Addiction Science (GMS MS710)
Course Syllabus
Fall 2017
Thursdays 10AM-12PM
E201

Description: This introductory course will cover the broad field of addiction with a focus on drug dependence. In one segment of the course, students will learn about the spectrum of drug dependence disorders and modalities for diagnosis and treatment. Another segment will present a wide variety of approaches for studying addiction using the tools of epidemiology, genetics, pharmacology, neurobehavior, and animal models. Emphasis will be placed on transdisciplinary approaches which are essential for understanding and combating addiction disorders. In addition, students will be exposed to the impact of addiction on the family and society, and to public policy issues addressing the prevention of addiction.

Lecture Series Overview

1. Sep 7 Introduction / History of Addiction Research - Lindsay Farrer
2. Sep 14 Current Approaches in Diagnosis & Treatment of Substance Use Disorders - Alexander Walley
3. Sep 21 Epidemiology of Addiction - Tim Heeren
4. Sep 28 Genetic Basis of Addiction - Lindsay Farrer
5. Oct 5 Animal Models of Addiction - Kathleen Kantak
6. Oct 12 Alcoholism and Alcohol Use Disorders - Marisa Silveri
8. Nov 2 Development of Pharmacological Treatments for Substance Use Disorders - Gary Kaplan
9. Nov 9 Clinical Trials for Addiction Disorders - Richard Saitz
10. Nov 16 Neonatal Abstinence Syndrome – Presentation, Treatment, and Emerging Research - Elisha Wachman
11. Nov 30 A Trauma-Informed Approach to Substance Abuse Treatment with Latinos - Luz Lopez
12. Dec 7 Prevention of Addiction - Michael Siegel
13. Dec 14 – student presentations
Lecture Outlines

Lecture 1 (September 7): Introduction / History of Addiction Research

Lindsay A. Farrer, Ph.D.
BU Distinguished Professor of Genetics
Chief, Biomedical Genetics
Professor of Medicine, Neurology, Ophthalmology, Epidemiology, and Biostatistics

Summary: This lecture will introduce the students to addiction as it pertains to diagnosis, treatment, research, and public policy. Insight into contemporary approaches in these domains will be provided by historical analysis.

Objectives: To give to the student some understanding of the history and attitudes and beliefs of drug abuse through the years by both the lay public and investigators.

Outline:
1. Introduction
   a) Overview of course and learning objectives
   b) Class organization
   c) Evaluation and grading
2. Definition of Substance Use Disorders
3. History of substance use and societal views
4. Brain reward system
5. Animal models in the study of drug addiction

Required Readings:
- Wikler, A. A Psychodynamic Study of a Patient During Experimental Self-Regulated Re-addiction to Morphine Psychiatric Quarterly, 26:270-293, 1952
Lecture 2 (September 14): Current Approaches in Diagnosis & Treatment of Substance Use Disorders

Alexander Y. Walley, MD, MSc
Assistant Professor of Medicine
Clinical Addiction Research and Education Unit, General Internal Medicine
Boston University School of Medicine

Summary: This lecture will review the diagnostic criteria and current treatment approaches for substance use disorders. Treatment approaches include existing evidence-based behavioral therapy and FDA-approved medications. The lecture will also include an introduction to treatment delivery systems.

Objectives:
1. Learners will be able to list the current diagnostic criteria for substance use disorders
2. Learners will understand the existing clinical treatment approaches for substance use disorders, including alcohol, opioids, stimulants, and benzodiazepines

Outline:
1. Diagnostic criteria for substance use disorders – DSM IV and V
2. Alcohol Disorders
   a) Behavioral treatment
   b) Pharmacological treatment
3. Opioid Disorders
   a) Maintenance treatment with methadone
   b) Maintenance treatment with buprenorphine
   c) Naltrexone treatment
4. Stimulant Disorders
   a) Cocaine
   b) Methamphetamine
   c) Contingency management
5. Benzodiazepine Disorders
   a) Medically managed withdrawal treatment (detoxification)
6. Polysubstance Disorders

