MEDICAL SCHOOL AND RESIDENCY PROGRAM
CURRICULUM RESOURCES ON DRUG ABUSE AND ADDICTION

Methamphetamine Lecture and Interclerkship

Creighton University School of Medicine

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Creighton UNIVERSITY Medical Center

NIDA Centers of Excellence for Physician Information

http://www.drugabuse.gov/coe

Methamphetamine Lecture Slides

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Introduction

This curriculum module contains a PowerPoint presentation that offers an introduction to methamphetamine abuse and dependence in the United States. It includes data and background material from the National Institute on Drug Abuse (NIDA). The slides can be used by faculty in any health science program; expertise in addiction medicine is not required. This product consists of PowerPoint slides that can be arranged or excluded for different audiences, including preclinical medical students, junior resident physicians, and senior resident physicians. The slides may also be used when teaching other health professions students. The accompanying facilitator guide provides speaker's notes, which are also made available in the notes section of the PowerPoint. The guide also provides information on how to use the presentation for different levels of student learners. The goals of the lectures are to educate medical students and resident physicians about prevalence, diagnosis, and treatments of methamphetamine abuse and dependence.

One hour is required to present the entire slide set. However, faculty members who use the slides are strongly encouraged to allow additional time to address learner questions and, if warranted, provide examples from their own clinical practices.

In addition, an interclerkship component is included as an attachment to this curriculum resource. This feature allows facilitators to use some of the lecture material in an interclerkship for students in their third year of medical school, when most have started their clinical education and are more likely to encounter patients with methamphetamine-related issues.

A pilot implementation of this product was conducted with 18 family medicine resident physicians. For more information, see Pilot Information.

Also available from NIDA's Centers of Excellence for Physician Information is the curriculum resource, "Two Problem-Based Learning Cases: Methamphetamine," which can be found here: http://www.drugabuse.gov/coe/. This curriculum resource introduces students to clinical presentations of substance abuse problems. The two problem-based learning (PBL) cases can be used in teaching situations where it may not be feasible to use clinical material or standardized patients, augmenting lecture material about the topic of drug abuse and dependence with clinically relevant cases that depict real-life scenarios for students to work through—either in a small-group format or an interclerkship seminar. Both PBL cases can be offered to third-year medical students or advanced second-year medical students.

For additional information on drug abuse and addictive disorders, please go to the National Institute on Drug Abuse's NIDAMED Web site: http://www.drugabuse.gov/nidamed/.

Key words: Drug abuse, drug addiction, substance abuse, methamphetamine abuse, methamphetamine treatment

Curriculum Module Components

This curriculum resource module includes:

- PowerPoint Slides
- Facilitator Guide
- Lecture Evaluation Form
- Learner Assessment Form
- References
- Suggested Readings
- Pilot Information
- Interclerkship

Educational Objectives

Pre-clinical Learner Objectives (slides 1–44, 63–71)

- Understand the significance of methamphetamine abuse/dependence and cite U.S. prevalence data
- Diagnose abuse and dependence and learn the differences between the two diagnostic categories
- Describe the mechanism of action for methamphetamine's stimulant effects.
- Review symptoms of intoxication and withdrawal
- Understand methods of abuse and the short- and long-term effects of methamphetamine use

Clinical Learner Objectives (slides 1–61, 72–83)

- Understand the significance of methamphetamine abuse/dependence and cite U.S. prevalence data
- Diagnose abuse and dependence and learn the differences between the two diagnostic categories
- Describe the mechanism of action for methamphetamine's stimulant effects.
- Review symptoms of intoxication and withdrawal
- Understand methods of abuse and the short- and long-term effects of methamphetamine use
- Learn principles for treatment of methamphetamine abuse and dependence
- Understand treatment options (pharmacological and non-pharmacological)
- Review treatment outcomes data
- Discuss clinical vignettes

Note: For advanced learners (i.e., resident physicians and practicing physicians), additional clinically-relevant information, such as the pharmacokinetics, pharmacodynamics, and drug-drug interactions for methamphetamine toxicity can be found in resources such as:

Chan, P., Chen, J. H., Lee, M. H., & Deng, J. F. (1994). Fatal and nonfatal methamphetamine intoxication in the intensive care unit. Journal of Toxicology Clinical Toxicology 32(2):147–55.

Richards, J. R., Derlet, R. W., & Duncan, D. R. (1997). Methamphetamine toxicity: Treatment with a Benzodiazepine versus a Butyrophenone. European Journal of Emergency Medicine, 4(3):130–135.

Martel, M., Sterzinger, A., Miner, J., Clinton, J., & Biros, M. (2005). Management of acute undifferentiated agitation in the emergency department: A randomized double-blind trial of Droperidol, Ziprasidone, and Midazolam. *Academic Emergency Medicine, 12*:1167.

Winslow, B. T., Voorhees, K. I., & Pehl, K. A. (2007). Methamphetamine Abuse. *American Family Physician, 76*, 1169–1174.

Methamphetamine: An Overview

The primary care physician plays an important role in the identification of substance use in adolescents and adults (Griswold, Aronoff, Kernan, & Kahn, 2008). Early identification and treatment of use and abuse is important before use escalates. About 20 percent of patients seeing a family physician have substance abuse problems (Mersy, 2003). Primary care physicians will be confronted with many patients suffering from substance use disorders. Physicians in training should recognize that they will encounter patients who suffer from substance use and abuse and must recognize the red flags in a patient's history, as well as specific physical findings related to substance use (Mersy, 2003). Although primary care physicians can treat substance abuse problems in their clinical settings, it is often prudent to refer patients to consultants who specialize in substance use disorders. Primary care physicians should know the appropriate resources in their regions so they can offer the appropriate referrals.

Methamphetamine is a sympathomimetic amine in the class of compounds, the phenethylamines, which have a variety of stimulant, anorexiant, euphoric, and hallucinogenic effects (National Institute on Drug Abuse, 2009). Methamphetamine was first synthesized in 1893 and was widely used by German, Japanese, and American forces during World War II to increase alertness and decrease fatigue. As a Class II schedule drug, methamphetamine can be prescribed; however, it has limited medical uses (National Institute on Drug Abuse, 2006).

Recreational use of methamphetamine and other amphetamine-derived stimulants has reached epidemic proportions in the United States. Use of amphetamine-type stimulants worldwide exceeds that of opioids and cocaine combined (United Nations, 2010). Approximately 5 percent of the U.S. population is estimated to have ever used methamphetamine, with an estimated 850,000 total users in 2008, including 95,000 new users (Substance Abuse and Mental Health Services Administration, 2009). Methamphetamine is readily absorbed following administration via oral, pulmonary, nasal, intramuscular, intravenous, rectal, and vaginal routes. Methamphetamine is lipophilic, readily crosses the blood-brain barrier, and has a large volume of distribution (3 to 4 L/kg). Peak plasma concentrations are achieved approximately 30 minutes following intravenous or intramuscular administration and up to 2 to 3 hours after ingestion. Although methamphetamine has a plasma half-life of about 11 to 12 hours, the duration of its effect commonly persists beyond 24 hours.

