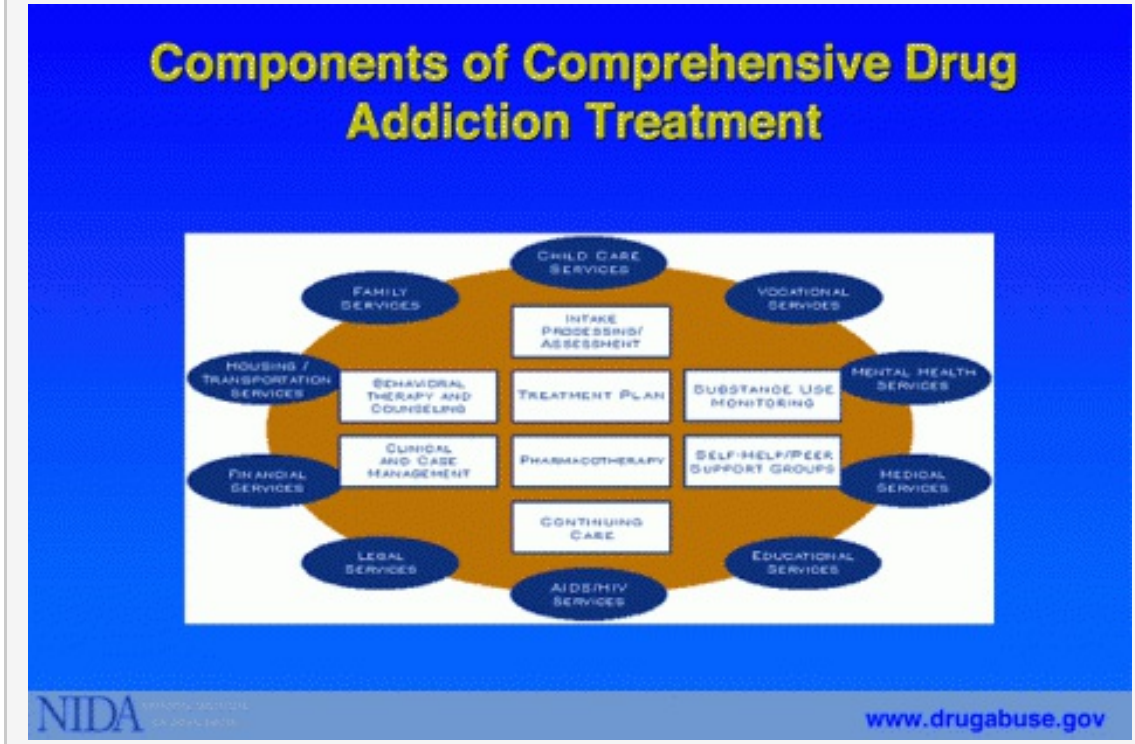
4: Principles of drug addiction treatment



Three decades of scientific research and clinical practice have yielded a variety of effective approaches to drug addiction treatment. In April 1998, NIDA held *The National Conference on Drug Addiction Treatment: From Research to Practice* which summarized this extensive body of research. Based on the findings reported at this conference, NIDA published in October 1999, *Principles of Drug Addiction Treatment: A Research-Based Guide* to foster more widespread use of scientifically-based components of drug addiction treatment. Key components of this guide are highlighted in the following images.

Note: The current version of this publication was revised in April 2009.

5: Components of comprehensive drug addiction treatment



A variety of scientifically-based approaches to drug addiction treatment exist. Drug addiction treatment can include behavioral therapy (e.g., counseling, cognitive therapy, or psychotherapy), medications, or their combination. Case management and referral to other medical, psychological, and social services are crucial components of treatment for many people as well. The best programs provide a combination of therapies and other services to meet the needs of the individual patient, which are shaped by such issues as age, race, culture, sexual orientation, gender, pregnancy, parenting, housing, and employment, as well as physical and sexual abuse.

Several of the key principles underlying this approach to treatment follow.