Required Readings:

Suggested Readings:

- McLellan, AT et.al , JAMA 1993
- Johnson RE et al. NEJM 343:1290-7, 2000
Lecture 3 (September 21): Epidemiology of Addiction

Tim Heeren, Ph.D.
Professor of Biostatistics
Boston University School of Public Health

**Summary:** This lecture will first give a brief overview of some of the goals, strengths, and weaknesses of addictions-related epidemiologic research. Then, focusing on a few students, we will discuss early predictors of substance use problems in early adulthood. Finally, we will take a look at some statistical methods currently being used in epidemiologic studies of substance use and substance use disorders.

**Objectives:**
1. To provide an introduction to epidemiological research into substance use and substance use disorders.
2. To provide an overview into early life predictors of substance use disorders in early adulthood
3. To provide an overview of some current methods in epidemiological research into substance use disorders.

**Outline:**
1. Overview: the use of epidemiology in alcohol and substance use research
2. Case studies: epidemiological studies of substance use disorders in emerging and early adulthood
   a) Prenatal alcohol exposure
   b) Early life predictors of adult drinking
   c) Age of onset and substance use disorders
3. Case studies: current methods in epidemiological substance use research
   a) Drinking trajectories
   b) Latent class analysis of alcohol use disorder criteria
   c) Structural equation modeling of the relationship between impulsivity and alcohol misuse

**Required Readings:**
Suggested Readings:


Lecture 4 (September 28): Genetic Basis of Addiction

Lindsay A. Farrer, Ph.D.
BU Distinguished Professor of Genetics
Chief, Biomedical Genetics
Professor of Medicine, Neurology, Ophthalmology, Epidemiology, and Biostatistics

Summary: This lecture will explore the genetic basis for addiction in humans. The session will begin with a discussion of the evidence from family and twin studies for the genetic component to dependence on various substances including nicotine, alcohol, cocaine, opioids and cannabis. There will be some didactic on methodologies for genetic linkage and association studies including genome-wide association studies. This will be followed by a demonstration of how these approaches have been applied in substance dependence with a focus on phenotype definition and discussion of qualitative versus quantitative trait outcomes. Finally, the lecture will introduce contemporary genetics research approaches in addictions including next generation sequencing and bioinformatics.

Objectives: At the end of the session, students will be able to:
1. Describe methodologies for determining the strength of the genetic component for addictions;
2. Differentiate the strengths and limitations for genetic linkage, candidate gene association,
GWAS and next generation sequencing approaches to identify genes for addiction:
3. Articulate principles for family-based and case-control designs for genetic discovery in the addictions;
4. Read and understand scientific papers focused on these topics.

Outline:
1. Review of basic principles of genetics
   a) Mendelian Inheritance
   b) Complex Inheritance
   c) Quantitative traits
   d) Linkage and association
2. Twin studies of addiction
3. Candidate gene studies of addiction
4. Genome-wide association studies of addiction

Required Readings:

Suggested Readings:
- Sherva R, Wang Q, Kranzler HR, Zhao H, Koesterer R, Herman A, Farrer LA, Gelernter J. Genome wide association study of cannabis dependence severity reveals novel risk variants,
genes previously implicated in schizophrenia risk, and shared risk with major depressive disorder. JAMA Psychiatry 2016; 73:472-480.

**Lecture 5 (October 5): Animal Models of Addiction**

**Kathleen Kantak, Ph.D.**

*Director Laboratory of Behavioral Neuroscience
Department of Psychological and Brain Sciences*

**Summary:** This lecture will explore the methods commonly used to study drug addiction in preclinical animal models ranging from fruit flies to non-human primates. Particular attention is paid to how different phases of the addiction cycle are modeled in animals.