Methamphetamine lacks direct adrenergic effects but is instead an indirect neurotransmitter. Methamphetamine is incorporated into cytoplasmic vesicles where it displaces epinephrine, norepinephrine, dopamine, and serotonin into the cytoplasm. As cytoplasmic concentrations rise, neurotransmitters diffuse out of the neuron and into the synapse, where they activate postsynaptic receptors. Methamphetamine also inactivates neurotransmitter reuptake transporter systems. Elimination of methamphetamine occurs via several hepatic and renal pathways, including cytochrome CYP2D6. Enzymatic degradation of methamphetamine results in active metabolites that may accumulate with repeated, frequent, or binge use. Renal elimination that is dependent upon urinary pH is related to methamphetamine's alkaline pKa of 9 to 10.

Overview References and Reading List

Cantrell, F. L., Breckenridge, H. M., & Jost, P. (2006). Transrectal methamphetamine use: A novel route of exposure. *Annals of Internal Medicine, 145,* 78.

Chiang, W. K. (2006). Amphetamines. In L. R. Goldfrank (Ed.), *Goldfrank's Toxicologic Emergencies* (8th ed.). New York: McGraw-Hill, 1118.

Griswold, K. S., Aronoff, H., Kernan, J. B., & Kahn, L. S. (2008). Adolescent substance use and abuse: Recognition and management. *American Family Physician, 77*, 331–336.

Hendrickson, R. G., Cloutier, R., & McConnell, K. J. (2008). Methamphetamine-related emergency department utilization and cost. *Academic Emergency Medicine, 15*, 23–31.

Hendrickson, R. G., Horowitz, B. Z., Norton, R. L., & Notenboom, H. (2006). "Parachuting" meth: A novel delivery method for methamphetamine and delayed-onset toxicity from "body stuffing." *Clinical Toxicology, 44,* 379–382.

Kashani, J. & Ruha, A. M. (2004). Methamphetamine toxicity secondary to intravaginal body stuffing. *Journal of Toxicol Clinical Toxicology, 42*, 987–989.

Meredith, C. W., Jaffe, C., Ang-Lee, K., & Saxon, A. J. (2005). Implications of chronic methamphetamine use: A literature review. *Harvard Review of Psychiatry*, 13, 141–154.

Mersy, D. J. (2003). Recognition of alcohol and substance abuse. *American Family Physician, 67,* 1529–1532.

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Office of National Drug Control Policy (2003). *Drug policy information clearinghouse fact sheet: Methamphetamine.* Rockville, MD. Retrieved June 30, 2009, from http://www.whitehousedrugpolicy.gov/pdf/drug_datasum.pdf.

Substance Abuse and Mental Health Services Administration. (2009). *Results from the 2008 National Survey on Drug Use and Health: National findings* (Office of Applied Studies, NSDUH Series H-36, HHS Publication No. SMA 09-4434). Rockville, MD.

United Nations Office on Drugs and Crime. (2006). *2006 world drug report, volume 1: Analysis.* Retrieved June 30, 2009, from www.unodc.org/pdf/WDR_2006/wdr2006_volume1.pdf.

United Nations Office on Drugs and Crime. (2010). *2010 world drug report.* Retrieved October 27, 2010, from www.unodc.org/unodc/en/data-and-analysis/WDR-2010.html.

Facilitator Guide

These are the speaker's notes for the PowerPoint presentation about methamphetamine abuse, diagnosis, and treatment. This presentation is intended to provide a tool to educate learners across the medical education continuum about the diagnosis and treatment of individuals who are abusing methamphetamine. These slides can be divided for presentations to learners at two levels:

- Preclinical Learners (M1–M2)
- Clinical Learners (M3–M4) and Residents (PGY 1–4)

Preparation

Review slides and the accompanying speaker notes.

For presentations to preclinical learners, use slides 1–44 and 63–71. For clinical learners, use slides 1–61 and 72–83. Please note that slides 84–89 are the interclerkship assessment questions.

Visit the NIDA Web site at http://www.drugabuse.gov/DrugPages/Methamphetamine.html.

Engaging the Learner

As much as possible, try to engage the learners by questioning their understanding of methamphetamine use and the problems associated with it. Depending on the size of the group of learners, specific questions can be asked that will facilitate discussion:

- What do the learners know about the incidence and prevalence of methamphetamine use in the United States?
- What do the learners know about the short- and long-term effects of methamphetamine use?
- What do the learners know about the treatment of methamphetamine abuse and dependence?

Assessment

The PowerPoint contains three sets of review questions at the end for each of the different learner levels (preclinical, clinical, and interclerkship) that learner answers on a separate sheet of paper. It can be scored later to objectively assess their performance.

Notes for Each Slide

Please note that references and recommended reading are included in the slide notes along with the goals and talking points that appear below. In addition, all the references and talking points are included in a separate reference list and recommended reading list in both the Facilitator's Guide and the PowerPoint slide deck. In some cases, the references and recommended reading list are included only in the Facilitator Guide because of space considerations. In such cases, a note is included in the PowerPoint.

Slide 1
Goal:

- Reinforce the significance of the problem.
- Identify that the problem is fixable.
- Reiterate that the physician/learner can influence the problem/solution.

Talking points:

- Methamphetamine is a very addictive stimulant drug.
- It is a Schedule II stimulant and has high potential for abuse.
- It can be made in small, illegal laboratories, although most methamphetamine comes from superlabs.
- Street methamphetamine is referred to by many names, such as "speed," "meth," and "chalk."

Slide 2
Goal:

- To review the objectives of the PowerPoint and the lecture.

Talking points:

- Cover important information that will explain the significance of the problem.
- Provide tools to the physicians/learners to address the problem.
- Provide resources where learners can obtain further information.

Slide 3
Goal:

- Provide the history of methamphetamine's discovery, use, and abuse, and of its several worldwide epidemics.

Talking points:

- Geographical spread of methamphetamine use.
- Risk of methamphetamine labs in rural areas (leading to a risk of more potential abusers in these areas).
- Provide examples of medical consequences.

Slide 4: Transition Slide

Slide 5:
Goal:

- Provide specific numbers on the significance of the problem.

Talking points:

- There are multiple ways to identify methamphetamine problems, such as emergency room visits and multiple treatment admissions.
- Prevalence/lifetime prevalence is often used to gauge the significance of the problem.
- Lifetime use, annual use, and use in past 30 days are used by the Substance Abuse and Mental Health Administration (SAMHSA) National Survey on Drug Use and Health (NSDUH) and the Monitoring the Future survey.

Slides 6–8

Goal:

- Compare data on use of methamphetamine in the general population and high school students.

Talking points:

- Most methamphetamine in the United States is supplied through illicit manufacturing and trafficking rather than the prescription drug distribution process.
- Methamphetamine use may have been underestimated in previous NSDUH surveys due to its inclusion within a set of questions about prescription-type drugs.
- The number of past month methamphetamine users decreased by over half between 2006 and 2008. The numbers were 731,000 in 2006, 529,000 in 2007, and 314,000 in 2008.
- From 2002 to 2008, rates of past month use of methamphetamine among youths aged 12 to 17 declined significantly (from 0.3 percent to 0.1 percent). For persons aged 18 to 25, the decline was 0.6 percent to 0.2 percent during the same period.
- The number of past year initiates of methamphetamine among persons aged 12 or older was 95,000 in 2008. This estimate was significantly lower than the estimate in 2007 (157,000) and was less than one third of the number estimated in 2004 (318,000).

