Biology of Addiction

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Injured Workers and Opioid Use Symposium
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What Do These Have in Common?

Addiction
Cancer
Diabetes

They’re All Considered DISEASES by the
NATIONAL INSTITUTES OF HEALTH

Isn’t It Time We Recognize & Support Treating Addiction as the Treatable, Preventable Brain Disease It Is?

Learn About It. Talk About It. Spread the Word...
ADDICTION IS A TREATABLE, PREVENTABLE BRAIN DISEASE

For information, visit “The Addiction Project,” www.hbo.com/addiction
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Timing

Priming

Biology
Early Exposure is Toxic

The Brain, particularly the decision making area does not finish developing until age 21.
9 OUT OF 10
PEOPLE WITH SUBSTANCE PROBLEMS STARTED USING BY AGE 18
1 in 4 Americans who first smoked, drank or used other drugs before age 18 has a substance problem, compared to 1 in 25 Americans who first drank, smoked or used other drugs at age 21 or older.
Priming
Adverse Childhood Experiences
Psychological Factors/Mental Illness
The Adverse Childhood Experiences Scale Score is Associated with Addiction

Childhood Abuse and Neglect as well as Parental Mental Illness and Addiction and Witnessing Violence increase risk of developing Addiction

https://acestoohigh.com/got-your-ace-score/
Mental Illness Increases Risk

Four childhood traits are associated with development of addiction:

- Impulsiveness
- Hopelessness
- Anxiety Sensitivity
- Sensation Seeking


Genetics account for 50-75% of the risk for addiction.

http://www.centeronaddiction.org/addiction/addiction-risk-factors
**Genetic Variants in Addiction**

**OPRM1 codes for mu receptor- low levels of receptors tied to increase risk of addiction and severity of OD**


**SNF804A is involved in Dopamine Release and Synthesis**


**Infants with NAS have genetic variant**

Opioids and the Reward System

http://grivina.com/diagram/brain-cell-diagram/
# Opioid Receptors

<table>
<thead>
<tr>
<th>Location</th>
<th>Action</th>
<th>Tolerance/Dependence</th>
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<tbody>
<tr>
<td>Reward Center</td>
<td>Euphoria</td>
<td>Yes</td>
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<tr>
<td>Pain Center</td>
<td>Analgesia</td>
<td>Yes</td>
</tr>
<tr>
<td>Brainstem</td>
<td>Respiratory Suppression</td>
<td>NO</td>
</tr>
<tr>
<td>GI tract</td>
<td>Constipation</td>
<td>Little to none</td>
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Neuroanatomy of Addiction

THE REWARD CIRCUIT:
Opioids in the VTA (ventral tegmental area) lead to more Dopamine in the NA (nucleus accumbens) which connects to the PFC (prefrontal cortex) which registers pleasure.
Neurological Basis of Addiction

There is something different about the reward circuit in people who go on to addiction:

Nothing moderates use and it becomes compulsive no longer responding to the judgement and decision making of the PFC.
Neurological Basis of Addiction

The PFC is responsible for integrating information from the NA along with the HC (hippocampus) and the Amg (amgydala) which process emotion and memory. The PFC uses this information to form judgements and make decisions. This regulates use in healthy people.
Neurological Basis of Pain

Pain signals from the body travel from the spinal cord to the Thalamus and then to the Sensory Cortex and the PFC. The PFC sends information to the PAG (periaqueductal gray) which then turns off the Thalamus.
With Chronic Use Opioid Receptors Become Less Responsive
Tolerance

- Drug effect: Big effect vs. Little effect
- Drug dose: Small vs. Large
- Response to first exposure
- After repeated exposure, more drug is needed to produce same effect
Withdrawal

Severe Body Pain
Chills and Sweats
Nausea, Diarrhea and Vomiting
Inability to Sit Still
Runny Nose and Teary Eyes
Shaking and Tremors
Yawning
Withdrawal fuels Ongoing Use
Tolerance fuels Escalating Doses and Accidental Overdose
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Overdose

Opioid Analgesic Overdose
Deaths in the USA

Heroin Overdose
Deaths in the USA

Prescriptions for Opioid Pain Medications have Skyrocketed

Opioid Prescriptions have Quadrupled since 1999

Oxycodone & Hydrocodone Prescriptions

[Bar chart showing the rise in prescriptions from 1999 to 2012]
Commonly Available Prescription Opioids

codeine (only available in generic form)
fentanyl (Actiq, Duragesic, Fentora)
hydrocodone (Hysingla ER, Zohydro ER)
hydrocodone/acetaminophen (Lorcet, Lortab, Norco, Vicodin)
hydromorphone (Dilaudid, Exalgo)
meperidine (Demerol)
methadone (Dolophine, Methadose)
morphine (Astramorph, Avinza, Kadian, MS Contin, Ora-Morph SR)
oxycodone (OxyContin, Oxecta, Roxicodone)
oxycodone and acetaminophen (Percocet, Endocet, Roxicet)
Heroin is attractive because it is cheap and available...

Percentage of the total heroin-dependent sample that used heroin or a prescription opioid as their first opioid of abuse. Data are plotted as a function of the decade in which respondents initiated their opioid abuse. Source: Cicero et al., 2014

SUMMARY

- Opioid Addiction is a multifactorial neurodevelopmental disease
- Early Use of ANY addictive substance increases risk
- Adverse Childhood Experiences increase risk
- Untreated Mental Illness increases risk
- Genetic Variants increase risk
- All these factors create the biological basis of addiction
- Anyone taking high doses is at risk for Overdose
- Opioid Prescription drugs are biochemically equivalent to Heroin
- Opioids produce tolerance and physical dependence in ALL, but only lead to addiction in SOME.
PREVENTION

- Reduce (STOP) Underage Drinking and Drug Use, including Nicotine
- Improve Mental Health and Access to Mental Health Treatment
- Design less addictive and more effective treatments for both acute and chronic pain
- Research the gene variants and learn make repairs
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Educate our Parents and Youth

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Mental Health Treatment Works
Improve Treatments for Pain

Less Addictive Opioid Medication
Non-Opioid Medication
Non-Pharmacological Treatments
Treatment for Opioid Use Disorder

- Medication Is Essential
  - Methadone
  - Buprenorphine
  - Naltrexone
Methadone

A Full mu receptor agonist
Shown to reduce use, reduce transmission of disease and save lives.
Buprenorphine

A Partial mu receptor Agonist
Can be prescribed in an office setting due to lower risk of misuse
Generally prescribed in fixed combination with Naloxone a short acting mu receptor antagonist to limit misuse and diversion
Naltrexone XR

A long acting full mu receptor Antagonist

Increases adherence, decreases use and decreases cravings.

Addiction is both preventable and treatable; it is an illness as real as any other chronic disease.

No one ever chooses to be an addict.