

Methamphetamine: Implications for the Dental Team



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Disclaimer: Participants must always be aware of the hazards of using limited knowledge in integrating new techniques or procedures into their practice. Only sound evidence-based dentistry should be used in patient therapy.

Conflict of Interest Disclosure Statement

- Ms. Frese has done consulting work for P&G.
- Ms. McClure reports no conflicts of interest associated with this course.

Introduction - Methamphetamine

Methamphetamine: Implications for the Dental Team explores the history, physical and psychological effects, implications for dental team members and other topics related to the methamphetamine phenomenon. The goal of this course is to increase dental health care providers' understanding of the effects of methamphetamine use/abuse.

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Overview

Methamphetamine (meth) abuse is a situation that continues and is being dealt with on a national level. Meth has a profound effect on the user's entire body including the oral cavity. As health professionals, we have an obligation to seek education on the symptoms of methamphetamine use and the protocol to use when treating a methamphetamine abuser. This course explores the history, physical and psychological effects, implications for dental team members and other topics related to the meth phenomenon.

Learning Objectives

Upon completion of this course, the dental professional should be able to:

- Trace the history of methamphetamine (meth) development and use.
- List characteristics of a 'typical' meth user.
- Summarize the indications of meth use.
- Recognize oral manifestations resulting from the use of meth.
- Employ management skills to safely treat a meth abuser.
- Suggest modalities available for treatment of meth abuse.
- Recall that toxic ingredients and byproducts of meth production have environmental impact and legal implications.
- Select appropriate resources for patient education.

History of Methamphetamine

Methamphetamine has existed as a drug since the late 1800s. Below is a brief historical timetable for meth.^{38,42}

- **1887** – German scientist first makes amphetamine.
- **1919** – A more potent methamphetamine (when compared to amphetamine, more of methamphetamine gets into the brain, making methamphetamine more potent) is synthesized in Japan and used to treat asthma, schizophrenia, depression, Parkinson's disease, alcoholism and narcolepsy.
- **1940s-1950s** – During WWII, American, British and German soldiers use meth to fight fatigue and depression; Japanese Kamikaze pilots use meth as well; truck drivers use it during long drives; students use it to stay awake; and women try it for weight control and to meet the demands of being a wife, mother and employee. Organized-crime syndicate Yakuza, in Japan, takes advantage of meth surplus after the war and begins distribution of meth.
- **1960s** – Lack of public attention allows meth abuse to grow. Outlaw biker gangs become "cookers" of meth as it becomes a part of the drug culture. The term 'crank' is used because bikers would hide the drug in the crank case

of their motorcycles. As IV meth use spreads through the 'speed freak' subculture, violent and erratic behavior is seen among abusers and prompts medical authorities to more closely regulate its use.

- **1970s** – Problems with use/abuse lead to federal legislation that restricts legal production, leading to an increase in illegal production. Most of the labs were in western and southwestern states because the chemicals used in meth production are easily obtained from Mexico. Labs were frequently in rural areas to avoid detection of the noxious fumes emitted during production.
- **1980s** – A purer and smokable form of meth appears in Hawaii.
- **1990s** – New recipes make meth easier to make and more potent. Meth use begins to move to Midwestern states. Lawmakers take an increased interest in stopping the spread of meth manufacture and use.
- **2000-2004** – Rural labs increase, and Oklahoma is the first state to limit access to raw materials.
- **2005** – The *Combat Methamphetamine Epidemic Act* sets limits on the sale of certain meth ingredients and requires that purchases be recorded. Products are placed behind the counter and purchaser must show identification.
- **2007** – The *Methamphetamine Remediation Research Act* directs the EPA to establish voluntary guidelines for cleanup of former meth labs.
- **2008** – A 4-day Summit was held by the Substance Abuse and Mental Health Services Administration (SAMHSA) to focus on the unique needs of 3 critically affected populations: justice-involved populations; lesbian, gay, bisexual and transgender individuals; and women.
- **2011-2012** – News coverage may focus on prescription drug abuse but first time meth user numbers are rising, meth labs are reemerging and meth seized at the Mexican border is at a 5-year high.
- **2012-present** – Seizure data, law enforcement reporting and localized treatment information all indicate meth trafficking and abuse continues to increase throughout the nation. Liquid

meth trafficking is a challenge for law enforcement because of its ease of concealment. The abuse of prescription opioids such as methadone, hydrocodone, oxycodone and fentanyl increase significantly. Carfentanil, used to tranquilize large mammals such as elk and elephants is illegally distributed for human use. The use of the illegal opioid heroin gains popularity as prescription drugs are more carefully regulated and become more expensive.