Slides 9 and 10

Goal:

- Compare 8th, 10th, and 12th grade students' use of methamphetamine.

Talking points:

- The annual prevalence rates in 2009 were 1.0 percent, 1.6 percent, and 1.2 percent for 8th, 10th, and 12th graders, respectively. All of these levels are down considerably from 1999, when they were 3.2 percent, 4.6 percent, and 4.7 percent.
- Methamphetamine has fallen steadily and substantially since it was first measured in 1999. Annual prevalence for the use of methamphetamine in 2009 for grades 8, 10, and 12 is roughly two thirds below rates observed in 1999.
- These declines occurred during a period in which there were many stories in the media suggesting that methamphetamine use was a *growing* problem—an example of the importance of having objective epidemiological data available against which to test conventional wisdom.

Slides 11 and 12

Goal:

- Demonstrate regional differences in methamphetamine use.

Talking points:

- Significant regional differences exist in the use of methamphetamines.

- Meth use started out as a big problem in the Western United States and has been moving eastward.
- Slide 11 indicates that from 2002 to 2006, there has been no change in meth use in the West and a decrease in the Midwest.
- Slide 12 shows treatment admissions for methamphetamine/amphetamine over time, depicting spread across the country.

Slide 13
Goal:
- To provide the number of treatment seekers for methamphetamine abuse.

Talking points:
- The number of people seeking treatment for this problem has grown considerably since 1996.
- An increase in people seeking treatment may be due to multiple factors, but the exact cause remains unknown.
- In 2007, 57 percent of methamphetamine/amphetamine admissions were referred through the criminal justice system, matching marijuana for the highest proportion.
- Other possible reasons (encourage attendees to identify possible reasons):
  - Increased awareness of the problem
  - Greater intensity of the problem
  - Increased treatment options
  - Decreased stigma
  - Greater law enforcement/child protective services involvement, etc.
  - Other reasons

Slide 14: Transition Slide

Slide 15
Goal:
- To review common methods of abusing methamphetamine.

Talking points:
- Methamphetamine can be smoked, injected intravenously, snorted, or ingested orally.
- Differences in methods of abuse lead to different speeds with which the drugs reaches the brain and exerts its euphoric effects.
- The drug alters mood in different ways, depending on how it is taken. Immediately after smoking or intravenous injection, the user experiences an intense “rush” or “flash” that lasts only a few minutes and is described as extremely pleasurable. Smoking or injecting produces the quickest effects, within 5 to 10 seconds. Snorting or ingesting orally produces euphoria—a high but not an intense rush. Snorting produces effects within 3 to 5 minutes, and ingesting orally produces effects within 15 to 20 minutes.
- Some cases of subcutaneous injections or “skin popping” have been described, more for cocaine and other drugs, but also for amphetamine/methamphetamine (See Johnston, C., & Keogan, M.T., 2004, for subcutaneous use of methamphetamine use that leads to renal problems). This type of use is observed more in clinical practice than documented extensively in the literature. Skin popping is intradermal injection of the abused drug (including methamphetamine) into the skin. Chronic injections lead to hyperpigmented depressed plaques in the skin with fibrotic hypopigmented centers. Chronic skin popping

can cause chronic skin inflammation in the form of skin abscesses and ulcerations. Skin popping can lead to a whole host of chronic illness, including hepatitis B and C, HIV infection, renal failure, renal amyloidosis, and acute glomerulonephritis after MRSA infection of the skin.

Reference:

National Institute on Drug Abuse. (1996). *NIDA notes*. Retrieved July 6, 2010, from http://archives.drugabuse.gov/NIDA_Notes/NNVol11N5/Tearoff.html.

Recommended reading:

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Binswanger, I. A., Kral, A. H., Bluthenthal, R. N., Rybold, D. J., & Edlin, B. R. (2000 Mar). High prevalence of abscesses and cellulitis among community-recruited injection drug users in San Francisco. *Clin Infect Dis, 30(3),* 579–81. PMID: 10722447.

Brown, P. D., & Ebright, J. R. (2002 Oct). Skin and soft tissue infections in injection drug users. *Curr Infect Dis Rep, 4,*(*5*), 415–419. PMID: 12228028.

Johnston, C., & Keogan, M. T. (2004 May). Imaging features of soft-tissue infections and other complications in drug users after direct subcutaneous injection ("skin popping"). *Am J Roentgenol, 182(5*), 1195–1202. No abstract available. PMID: 15100118.

Meador, K. H., Sharon, Z., & Lewis, E. J. (1979 Oct). Renal amyloidosis and subcutaneous drug abuse. *Ann Intern Med, 91(4),* 565–7. PMID: 484955.

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Patel, R. I., & German, E. (1986 Dec). Skin popping. *N J Med, 83(12),* 844. No abstract available. PMID: 3474564.

Rakhit, R. D., Sethi, D., Woodrow, D. F., & Phillips, M. E. (1993). Complications of "skin popping" in a British heroin addict. *Nephrol Dial Transplant*; *8(6),* 572–3. No abstract available. PMID: 8394549.

Redondo, P., Molano, E., Lloret, P., & Bauza, A. (2002 Jul). "Skin popping" ulceration in an HIV patient. Successful treatment with antiretroviral drugs and stanozolol. *Int J STD AIDS, 13(7),* 508–9. PMID: 12171674.

Reese, W. G., & Sullivan, L. M. (1997 Dec). Tc-99m labeled WBC imaging of lower extremity abscesses and skin necrosis due to skin popping. *Clin Nucl Med*, *22(12),* 865–866. No abstract available. PMID: 9408660.

Shih, L., Sharma, O. P., & Barnett, K. (1983 Feb). Pneumothorax: a complication of "skin popping." *West J Med. 138(2),* 272. No abstract available. PMID: 6837036.

Vega, J. M., & Lucas, C. E. (1979 Jun). Rapidly spreading subcutaneous inflammation after "skin popping" in drug addicts. *Am Surg, 45(6),* 392–3. PMID: 453731.

Slide 16: Transition Slide

Slide 17
Goal:

- Review mechanism of action of methamphetamine.

Talking points:

- Methamphetamine increases levels of dopamine, norepinephrine, and serotonin—all with different consequences.
- Methamphetamine effects on the dopamine pathway are primarily responsible for its reinforcing effects. The methamphetamine effects on serotonin likely influence issues such as memory, cognitive functions, and depression, while the noradrenergic effects are likely related to responses of the hypothalamus and sympathetic nervous system to methamphetamine use.

Slide 18
Goal:

- To review normal transmission of a neurochemical impulse.

Talking points:

- VMAT: Vesicular monoamine transporter is a transport protein responsible for sequestering neurotransmitters such as dopamine, norepinephrine, and serotonin in vesicles within neurons.
- The stimulation of the neuron generates an action potential, which causes the release of these neurotransmitters (in this case, dopamine) into the synaptic cleft, where it binds receptors on the postsynaptic cell.
- The dopamine is then cleared from the synapse through uptake by the dopamine transporter.

