NEUROSCIENCE OF SUBSTANCE USE AND DEPENDENCE

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History

- Early and Mid 19th century-
- In 1810- Benjamin Rush- excessive use of alcohol was a disease rather than a defect.
- Washingtons- reformed drunkards to adopt & maintain sobriety thereby developing self help and rediscovered Alcohol Anonymous.
- Later 19th century-
- 1860- Cocaine was isolated from coca leaves, pharma companies made widespread use of it in USA & Europe by 1885.

- 19th and early 20th century-
- 1893- Anti Saloon League- prohibited use of alcohol.
- 1903- Cocaine in Coca-cola was replaced by caffeine.
- 1912- Hague Convention- passed legislation controlling opiates and cocaine.
- Early 20th century-
- 1920-18th amendment to US constitution prohibited sale of alcohol.

- Mid 20th century-
- In 1960-Public concern about hallucinogens rose when potent compound LSD (Lysergic acid diethylamide) was used by few elite and college students.
- 20th century-
- In 1950- Inspired other types of drug users- Narcotics Anonymous.
- 1950- treatment program for alcoholism developed and modified known as 28day program or 12step program or the Minnesota Model.

- Late 20th century-
- By 2005- More than 13000 recognized programs existed for Alcoholism and substance dependence.

SUBSTANCE DEPENDENCE

- Substance dependence can refer to a syndrome of problematic use, with various features captured in diagnostic criteria sets.
- Dependence also is used to indicate a physical adaptation by an organism (physical dependence) following, typically, chronic administration of a substance.
- Feature of dependence- Cluster of cognitive, behavioral and physiological symptoms indicating individual continues substance use despite significant substance related problems.

SUBSTANCE ABUSE

- Maladaptive pattern of substance use manifested by recurrent and significant adverse consequences related to repeated use of substances.
- Problems must occur during same 12 month period.
- Criteria for Abuse doesn’t include tolerance and withdrawal but includes harmful consequences of repeated use.

SUBSTANCE WITHDRAWAL

- Minor symptoms that technically are due to cessation of use of drug
- Don’t by themselves fulfill criteria for withdrawal
- Unless accompanied by maladaptive behavioral changes and
- Cause significant distress or socio-occupational impairment.

SUBSTANCE INTOXICATION

- Variety of drugs produce unwanted physiological or psychological effects that could be construed an intoxic.
- ICD-10 specifies intoxication must produce disturbances in-
- Level of consciousness, cognition, perception, affect or behavior.

SUBSTANCE INDUCED DISORDER

- Certain psychoactive drugs can induce syndromes which are called substance induced disorder.

EPIDEMIOLOGY

- RUBRICS –
- Depends on

✓ Quantity

✓ Location

✓ Causes

✓ Mechanism

✓ Prevention and Control

ETIOLOGY

Motivations for Drug Use

- People take drugs for many reasons, and they may take stimulants to keep alert, or cocaine for the feeling of excitement it produces.
  - peer pressure
  - relief of stress
  - increased energy
  - to relax
  - to relieve pain
  - to escape reality
  - to feel more self-esteem, and for recreation.
- Athletes and bodybuilders may take anabolic steroids to increase muscle mass

DSM - 5

- Addiction/ Brain Disease (Substance Use Disorder per DSM 5)
- Compulsion to seek and take a drug/ substance
- Loss of control in limiting the intake of the substance
- Negative emotional and/or physiological state if access to the substance is prevented
- Progressive disease with chronic relapses
- Shifts from an impulse control disorder involving positive reinforcement to a compulsive disorder involving negative reinforcement

Diagnostic criteria as per ICD 10

- ICD-10 Diagnostic Criteria for Mental and Behavioral Disorders Due to Psychoactive Substance Use

- **Mental and behavioral disorders due to use of alcohol**
- **Mental and behavioral disorders due to use of opioids**
- **Mental and behavioral disorders due to use of cannabinoids**
- **Mental and behavioral disorders due to use of sedatives or hypnotics**
- **Mental and behavioral disorders due to use of cocaine**
- **Mental and behavioral disorders due to use of other stimulants, including caffeine**
- **Mental and behavioral disorders due to use of hallucinogens**
- **Mental and behavioral disorders due to use of tobacco**
- **Mental and behavioral disorders due to use of volatile solvents**
- **Mental and behavioral disorders due to multiple drug use and use of other psychoactive substances**

- Diagnosis of the dependence syndrome may be further specified by the following:

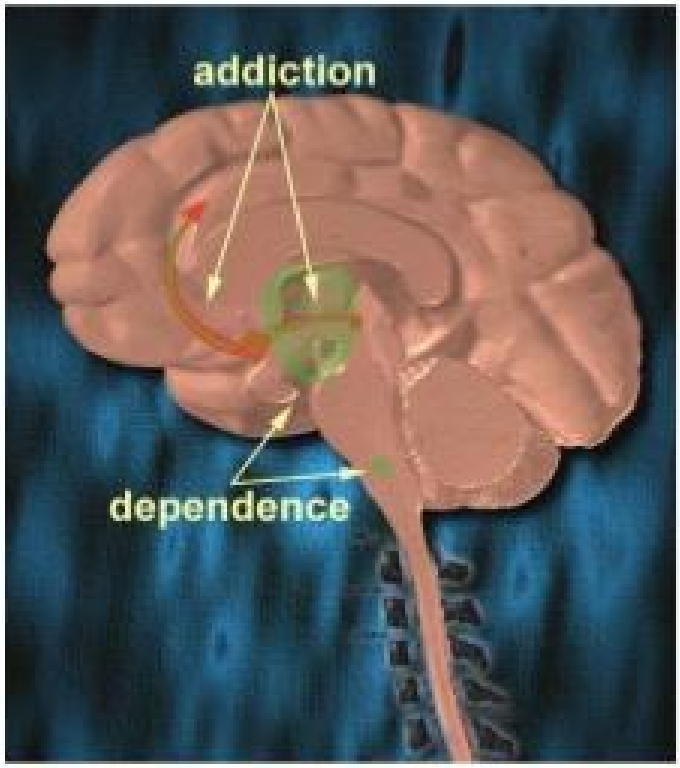
- Currently abstinent
- Early remission
- Partial remission
- Full remission
- Currently abstinent but in a protected environment (e.g., in a hospital, in a therapeutic community, in prison, etc.)
- Currently on a clinically supervised maintenance or replacement regime (controlled dependence) (e.g., with methadone; nicotine gum or nicotine patch)
- Currently abstinent, but receiving treatment with aversive or blocking drugs (e.g., naltrexone or disulfiram)
- Currently using the substance (active dependence)

- The course of the dependence may be further specified, if desired, as follows:

- Continuous use
- Episodic use (dipsomania)

- **Withdrawal state-**
- G1. There must be clear evidence of recent cessation or reduction of substance use after repeated, and usually prolonged and/or high dose, use of that substance.
- G2. Symptoms and signs are compatible with the known features of a withdrawal state from the particular substance or substances.
- G3. Symptoms and signs are not accounted for by a medical disorder unrelated to substance use, and not better accounted for by another mental or behavioral disorder.