**Objectives:**
1. To acquire basic knowledge of a variety of behavioral approaches to study drug addiction in animals. This will prepare students for the upcoming lectures on the neurochemistry, neurobiology and pharmacology of addiction.
2. To gain perspective on the advantages and limitations of each species used in the preclinical assessment of drug addiction.
3. To instill and appreciation for the translational relevance of the addiction cycle, as studied in animals, to the human condition.

**Outline:**
1. Common behavioral approaches
   a) Self-Administration
   b) Conditioned Place Preference
   c) Intracranial Self-Stimulation
   d) Conditioned Reinforcement, Tolerance and Withdrawal
2. Model organisms for addiction research
   a) Drosophila
   b) Zebrafish
   c) Mice
   d) Rats
   e) Monkeys
3. Modeling the addiction cycle in animals
   a) Acquisition
   b) Maintenance
c) Escalation
d) Extinction
e) Relapse/Craving

**Required Readings:**


**Suggested Readings:**


**Lecture 6 (October 12): Alcoholism and Alcohol Use Disorders**

Marisa M. Silveri, Ph.D.

*Director, Neurodevelopmental Laboratory on Addictions & Mental Health,*
Summary: This lecture will discuss alcohol use disorders (AUDs) and associated disparate and widespread residual consequences for brain functioning and behavior. Cognitive deficiencies and emotional abnormalities observed in individuals with a history of heavy and binge patterns of alcohol use, and those with alcohol use disorders. Brain systems most vulnerable to AUDs, compensatory changes associated with structural and behavioral deficits, and neurobiological recovery associated with alcohol abstinence will be discussed.

Objectives: At the end of the session, students will be able to:

1. Understand the prevalence of and risk factors for AUDs, as well as antecedents and consequences of alcohol use
2. Gain familiarity with a variety of neuroimaging modalities and neuropsychological assessments to study assess multiple aspects of addiction.
3. Describe the neurocircuitries implicated in alcohol use and abuse behaviors
4. Understand the complexity of brain damage and effects on mental functions related to AUDs, as well as neurobiological and neuropsychological recovery associated with alcohol abstinence

Outline:
1. Neuroimaging and Neuropsychology Tools for the Study of Alcohol Addiction
2. Overview of Brain Structural and Functional Impairments:
   a) Memory systems
   b) Executive functions
   c) Emotion and psychosocial skills
   d) Visuospatial cognition
   e) Psychomotor abilities
3. Individual Factors Influencing AUD-Related Brain Damage:
   a) Age and age of onset of first use
   b) Sex
   c) Family history of addiction
   d) Mental Health

Required Readings:


**Suggested Reading:**


**Midterm Exam – October 19**

**Lecture 7 (October 26): Neurochemistry and Neurobiology of Addiction**
Summary: This lecture will provide information about the molecular mechanisms of action of the most common drugs of abuse. Neurocircuitries involved in the different stages of drug addiction will be described, with a focus on the neurochemical and molecular changes taking place in the transition to dependence.

Objectives: At the end of the session, students will be able to:
1. Describe the mechanism of action of psychostimulants, opiates, alcohol, and cannabinoids
2. Describe the neuroanatomy and neurochemistry of drug addiction
3. Explain the neurochemical and molecular adaptations characterizing the transition to dependence.

Outline:
1. Addiction Definitions: Drug Use, Abuse, Dependence, Addiction
2. Classification of drugs of abuse
3. Mesolimbic system and reward neurotransmission
4. Mechanism of action of most common drugs of abuse (psychomotor stimulants, opiates, alcohol, cannabinoids)
5. Transition to addiction and stages of the addiction cycle
6. Molecular neuroadaptations in addiction
7. Animal models

Required Readings

Suggested Reading:

Lecture 8 (November 2): Development of Pharmacological Treatments in Addiction
Gary B. Kaplan, MD,
Professor of Psychiatry and Pharmacology & Experimental Therapeutics, Boston University School of Medicine; Director of Mental Health, VA Boston Healthcare System

Summary: This lecture will explore the pharmacological basis for addiction treatment. The lecture begins with a review of the role of drug agonists, antagonists, and inverse agonists and their role in addiction pharmacotherapy. This will be followed by a discussion of the application of pharmacological treatment at the different phases of substance use disorders. It focuses on the different receptor and neurotransmitter targets for addiction pharmacotherapy. Finally, it describes how synaptic and structural plasticity in addiction are relevant to future medication development in addiction.