Slide 19
Goal:

- To review the effect of nondrug stimuli that naturally increase dopamine levels in the brain's reward pathways.

Talking points:

- Normal, everyday, pleasurable stimuli, such as particular types of food and sex, can increase dopamine centers of the brain leading to feelings of:
  - Pleasure
  - Reward/high
- Through this mechanism, our brains teach us to repeat behaviors necessary for our survival. This process is hijacked by drugs of abuse.
- However, the level of dopamine released is lower than the level of dopamine that will be released with drugs of abuse.

Slide 20
Goal:

- To review the effect of methamphetamine use on the transmission of a neurochemical impulse.

Talking points:

- When methamphetamine is present in the neuron and the synapse, it stimulates the release of neurochemicals from the vesicles.
- Methamphetamine also reverses transport of the released neurochemicals into the synapse.
- This increases the level of neurochemicals on the synapse that continue to stimulate the receptors and continue to excite the post-synaptic cells.

Slide 21

Goal:

- To compare the dopamine release with substances of abuse, such as:
  - Amphetamine
  - Cocaine
  - Nicotine
  - Alcohol

Talking points:

- Drugs of abuse increase dopamine neurotransmission more than natural rewards.
- All the drugs depicted in this slide have different mechanisms of action.
- All of these drugs increase activity in the reward pathway by increasing dopamine neurotransmission.
- Because drugs activate these brain regions more effectively than natural rewards, they have an inherent risk of being abused.

Slide 22: Transition Slide

Slides 23 and 24

Goal:

- To review the effects of methamphetamine on the brain.

Talking points:

- Different neurochemicals have different roles.
  - The dopamine pathways are primarily responsible for:
    1) Feeling the reward, pleasure
    2) Motor function
    3) Perseveration
  - The serotonin pathways are responsible for:
    1) Mood
    2) Memory
    3) Sleep
    4) Cognition
- Dopamine is responsible for memory as well, and according to Volkow et al., memory loss in methamphetamine users has been documented in these articles: (*Am J Psychiatry*, March 2001, Volume 158, Number 3, 377–382; 383–389).

Slides 25–27

Goal:

- To review the effect of methamphetamine use on the structure of the neurons.

Talking points:

- Stimulants like amphetamines can alter the structure of neurons. In this case, the dendrites of dopamine neurons in the nucleus accumbens (NAc)—a part of the reward pathway—have more dendritic spines or connections in the amphetamine-exposed animal compared to one treated only with saline.
- Research in humans and in animal models demonstrates that repeated exposure to drugs of abuse alters brain function and behavior. Therefore, early intervention is key—before brain changes take hold and drug abuse becomes compulsive.
- The functional impact of these changes is not completely understood; however, they could increase the excitability of the neuron and/or increase its ability to excite neurons adjacent to it.

Slide 28

Goal:

- To review the effect of repeated drug exposure to brain function.

Talking points:

- Positron emission tomography (PET) images show brain changes in dopamine receptors resulting from addiction to different substances.
- Dopamine D2 receptors are one of five receptors that bind dopamine in the brain.
- In this slide, the brains on the left are those of controls, and the brains on the right are from individuals addicted to cocaine, methamphetamine, alcohol, or heroin.
- The striatum (which contains the reward and motor circuitry) shows up as bright red and yellow in the controls, indicating numerous D2 receptors.
- Conversely, the brains of addicted individuals (in the right column) show a less intense signal, indicating lower levels of D2 receptors.
- This reduction likely stems from a chronic overstimulation of the second (postsynaptic) neuron (schematically illustrated in the far right-hand column), a drug-induced alteration that contributes to the addict's compulsion to abuse drugs.

Slide 29

Goal:

- To review another example of the functional impact of methamphetamine.

Talking points:

- Methamphetamine abuse decreases dopamine transporter (DAT) activity and can compromise mental and motor function.
- The brain image at the top left is from a normal control.
- The striatum is brightly lit in red and yellow, indicating the presence of many DATs, which contrasts with the brain of a methamphetamine abuser (bottom left).
- The graphs on the right show the impact on motor and memory tasks of this methamphetamine-driven decrease in DATs.
- The magnitude of the decline in the amount of DAT binding correlates with the extent of motor and memory impairment.

Slide 30

Goal:

- To review the functional improvement in the brain after prolonged sobriety.

Talking points:

- Recovery of the brain from addiction takes time, but it does happen.
- This slide shows images of DAT levels in three brains:
  - A healthy control (left)
  - A methamphetamine abuser 1 month after discontinuing drug abuse (middle)
  - A methamphetamine abuser after 24 months of abstinence (right)
  - The amount of time it would take an individual to regain brain function varies depending on when they started, and how much, how often, and how they used it; this study simply looked at 24 months
- The control brain shows a robust concentration of DATs in the striatum (red and yellow), while the methamphetamine abuser has a dramatic drop in DATs, even a month after drug abuse has stopped.
- Two years of abstinence, however, allows a near full return of DATs to normal levels. This means that it can take a long time to recover from methamphetamine abuse, but recovery is possible.

(Source: Volkow et al., *Journal of Neuroscience*, 2001)

Slide 31: Transition Slide

Slides 32–35

Goal:

- To discuss the diagnostic terms for identifying the level of methamphetamine problem.

Talking points:

- The difference between abuse and dependence.
- Abuse is the less severe of the two.
- Dependence does not require the presence of physiological tolerance and/or withdrawal.
- Criteria may be met anytime over a consecutive 12-month period.
- The criteria are the same for all substances.

Slide 36: Transition Slide

Slides 37–39

Goal:

- To review the clinical syndrome seen with methamphetamine intoxication and withdrawal.

Talking points:

- The effects of methamphetamine intoxication and withdrawal occur due to increased stimulation with:
  - Increased release
  - Decreased re-absorption of dopamine, serotonin, and norepinephrine
- Intoxication will involve signs and symptoms of increased arousal.
- The pleasurable effects of methamphetamine disappear even before the drug concentration in the blood falls significantly—users try to maintain the high by taking more of the drug.
- With chronic abuse, tolerance to methamphetamine's pleasurable effects can develop. In an effort to intensify the desired effects, abusers may take higher doses of the drug, take it more frequently, or change their method of drug intake.
- Withdrawal will involve signs and symptoms of decreased arousal.

- Anxiety, depression, and disruptive behavior disorders are common co-morbidities with substance abuse (Griswold et al., 2008). The physician should also be concerned about substance abuse in patients with mental disorders such as schizophrenia, antisocial personality disorder, anxiety disorders, and affective disorders (Mersey, 2003; Regier et al., 1990).

Slide 40: Transition Slide

Slides 41 and 42

Goal:

- To review the short- and long-term effects of methamphetamine use.