Street Names, Common Forms and Paraphernalia

Meth is known by more than 200 street names. The purest forms of meth are known as ice, crystal or Tina. "Glass" usually indicates a chunk form of meth. Meth is also known as "poor man's cocaine" because of its lower cost and the longer high it produces. Additional names include beanies, chalk, crank, fire, Jenny Crank diet, junk, sketch, speed, zip and zoom. A combination of meth and caffeine is called yaba in Thailand and means 'danger'²⁹ or 'crazy medicine.'²⁸ The use of meth and yaba is widespread in Thailand. Prostitutes, truck drivers and many other workers were regularly using meth. Because of traffic accidents and workplace violence, the Thai government began a campaign in 2003 to reduce meth use. Although prices rose and use decreased among workers as a result of this crackdown, it remains a popular party drug. Globally, tweakers are people who abuse meth regularly causing them to behave or react violently. Users may also be known as speed freaks. Manufacturers of meth are known as cooks.³⁸

Due to the variety of ingredients and recipes, the forms and colors of meth vary widely. This lack of consistent color and form makes it difficult for law enforcement agents to identify. The powder form of meth can be almost any color but the most popular colors are white, pink, brown, grey, orange or yellow. Meth also comes in pill form and can be almost any color. A third form is rock crystals or chunks which are generally an off-white color. Liquid meth is being smuggled into the United States, especially the West, Midwest and Southeast, and converted to crystal meth. Liquid meth is finished meth that is dissolved in a solvent.

Once the solvent is evaporated, meth remains. Liquid meth can be easily concealed in gas tanks; windshield fluid reservoirs; liquor bottles, laundry, antifreeze and horse shampoo containers; and bottles of flavored water, iced tea and aloe vera herbal supplements. Frequently the containers appear to be factory sealed, further hampering identification.⁶⁷ Meth readily dissolves in beverages so it is possible for the drug to be inadvertently ingested. It can be taken vaginally, rectally, orally, optically, smoked, snorted or injected.^{21,22} The preferred method of abusing meth varies by geographical region and has changed over time. Smoking meth is currently the most common way of ingesting the drug.³⁰

There are a variety of items associated with the use of meth, depending on how the drug is used. If the drug is taken orally, various pills may be evident. If injected, syringes may be found. If aluminum foil and glass pipes or light bulbs with the filament end removed or a soda can with a hole in the side are found, the user may be smoking meth. If meth is snorted, hollowed pens or straws may be found among the user's possessions. Be suspicious of large numbers of juice, water, or other beverage bottles. Containers such as laundry detergent or antifreeze that may be out of place, for example in a teen's room, should arouse suspicion and need further investigation. Liquid meth is a very concentrated and deadly form of meth that is not meant to be used prior to evaporation. CBS News reported the November, 2013, death of a teenager due to ingestion of liquid meth.⁴ The teen was attempting to smuggle liquid meth in an apple juice bottle from Mexico to San Diego. In an attempt to persuade inspectors that the liquid was just apple juice, the teen took "a big sip." Shortly thereafter, the teen began screaming in pain and died hours later from acute meth intoxication.

According to the 2018 National Drug Threat Assessment (NDTA), seizures of meth mixed with fentanyl and fentanyl-related substances are increasing in the US. The potency of these substances and concern that the user may not know that the meth contains these substances increases the occurrence of overdose.⁶⁹

Methamphetamine as a Social Problem

The problems with meth are widespread. Children and the general public may be affected by the fumes from meth labs operating in or near their homes. The prison system is overwhelmed by the dental needs of incarcerated meth users. Hospital emergency departments (ED) report that meth is a significant drug problem. The Drug Abuse Warning Network (DAWN) is a public health surveillance system that monitors drug-related ED visits in the United States. DAWN reports that meth-related ED visits rose from 67,954 in 2007 to 102,961 in 2011.⁵⁵ The meth production method known as the shake and bake, one pot, or 2-liter bottle method is resulting in serious burns, overwhelming hospitals with uninsured burn victims. Burn care averages \$6,000 per day and the average meth burn victim stays approximately 3 weeks resulting in a bill of \$130,000 which is 60% more than other burn victims.⁷⁰ This influx is causing the closure of burn units.⁴⁸ Meth labs are frequently guarded by attack dogs or explosive booby-traps. Law enforcement officers are at-risk as they investigate complaints of possible meth labs. The general public faces potential hazards as meth labs are inadvertently discovered during such activities as hunting, fishing, and hiking. Due to the explosive and toxic nature of the manufacturing process, meth labs in homes, hotel rooms, and cars both on the street and in parking lots put the general public at risk. Meth production in a nursing home room in Ohio resulted in a fire that killed one person and injured 6 others. It is believed that at least 3 visitors and 1 resident knew about the meth production which used the 2-liter bottle method.²⁵