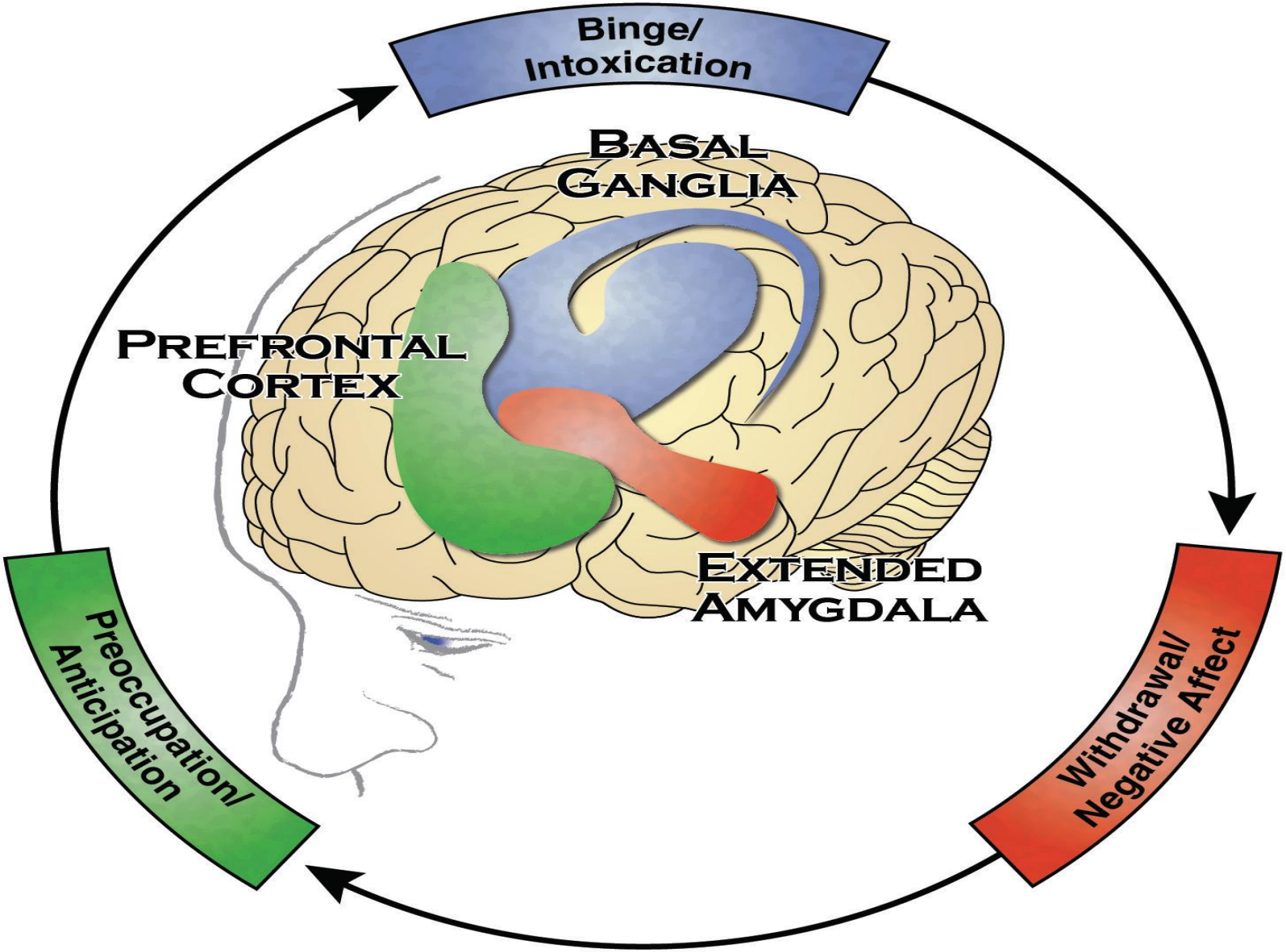
Drug addiction and drug abuse



- addiction to morphine (reward pathway)
- dependence to morphine (thalamus and brainstem)

