Reframing the Conversation
Talking to Teens about Addiction
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Faculty Disclosure Information

• In the past 12 months, I have had no relevant financial relationships with the manufacturer(s) of any commercial product(s) and/or provider(s) of commercial service(s) discussed in this CME activity.

• Funding Sources: National Institutes of Health, Health Resources and Services Administration, Substance Abuse and Mental Health Services Administration.

• I do not intend to discuss an unapproved/ investigative use of a commercial product/ device in my presentation.
Session Objectives

1. List 3 ways the brain changes during adolescence
2. Describe the current evidence around the impact of substances on the neurobiology of the adolescent brain and development of addiction
3. Apply strategies for discussing neurobiology when counseling teens and parents about substance use.
Adolescence

Derived from the Latin term “adolescere”

To grow up or grow into maturity

Adolescence

Marked by changes in
- Brain structure
- Function
- Connectivity

THE ADOLESCENT BRAIN

IS GROWING (A LOT)

Source: Stanford Cannabis Awareness and Prevention Toolkit
Image Credit: Pixabay.com
Change 1: Synaptic Pruning & Myelination

- Teen
  - Myelination

- Mid-20s
  - Synaptic Pruning

Source: Stanford Cannabis Awareness and Prevention Toolkit
Change 2: Improved connectivity between the pre-frontal cortex and limbic regions

From: NASEM 2019. The Promise of Adolescence: Realizing Opportunity for All Youth.
Image source: Microsoft Stock Image
Asynchronous development

Early maturation of dopaminergic systems in the limbic regions

Later maturation of innervation between the dopaminergic regions and prefrontal cortex.

Asynchronous development leads to:

A unique sensitivity to drug initiation

Asynchronous development leads to:

- Propensity to explore new things and take risks
- The development of the cognitive, social, and emotional skills for adulthood

From: NASEM 2019, The Promise of Adolescence: Realizing Opportunity for All Youth.
• Complex problem-solving skills
• Creativity
• Deep Learning
Change 3: Neuroplasticity

“The ability of the nervous system to change its activity in response to stimuli by reorganizing its structure, functions, or connections.”

The Adolescent Brain is Designed to Adapt to the Environment
Epigenetics - The environment influences how genes are expressed

DNA methylation
Methyl group (an epigenetic factor found in some dietary sources) can tag DNA and activate or repress genes.

Histones are proteins around which DNA can wind for compaction and gene regulation.

Histone modification
The binding of epigenetic factors to histone “tails” alters the extent to which DNA is wrapped around histones and the availability of genes in the DNA to be activated.
Epigenetics - The environment influences how genes are expressed across the life course

Session Objectives

1. List 3 ways the brain changes during adolescence
   1. Synaptic Pruning & Myelination
   2. Connectivity
   3. Neuroplasticity and Epigenetics

2. Describe the current evidence around the impact of substances on the neurobiology of the adolescent brain and development of addiction

3. Apply strategies for discussing neurobiology when counseling teens and parents about substance use.
Positron emission tomography (PET) scan

• Measures brain activity by measuring Glucose utilization

- Red= high glucose utilization
- Yellow= Medium
- Blue=Low
NORMAL BRAIN ACTIVITY  Cocaine Exposed Brain

10 days abstinent  100 days abstinent
Brain Regions
Affected by Drug Exposure

Prefrontal Cortex
9 Functions of the Prefrontal Cortex
1. Empathy
2. Insight
3. Response Flexibility
4. Emotion Regulation
5. Body Regulation
6. Morality
7. Intuition
8. Attuned Communication
9. Fear Modulation

Limbic Brain
1. Fight, flight, freeze stress response
2. Thinks, "Am I safe? Do people want me?"
3. Emotions live here

Slide courtesy of Gretchen Hermes, MD
SUBSTANCE USE DISORDERS:
Disease of Neuroplasticity

Limbic Function

Executive Function

Slide courtesy of Gretchen Hermes, MD
Stages of addiction cycle

- **Intoxication**
  - The brain’s reward regions (in blue) release large amounts of dopamine

- **Withdrawal**
  - Activation of brain regions involved in emotions (in pink) results in negative mood and enhanced sensitivity to stress.

- **Preoccupation**
  - Decreased function of the prefrontal cortex leads to an inability to balance the strong desire for the drug with the will to abstain.
Neurobiology of preoccupation/relapse

Drug exposure can:

- Down-regulate dopamine signaling
- Change the function of the prefrontal cortical regions
- Seriously impair executive processes
  - Self-regulation,
  - Decision making,
  - Flexibility in the selection and initiation of action.
- **Explains why people can be sincere in their desire and intention to stop and simultaneously impulsive and unable to stop.**
ASAM Definition of Addiction

A treatable, chronic medical disease involving complex interactions among brain circuits, genetics, environment, and an individual’s life experiences.
ASAM Definition of Addiction

A treatable, chronic medical disease involving complex interactions among brain circuits, genetics, environment, and an individual’s life experiences.