Crimes, including identity theft are increasingly associated with meth users. While identity theft is normally associated with elaborate computer schemes, when officials in Colorado and other western states looked at a rise in meth use and a rise in mailbox break-ins and theft of documents from garbage cans, a connection became apparent. Because meth users are awake for days and can fixate on small details, identity theft is the perfect drug habit support system. Meth users are able to look for check

or credit card numbers and then convert the stolen identities to money, drugs or ingredients to make more meth. Violent crime, theft, domestic violence and rape are also associated with meth users and producers.³⁵ A system of obtaining cold pills known as 'smurfing' is on the rise.²⁷ Meth producers recruit people to go to every store in an area and purchase the limit of cold medicine. They punch out the pills from the blister pack into a bucket. The purchaser pays \$7-8 a pack yet earns \$40-50. There are willing participants lured by the economy and the promise of easy money. Meth incidents decreased by almost 2/3 from 2005-2007 with the advent of tracking laws. From 2007-2009, meth incidents increased 62% over the prior two years, largely due to smurfing.⁴⁷

Dealing with meth is expensive. Oklahoma estimates that the typical meth lab case costs the state \$350,000. Added to that are the costs of training law enforcement officers, incarceration and treatment of the user, and child welfare services that can easily add an additional \$50,000. Furthermore, meth lab cleanup is complicated and expensive. According to the National Drug Intelligence Center, the manufacture of one pound of meth creates five to seven pounds of toxic waste that is as dangerous as the drug. When the toxic waste is dumped, protected lands and ground water are contaminated. This contamination places domestic and wild animals and humans at risk for sickness and death. In 2009, the RAND Corporation published a national estimate of the economic burden of meth use.⁶⁷ Using data from 2005, they estimated that \$23.4 billion is spent yearly in the US due to meth abuse. Included are such costs as the burden of addiction, premature death, drug treatment, and aspects of lost productivity, crime and criminal justice, health care, production and environmental hazards, and child endangerment.⁵⁷ Meth abuse also contributes to increased transmission of infectious diseases, such as hepatitis and HIV/AIDS, and makes communities vulnerable to social ills such as new crime waves, unemployment, and child neglect or abuse.³⁰

Meth users can be seduced by the intensity of the initial high – a high many users say is unlike anything they have experienced before. Most of

the pleasurable effects of methamphetamine are believed to result from the release of very high levels of the neurotransmitter dopamine. Dopamine is involved in motivation, the experience of pleasure, and motor function, and is a common mechanism of action for most drugs of abuse. The elevated release of dopamine produced by methamphetamine is also thought to contribute to the drug's deleterious effects on nerve terminals in the brain.⁶ Almost immediately, users build up a tolerance for the drug causing the user to adjust the quantity, frequency or method of intake in an attempt to recreate that first high. The user may binge, using a gram of meth every 2-3 hours for several days until they exhaust their supply or are too disoriented to continue. This binge is known as a 'run.'

Public awareness has been raised recently with the various anti-meth campaigns. Texas, Montana and Oregon have been leaders in these public awareness campaigns. Meth is considered by many to be the world's most dangerous drug. However, a survey conducted by the *Meth Project* indicated that 24% of teens believe meth has positive benefits including making you feel happy, helping you deal with boredom and helping you lose weight. These results underscore the continuing need for meth education programs. A focused program of the *Montana Meth Project* reduced meth use among Montana teens by 45% between 2005 and 2008 while use nationally did not decrease. Additionally, meth related crimes dropped by 50% and workers testing positive for meth dropped by 70%. As part of a federal grant, Ohio has begun a program called *Face:Meth*. This program strives to educate employees to spot purchases that might indicate someone is gathering ingredients to make meth.³ In September 2015, the US Department of Justice awarded a total of \$6.1 million in grant money, through the COPS (Community Oriented Policing Services) Anti-Methamphetamine Program, to California, Iowa, Missouri, New Mexico, New York, Ohio and Tennessee to help stem the manufacture of meth and related crimes.