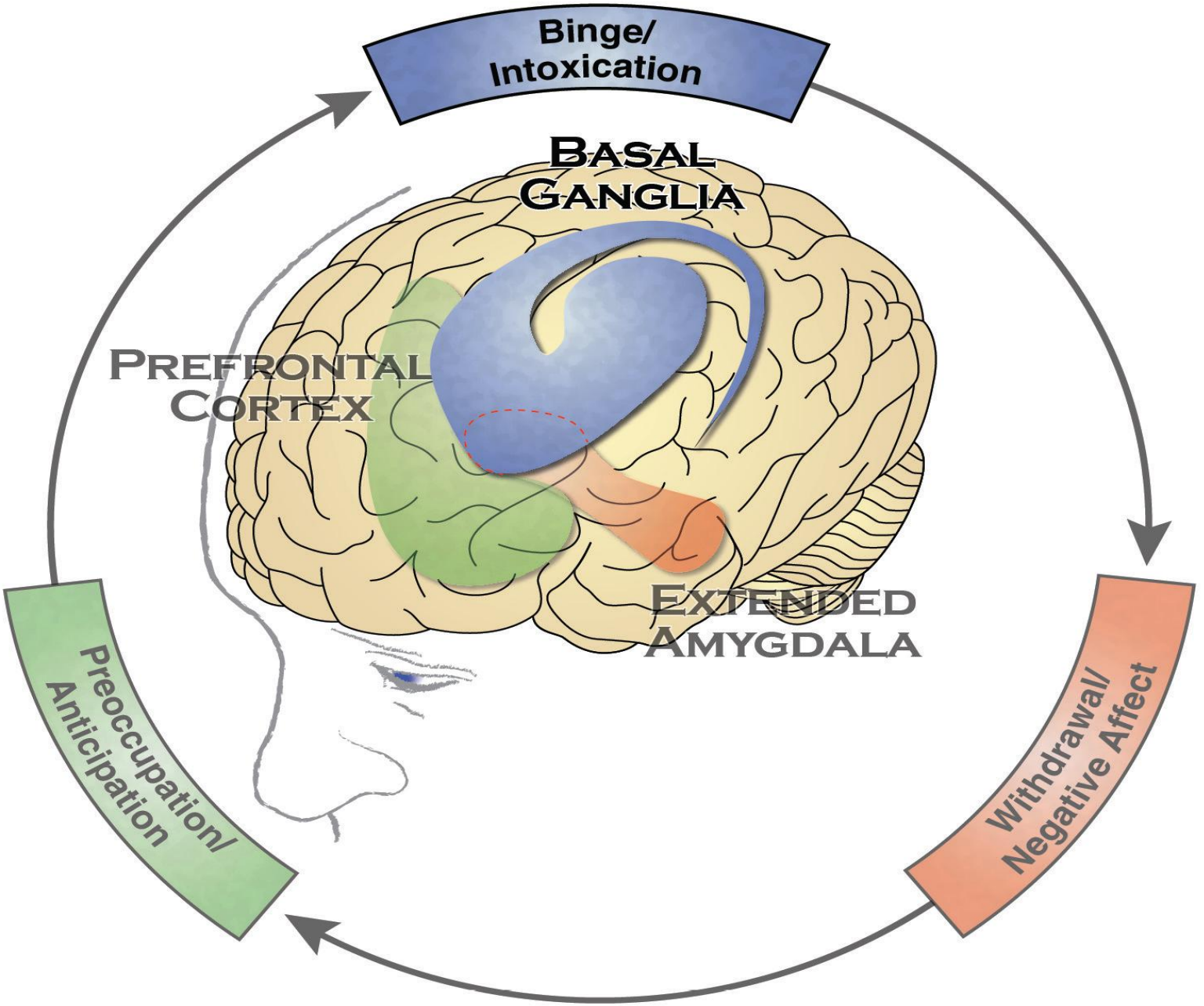
- Dependence:
  - Psychological dependence is the subjective feeling that the user needs the drug to maintain a feeling of well-being. Eg: cocaine
  - Physical dependence is characterized by tolerance (the need for increasingly larger doses in order to achieve the initial effect) and withdrawal symptoms when the user is abstinent.

STAGES OF SUBSTANCE ADDICTION & BRAIN AREAS INVOLVED



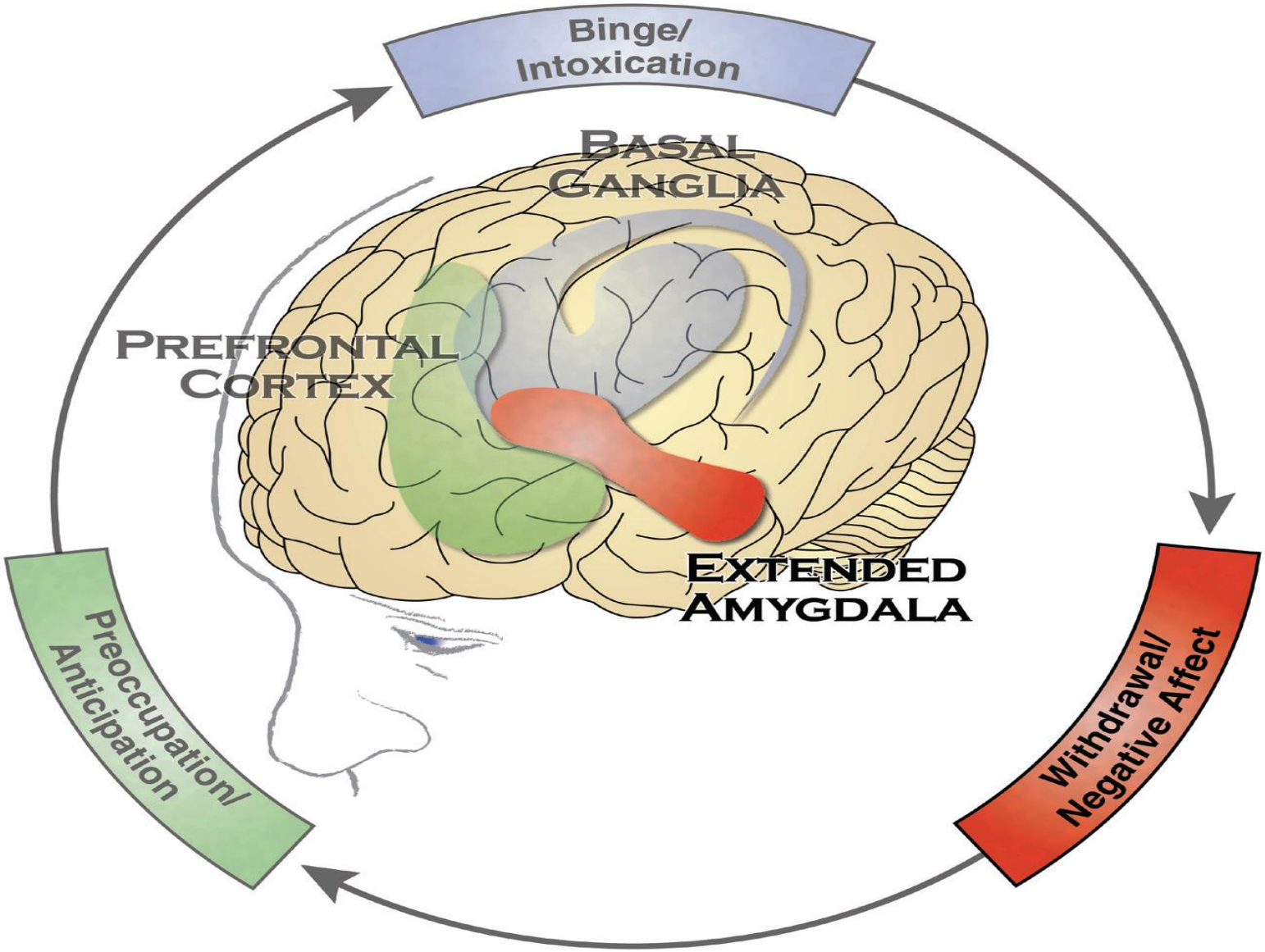
- **Impulsivity. An inability to resist urges, deficits in delaying gratification, and unreflective decision-making. It is a tendency to act without foresight or regard for consequences and to prioritize immediate rewards over long-term goals.1**
- **Positive reinforcement. The process by which presentation of a stimulus such as a drug increases the probability of a response like drug taking.**
- **Negative reinforcement. The process by which removal of a stimulus such as negative feelings or emotions increases the probability of a response like drug taking.**
- **Compulsivity. Repetitive behaviors in the face of adverse consequences, and repetitive behaviors that are inappropriate to a particular situation. People suffering from compulsions often recognize that the behaviors are harmful, but they nonetheless feel emotionally compelled to perform them. Doing so reduces tension, stress, or anxiety.**

