# Addiction is a Brain Disease and It *Still* Matters

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#### Addiction Is a Brain Disease, and It Matters

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Scientific advances over the past 20 years have shown that drug addiction is a chronic, relapsing disease that results from the prolonged effects of drugs on the brain. As with many other brain diseases, addiction has embedded behavioral and social-context aspects that are important parts of the disorder itself. Therefore, the most effective treatment approaches will include biological, behavioral, and social-context components. Recognizing addiction as a chronic, relapsing brain disorder characterized by compulsive drug seeking and use can impact society's overall health and social policy strategies and help diminish the health and social costs associated with drug abuse and addiction.

Dramatic advances over the past two decades in both the neurosciences and the behavioral sciences have revolutionized our understanding of drug abuse and addiction. Scientists have identified neural circuits that subsume the actions of every known drug of abuse, and they have specified common pathways that are affected by almost all such drugs. Researchers have also identified and cloned the major receptors for virtually every abusable drug, as well as the natural ligands for most of those receptors. In addition, they have elaborated many of the biochemical cascades within the cell that follow receptor activation by drugs. Research has also begun to reveal major differences between the brains of addicted and nonaddicted individuals and to indicate some common elements of addiction. regardless of the substance.

That is the good news. The bad news is the dramatic lag between these advances in science and their appreciation by the general public or their application in either practice or public policy settings. There is a wide gap between the scientific facts and public perceptions about drug abuse and addiction. For example, many, perhaps most, people see drug abuse and addiction as social problems, to be handled only with social solutions, particularly through the criminal justice system. On the other hand, science has taught that drug abuse and addiction are as much health problems as they are social problems. The consequence of this gap is a significant delay in gaining control over the drug abuse problem.

Part of the lag and resultant disconnection comes from the normal delay in transferring any scientific knowledge into practice and policy. However, there are other factors unique to the drug abuse arena that compound the problem. One major barrier is the tremendous stiema attached to being a

drug user or, worse, an addict. The most beneficent public view of drug addicts is as victims of their societal situation. However, the more common view is that drug addicts are weak or bad people, unwilling to lead moral lives and to control their behavior and gratifications. To the contrary, addiction is actually a chronic, relapsing illness, characterized by compulsive drug seeking and use (1). The gulf in implications between the "bad person" view and the "chronic illness sufferer" view is tremendous. As just one example, there are many people who believe that addicted individuals do not even deserve treatment. This stigma, and the underlying moralistic tone. is a significant overlay on all decisions that relate to drug use and drug users.

Another barrier is that some of the people who work in the fields of drug abuse prevention and addiction treatment also hold ingrained ideologies that, although usually different in origin and form from the ideologies of the general public, can be just as problematic. For example, many drug abuse workers are themselves former drug users who have had successful treatment experiences with a particular treatment method. They therefore may zealously defend a single approach, even in the face of contradictory scientific evidence. In fact, there are many drug abuse treatments that have been shown to be effective through clinical trials (1, 2).

These difficulties notwithstanding, I believe that we can and must bridge this informational disconnection if we are going to make any real progress in controlling drug abuse and addiction. It is time to replace ideology with science.

#### Drug Abuse and Addiction as Public Health Problems

At the most general level, research has shown that drug abuse is a dual-edged health issue, as well as a social issue. It

affects both the health of the individual and the health of the public. The use of drugs has well-known and severe negative consequences for health, both mental and physical. But drug abuse and addiction also have tremendous implications for the health of the public, because drug use, directly or indirectly, is now a major vector for the transmission of many serious infectious diseases-particularly acquired immunodeficiency syndrome (AIDS), hepatitis, and tuberculosis-as well as violence. Because addiction is such a complex and pervasive health issue, we must include in our overall strategies a committed public health approach, including extensive education and prevention efforts, treatment, and research.

Science is providing the basis for such public health approaches. For example, two large sets of multisite studies (3) have demonstrated the effectiveness of well-delineated outreach strategies in modifying the behaviors of addicted individuals that put them at risk for acquiring the human immunodeficiency virus (HIV), even if they continue to use drugs and do not want to enter treatment. This approach runs counter to the broadly held view that addicts are so incapacitated by drugs that they are unable to modify any of their behaviors. It also suggests a base for improved strategies for reducing the negative health consequences of injection drug use for the individual and for society.

#### What Matters in Addiction

Scientific research and clinical experience have taught us much about what really matters in addiction and where we need to concentrate our clinical and policy efforts. However, too often the focus is on the wrong aspects of addiction, and efforts to deal with this difficult issue can be badly misguided.

Àny discussion about psychoactive drugs inevitably turns to the question of whether a particular drug is physically or psychologically addicting. In essence, this issue revolves around whether or not dramatic physical withdrawal symptoms occur when an individual stops taking a drug, what is typically called physical dependence by professionals in the field. The assumption that often follows is that the more dramatic the physical withdrawal symptoms, the more serious or dangerous the drug must be.

This thinking is outdated. From both clinical and policy perspectives, it does not 8

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## **Fundamental argument**

Addiction is a brain disease, and that has implications for how we deal with the issue Advances in science over the past 50 years have changed some fundamental concepts

- How the brain and mind work normally
- Brain dysfunction and its tie to disease
- What to do about brain disorders
  - Clinically
  - Public policy

# Your Brain on Drugs!

Why do people take drugs in the first place?