The "Not Even Once" campaign focuses on reaching youth at their level to promote the

dangers of substance abuse. Since youth find a sense of belonging in subcultures, this program promotes healthy lifestyles by enjoying alternative adrenaline-fueled pursuits without drugs and alcohol. At events centered on surfing, skateboarding and music, the promoters encourage social youth responsibility while learning new sports skills.

There are two emerging trends in the meth phenomenon. The 2018 NDTA reports that drones are increasingly being used to distribute meth.⁶⁹ In 2017, a US citizen was arrested near San Diego for flying 13 pounds of meth across the border, using a drone. Drones have also been used to drop heroin and marijuana. While disadvantages of drone use include the noise level and limited battery life and payload weight, it is predicted that technological advances will most likely address these issues. The advantages of drone use include GPS tracking and remote/autopilot features. Since the operator is away from the area where the drugs are dropped, the likelihood of being caught decreases. The second trend, reported in the 2018 World Drug Report, is the use of the darknet to sell meth.⁶⁵ Although the scale is limited, it is increasing. From 2011-2016, the sale of meth on the darknet was estimated at \$44 million per year. A newer study in early 2016 estimated that sales have increased to \$170 - 300 million per year. While strides are being made in shutting down meth sales on the darknet, it remains an area of concern.

Methamphetamine Production

Meth is "cooked" from a variety of common, easily obtainable ingredients. While most of the meth in the United States comes from the super labs - those that can produce more than 10 pounds of meth in 24 hours - in Mexico or California, smaller labs are still active and problematic. Recipes for cooking meth can be found on the Internet and making meth is said to be as easy as making chocolate chip cookies. Meth is inexpensive to make; \$1000 of raw materials yield approximately \$20,000 of meth. Depending on the locality, supply and demand and purity, meth prices can range from \$20-300 per gram. The Drug Enforcement Administration (DEA) reports in the 2013 NDTA that between 2007 and 2012, the price

of meth decreased more than 70% while its purity increased 130%.⁶⁷ The 2017 and 2018 National Survey on Drug Use and Health noted that the current purity of meth is at least 90% pure, at least 95% potent and costs as little as \$5.00 per dose or 'hit'. A typical dose of meth is ¼ gram or 0.01 ounce.^{61,71,68} A gram of meth is consumed in 1-2 days and is the weight of a typical packet of artificial sweetener. The main ingredient is pseudoephedrine or ephedrine found in over-the-counter cold and allergy medicines. Ingredients used in meth production are shown in Table 1.¹⁷

Equipment frequently used in the production of meth is shown in Table 2.⁷⁰

Cooking labs are becoming more prevalent in rural areas. The pronounced unpleasant odors associated with meth production have caused cooks to use less-populated areas, including national parks and other federal lands, to avoid detection.

A simpler, less expensive and faster method of making meth is increasing in popularity. The smaller batch known as the one pot, shake and bake, or 2L bottle method uses a 2-liter plastic bottle. Cold medicine and noxious chemicals are added to the bottle and shaken. No flame is needed. Even under the most stringent laws, enough cold medicine can easily be obtained to make a batch of meth. There is less need for big labs as the ingredients can fit in a backpack. This method also increases drug purity from approximately 39% to 83% and therefore lowered the average price of a gram of meth from \$270 in 2007 to \$105 in 2010, making meth more 'accessible.' This 2-liter method produces powerful explosions, intense fires and releases toxic waste. Even small mistakes in the process, such as removing the cap too soon or allowing water into the mix, can cause an explosion. Since this method is easier and portable many more labs are using this method. The ease of portability results in these labs turning up in more populated areas and, therefore, they may be more visible to law enforcement than labs in remote areas. This visibility is resulting in an increase in meth lab seizures and arrests after a period of decline.^{18,25}

Table 1. Ingredients Used in the Production of Meth.

Alcohol	Hydrochloric/muriatic acid
Anhydrous ammonia-fertilizer	Hydrogen peroxide
Antifreeze	Iodine crystals
Battery acid	Lead acetate
Benzene	Lighter fluid
Charcoal lighter fluid	Lithium from batteries
Diet aids/ephedrine	Lye-sodium hydroxide
Di-ethyl ether – camp stove fuel	Nail polish remover – acetone
Energy boosters	OTC cold medicine/pseudoephedrine
Ethyl ether – starter fluid	Paint thinner
Freon	Red phosphorus – matches/flares
Gasoline	Sulfuric acid – drain cleaner

Table 2. Equipment Used in the Production of Meth.