- **The Binge/Intoxication Stage and the Basal Ganglia**
- The “reward circuitry” of the basal ganglia (i.e., the nucleus accumbens), along with dopamine and naturally occurring opioids, play a key role in the rewarding effects of alcohol and other substances and the ability of stimuli, or cues, associated with that substance use to trigger craving, substance seeking, and use.
- As alcohol or substance use progresses, repeated activation of the “habit circuitry” of the basal ganglia (i.e., the dorsal striatum) contributes to the compulsive substance seeking and taking that are associated with addiction.
- The involvement of these reward and habit neuro circuits helps explain the intense desire for the substance (craving) and the compulsive substance seeking that occurs when actively or previously addicted individuals are exposed to alcohol and/or drug cues in their surroundings


Binge/
Intoxication
Basal
Ganglia
Prefrontal
Cortex
Extended
Amygdala
Withdrawal/
Negative Affect
Preoccupation/
Anticipation

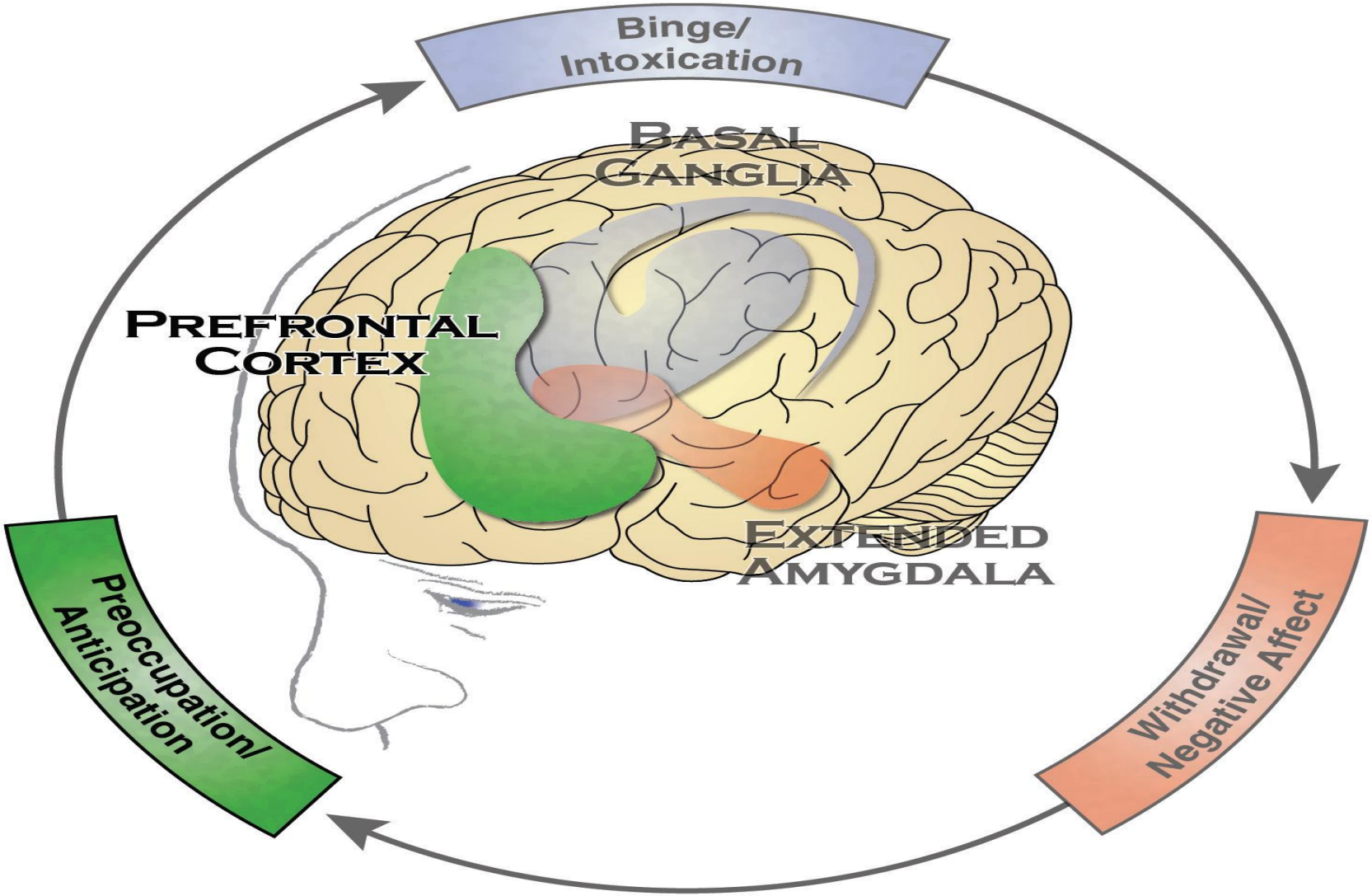
- **The Withdrawal/Negative Affect Stage and the Extended Amygdala**
- This stage of addiction involves a decrease in the function of the brain reward systems and an activation of stress neurotransmitters, such as CRF in the extended amygdala. Together, these phenomena provide a powerful neuro chemical basis for the negative emotional state associated with withdrawal. The drive to alleviate these negative feelings negatively reinforces alcohol or drug use and drives compulsive substance taking

The Withdrawal/Negative Affect Stage and the Extended Amygdala



- **The Preoccupation/Anticipation Stage and the Prefrontal Cortex**
- This stage of the addiction cycle is characterized by a disruption of executive function caused by a compromised prefrontal cortex. The activity of the neurotransmitter glutamate is increased, which drives substance use habits associated with craving, and disrupts how dopamine influences the frontal cortex. The over-activation of the Go system in the prefrontal cortex promotes habit-like substance seeking, and the under-activation of the Stop system of the prefrontal cortex promotes impulsive and compulsive substance seeking.