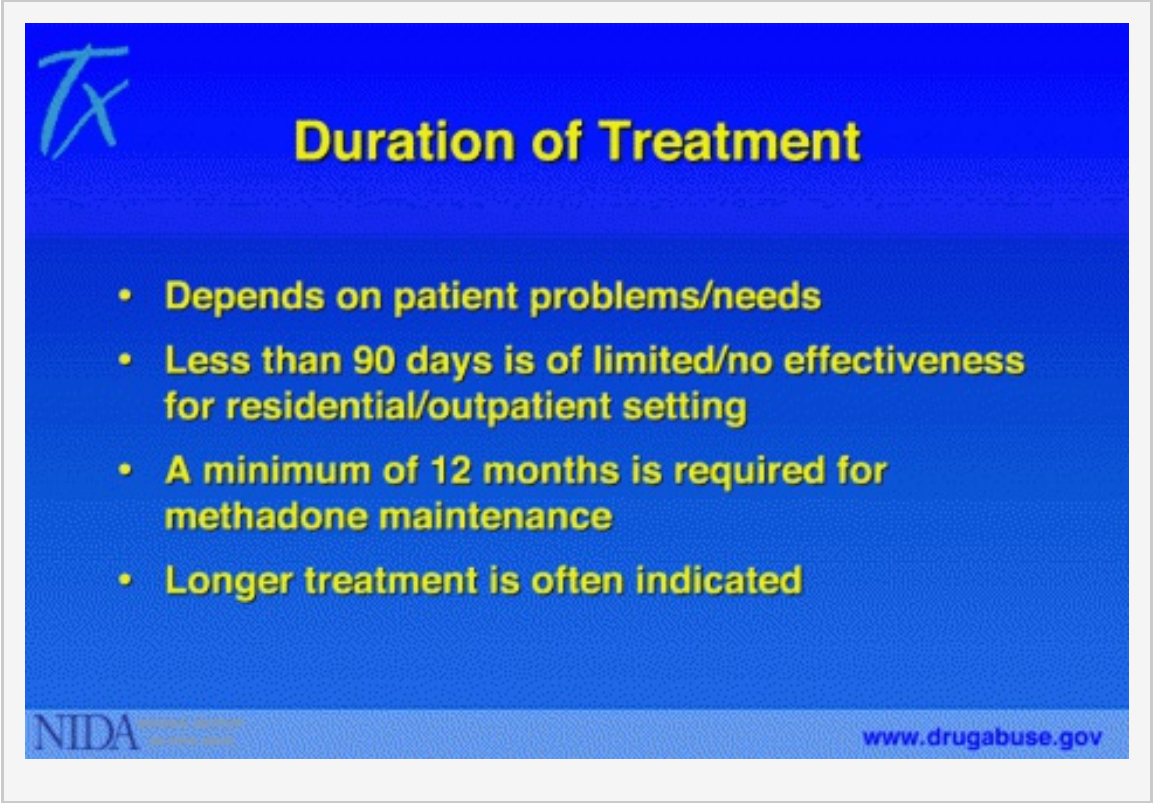
6: Matching patients to individual needs



No single treatment is appropriate for all individuals. Matching treatment setting, interventions, and services to each individual's particular problems and needs is critical to his or her ultimate success in returning to productive functioning in the family, workplace, and society.

Effective treatment attends to multiple needs of the individual, not just his or her drug use. To be effective, treatment must address the individual's drug use and any associated medical, psychological, social, vocational, and legal problems.