Gas cans	Pails/buckets
Hot plates	Propane cylinders
Ice chests	Rubber gloves
Jugs and bottles	Rubber tubing
Kitty litter	Tempered glassware
Laboratory beakers/glassware	Thermometers

Mexico remains the primary supplier of meth to the US. Dismantling the La Familia cartel, once the top meth producer, was thought to reduce the meth pipeline. It seems, however, that a rival cartel, Sinaloa, has taken over industrial size meth production. A Mexican meth bust in 2012 netted 15 tons of pure meth valued at more than \$4 billion. Seizure

of almost 500 tons of precursor chemicals, all attributed to Sinaloa, indicate a continued increase in Mexican meth production.⁵³ The largest single seizure of meth in the United States occurred in January 2019, when 3,800 pounds of meth were seized at the Los Angeles-Long Beach port complex by U.S. Customs and Border Patrol.

User Demographics

Methamphetamine users come from many populations. Adolescents and college students use meth for the powerful high, ability to stay awake to study and to have a good time. Reported users wishing to 'do it all' – students, workers, mothers – turn to the drug for its hyperactivity effect. Certified public accountants during tax season and medical residents on call have used meth. Truck drivers use it to stay awake during long drives. People who are bored, angry or depressed turn to meth in the hopes it will make them feel better. People who want to be thin use meth for the appetite suppression effect. Basically anyone can be a meth user. According to data from the 2012 National Survey on Drug Use and Health (NSDUH), over 12 million Americans (4.7% of the population) age 12 and older have tried methamphetamine at least once. NSDUH also reports that approximately 1.2 million people used methamphetamine in the past year (2011) and 444,000 reported using methamphetamine in the past month.⁵⁸ The 2014 NSDUH reports that 183,000 Americans age 12 and older used meth for the first time. That number is equal to or higher than past year initiate numbers since 2007.⁵⁹ The 2009 NSDUH report indicated that approximately 70% of meth users are getting meth from friends or family.⁵⁶ The typical meth user is Caucasian and between the ages of 19 and 30. Meth use is increasing among college students and young professionals who frequent nightclubs. Some meth distributors are targeting Indigenous People. With a disposable income and a history of alcohol abuse, there is an increase in meth problems on reservations. Women are also at risk because of a desire to lose weight, increase confidence, have more energy for multiple responsibilities or because their partner uses meth.⁵⁷

By the 1980s, Mexican drug cartels were manufacturing meth for distribution in Hawaii and Southern California. According to the World Health Organization (WHO) in 2008 the Mexican government placed strict regulations on medications containing pseudoephedrine. All distribution of products containing pseudoephedrine in Mexico now requires a written prescription. It is the hope of the

Mexican government that this measure will limit the amount of meth that is produced. The use of methamphetamine continues to spread across the Western states, the Midwest and the South. The Northeastern states have experienced increased use of meth as a club drug in club subcultures.²⁰ According to the 2014 NDTA, West Coast states and Hawaii have the highest rate of meth use followed by the Central and Southwest states. The 2017 NSDUH reports the highest state prevalence rates include Alaska, Arkansas, California, Hawaii, Kansas, Kentucky, Nevada, Oklahoma, Oregon and South Dakota.⁶¹ Worldwide, the market for meth is increasing in East and Southeast Asia and Oceania.⁶⁵

Regions of the U.S. with the least meth use are Mid-Atlantic, Southeast, and Great Lakes.^{57,67} The 2014 Drug Enforcement Agency statistics show that Indiana, Missouri, Ohio and Tennessee have the highest meth seizure rates and Nevada, Maryland Rhode Island, Utah and Vermont have the lowest meth seizure rates. The 2011 United Nations Office of Drugs and Crime (UNODC) report estimates annual prevalence of amphetamine-type stimulants (ATS), including methamphetamine, as the second most widely used illicit drug in the world, following cannabis. The 2018 UNODC report states that due to the increasing availability of meth between 2013 and 2016, meth was reported to be the second greatest drug threat in the US, after heroin.⁶⁵ ATS were used by 14-56 million people worldwide in 2009.⁶⁴ Both the 2016 and 2017 NSDUH, the most recent reports, indicate methamphetamine remains a drug of concern.^{60,61}

Methamphetamine Effects on the Body

Methamphetamine is classified by the US Drug Enforcement Administration as a Schedule II stimulant, which means it has a high potential for abuse and is available only through a prescription that cannot be refilled. There are a few accepted medical reasons for its use, such as the treatment of narcolepsy, attention deficit disorder and for short-term use to treat obesity. The medical uses of methamphetamine are limited and

it is rarely prescribed. When prescribed, the dose is far lower than that typically abused. Meth use can produce devastating, sometimes fatal consequences that affect all systems of the body, including central nervous system, cardiovascular and respiratory effects. Numerous acute and chronic physical, behavioral and psychological side effects are evident.