People with addiction use substances or engage in behaviors that become compulsive and often continue despite harmful consequences.
Spectrum of Addiction
No Use

**SUD as a chronic disease**

Starting to Use

Pre-addiction
TRENDS IN NO USE OF ANY ALCOHOL, CIGARETTES, MARIJUANA OR OTHER ILLICIT DRUGS

by 12th Grade Students in the US, 1976–2018

No Use

Past Month Non-Use

Lifetime Non-Use

SUD as a chronic disease

Starting to Use

Pre-addiction

No Use
Patterns of Mean Age at Drug Use Initiation Among Adolescents Aged 12-21

Earlier age of initiation and risk of progressing to tobacco dependence

% who experience 1 or 3 symptoms of DSM-IV dependence criteria by adulthood, by age of initiation.

Preaddiction—A Missing Concept for Treating Substance Use Disorders

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Despite decades of federal funding to develop and deliver treatments for individuals with serious addictions, treatment penetration rates are less than 20%.1 Facing a similar situation, the diabetes field increased treatment penetration and impact by identifying and intervening with early-stage diabetes, termed prediabetes. We use this example to illustrate the essential elements of this strategic clinical approach and discuss the changes that will be required within the substance use disorder (SUD) field to implement an analogous strategy. We suggest the DSM-5 diagnostic categories mild to moderate SUD as a starting operational definition for the term preaddiction, a commonly understood, motivating term that could engender broader clinical efforts to effect that strategy.

Background
The centuries-old term addiction remains widely used in both professional and popular media because it communicates commonly held imagery of those whose once-promising lives were ruined by their uncontrolled use of substances, such as alcohol, opiates, or other drugs. Nonetheless, addiction is a diverse phenomenon, and one of its distinguishing features is the high rate of treatment failure. In the United States, most individuals do not receive treatment for their substance use disorder (SUD), even if they believe they need it. Among those who do seek treatment, the vast majority receive only one or two treatment episodes. This is true not only for SUD but for other chronic illnesses as well.2

Suggest impaired control as the core defining diagnostic construct, hypothesized to be the result of gradual use-related damage to brain circuits controlling reward sensitivity, motivation, self-regulation, negative emotional states, and stress tolerance.2

Among those who initiate alcohol or other drug use, progression to serious SUD is not common. When it does occur, the progression is rarely linear or rapid,3 usually following years of harmful misuse that by itself is a serious personal and public health threat.1 Adolescence is a particularly risky period for transition from use to disorder, likely owing to heightened sensitivity of still-developing brain circuits. Those adolescents at highest risk of transition have earlier onset of use, history of traumatic events, family history of substance use, and/or mental health problems.3 Two points here are important. First, the long latency from use to disorder offers a significant window of opportunity for clinical interventions to stop progression. Second, early-stage harmful substance misuse is a pervasive, costly, and serious public health risk in itself.1

Recognizing that transition to serious SUD can be pro-
“Among those who initiate alcohol or other drug use, most do not develop addiction, but some develop pre-addiction.
<table>
<thead>
<tr>
<th></th>
<th>Diabetes</th>
<th>Substance Use Disorder</th>
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</thead>
<tbody>
<tr>
<td>Preventable</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Disease progression dependent on behaviors</td>
<td>Yes- Physical Activity and diet choices</td>
<td>Yes- Use of substances</td>
</tr>
<tr>
<td>Both environment and genetics affects disease expression</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Treatment includes behavioral changes and medications</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Can be &quot;cured&quot;</td>
<td>No-always risk of returning</td>
<td>No-always risk of returning</td>
</tr>
</tbody>
</table>
"The criteria defining mild to moderate SUD are one reasonable starting point for operationally defining pre-addiction until more objective measures are developed."
Prevalence of Pre-Addiction (1975-84)

# Substance Use Disorder Symptoms at age 18

- Addiction: 11.5
- Pre-addiction: 46.3
- 0
- 1
- 2-3
- 4-5
- 6+

% with 2+ SUD symptoms at ages 35-50

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   - Down-regulates dopamine signaling
   - Changes the function of the prefrontal cortical regions
   - Seriously impairs executive processes

3. Apply strategies for discussing neurobiology when counseling teens and parents about substance use.
Session Objectives

1. List 3 brain changes that occur during adolescence

2. Describe how substances can impact neurobiology and brain development
   - Down-regulates dopamine signaling
   - Changes the function of the prefrontal cortical regions
   - Seriously impairs executive processes

3. Explain concepts of neurobiology to adolescents
At this time in your life, your brain is growing to become FASTER and more EFFICIENT.

[Marijuana] affects how FAST and EFFICIENT it can be.
Asynchronous Development of Limbic and Prefrontal Systems

When you vape….

Your brain is wired to act differently than an older person’s brain.

You have to be very careful, because, during adolescence, the brain is wired to develop an addiction very quickly.
When you are around positive things, your brain can start to rewire and heal itself.
These are signs that **your brain wiring might be changing** and you may start developing an addiction

- Cravings
- Withdrawal when not Using
- Tolerance - Needing more cannabis to get the same effect
- Anger, depression, irritability
- Sleep Disturbance
- Pain
- Spending a lot of time using [cannabis]
Summary

• Adolescence is a period of learning, exploration and growth

• Substances can adversely impact the brain’s ability to grow, learn, and explore...

• But the adolescent brain has a profound ability to change and adapt
Thank you!

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