7: Duration of treatment



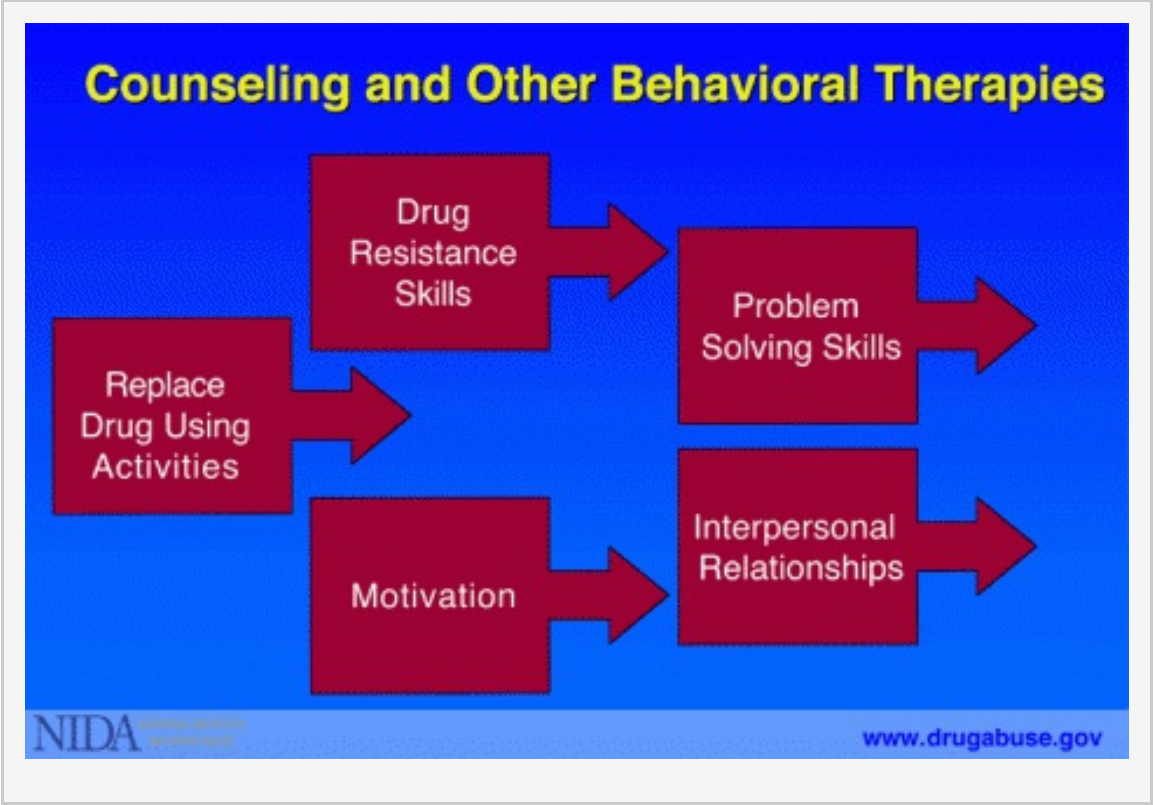
Individuals progress through drug addiction treatment at various speeds, so there is no predetermined length of treatment. However, research has shown unequivocally that good outcomes are contingent on adequate lengths of treatment. Generally, for residential or outpatient treatment, participation for less than 90 days is of limited or no effectiveness, and treatments lasting significantly longer often are indicated. For methadone maintenance, 12 months of treatment is the minimum, and some opiate-addicted individuals will continue to benefit from methadone maintenance treatment over a period of years.

8: Medical detoxification



Medical detoxification safely manages the acute physical symptoms of withdrawal associated with stopping drug use. However, medical detoxification is only the first stage of addiction treatment and by itself does little to change long-term drug use. Although detoxification alone is rarely sufficient to help addicts achieve long-term abstinence, for some individuals it is a strongly indicated precursor to effective drug addiction treatment.