Stages of Meth Use

The Rush (or Flash) – the initial response the abuser feels when smoking or injecting methamphetamine. The methamphetamine rush can continue for up to thirty minutes whereas the initial response to cocaine lasts only 5 minutes. Snorting or oral ingestion produces euphoria – a high – but not the intense rush.

The High – the rush is followed by a high, sometimes called “the shoulder.” During the high, the abuser often feels aggressively smarter and becomes argumentative, often interrupting other people and finishing their sentences. The delusional effects can result in a user becoming intensely focused on an insignificant item, such as repeatedly cleaning the same window for several hours. The high can last four to sixteen hours.

The Binge – is uncontrolled use of methamphetamine. The abuser tries to maintain the high by smoking or injecting more methamphetamine. The binge can last three to fifteen days. During the binge, the abuser becomes hyperactive both mentally and physically. Each time the abuser smokes or injects more of the drug, he experiences another but smaller rush until, finally, there is no rush and no high.

Tweaking – this is the most dangerous phase of meth addiction. This is the end of a drug binge when methamphetamine no longer provides a rush or a high. Unable to relieve the feelings of emptiness and craving, an abuser loses his sense of identity. Intense itching is common and a user can become convinced that bugs are crawling under his skin. Unable to sleep for days at a time, the abuser is often in a completely psychotic state

and he exists in his own world, seeing and hearing things that no one else can perceive. The hallucinations are so vivid that they seem real and, disconnected from reality, the user can become hostile and dangerous to himself and others. The potential for self-mutilation is high.

The Crash – occurs when the body shuts down, unable to cope with the overwhelming effects of the drug resulting in a long period of sleep. Even violent abusers can become almost lifeless during the crash, which can last one to three days.

Meth Hangover – after the crash, the abuser is in a deteriorated state: starved, dehydrated and exhausted physically, mentally and emotionally. This stage ordinarily lasts from two to fourteen days. This leads to enforced addiction, as the “solution” to these feelings is to take more meth.

Withdrawal – often thirty to ninety days can pass after the last drug use before the abuser realizes that he is in withdrawal. First, he becomes depressed, loses his energy and the ability to experience pleasure. Then the craving for more methamphetamine hits, and the abuser often becomes suicidal. Meth withdrawal is painful and difficult and most users continue to use meth.

Stages of Addiction

Addiction to methamphetamine and other drugs is a multifaceted phenomenon, varying with the individual’s level of use and the dysfunction experienced as a result of that use. The stages of addiction are listed below.¹⁰

Experimental Use – is the use of meth at any time for experimentation. While this use may not appear to be abusive, even a single use of a drug can result in substantial harm to self or others. Examples are use while pregnant or driving. Children may be injured if left alone while a parent is under the influence. If this use continues or serves as a gateway to other drugs, patterns of abuse may develop. Since the high experienced with meth use, especially the first use, is so intense, many education programs focus on the ‘not even

once' message because of the strong potential for increased use or addiction.

Social Use – is the use of meth in social situations or for social reasons. If this use causes harm to self or others, it is considered abuse. Social use of meth often leads to further and elevated use.

Abuse – is problem or risky use. It is a pattern of use in which the user consumes the substance in amounts or with methods which are harmful. Harm may be to self or others. Meth abuse interferes with health, occupational and social functioning. Abuse can occur without progressing to addiction.

Addiction – is a chronic, potentially fatal, often relapsing brain disease that causes compulsive drug seeking and use despite harmful consequences to the individual and others. Recovery may be increasingly difficult as addiction progresses. Physical withdrawal symptoms occur when the drug is withdrawn.