The Preoccupation/Anticipation Stage and the Prefrontal Cortex

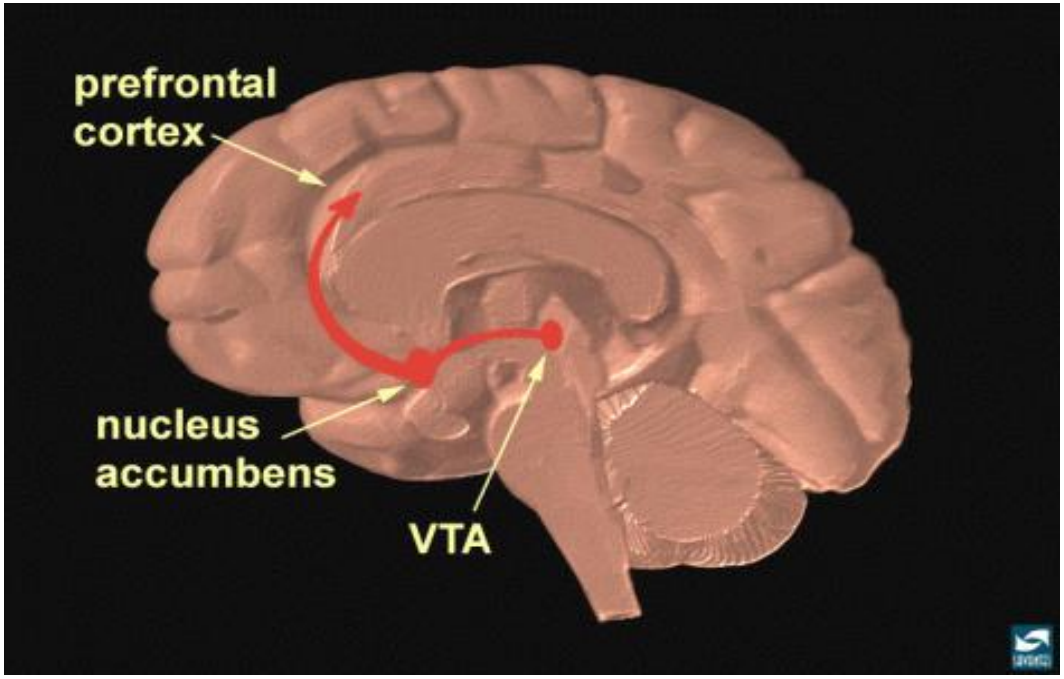


- How the prefrontal cortex is involved in addiction, some scientists divide the functions of this brain region into a “Go system” and an opposing “Stop system.” The Go system helps people make decisions, particularly those that require significant attention and those involved with planning.
- increased activity stimulates the nucleus accumbens to release glutamate, the main excitatory neurotransmitter in the brain. This release, in turn, promotes incentive salience, which creates a powerful urge to use the substance in the presence of drug-associated cues.
- The Stop system inhibits the activity of the Go system. Especially relevant to its role in addiction, this system controls the dorsal striatum and the nucleus accumbens, the areas of the basal ganglia that are involved in the binge/intoxication stage of addiction. Specifically, the Stop system controls habit responses driven by the dorsal striatum, and scientists think that it plays a role in reducing the ability of substance-associated stimuli to trigger relapse—in other words, it inhibits incentive salience.

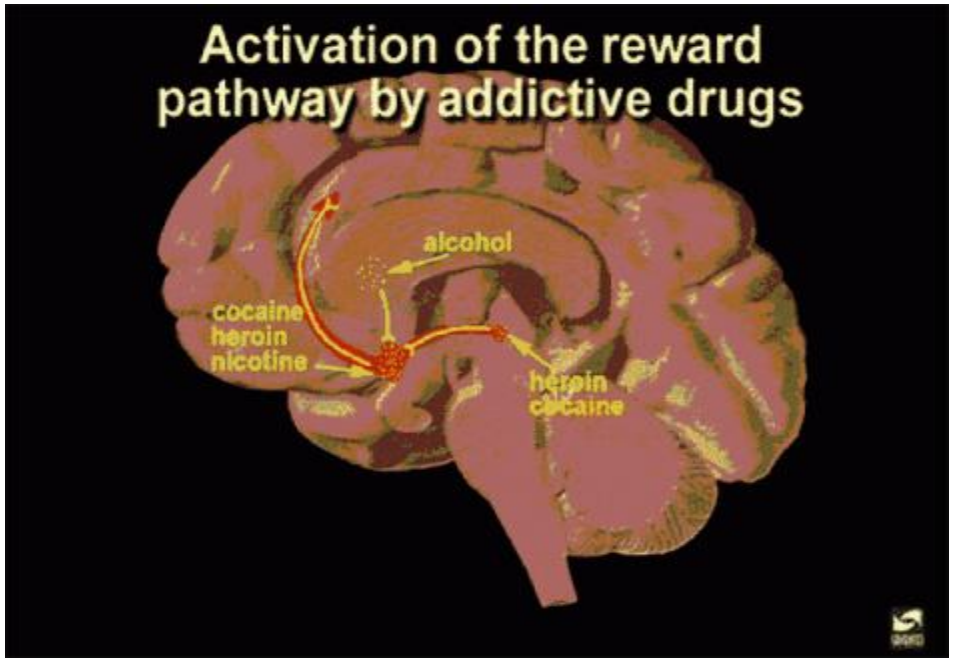
The reward pathway is shown and the major structures are highlighted: the ventral tegmental area (VTA), the nucleus accumbens, and the prefrontal cortex.

The VTA is connected to both the nucleus accumbens and the prefrontal cortex via this pathway and it sends information to these structures via its neurons.

The neurons of the VTA contain the neurotransmitter dopamine, which is released in the nucleus accumbens and in the prefrontal cortex.