Objectives: At the end of the session, students will be able to:
1. Understand how basic pharmacological approaches for drug agonists, antagonists, inverse agonists relate to addiction treatment
2. Understand how pharmacological agents can be applied at different phases of addiction treatments such as withdrawal, maintenance and relapse prevention
3. Describe the different targets for addiction pharmacotherapy at GABA, glutamate, and opioid receptors and at different ion channels
4. Explain how changes in synaptic plasticity in key neuroanatomical pathways represent targets for future addiction pharmacotherapy

Outline:
1. Understanding Basic Pharmacology and it Translation to Addiction Pharmacotherapy
2. Use of Drug Agonists, Partial Agonists and Antagonists in Addiction
3. Overdose reversal
4. Detoxification
5. Drug Substitution
6. Drug Antagonists
7. Aversive pharmacology (disulfiram)
8. Anti-craving agents
9. New Treatments Based on Glutamergic Transmission
10. New Treatments Based on GABAergic Transmission
11. Novel Treatments Based on Ion Channel Transmission
12. Synaptic Plasticity in Addiction and Novel Targets

Required Readings

Supplemental Readings

Lecture 9 (November 9): Clinical Trials for Addiction Disorders

Richard Saitz MD, MPH
Chair, Department of Community Health Sciences (CHS)
Professor of Community Health Sciences & Medicine
Boston University School of Public Health Director, CARE Unit, Section of Internal Medicine, Boston Medical Center
Professor of Medicine and Epidemiology

Summary: This lecture will describe and critically appraise clinical trials of treatments for people with addictions. Key examples and design issues will be reviewed.

Objectives:
1. Learners will become familiar with several examples of addiction clinical trials
2. Learners will gain skills in critical appraisal of addiction clinical trials
3. Learners will be able to list the key design issues relevant to addiction clinical trials

Outline:
1. Review of examples of addiction clinical trials
2. Principles of critical appraisal
   f) Validity
   g) Results
   h) Generalizability
3. Critical appraisal of an addiction clinical trial
4. Special challenges in studying addiction treatments
   a) Surrogate outcomes
   b) Anonymity/confidentiality
   c) Motivation to change
5. Key design issues
   a) Experimental design
   b) Participant selection
   c) Intervention fidelity
   d) Control groups
   e) Blinding
   f) Follow-up
   g) Outcomes
   h) Effectiveness versus efficacy
6. Exercise: design a trial
Required Readings:


Supplemental Readings:

Lecture 10 (November 16): Neonatal Abstinence Syndrome – Presentation, Treatment, and Emerging Research

Elisha Wachman, MD  
Assistant Professor of Pediatrics  
Division of Neonatology, Boston Medical Center  
Boston University School of Medicine

Summary: This lecture will review the diagnosis, assessment, and current treatment approaches for neonatal abstinence syndrome (NAS) secondary to in-utero opioid exposure. This will include a review of both non-pharmacologic and pharmacologic treatment strategies, and new research regarding the genetic and epigenetic contributors to NAS outcomes.

Objectives:
1. Learners will be able to identify signs and symptoms of NAS, and ways to assess NAS.
2. Learners will understand the existing treatment approaches, both non-pharmacologic and pharmacologic, to NAS.
3. Learners will be able to identify new research areas related to the genetics and epigenetics of NAS.