# Immediate (proximal) reasons people take drugs

- To feel good
  - Sensation seeking
- To feel better
  - Self-medicating

People take drugs to change their mood, perception or emotional state

Hoping to change their brains

#### Your Brain on Drugs

Front of brain

Back of brain

YELLOW shows places in brain where cocaine goes (Striatum)



#### Acute Effects of Cocaine (0.6 mg/kg, iv)

Transient activation correlates with euphoria











### How do drugs work in the brain?

Despite Their Many Differences, most Abused Substances Enhance the Dopamine and Serotonin Pathways

#### **Dopamine Pathways**

#### **Serotonin Pathways**

frontal cortex hippocampus

Functions
reward (motivation)
pleasure,euphoria
motor function (fine tuning)
compulsion
perserveration

nucleus accumbens

triatum

substantia nigra/VTA

raphe

<u>Functions</u> •mood •memory processing •sleep •cognition



All of These Must Be Considered In Developing Strategies to Most Effectively Treat Addiction

## A Major Reason People Take a Drug is They Like What It Does to Their Brains

# Activation of the reward pathway by addictive drugs

alcohol

cocaine heroin nicotine



### **Effects of Drugs on Dopamine Levels**



Source: Di Chiara and Imperato

**Another Critical Question...** 

Why Do Some People Get Into Trouble With Drugs And Others Don't?





### **Heritabilities Derived From Twin Studies**

DRUG	Males	Females
Cocaine	44% (Tsuang et al., 1996) 79% (Kendler et al., 2000)	81% (Kendler et al., 1999)
Heroin (opiates)	54% (Tsuang et al., 1996)	
Sedatives	87% (Kendler, et al., 2000)	
Marijuana	33% (Tsuang et al., 1996) 58% (Kendler, et al., 2000)	79% (Kendler & Prescott, 1998)
Hallucinogens	<b>79% (Kendler, et al., 2000)</b>	
Nicotine	53% (Carmelli et al., 1990)	72% (Kendler et al., 1999)

After a person uses drugs for a while, why can't they just stop?

Prolonged drug use changes the brain in fundamental and long-lasting way

#### **Effect of Cocaine Abuse on Dopamine D2 Receptors**



cocaine abuser (4 months post)

#### **Dopamine Transporter Loss After Heavy Methamphetamine Use**



#### **Comparison Subject** METH Abuser

Source: Volkow, N.D. et al., Am J. Psychiatry, 158(3), pp. 377-382, 2001.



The Brains of Addicts Are Different From the Brains of Non-Addicts

...And Those Differences Are An Essential Element of Addiction





## We don't know the exact switch

But we know the circuits involved in addiction are similar to other motivations

### **Effects of Drugs on Dopamine Levels**



Source: Di Chiara and Imperato

### **Natural Rewards Elevate Dopamine Levels**





## **Does the Brain Recover?**

DAT Recovery with prolonged abstinence from methamphetamine



# Addiction is, Fundamentally, a Brain Disease

# Addiction is Not

### Just a Brain Disease

Addiction Is A Brain Disease Expressed As Compulsive Behavior

Both Developing and Recovering From It Depend on Behavior and Social Context

#### **Drug Addiction: A Complex Behavioral and Neurobiological Disorder**



As with all complex scientific issues, people only hear the sound bite

Addiction is a Brain Disease

# Back then, more than half of people <u>hated</u> the claim

- Too simplistic
- Let addicts "off the hook"
- Some thought it stigmatizing
  - Or destigmatizing

### Why does society care about that?

- We can't just will addiction away
- Addiction requires comprehensive treatment and rehabilitation approaches
- Policy questions:
  - How to deal with addicted individuals
    - Particularly if they commit crimes

The complexity of addictive disorders requires strategies for dealing with them that equal their complexity Treatment strategies are also very complex

Must attend to biological, behavioral and social aspects

### **Treatment Process and Outcomes Model**



Modified from: Simpson, 2001 (Addiction)

# Drug abuse and addiction are more than just health issues

- Drugs are illegal
- Some addicts commit crimes other than drug use
- Addiction often leads to family disruption
- Addicts can be a drain on societal resources

We need societal strategies that are as complex as the phenomenon(a)



# We need to stop polarizing drug abuse related issues

- Controlling supply versus reducing demand
- Failure of will versus chronic relapsing illness
- Punishment versus treatment

# We need blended criminal justice/public health strategies

We make a big mistake not treating people while they are under criminal justice control

Could argue it's unethical
 Denying needed medical care
 At a minimum, it's dumb!

#### Percent Offenders Arrest-Free 3 Years After Release CREST Work-Release Therapeutic Community and Aftercare



Martin, Butzin, Saum, & Inciardi, 1999, The Prison Journal



Lee, J.D., et al., <u>NEJM</u>, 2016

### One does not need to want treatment!

#### **Legal Pressure and 90-Day Retention Rates**



Source: Hiller, et al., Legal Pressure and Treatment Retention in DATOS (ASC Meeting, San Diego, Nov 1997)

### How far have we come since 1997?

## In spite of the evidence

- Only 20% of individuals with opioid use disorder receive treatment in any year
- Only 5% of people in prison who have OUD receive treatment
- Only 36% of formal treatment programs offer medication
  - (As of 2016; up from 20% in 2007)

National Academies of Science, Engineering and Medicine

Committee on Medication-Assisted Treatment for Opioid Use Disorder

# Making the case for using medications based on

- Evidence base about their effectiveness
- Rationale based on understanding addiction as a brain disease

Also looking at barriers to use of medications – and to concept of addiction as a brain disease

- Misunderstanding about addiction and about medications
- Ideology
- Stigma
- Search for simple solutions
- Everyone's an expert

Science must replace ideology, stigma and misunderstanding as the basis for how we approach this issue

- Clinically
- From a policy perspective