Heroin or morphine and cocaine activate the reward pathway in the VTA and nucleus accumbens, other drugs such as nicotine and alcohol activate this pathway as well, and sometimes indirectly (point to the globus pallidus, an area activated by alcohol that connects to the reward pathway). Although each drug has a different mechanism of action, each drug increases the activity of the reward pathway by increasing dopamine transmission.



Effects of Substance Abuse

- The effects of substance abuse can be on many levels:
  - on the individual,
  - on friends and family,
  - on society.

Effects of Substance Abuse- on individual

- Around 10000 death causes by drug abuse in USA every year.
- Many drug users engage in criminal activity, such as burglary and prostitution, to raise the money to buy drugs, and some drugs, especially alcohol, are associated with violent behavior.
- Cocaine: anxiety, fatigue, depression, and an acute desire.
- Marijuana and alcohol interfere with motor control and are factors in many automobile accidents.
- Users of marijuana and hallucinogenic drugs may experience flashbacks, unwanted recurrences of the drug's effects weeks or months after use.

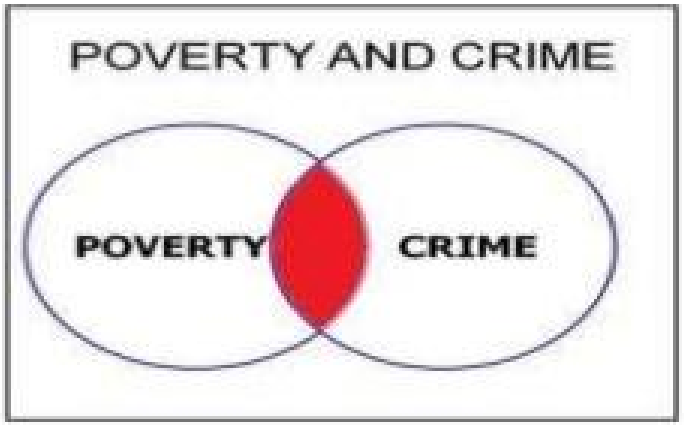
Effects of Substance Abuse-on friends and family

- Marital problems and poor work performance
- Pregnant drug users, because of the drugs themselves or poor self-care in general, bear a much higher rate of low birth-weight babies than the average.

ALCOHOL AND DRUGS CAN IMPAIR YOUR JUDGMENT
AND AFFECT YOUR ABILITY TO MAKE SAFE CHOICES.
PUTTING YOU AT GREATER RISK FOR HIV.

Effects of Substance Abuse- on society

- Drug abuse affects society in many ways.
- In the workplace it is costly in terms of lost work time and inefficiency.
- Drug-related crime can disrupt neighborhoods due to violence among drug dealers, threats to residents, and the crimes of the addicts themselves.
- Half of the highway deaths in the United States involve alcohol.



Estimated Economic Cost to Society Due to Substance Abuse and Addiction:

Illegal drugs:	$181 billion/year
Alcohol:	$185 billion/year
Tobacco:	$193 billion/year
Total:	$559 billion/year

NIDA

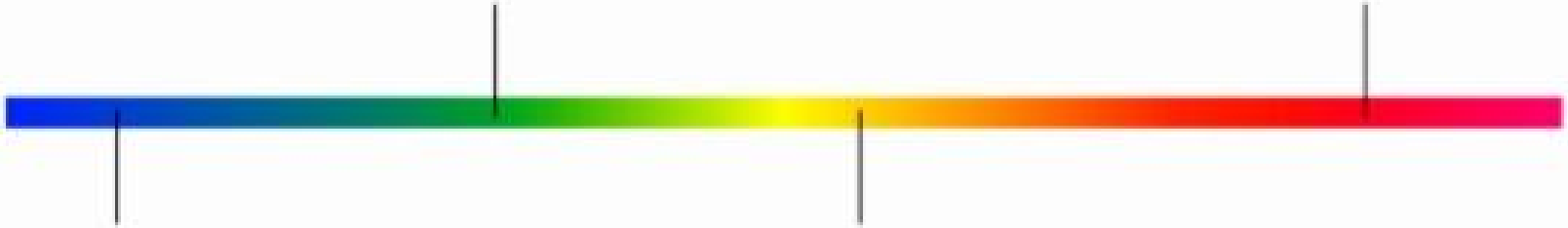
Spectrum of Psychoactive Substance Use

Casual/Non-problematic Use

- recreational, casual or other use that has negligible health or social effects

Chronic Dependence

- Use that has become habitual and compulsive despite negative health and social effects



Beneficial Use

- use that has positive health, spiritual or social impact:
- e.g. medical pharmaceuticals; coffee/tea to increase alertness; moderate consumption of red wine; sacramental use of ayahuasca or peyote

Problematic Use

- use that begins to have negative consequences for individual, friends/family, or society
- e.g. impaired driving; binge consumption; harmful routes of administration

COMMON SYMPTOMS

- *Psychological/Mood:*
- Altered mood state
- Continued drug use despite the knowledge it is causing or exacerbating a psychological disorder
- Difficulty making decisions
- Poor judgment
- Changes in personality
- Sudden changes in mood, irritability
- Angry outbursts
- Feeling fearful, anxious or paranoid without reason
- Lack of motivation to pursue any goal-related activity
- Loss of pleasure in previously enjoyed activities

- *Behavioral:*
- Neglecting responsibilities at home, work, or school
- Engaging in risky behavior when under the influence
- Using the substance in hazardous conditions
- Continued drug use despite legal problems
- Much time and effort spent obtaining, using and recovering from the substance
- Deterioration of physical appearance
- Hiding drugs in different places
- Hiding drug use from others
- Social withdrawal to avoid negative judgments or pressure to stop using the drug
- Unexplained financial problems.
- Illegal acts such as stealing to buy drugs
- Lack of participation in previously frequented activities

- *Physical*
- Altered perceptual experiences
- Continued drug use despite knowledge it is causing or exacerbating an illness
- Tolerance – the need to take more of the substance to produce desired effects
- Taking the drug to avoid withdrawal symptoms
- Effect on immune system resulting in frequent illnesses
- Change in appetite
- Change in sleep patterns

EFFECTS OF SUBSTANCE ABUSE

- Accidents and injuries
- Criminal activity
- Domestic violence, child abuse and neglect
- Physical and psychological illness
- Lost opportunities
- Reduced productivity
- Risky sexual behavior and promiscuity
- Engaging in theft, violence