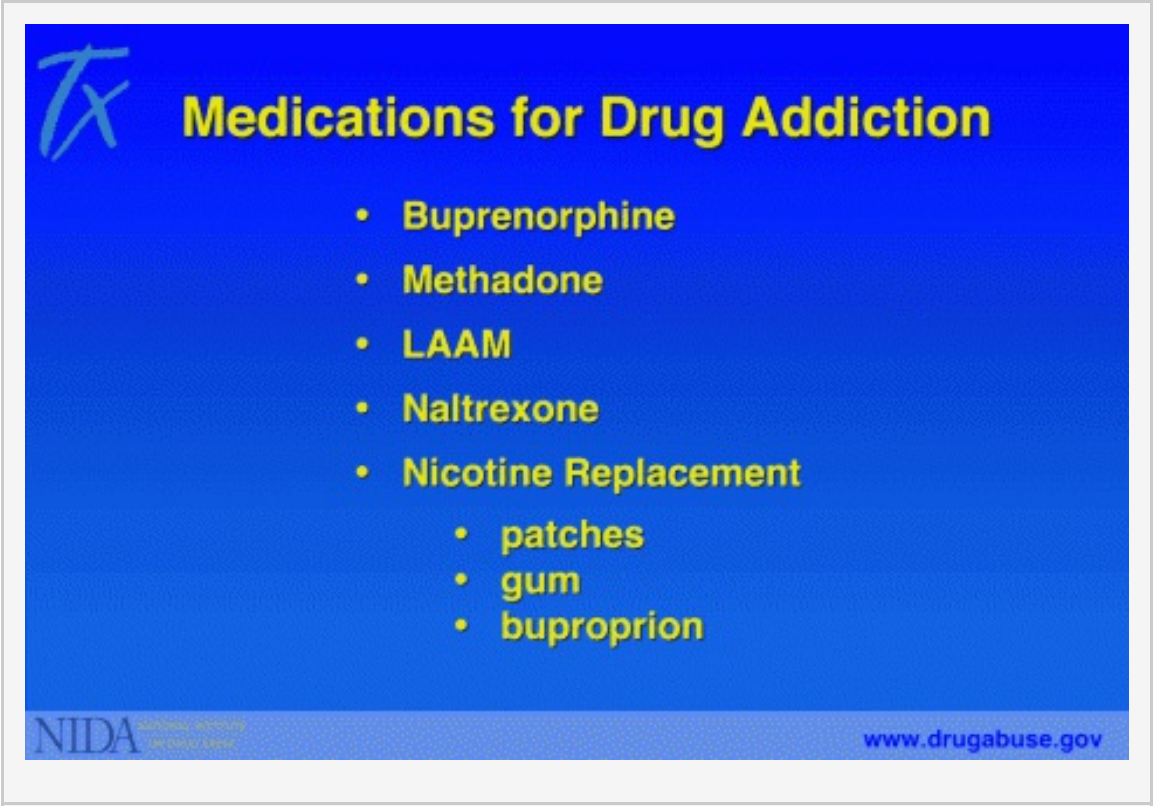
9: Counseling and other behavioral therapies



Counseling (individual and/or group) and other behavioral therapies are critical components of effective treatment for addiction. In therapy, patients address issues of motivation, build skills to resist drug use, replace drug-using activities with constructive and rewarding nondrug-using activities, and improve problem-solving abilities. Behavioral therapy also facilitates interpersonal relationships and the individual's ability to function in the family and community.

