Opioid Initiative Wave I

The Neurobiology of Addiction
Presenter

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The Neurobiology of Addiction

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Objectives

1. Understand why adolescents are at greater risk for substance use disorders

2. Understand how addiction changes the brain
Addiction is a Pediatric Brain Disorder
Addiction is a Pediatric Disorder

- 90 percent of adults with any substance use disorder initiated substance use as teens
- Early adverse experiences strongly influence risk for substance use disorder
  - Child neglect and maltreatment
  - Drug use and addiction among parents

Age of Initiation

% who develop SUD

Brain Development Continues Until the Early to Mid 20’s
Experiences
Drive Brain Development
The brain grows rapidly, forming trillions of short and long range connections between cells. The final stage of development is pruning these connections for specificity and precision. Pruning is driven by experience.

Addiction is a Pediatric Disease

- **9 out of 10** people with a substance use disorder started using in adolescence
- Those who use addictive substances before age 15 are **6.5 times more likely** to develop an addiction as those who delay use until age 21 or older
- **11%** of adolescents develop a substance use disorder before they reach 18
- Earlier onset of substance use **predicts greater addiction severity**

Delaying Initiation is **Key** to Prevention

Addiction Changes the Brain
Addiction Changes Brain Circuits

- Decision Making
- Stress
- Impulse Control
- Motivation
- Reward/Survival
- Memory
- Learning
Biopsychosocial Model

Biological
(e.g. genetics, epigenetics, neurochemistry, physiological responses)

Psychological
(e.g. mental health, attitudes, memories, perceptions, stress, beliefs)

Social
(e.g. relationships, social supports, culture, socio-economic status)
The Reward Circuit Reinforces Behaviors that are Essential for Survival
What makes substances addictive?

Hijacking the Survival Center
Your Brain Likes Balance
Too much dopamine
Your brain adjusts to be less responsive to dopamine
With abstinence dopamine decreases and the circuit is out of balance in the other direction.
Because the adolescent brain is more plastic, the changes are more pronounced and persistent.
Your Brain Likes to Stay Balanced

Dopamine Transporter
Dopamine Receptor
Dopamine

No SUD
With SUD

When Dopamine Receptors go Up, Substance Use Goes Down

Virus to Increase Dopamine Receptors in the Reward Circuit

Decreased Dopamine Receptors

Decreased Activity in the Prefrontal Cortex

Poor Impulse Control and Decision Making

“I NEED it to SURVIVE”

“But I want to get healthy”
Addiction Changes Your Stress Response

In a healthy brain:
• the stress response is activated
• cortisol is released and spreads through the body
• when cortisol reaches the brain it turns off the stress response

In an addicted brain:
• The brain circuits that normally turns off the stress response don’t work very well
• Their stress response stays on high for longer

https://www.sciencedirect.com/journal/international-journal-of-physiology/vol/59/issue/3
Addiction is a Progressive Brain Disorder

• Cravings
• Altered perception of substance’s value
• Impulse control deficit
• Decision making impairments

• Diminished response to natural reward
• Increased motivation to seek substance
• Conditioned cravings (triggers)
• Compulsivity

• Withdrawal symptoms
• Anxiety and agitation
• Excessive stress
• Negative reinforcement (avoiding pain of withdrawal)

“I NEED it to SURVIVE”
Brain Circuit Changes Persist After Withdrawal

Comparison Subject

1 Month After Cocaine Use

4 Months After Cocaine Use

Low dopamine D2 receptors may contribute to the loss of control in cocaine users.

Modified with permission from Volkow et al., (1993)
Do NOT Wait for Rock Bottom

The sooner treatment starts the better the changes of long term recovery

https://www.ncbi.nlm.nih.gov/books/NBK424859/
BRAIN RECOVERY WITH PROLONGED ABSTINENCE

Healthy Control  1 Month Abstinence  14 Months Abstinence
Summary

• Addiction is a pediatric brain disorder
• Addiction changes brain circuits – making it progressively harder to stop using
• Substance use disorders are progressive
• Early diagnosis and treatment are critical
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Addiction Policy Forum

The Addiction Policy Forum is a diverse partnership of organizations, policymakers and stakeholders committed to working together to elevate awareness around addiction and to improve national policy through a comprehensive response that includes prevention, treatment, recovery and criminal justice reform.

We envision a world where fewer lives are lost and help exists for the millions of Americans affected by addiction every day.
For More Information

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