Talking points:

- Methamphetamine is a powerful, addictive drug.
- It initially causes increased alertness.
- It causes decreased appetite.
- It gives a distorted sense of well-being that can last 8 to 24 hours.
- This is why we sometimes see methamphetamine used by curious teens and college students for increased energy, by some truck drivers and shift workers to stay awake and remain alert, and by young and middle-aged women who might see it as a way to increase energy or lose weight.
- Behavior changes can include: psychotic behavior, paranoia, aggression, anxiety, fatigue, depression, delusions, mood swings, confusion, insomnia, and hallucinations.
- Health changes can include: stroke, brain damage, weight loss, and death.
- Methamphetamine addicts may lose their teeth quickly, due to a condition known as "meth mouth." This effect is not caused by any corrosive effects of the drug itself, which is a common myth. According to the American Dental Association, meth mouth "is probably caused by a combination of drug-induced psychological and physiological changes resulting in xerostomia (dry mouth), extended periods of poor oral hygiene, frequent consumption of high-calorie, carbonated beverages, and tooth grinding and clenching." Like other substances that stimulate the sympathetic nervous system, methamphetamine causes decreased production of acid-fighting saliva and increased thirst, resulting in increased risk for tooth decay, especially when thirst is quenched by high-sugar drinks.

References:

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Slides 43 and 44
Goal:

- To review the secondary consequences of methamphetamines, such as increased risk to fetus and child and increased possibility of HIV transmission.

Talking points:

- Preliminary evidence suggests that methamphetamine exposure during pregnancy causes subtle physical and neurobehavioral effects to the fetus. It is important to note that we don't know much about this yet, because it has been difficult to conduct these studies with the appropriate controls. These risks are currently under investigation.
- Drug abuse and HIV/AIDS are intertwined epidemics in ways that go beyond the sharing of drug injection equipment. While injection drug users are still at great risk, anyone under the influence of drugs or alcohol is also at heightened risk of contracting or transmitting HIV.
- Drug abuse can also contribute to a more serious HIV disease progression, possibly through direct effects or interactions with HIV on the immune system, and by adversely impacting adherence to HIV treatment.

Slide 45: Transition Slide

Slides 46 and 47
Goal:

- To review the basic principles of substance abuse treatment that also apply to the treatment of methamphetamine dependence.

Talking points:

- Treatment needs to be ongoing.
- Multiple treatments may be required.
- Detoxification is not treatment.
- Strong motivation can facilitate the treatment process. Sanctions or enticements in the family, employment setting, or criminal justice system can significantly increase both treatment entry and retention rates and the success of drug treatment interventions.

Slide 48
Goal:

- To review the theory that explains drug addiction behavior and review the scientific data supporting this theory.

Talking points:

- Addiction changes brain circuitry, making it hard to control desire and hard to "apply the brakes" to detrimental behaviors.
- In the non-addicted brain, control mechanisms constantly assess the value of stimuli and the appropriateness of the planned response, applying inhibitory control as needed.
- In the addicted brain, this control circuit becomes impaired through drug abuse, losing much of its inhibitory power over the circuits that drive response to stimuli deemed salient.
- This may be due to previous memory of positive reinforcement with drugs.

(Source: Adapted from Volkow, N. D., Fowler, J. S., Wang, G-J. (2004). The addicted human brain viewed in the light of imaging studies: Brain circuits and treatment strategies. *Neuropharmacology,* 47, 3–13.)

Slide 49: Transition Slide

Slide 50

Goal:

- To review the pharmacological options for methamphetamine treatment.

Talking points:

- There is no approved pharmacotherapy. Data are still very limited.
- Research to develop medications for methamphetamine is ongoing. Recent studies suggest the following medications may be promising:
    - Antidepressants such as bupropion (Elkashef et al., 2008)
    - Mood stabilizers such as valproate (very limited data, some animal studies) (Li, Han, Deng, Chen, & Liang, 2005)
    - Antipsychotic medications such as aripiprazole (Lile et al., 2005; Stoops, 2006; Stoops, Lile, Glaser, & Rush, 2006; Wee, Want, Woolverton, Pulvirenti, & Koob, 2007)
- Methamphetamine intoxication can present to the emergency department or primary care physician's office with symptoms ranging from a virtual asymptomatic presentation to a patient in crisis with seizures, metabolic acidosis, and imminent cardiovascular collapse. Most frequent presenting findings are agitation, tachycardia, and psychosis. Life-threatening intoxication often presents with hypertension, tachycardia, delirium, hyperthermia, metabolic acidosis, and seizures.
- Control of agitation and hyperthermia comprise the core of the acute management of methamphetamine toxicity. Patients appearing hypovolemic should receive fluid resuscitation. Control of violent behavior, in order to protect the patient, others, and medical staff, must be treated immediately with intravenous benzodiazepines (lorazepam 4 mg IV or diazepam 5 to 10 mg IV). These agents blunt the hyperadrenergic effects of methamphetamine toxicity. Atypical antipsychotic medications such as ziprasidone 10 mg, droperidol 10 mg, or haloperidol 10 mg can be used as adjuncts to benzodiazepines to control the severe agitation.
- Symptomatic treatment may address: methamphetamine withdrawal, hyperthermia, and convulsions (Petry, Pierrce, Stitzer, Blaine, Roll, Cohen, … Li, 2005; Rawson, Marinelli-Casey, Anglin, Dickow, Frazier, Gallagher, ... Methamphetamine Treatment Project Corporate Authors, 2004).

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Slide 51

Goal:

- To review the non-pharmacological treatment options (i.e., behavioral treatment options).

Talking points:

- Several treatment options are available.
- Need to individualize treatment to patients' abilities/preference/resources.
- Evidence-based options are available (e.g., NIDA sponsored the development of the Matrix model).
- Cognitive behavioral therapy and contingency management, as well as some of the others as part of Matrix, have a research base.
- However, not all of these (e.g., self help) on their own have been shown to be efficacious for methamphetamine addiction.

The following is a brief synopsis of each suggested treatment option:

Motivational Enhancement Therapy or motivational interviewing:

- Uses a nonconfrontational approach.
- Identifies contradictions between what an individual is saying and what is happening in his or her life.
- Involves rolling with the resistance.

Cognitive behavioral therapy:

- Identifies thoughts that trigger the use of drugs.
- Identifies thoughts and behaviors that a person can focus on when thoughts of drug use arise.
- Provides opportunities to practice these skills and offers follow up.

Contingency management:

- Uses a system of offering a tangible reward for consistently staying clean.
- Implements multiple strategies to help the individual stay sober, fight cravings, etc.

Matrix Model:

- The Matrix Model (Rawson et al., 1995) of outpatient treatment was developed during the 1980s in response to an overwhelming demand for stimulant abuse treatment services.
- The goal of the Matrix Model has been to provide a framework within which stimulant abusers can achieve the following: (a) cease drug use, (b) remain in treatment, (c) learn about issues critical to addiction and relapse, (d) receive direction and support from a trained therapist, (e) receive education for family members affected by the addiction, (f) become familiar with the self-help programs, and (g) receive monitoring by urine testing.
- The Matrix Model requires that therapists use a combination of skills that are required to function simultaneously as a teacher and a coach.
- The therapist fosters a positive, encouraging relationship with the patient and uses that relationship to reinforce positive behavior changes.
- The interaction between therapist and patient is realistic and direct, but not confrontational or parental.
- More information is available at http://archives.drugabuse.gov/btdp/Effective/Rawson.html.