- Behaviors Associated with Addiction
 - Obsession with the drug
 - Controlling of others but lack self-control
 - Manipulative
 - Preoccupation with obtaining the drug
 - Compulsive use in spite of adverse consequences
 - Relapse following periods of absence
 - Hides or denies drug use and destructive behavior
 - Blackouts
 - Depression
- Risk Factors for Addiction
 - Family history of substance abuse
 - Early onset of substance use
 - Binge drinking - a pattern of drinking that brings blood alcohol concentration (BAC) levels to at least 0.08 g/dL. This typically occurs after 4 drinks for women and 5 drinks for men are consumed within approximately 2 hours.
 - Environmental/peer pressure, physical and sexual abuse, stress

Central Nervous System (CNS) Effects

Methamphetamine dramatically affects the central nervous system (CNS). It acts as a

potent CNS stimulant and is highly addictive. Several areas of the brain are affected: the nucleus accumbens, the prefrontal cortex and the striatum. Meth use causes the release of the neurotransmitters dopamine, norepinephrine and serotonin and blocks their re-uptake, which results in a sense of euphoria. Dopamine is the primary neurotransmitter that causes the enhanced mood and feelings of pleasure that accompanies meth abuse. Because meth is metabolized slowly, the high is longer and the potential for damage, including neurological damage, is greater than for other drugs of abuse. Whereas cocaine is metabolized in 1 hour, meth takes 12 hours. Meth is rapidly absorbed and reaches its peak effect in 2 to 3 hours. Continued meth use reduces the levels of dopamine in the brain and requires an increase in drug use to obtain the same sensations. This reduction in dopamine levels allows symptoms similar to those of Parkinson's disease to become evident. One such symptom is compulsivity problems.⁴⁶ Men more frequently suffer from pathological gambling and compulsive sexual behavior whereas women tend toward compulsive buying and binge eating. A unique manifestation of methamphetamine abuse is the development of stereotypy or punding defined as non-goal-directed repetitive activity for prolonged periods of time without any apparent gain.⁴⁶ There is a predilection for these behaviors to entail activities in which users had previously been involved. For example, a carpenter may repetitively build wooden objects, an artist may draw or paint excessively or a businessman may make and add to spreadsheets for hours. There is also a gender-related component: men typically tinker with electronics and women engage in grooming behaviors such as hair brushing or nail polishing. Chronic methamphetamine abuse also significantly changes the brain. Brain imaging studies have demonstrated alterations in the activity of the dopamine system that are associated with reduced motor speed, emotion, reward, memory, cognitive skills and impaired verbal learning. Some of the effects of chronic methamphetamine abuse appear to be, at least partially, reversible. A recent neuroimaging study showed recovery in some brain regions following prolonged

abstinence (2 years). This was associated with improved performance on motor and verbal memory tests. However, function in other brain regions did not display recovery even after 2 years of abstinence, indicating that some methamphetamine-induced changes are very long-lasting or permanent.⁴¹ Since meth is a neurotoxin, abusing it can also result in irreversible damage to the brain including stroke, cerebral edema, cerebral hemorrhage, paranoia and hallucinations.^{30,34,39} Meth users describe themselves as brave, confident and energetic. Some users believe they have superpowers when high on meth which is why meth has been described as the 'magic drug.' Meth combines the hyperactivity of cocaine use with the delusions of LSD use.

Short-term CNS effects of meth abuse include insomnia, hyperactivity, decreased appetite and tremors. Extended meth abuse can cause depletion of monoamines in the brain, which can have a deleterious effect on learning. Long-term use of meth can also lead to psychological addiction, stroke, violent behavior, aggressiveness, anxiety, confusion, auditory hallucinations, mood disturbances, delusions, insomnia, seizures and short-or long-term psychosis. Withdrawal from the drug produces severe depression, anxiety, fatigue, paranoia, aggression, increased appetite and extreme cravings for the drug.³⁴

Cardiovascular and Respiratory Effects

The ingredients of methamphetamine stimulate the cardiac and respiratory systems, causing uncontrolled hypertension, tachycardia and possibly arrhythmias. Increased respiration and shortness of breath can result. These

effects lead to a greater incidence of heart attack or stroke in meth users.³² Additionally, pericarditis and permanent coronary artery disease have been shown in long-term abusers. Users can also experience diaphoresis (sweating) along with dangerous hyperthermia (elevated body temperature), which can lead to seizures, permanent brain damage or death.³²

Physical Indicators of Use/Abuse

Clinically, the chronic meth user may present with formication (speed bumps, meth sores, etc.) which are unusual lesions and scabbing on the face, arms, torso and legs (Figures 1, 2 and 3). These cutaneous manifestations are commonly caused by the user scratching at the imaginary insects ("crank bugs, meth mites, etc.) that the user feels crawling beneath the skin. These lesions frequently become infected from scratching, unsanitary conditions and vasoconstriction of the tissue. The name 'formication' comes from the fact that ants inject formic acid when they bite. Some research has indicated that there may be a chemical or allergic skin reaction to the drug that causes this sensation.⁴⁹ The feeling of this sensation is called delusional parasitosis, and with meth use it is hypothesized to be the result of vasoconstriction of the nerve endings on the skin and cause the addict feelings of something irritating or "crawling" under the skin.⁷⁴

When a meth user is under the influence of the drug, they have decreased appetite and increased activity. Consequently, the long-term user will often have a marked weight loss and may show effects of malnutrition. Additional physical indicators of meth use include hyperthermia, diaphoresis, hypertension,



Figure 1. Lesions and scabbing on the face.