CONTD…

- Drug-related death
- Infectious diseases
- Homelessness
- Loss of employment
- Lack of control, impulsivity
- Disruptive and antisocial behavior
- Increased aggression

WITHDRAWAL SYMPTOMS

- Anxiety, nervousness
- Restlessness, agitation
- Social withdrawal or isolation
- Sweating
- Racing heart
- Palpitations
- Muscle tension
- Tightness in the chest
- Difficulty breathing
- Tremor
- Nausea, vomiting, or diarrhea
- Seizures

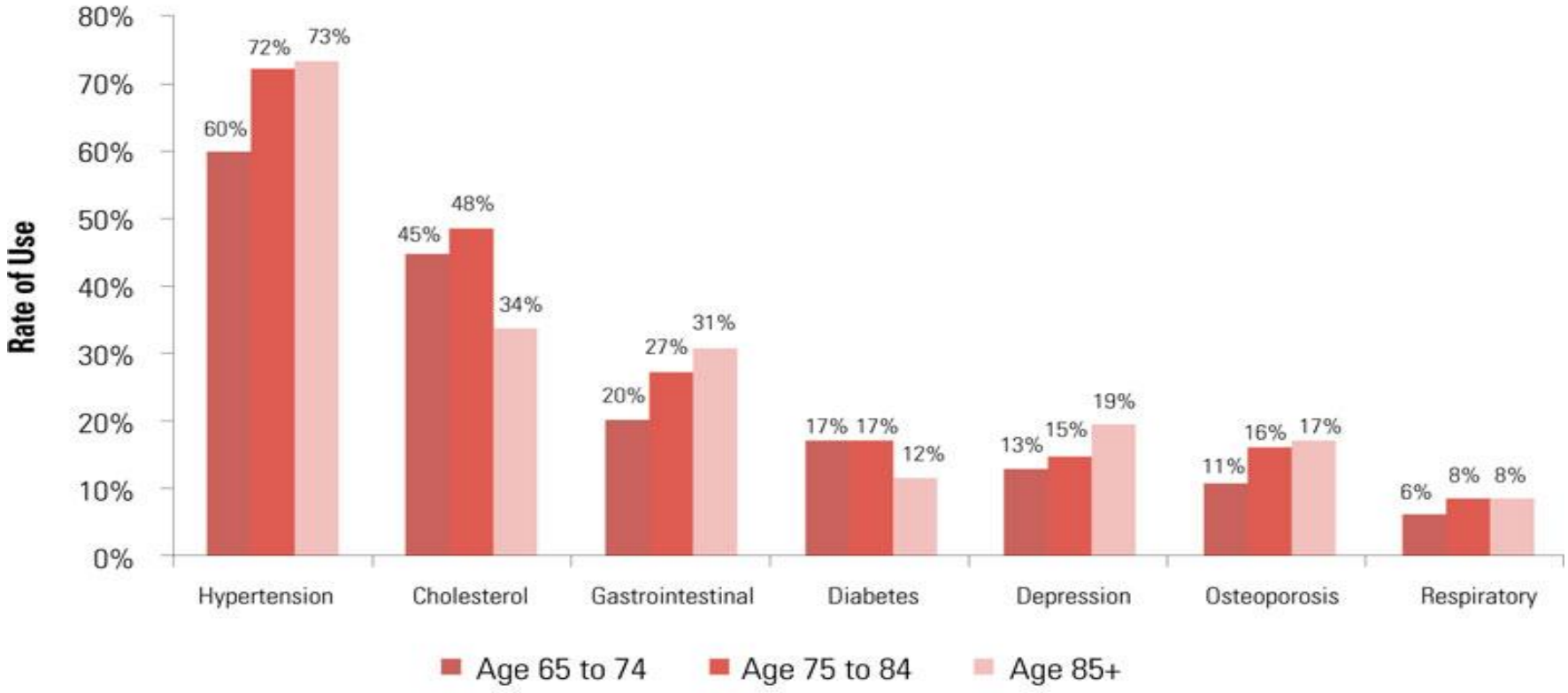
- Irregular heart beat or heart attacks
- Strokes
- Hallucinations
- Thoughts of death or suicide
- Feelings of helplessness/ hopelessness
- Irritability
- Insomnia
- Headaches
- Inability to concentrate
- Depression

SUBSTANCE	WITHDRAWAL	REINFORCE-MENT	TOLERANCE	DEPENDENCE	INTOXICA-TION
NICOTINE	3	4	2	1	5
HEROIN	2	2	1	2	2
COCAINE	4	1	4	3	3
ALCOHOL	1	3	3	4	1
CAFFEINE	5	6	5	5	6
MARIJUANA	6	5	6	6	4

TABLE SHOWING SUBSTANCES AND THE SEVERITY OF PROBLEMS WHERE 1 = MOST SERIOUS AND 6 = LEAST SERIOUS

FIGURE 1.

Rate of chronic use of at least one drug class in defined diseases among seniors on public drug programs, by disease and age group, 2010–2011*



*The seven provinces submitting data to the National Prescription Drug Utilization Information System Database as of March 2011: Alberta, Saskatchewan, Manitoba, Ontario, New Brunswick, Nova Scotia and Prince Edward Island.

Source: National Prescription Drug Utilization Information System Database, Canadian Institute for Health Information, 2010–2011.

WHAT IS A STANDARD DRINK?