Family education:

- Recognizing that drug use effects are felt within the family system.
- Involves family members in treatment to offer support and monitor drug use, craving, etc.

Group therapy:

- Involves individual with others who have drug use and/or mental health issues.
- Uses group dynamics to support the individual's strengths against using drugs.

Self-help groups:

- Based on the 12-step philosophy.
- Uses established outcome data.
- Offers flexibility of availability, cost, etc.

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Slides 52–55

Goal:

- To describe the main goals of the Motivational Enhancement Therapy (MET) approach.

Talking points:

- Components of the MET approach are:
  - Increasing patient awareness of substance abuse problems
  - Explaining to patients the consequences and risks of drug abuse
  - Getting patients to consider what might be gained through change
- It is important for medical providers to provide a nonjudgmental and nonconfrontational approach.

Slide 56: Transition Slide

Slide 57
Goal:
To review data about the outcomes of chronic medical problems, such as diabetes, hypertension, and asthma and compare these data to the outcomes data of general addiction treatment.

Talking points:

- Methamphetamine dependence is a chronic, remitting, and relapsing illness.
- No specific data about methamphetamine relapse rates are available.
- However, like other addictions, it has a long-term course and the outcome data should be comparable.
- Long-term outcome of drug addiction treatment is about 40 to 60 percent relapse.
- Compared to the outcome of chronic medical conditions with physiological and behavioral components, the outcome is not significantly different.
- When evaluating the success of a treatment, clinicians must consider that methamphetamine addiction is similar to other chronic illnesses, with both physiological and behavioral components. Treating it requires changing deeply imbedded behaviors and therefore may require multiple episodes of treatment. However, this is not an indication that the treatment has failed, rather that it must be reinstated or adjusted as would be done for any other chronic condition.

Slide 58: Transition Slide

Slides 59–61
Goal:

- To provide three cases depicting possible presentations of methamphetamine-abusing patients and their pertinent medical and psychiatric sequelae.

Talking points:

- Acute changes in behavior need to be assessed for medical etiology first and then substance use.
- In cases of potential risk to self or others, appropriate actions need to be taken.
- Acute intoxication can often present with symptoms of mania and psychosis, while withdrawal symptoms often present with depression and possibly suicidal ideation.
- Acute management of these patients may require sedation with traditional sedating medications such as benzodiazepines and antipsychotic medications.
- Medical management should include use of oral or IM/IV benzodiazepines if the patient is agitated, antipsychotic medications if the patient is exhibiting psychotic behavior, IV fluids in case of dehydration/hyperthermia (a common presentation), and a quiet and low-stimulus environment.
    - The prolonged administration of Haloperidol can lead to several adverse reactions such as tardive dyskinesia (involuntary, repetitive movements); neuroleptic malignant syndrome (a life-threatening neurological disorder caused almost exclusively by the blocking of dopamine receptors with antipsychotic medications and which presents with muscle rigidity, fever, autonomic instability, cognitive changes such as delirium, and is associated with elevated creatine phosphokinase [CPK]); hyperpyrexia; seizures (lowers the seizure threshold); severe extrapyramidal symptoms (tardive dyskinesia, involuntary, irregular muscle movements, usually in the face); akathisia (restlessness); dystonia (muscular spasms of neck–torticollos, eyes–oculogyric crisis, tongue, or jaw;

more frequent in children); drug-induced parkinsonism (muscular lead-pipe rigidity, bradykinesia/akinesia, resting tremor, and postural instability); prolongation of the QT interval (leading to an increased risk for developing ventricular arrhythmias); and torsades de pointes (a rare ventricular arrhythmia that can develop into ventricular fibrillation and death).
    - Lorazepam may cause a paradoxical reaction (restlessness, agitation) in less than 1 percent of patients (adults and children). Use with caution in patients with a history of drug abuse, alcoholism, or significant personality disorders; potential for drug dependency exists. Tolerance, in addition to psychological and physical dependence, may occur with prolonged use. Risk of dependence increases with higher dosages and longer duration of therapy.
- Urine drug screen can be effective to identify substances of use. Urine drug screening (UDS) tests are made to be sensitive to amphetamine by some manufacturers and to methamphetamine by others. UDS may be positive to interfering compounds including other amphetamines such as methylenedioxyamphetamine (MDA), methylenedioxymethamphetamine (MDMA, Ecstasy), pseudoephedrine (Sudafed), phenylpropanolamine, L-methamphetamine (Vick's inhalers), bupropion, selegiline, and benzphetamine. Current government standard cutoff concentrations for screening are 500 ng/ml. For gas chromatography (GCMS) confirmation, the cutoff is 250 ng/ml for methamphetamine.
- Methamphetamine can be detected in the urine from 22 to 66 hours for a single methamphetamine dose using the current concentration cutoff of 1000/500. Users ingesting four consecutive doses of 10 mg of methamphetamine can expect to have a final detection time of 27 to 55 hours. With 20 mg doses of methamphetamine use, the detection times are 70 hours for single use and 46 to 92 hours after four consecutive doses. Using the newer and lower concentration cutoffs of 500/250, a single 10 mg dose of methamphetamine would have a final detection time of 25 to 77 hours; and in users with four consecutive 10 mg doses, the times were 44 to 73 hours. With 20 mg doses, the single dose detection time was 94.5 hours and after four consecutive 20 mg doses it was 56 to 96 hours. In summary, using current concentration cutoffs, methamphetamine will remain positive in the urine for 2 to 4 days following use.
- Therefore, a useful clinical guide when screening for methamphetamine is:
    - Always confirm positive urine drug screens for methamphetamine by ordering GCMS.
    - Assume with current concentration cutoffs for methamphetamine screening, that methamphetamine will be positive for 2 to 4 days in the urine after use.
    - With the new lower concentration cutoffs for methamphetamine screening, we will get more screening positives, but sensitivity will improve, therefore allowing physicians to detect up to 75 percent of recent users within 4 days after use.
    - UDS tests only support the diagnosis of acute methamphetamine intoxication. The UDS has little clinical utility because treatment for suspected methamphetamine intoxication should not be delayed by waiting for screening test results.

Slide 62: Transition Slide

Slides 63–71
Preclinical Learner assessment questions with multiple-choice answers.

Slides 72–83
Clinical Learner assessment questions with multiple-choice answers.

Slides 84–89
Interclerkship assessment questions with multiple-choice answers.

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Lecture Evaluation Form

Methamphetamine Abuse and Dependence
Lecture Evaluation Form

Please complete the following evaluation by rating the items on the 5-point scale and providing additional feedback. Your comments, along with the ratings, are used to improve the curriculum for subsequent lectures, so please be specific, focus on observable behaviors and how these affect you, avoid emotionally charged language, and provide suggestions for change.

These evaluations are confidential.