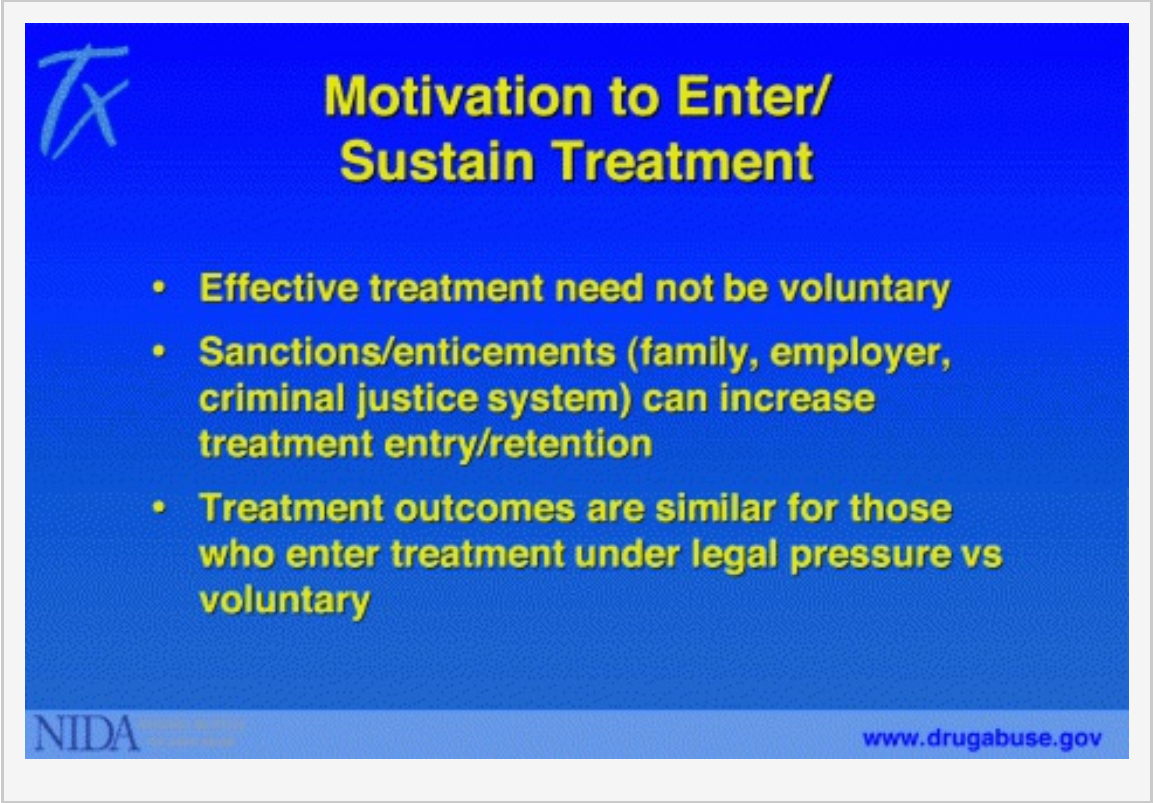
Section IV

1: Medications for drug addiction



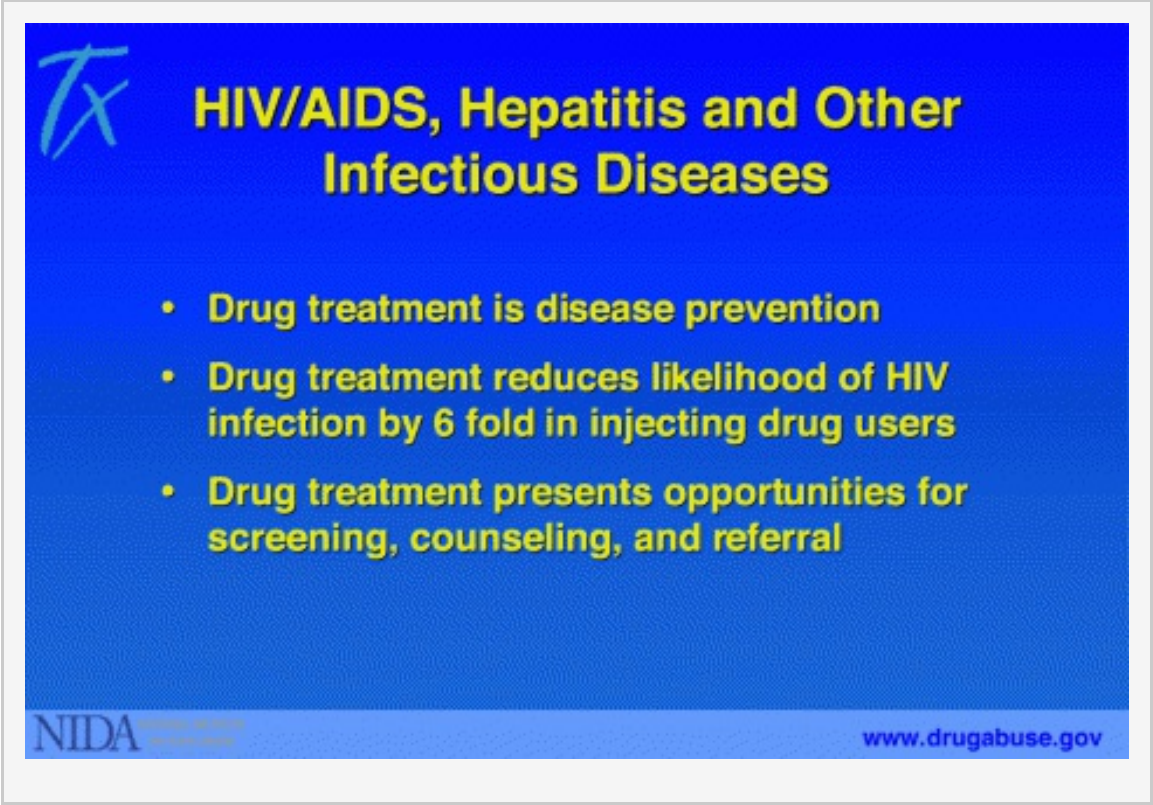
Medications are an important element of treatment for many patients, especially when combined with counseling and other behavioral therapies. Methadone and levo-alpha-acetylmethadol (LAAM) are very effective in helping individuals who are addicted to heroin or other opiates stabilize their lives and reduce their illicit drug use. Naltrexone is also an effective medication for some opiate addicts and some patients with co-occurring addiction to alcohol. For persons addicted to nicotine, a nicotine replacement product (such as patches or gum) or an oral medication (such as bupropion) can be an effective component of treatment. For patients with mental disorders, both behavioral treatments and medications can be critically important.

2: Motivation to enter/sustain treatment



Treatment does not need to be voluntary to be effective. Strong motivation can facilitate the treatment process. Sanctions or enticements in the family, employment setting, or criminal justice system can increase significantly both treatment entry and retention rates and the success of drug treatment interventions. Individuals who enter treatment under legal pressure have outcomes as favorable as those who enter treatment voluntarily.

3: HIV/AIDS, hepatitis and other infectious diseases



Drug injectors who do not enter treatment are up to six times more likely to become infected with HIV than injectors who enter and remain in treatment. Drug abusers who enter and continue in treatment reduce activities that can spread disease, such as sharing injection equipment and engaging in unprotected sexual activity. Participation in treatment also presents opportunities for screening, counseling, and referral for additional services. The best drug abuse treatment programs provide HIV counseling and offer HIV testing to their patients.

4: Effectiveness of treatment



According to several studies, drug treatment reduces drug use by 40 to 60 percent and significantly decreases criminal activity during and after treatment. For example, a study of therapeutic community treatment for drug offenders demonstrated that arrests for violent and nonviolent criminal acts were reduced by 40 percent or more. Methadone treatment has been shown to decrease criminal behavior by as much as 50 percent. Research shows that drug addiction treatment reduces the risk of HIV infection and that interventions to prevent HIV are much less costly than treating HIV-related illnesses. Treatment can improve the prospects for employment, with gains of up to 40 percent after treatment. (Note: Although these effectiveness rates hold in general, individual treatment outcomes depend on the extent and nature of the patient's presenting problems, the appropriateness of the treatment components and related services used to address those problems, and the degree of active engagement of the patient in the treatment process.)

5: Self-help and drug addiction treatment



Self-help groups can complement and extend the effects of professional drug addiction treatment. The most prominent self-help groups are those affiliated with Alcoholics Anonymous (AA), Narcotics Anonymous (NA), and Cocaine Anonymous (CA), all of which are based on the 12-step model and Smart Recovery. Most drug addiction treatment programs encourage patients to participate in a self-help group during and after formal treatment.