REGULAR BEER
341 mL = 12 oz
5% alcohol

WINE
142 mL = 5 oz
12% alcohol

FORTIFIED WINE
85 mL =3 oz
16–18% alcohol

HARD LIQUOR
43 mL = 1.5 oz
40% alcohol

TYPES OF ALCOHOLIC BEVERAGES -

BEVERAGE	SOURCE	ALCOHOL CONTENT
BRANDY	FRUIT JUICE	40 TO 50 %
WHISKEY	CEREAL GRAINS	40 TO 55 %
RUM	SUGARCANE	40 TO 55 %
WINE	GRAPES	10 TO 22 %
BEER	CEREALS	4 TO 8 %

2013 Survey Census Records

- In 2013 drug use disorders resulted in 127,000 deaths; up from 53,000 in 1990.
- The highest number of deaths are from opioid use disorders at 51,000.
- Cocaine use disorder resulted in 4,300 deaths.
- Amphetamine use disorder resulted in 3,800 deaths.
- Alcohol use disorders resulted in an additional 139,000 deaths

MANAGEMENT

- **Addiction severity index**
- Some medical systems, including those of at least 15 states of the United States, refer to an Addiction Severity Index to assess the severity of problems related to substance use.
- The index assesses problems in six areas: medical, employment/support, alcohol and other drug use, legal, family/social, and psychiatric.
- **Detoxification**
- Early treatment of acute withdrawal often includes medical detoxification, which can include doses of anxiolytics or narcotics to reduce symptoms of withdrawal.
- An experimental drug, ibogaine, is also proposed to treat withdrawal and craving.
- Neuro feedback therapy has shown statistically significant improvements in numerous researches conducted on alcoholic as well as mixed substance abuse population. In chronic opiate addiction, a surrogate drug such as methadone is sometimes offered as a form of opiate replacement therapy.

- **Tailoring treatment**
- Therapists often classify patients with chemical dependencies as either interested or not interested in changing.
- Treatments usually involve planning for specific ways to avoid the addictive stimulus, and therapeutic interventions intended to help a client learn healthier ways to find satisfaction.
- Clinical leaders in recent years have attempted to tailor intervention approaches to specific influences that affect addictive behavior, using therapeutic interviews in an effort to discover factors that led a person to embrace unhealthy, addictive sources of pleasure or relief from pain.

TREATMENTS

- ***Behavioral pattern***
- Low self-esteem, anxiety, verbal hostility
- Defective personal constructs, ignorance of interpersonal means
- Focal anxiety such as fear of crowds
- Undesirable behaviors, lacking appropriate behaviors
- Lack of information
- Difficult social circumstances
- Poor social performance, rigid interpersonal behavior
- Grossly bizarre behavior

- ***Intervention***
- Relationship therapy, client centered approach
- Cognitive restructuring including directive and group therapies
- Desensitization
- Provide information
- Organizational intervention, environmental manipulation, family counseling
- Sensitivity training, communication training, group therapy
- Medical referral

- ***Goals***
- Increase self-esteem, reduce hostility and anxiety
- Insight
- Change response to same cue
- Eliminate or replace behavior
- Have client act on information
- Remove cause of social difficulty
- Increase interpersonal repertoire, desensitization to group functioning
- Protect from society, prepare for further treatment

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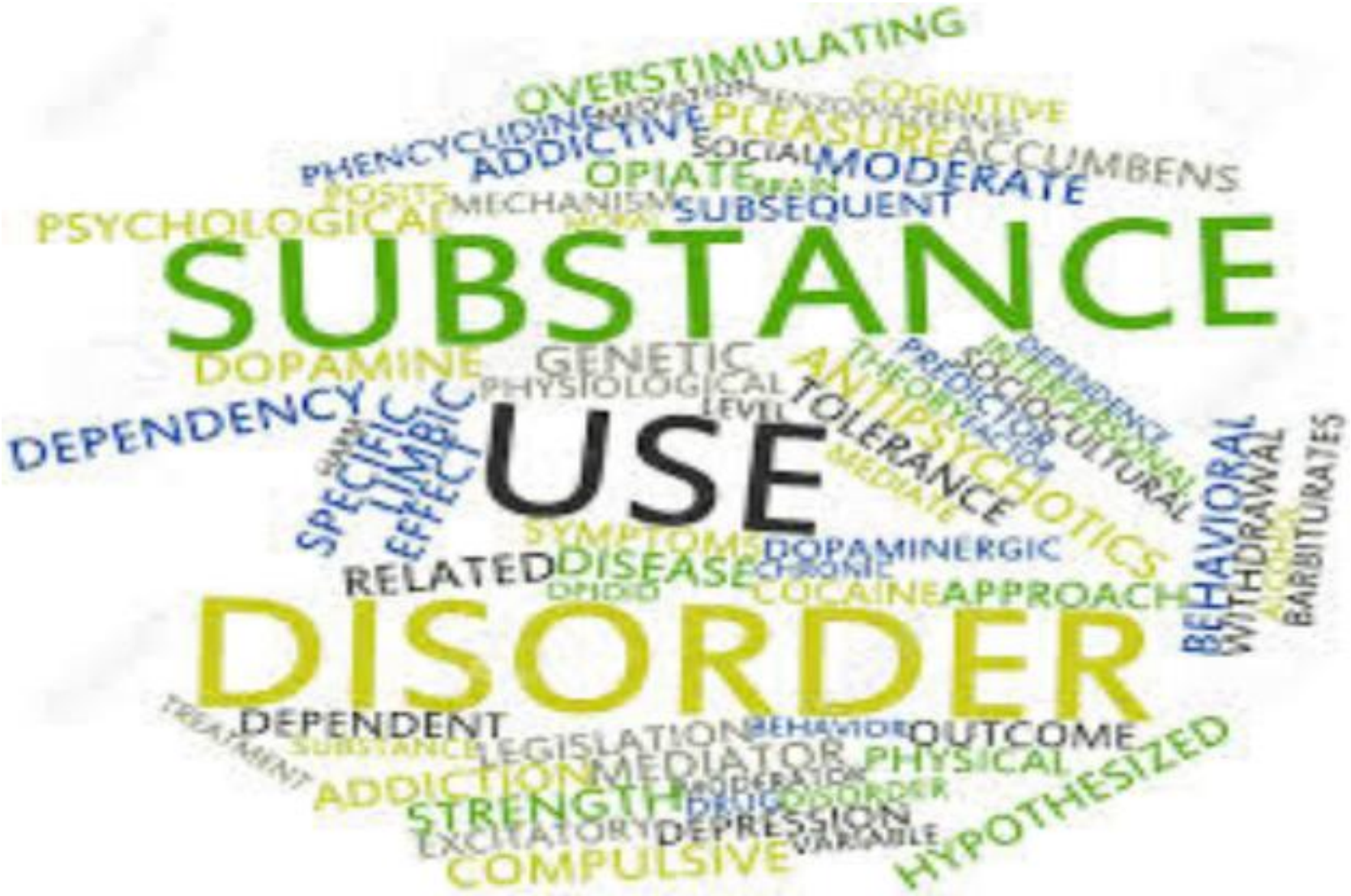
THANK - YOU


SUBSTANCE
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