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1. I was pleased with what I learned about methamphetamine abuse and dependence.
    - Strongly Agree
    - Agree
    - Neutral
    - Disagree
    - Strongly Disagree

2. This session was well designed and organized.
    - Strongly Agree
    - Agree
    - Neutral
    - Disagree
    - Strongly Disagree

3. The goals for the session were clear.
    - Strongly Agree
    - Agree
    - Neutral
    - Disagree
    - Strongly Disagree

4. The session followed a logical sequence.
    - Strongly Agree
    - Agree
    - Neutral
    - Disagree
    - Strongly Disagree

5. The time allotted for this session was about right.
    - Strongly Agree
    - Agree
    - Neutral
    - Disagree
    - Strongly Disagree

6. This session was an effective format for learning about methamphetamine abuse and dependence for my level of training.
    - Strongly Agree
    - Agree
    - Neutral
    - Disagree
    - Strongly Disagree

7. The facilitators were helpful to my learning.
    - Strongly Agree
    - Agree
    - Neutral
    - Disagree
    - Strongly Disagree

8. The discussion was helpful to my learning.
    - Strongly Agree
    - Agree
    - Neutral
    - Disagree
    - Strongly Disagree

9. I had adequate opportunity to participate.
    - Strongly Agree
    - Agree
    - Neutral
    - Disagree
    - Strongly Disagree

10. I recommend offering this session to next year's students/residents.
    - Strongly Agree
    - Agree
    - Neutral
    - Disagree
    - Strongly Disagree

11. Working in small groups was helpful to my learning.
    - Strongly Agree
    - Agree
    - Neutral
    - Disagree
    - Strongly Disagree

12. What did you like best about this session?

13. What do you suggest for improving this session?

Learner Assessment Form

Template for Methamphetamine Lecture Learning Assessment

The PowerPoint contains three sets of review questions at the end for each of the different learner levels (preclinical, clinical, and interclerkship) that learner answers on a separate sheet of paper. It can be scored later to objectively assess their performance.

(Asterisk indicates correct answer.)

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1. For a diagnosis of methamphetamine abuse, a maladaptive pattern of abuse needs to be present over a period of:
    a. One month
    b. One year*
    c. One week
    d. One decade

2. Diagnosis of methamphetamine dependence requires the presence of the following number of criteria out of the possible seven:
    a. Three*
    b. Four
    c. Five
    d. Seven

3. Methamphetamine is a potent stimulant drug that works primarily by increasing:
    a. Dopamine breakdown
    b. Dopamine release*
    c. Acetylcholine blockade
    d. Nor epinephrine synthesis

4. Methamphetamine can cause death by:
    a. Respiratory depression
    b. Hyperthermia*
    c. Metabolic acidosis
    d. Metabolic alkalosis

5. The fastest way to get high from methamphetamine use is:
    a. Skin popping
    b. Ingesting
    c. Snorting
    d. Smoking*

6. Approximately the following percentage of people can be expected to have used methamphetamine in the United States:
    a. 10%
    b. 5%*
    c. 2%
    d. 1%

7. The effects of methamphetamine can generally last for:
    a. 60 seconds or less
    b. 1 hour
    c. 2 hours
    d. 24 hours*

8. Methamphetamine dependence can be successfully treated with:
    a. Naltrexone
    b. Disulfiram
    c. Acamprosate
    d. Behavioral therapies*

10. Relapse rates for substance use disorders are:
    a. Higher than for other chronic diseases
    b. Lower than for other chronic diseases
    c. Similar to other chronic diseases*

11. Methamphetamine use most commonly presents with another co-morbid condition that is:
    a. Bipolar disorder
    b. Hypertension
    c. Suicidal disorder
    d. Another substance use disorder*

12. In the treatment of methamphetamine use disorders:
    a. A high-stimulus environment is required to ensure the patient stays awake
    b. Hydralazine treatment is often required
    c. Haloperidol treatment is contraindicated as it can lower the seizure threshold
    d. Antidepressants may be prescribed to decrease a patient's depression*

Pilot Information

General Outcome

This PowerPoint is intended to provide a tool to educate learners across the medical education continuum about the diagnosis and treatment of individuals who are abusing methamphetamine.

Intended Learning Outcomes

Learners will be able to:

- Understand the significance of the problem by reviewing latest U.S. statistics.
- Diagnose abuse and dependence and describe the differences between the two diagnostic categories.
- Understand the mechanism of action for methamphetamine's stimulant effects.
- Describe short- and long-term effects of methamphetamine use.
- Describe treatment options.

Assessment

The PowerPoint contains three sets of review questions at the end for each of the different learner levels (preclinical, clinical, and interclerkship) that learner answers on a separate sheet of paper. It can be scored later to objectively assess their performance.

Methamphetamine Learning Assessment Pilot Data: October 2008

Following are the results of pilot tests using the learner assessment form.

(Asterisk indicates correct answer.)

1. For a diagnosis of methamphetamine abuse, a maladaptive pattern of abuse needs to be present over a period of:

Answer	Pre-quiz frequency	Pre-quiz percentage	Post-quiz frequency	Post-quiz percentage
1 month	13	76.5	1	6.7
1 year*	2	11.8	14	93.3
1 week	2	11.8	—	—
1 decade	—	—	—	—

2. Diagnosis of methamphetamine dependence requires the presence of the following number of criteria out of the possible seven:

Answer	Pre-quiz frequency	Pre-quiz percentage	Post-quiz frequency	Post-quiz percentage
Three *	—	—	13	86.7
Four	10	58.8	—	—
Five	5	23.5	—	—
Six	—	—	1	6.7
Seven	3	17.6	1	6.7

3. Methamphetamine works primarily by:

Answer	Pre-quiz frequency	Pre-quiz percentage	Post-quiz frequency	Post-quiz percentage
Increasing dopamine breakdown	1	5.9	2	13.3
Increasing serotonin release*	2	11.8	12	80.0
Increasing acetylcholine blockade	4	23.5	—	—
Increasing norepinephrine synthesis	10	58.8	—	—
Did not answer	—	—	1	6.7

Please note that since this resource was piloted, the answer has been changed to dopamine release.

4. Methamphetamine can cause death by:

Answer	Pre-quiz frequency	Pre-quiz percentage	Post-quiz frequency	Post-quiz percentage
Respiratory depression	4	23.5	1	6.7
Hyperthermia*	7	41.2	14	93.3
Metabolic acidosis	2	11.8	—	—
Metabolic alkalosis	1	5.9	—	—
Did not answer	1	17.6	—	—

5. The fastest way to get high from methamphetamine use is:

Answer	Pre-quiz frequency	Pre-quiz percentage	Post-quiz frequency	Post-quiz percentage
Skin popping	2	11.8	2	13.3
Ingesting	1	5.9	—	
Snorting	11	64.7	10	66.7
Smoking*	3	17.6	2	13.3
Did not answer	—	—	1	6.7

6. Approximately the following percentage of people can be expected to have used methamphetamine in the United States:

Answer	Pre-quiz frequency	Pre-quiz percentage	Post-quiz frequency	Post-quiz percentage
10 percent	10	58.8	4	26.7
4 percent*	6	35.3	11	73.3
2 percent	1	5.9	—	—
1 percent	—	—	—	—

Please note that since this resource was piloted, more current data have become available on methamphetamine use in the United States. According to SAMHSA's *Results from the 2008 National Survey on Drug Use and Health: National findings,* five percent of Americans have used methamphetamine. The assessment question has been updated to reflect the new data.

