What are Substance Use Disorders?

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The contents of this activity may include discussion of off label or investigative drug uses. The faculty is aware that is their responsibility to disclose this information.
At the conclusion of this activity participants should be able to:

1. Describe major features of substance use disorders and explain how a substance use disorder is diagnosed.
2. Identify factors that predispose an individual to becoming addicted.
3. Describe how addictive substances act on the brain to influence motivation and behavior.
4. Explain the roles of positive and negative reinforcement in substance use disorders.
5. Compare recovery from addictions to other chronic medical conditions.
Outline

1. Case study
2. Diagnosis
3. Neurobiology
   - cells and signaling
   - motivation, thinking, and behavior
   - biology of addiction
4. Relapse and recovery
5. Summary
SP is a 38 year old woman and mother of two who was working as a waitress when she fell and injured her back. Lacking health insurance, when she had persistent pain she tried opioid pain pills given to her by her boyfriend.

At first the pills helped, but she found herself needing more as time went on and feeling worse when she went without. Within a few months she could no longer afford the pills and resorted to heroin, which she could get for one tenth the price of prescription opioids. She tried repeatedly to quit but became very sick and had intense cravings, along with feeling more anxious, depressed, and ashamed. She started heroin again each time.

SP lost her job as a waitress after missing too many days of work, and her children were removed from her custody after a teacher reported signs of neglect to a state agency.
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Diagnosis

**Loss of control**
- more than intended
  - amount
  - time spent
- unable to cut down
- giving up activities
- craving

**Physiology**
- tolerance
- withdrawal

**Consequences**
- unfulfilled obligations
  - work
  - school
  - home
- interpersonal problems
- dangerous situations
- medical problems

formerly “Dependence”

formerly “Abuse”

A *substance use disorder* is defined by having 2 or more in the past year resulting in distress or impairment.

The diagnosis is made separately for each substance.

Severity is rated by the number of symptoms present:

- 2–3 = mild
- 4–5 = moderate
- 6+ = severe
Spectrum of Substance Use

<table>
<thead>
<tr>
<th>None or low risk</th>
<th>At risk</th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increasing amounts, higher-risk substances or situations</td>
<td>Craving, loss of control, consequences</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

**Tolerance** and **withdrawal** *can* be present with no disorder at all (i.e. many long term prescription medications used as directed)
Who Develops a Disorder?

- **Genetics**
- **Environment**
  - **Social influence**
    - parents
    - siblings
    - friends
  - **Adversity**
    - psychiatric disorders
    - stress
    - lack of positive experiences
  - **Availability**
    - illicit sources
    - prescription
    - family and friends
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Neurobiology

Receive chemical signals from other neurons

Generate and carry an electrical signal

Release a chemical signal to another cell

The chemical is called a neurotransmitter

The place where it is released is called a synapse
Synapses

Stored neurotransmitter is released into the synapse, where it can bind receptors on the target cell.

Response in the target cell.

The more receptors bound, the stronger the response.
Receptors and Adaptation

When too much transmitter is present, the cell compensates by making fewer receptors.

Now the cell can work normally even with the high level of neurotransmitter...

...but it won't work normally if the level of transmitter falls back to normal.
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Biology of Motivation

Positive reinforcement

Neurons in the brainstem release dopamine in the *nucleus accumbens*

- Liking and wanting
- Seek out and do more of this

Negative reinforcement

Neurons in the *amygdala* are stimulated (by thoughts, memories, sensory input)

- Anxiety, fear, and distress
- Avoid things that cause, and seek out things that relieve
Thinking and Planning

Complex thinking, learning, and planning are performed in the **prefrontal cortex**

During positive reinforcement, dopamine is released here also

Learning of cues and behaviors that led to the reward

Strong activation of the amygdala suppresses the prefrontal cortex

Less thinking and planning, more response to emotions and past conditioning.
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What Makes a Substance Addictive?

All addictive substances increase the availability of **dopamine** in the **nucleus accumbens**, usually more powerfully than natural rewards like food or sex.

- Pleasure, satisfaction, gratification
- Relief from anxiety and distress
- Motivation to use the substance again

Some, like alcohol and opioids, also decrease activity of the **amygdala**.
Positive Reinforcement in Addiction

In the **nucleus accumbens**, cells respond to excessive dopamine by becoming less sensitive (such as by decreasing the number of receptors).

All activities become less enjoyable, and more substance is needed to achieve the same subjective effect.

In the **prefrontal cortex**, the increased dopamine causes cues and behaviors related to substance use to become more deeply learned and automatic.
Dopamine Receptors

Volkow et al 1999

Martinez et al 2012
Negative Reinforcement in Substance Use Disorders

With long-term substance use, the **amygdala** becomes more active, due to the substance itself and to unpleasant experiences like withdrawal.

Abnormally increased feelings of anxiety and distress result when the substance is not used regularly.

In the **prefrontal cortex**, functions like planning, thinking about consequences, and effortful control are inhibited by the over-active amygdala.
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SP entered treatment multiple times, usually via the emergency department during bouts of withdrawal. She went through several cycles of week-long “detox” and month-long residential treatment, but each time used heroin again within a month.

After her latest relapse SP was referred to Drug Court where she engaged in therapy that included medication and regular groups, and with continued work she was able to stop using heroin. She has been sober for 6 months, regained custody of her children, and started a new job.
Relapse

PLNDP 2008, based on McLellan et al. 2000
Recovery

Hunt et al 1971
Recovery in the Brain

Normal

Chronic methamphetamine use:

After 1 month of abstinence

After 14 months of abstinence

Volkow et al 2001
1. Humans have brain systems that motivate us to seek out pleasure, avoid distress, and learn the behaviors that help us do these things.

2. Addictive substances hijack these basic systems by activating them more powerfully than any natural experience.

3. Substance use disorders involve long-term changes in the brain that decrease pleasure and increase distress when the substance is not used.

4. Substance use disorders are chronic conditions, like asthma or diabetes, with similar rates of relapse and opportunities for successful management.


References


About this Project

For More Information:
Website: www.ndcrc.org

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