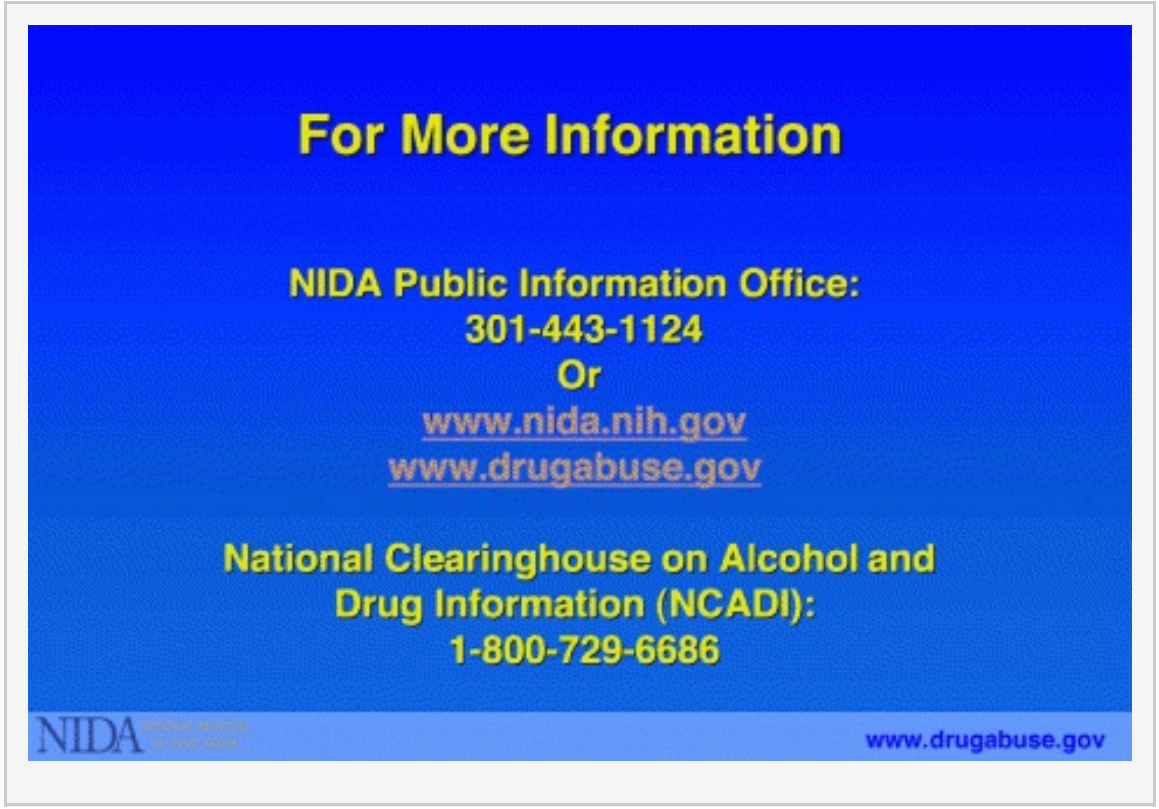
6: Cost effectiveness of drug treatment



Drug addiction treatment is cost-effective in reducing drug use and its associated health and social costs. Treatment is less expensive than alternatives, such as not treating addicts or simply incarcerating addicts. For example, the average cost for 1 full year of methadone maintenance treatment is approximately $4,700 per patient, whereas 1 full year of imprisonment costs approximately $18,400 per person.

According to several conservative estimates, every $1 invested in addiction treatment programs yields a return of between $4 and $7 in reduced drug-related crime, criminal justice costs, and theft alone. When savings related to health care are included, total savings can exceed costs by a ratio of 12 to 1. Major savings to the individual and to society also come from significant drops in interpersonal conflicts, improvements in workplace productivity, and reductions in drug-related accidents.

7: For More Information



Contact NIDA