7. The effects of methamphetamine can generally last for:

Answer	Pre-quiz frequency	Pre-quiz percentage	Post-quiz frequency	Post-quiz percentage
60 seconds or less	—	—	—	—
1 hour	—	—	—	—
2 hours	7	41.2	1	6.7
Methamphetamine's effects can last for a long time, perhaps up to 24 hours*	10	58.8	14	93.3

8. Methamphetamine dependence can be successfully treated with:

Answer	Pre-quiz frequency	Pre-quiz percentage	Post-quiz frequency	Post-quiz percentage
Naltrexone	—	—	—	—
Disulfiram	1	5.9	—	—
Antidepressant medications	4	23.5	—	—
Behavioral therapies*	11	64.7	14	93.3
Did not answer	1	5.9	1	6.7

9. Cues that produce cravings can:

Answer	Pre-quiz frequency	Pre-quiz percentage	Post-quiz frequency	Post-quiz percentage
Stimulate the amygdala*	2	11.8	—	—
Stimulate the frontal cortex	3	17.6	7	46.7
Stimulate the nigrostriatal pathway	6	35.3	2	13.3
Can inhibit the nucleus accumbens	6	35.3	4	26.7
Can stimulate the temporal lobe	—	—	1	13.3

Please note that since this resource was piloted, this question has been removed because insufficient information is available in the lecture.

10. The treatment of substance use disorders is:

Answer	Pre-quiz frequency	Pre-quiz percentage	Post-quiz frequency	Post-quiz percentage
Less effective than treatment of other chronic diseases.	11	64.7	3	20.0
More effective than treatment of other chronic diseases.	3	17.6	—	—
Has similar efficacy to treatment of other chronic diseases.*	3	17.6	12	80.0

Please note that since this resource was piloted, this question has been modified.

11. Methamphetamine use most commonly presents with another comorbid condition that is:

Answer	Pre-quiz frequency	Pre-quiz percentage	Post-quiz frequency	Post-quiz percentage
Bipolar disorder	4	23.5	2	13.3
Hypertension	1	5.9	—	—
Suicidal disorder	—	—	—	—
Another substance use disorder*	10	58.8	13	86.7
Did not answer	2	11.8	—	—

12. In the treatment of methamphetamine use disorders:

Answer	Pre-quiz frequency	Pre-quiz percentage	Post-quiz frequency	Post-quiz percentage
A high-stimulus environment is required to ensure that the patient stays awake.	1	5.9	—	—
Hydralazine treatment is often required.	5	29.4	2	13.3
Haloperidol treatment is contraindicated as it can lower the seizure threshold.	3	17.6	2	13.3
Antidepressants are prescribed to decrease depression.*	7	41.2	11	73.3
Did not answer	1	5.9	—	—

Please note that since this resource was piloted, this question has been modified.

Methamphetamine Lecture Evaluation Pilot Data from Family Practice Residents October 2008

Following is a summary report of the results of pilot tests using the lecture assessment form with family practice residents.

Strongly Agree = 5, Strongly Disagree = 1

	Strongly Agree N (%)	Agree N (%)	Neutral N (%)	Disagree N (%)	Strongly Disagree N (%)	N	Mean	SD
I was pleased with what I learned about methamphetamine abuse.	10(77)	3(23)	0(0)	0(0)	0(0)	13	4.77	.44
This program was well designed and organized.	12(92)	1(8)	0(0)	0(0)	0(0)	13	4.92	.28
The goals for the program were clear.	12(92)	1(8)	0(0)	0(0)	0(0)	13	4.92	.28
The program followed a logical sequence.	11(85)	2(15)	0(0)	0(0)	0(0)	13	4.85	.38
The time allotted for this program was about right.	12(92)	1(8)	0(0)	0(0)	0(0)	13	4.92	.28
This approach was an effective format for learning about methamphetamine for my level of training.	12(92)	1(8)	0(0)	0(0)	0(0)	13	4.92	.28
The facilitators were helpful to my learning.	11(85)	2(15)	0(0)	0(0)	0(0)	13	4.85	.38
The discussion was helpful to my learning.	10(77)	3(23)	0(0)	0(0)	0(0)	13	4.77	.44
I had adequate opportunity to participate.	11(85)	1(8)	1(8)	0(0)	0(0)	13	4.77	.60
I recommend offering this program to next year's residents.	12(92)	1(8)	0(0)	0(0)	0(0)	13	4.92	.28

Family Medicine Residents Attending Product 1 Lecture on 10-31-2008

Graduate Level	**# of Attendees**	**Male/Female**
PGY - 1	6	5 / 1
PGY - 2	6	2 / 4
PGY - 3	6	5 / 1
Totals	**18**	**12/ 6**

(Total # of Family Medicine Residents = 24)

Family Practice Residents' Comments

What did you like best about this program?

- The way the lecture was presented. Interesting.
- Very essential topic for those who have not been very exposed to such patients. Excellent presentation. Effective data.
- It was concise and covered the needed areas.
- Was very informative.
- Practical tips, for diagnosis and treatment.
- Very informative.
- Pre- & post-test helped one focus on lecture.
- Good source of teaching, well made & presented in a fun manner.
- Precise presentation.

What do you suggest for improving this program?

- Nothing.
- It was perfect.

Methamphetamine Lecture Evaluation Pilot Data from Psychiatry Residents (PGY3): September 2008

Strongly Agree = 5, Strongly Disagree = 1

	Strongly Agree N(%)	Agree N(%)	Neutral N(%)	Disagree N(%)	Strongly Disagree N(%)	N	Mean	SD
I was pleased with what I learned about methamphetamine abuse.	4(100)	0(0)	0(0)	0(0)	0(0)	4	5.00	.00
This program was well designed and organized.	4(100)	0(0)	0(0)	0(0)	0(0)	4	5.00	.00
The goals for the program were clear.	3(75)	1(25)	0(0)	0(0)	0(0)	4	4.75	.50
The program followed a logical sequence.	3(75)	1(25)	0(0)	0(0)	0(0)	4	4.75	.50
The time allotted for this program was about right.	3(75)	0(0)	0(0)	1(25)	0(0)	4	4.25	1.5
This approach was an effective format for learning about methamphetamine for my level of training.	2(50)	2(50)	0(0)	0(0)	0(0)	4	4.50	.58
The facilitators were helpful to my learning.	4(100)	0(0)	0(0)	0(0)	0(0)	4	5.00	.00
The discussion was helpful to my learning.	2(50)	2(50)	0(0)	0(0)	0(0)		4.50	.58
I had adequate opportunity to participate.	4(100)	0(0)	0(0)	0(0)	0(0)	4	5.00	.00
I recommend offering this program to next year's residents.	3(75)	1(25)	0(0)	0(0)	0(0)	4	4.75	.50

Psychiatry Residents' Comments

What did you like best about this program?

- Simplicity and comprehension.
- Interviewing style.
- Relaxed teaching style and use of "mock interview" on monitor.
- Discussion of dopamine concentrations and role in addictive behavior.

What do you suggest for improving this program?

- I am not sure due to lack of experience in substance abuse.
- Handouts.
- More time would be helpful but possibly not possible.