Outline:
1. Definition and epidemiology of NAS  
2. NAS symptoms and assessment tools  
3. Clinical variables affecting NAS presentation and outcomes  
4. Non-Pharmacologic Management of NAS  
5. Pharmacologic Treatment of NAS  
6. Emerging research – genetic and epigenetic contributors to NAS outcomes  
7. Long-term outcomes

Required Readings:

NO CLASS (November 23) – Thanksgiving vacation
Lecture 11 (November 30): A Trauma-Informed Approach to Substance Abuse Treatment with Latinos

Luz M López, PhD, MPH, LCSW
Clinical Professor, Clinical Practice
Associate Director, Dual Degree Program in Social Work & Public Health
Boston University School of Social Work

Summary: This lecture will examine the relationship between trauma/violence, substance abuse, HIV and related mental health symptoms. These issues will be analyzed within a socio-cultural context working with Latinos and other ethnically diverse groups. Utilizing a human rights and resilience approach, we will also explore a community participatory approach to conduct outreach and research among homeless Latinos with addiction.

Objectives:

1) Identify the connection between addiction, trauma/violence & mental health
2) Analyze socio-cultural perspectives, taboos and stigma in the treatment of trauma and addiction among Latinos.
3) Describe three effective evidenced based trauma intervention models for substance abuse treatment.
4) Illustrate ways to increase access to trauma informed services for Latinos and other ethnically diverse groups.

Outline:

I. Addiction heroin crisis among Latinos
II. Substance Abuse Myths and Controversies
III. Addiction: cultural taboos and stigma
IV. Strategies for Outreach and Research with homeless Latinos with addiction using a community participatory approach
V. Discuss the application of three evidenced based trauma informed interventions
   a. Seeking Safety, Lisa Najavitz
   b. Trauma Recovery Empowerment Model (TREM) by Maxine Harris & M-TREM,
      Trauma Recovery Empowerment Model for Men by Roger Fallot & Maxine Harris
   c. ATRIUM, by Dusty Miller & Laurie Guidry
VI. Small groups case discussion

Suggested Readings:


**Lecture 12 (December 7): Research, Advocacy, and Policy in Addiction Prevention: From Tobacco to Alcohol**

**Michael Siegel, MD, MPH**

*Professor, Department of Social and Behavioral Sciences*  
*Boston University School of Public Health*

**Summary:** This session will investigate the role of research in understanding policies that can be most effective in preventing youth addiction to tobacco and alcohol. Drawing on the field of research on tobacco advertising, the session will start with a case study of national cigarette advertising policy. It will describe limitations in the research on the effect of cigarette advertising on youth smoking and how a new area of research was developed to overcome these limitations. It will explain how the results of this new line of research helped lead to the adoption of national policies to reduce youth exposure to cigarette advertising. It will then consider how these methods can be translated to the alcohol field. Finally, it will address the role of research in policy development in the field of addiction prevention.

**Objectives:** At the end of the session, students will be able to:
1. Describe the limitations in the current research on the relationship between alcohol advertising and underage youth drinking behavior;
2. Articulate a research strategy to overcome the limitations of current research on alcohol
advertising effects on youth, drawing on the example of the tobacco advertising literature

3. Explain the role of research in the development and implementation of evidence-based policies to prevent youth smoking and underage drinking.

Outline:
1. State of the evidence linking cigarette advertising and youth smoking behavior in 1993
2. Reasons for the conflicting evidence
   a) Specificity of the dependent variable
   b) Specificity of the independent variable
3. Strategy to overcome limitations of existing studies
   a) Re-characterization of dependent variable
   b) Re-characterization of independent variable
4. Current state of the evidence linking alcohol advertising and youth drinking behavior
5. Reasons for the conflicting evidence
6. Strategies for translating research paradigms from tobacco to alcohol
7. Preliminary results of these alcohol studies

Required Readings:


Lecture 13 (December 14): Student Presentations

Final Exam – December 21