Source: CMP Media



Figure 2. Lesions and scabbing on the arms.

Source: <http://www.instablogs.com>



Figure 3. Lesions and scabbing on the legs.

Source: archives.zinester.com

tremors, paranoia, hyperactivity, nausea, vomiting, diarrhea, unusual body odors, dilated pupils, blurred vision, unexplained bruises from falling, persistent cough, severe lung and kidney damage, inflamed or eroded nasal septum and track marks at injection sites. Hyperthermia and convulsions occur with methamphetamine overdoses, and if not treated immediately can result in death.²¹

The oral manifestations will be discussed later. Figures 4 and 5 demonstrate some of the physical effects of methamphetamine use.

Behavioral Indicators

Many methamphetamine users abuse the drug in pursuit of the appetite suppression and/or increased physical activity effects, which can last for hours and sometimes days. The user may experience prolonged periods of insomnia and increased activity, which can be desirable to an overworked mother or student preparing for examinations.³² However, undesired effects include sudden mood swings, bizarre behavior, tremors, slurred/rapid speech and repetitive motor activity.³² Methamphetamine users frequently abuse other illegal drugs as well as tobacco and alcohol. Many meth users are

in prison following exhibition of uncontrolled violent and aggressive behavior.³²

Psychological Indicators

There are numerous psychological effects associated with methamphetamine use, which can range from mild anxiety, confusion and nervousness to more extreme effects such as depression, paranoia and homicidal and suicidal thoughts.³² Auditory, visual, olfactory and tactile hallucinations are also common among those abusing methamphetamine. These hallucinations can lead to psychotic symptoms that can last for months or years after the drug has been stopped.³² Additionally, the user's personality profile may change, involving occupational and social deterioration as well as marked changes in habits, friends and drug-seeking behaviors.³⁷

Other Effects

The potent crystal meth is particularly prevalent among men who have sex with men (MSM). MSM is the term used to categorize males who engage in sexual activity with other males, regardless of how they identify themselves. This term focuses on behavior rather than cultural or social self-identification.



Figure 4. Physical effects of methamphetamine use.

Source: sneakhype.com



Figure 5. Physical effects of methamphetamine use.

Source: www.bing.com/images/

Users report an amplified libido, increased sexual stamina and reduction of inhibitions.³¹ As a result, there is an increased incidence of HIV/AIDS and hepatitis B and C, primarily due to sharing of needles and unprotected and rougher sex. Antibiotic resistant forms of sexually transmitted infections and more virulent forms of AIDS are being observed in meth users.

Heavy metal (lead and mercury) toxicity has been reported in meth users, especially those who receive treatment in emergency departments.

Methamphetamine use during pregnancy poses a significant risk to the developing fetus, including premature birth and low birth weight, possibly due to increased maternal cardiovascular stress; placental abruption (separation of the placental lining from the uterus) cerebral infarctions; and congenital anomalies such as cleft lip and palate and heart abnormalities.^{30,32,45} There is evidence of structural brain abnormalities that may be

worse than Fetal Alcohol Syndrome.⁴⁵ Meth clears from the newborn's system after 5 days but the effects continue. Because meth disturbs the neurotransmitters that regulate the sleep cycle, exposed infants can sleep up to 23 hours a day in the early weeks of life. Feeding may be compromised as sucking and swallowing reflexes are weak. At approximately 4 weeks, these infants exhibit excessive irritability. The long-term effects of fetal exposure are less clear. There appears to be an increased risk of attention deficit hyperactivity disorder during the school-aged years. Changes have been demonstrated in the caudate nucleus of the brain which is involved in learning and memory, motor control and reward and punishment.⁷²

Oral Manifestations of Methamphetamine Abuse

The oral signs and symptoms of methamphetamine abuse are significant and severe. The dental professional is often the first to observe the signs of meth abuse, the most dramatic sign of which been termed "meth



Figure 6A. Damage caused by meth.

Images used with permission of Dr. J. Allen, Cincinnati, Ohio



Figure 6B. Post-treatment.

mouth.”¹ Figures 6A-B show the damage caused by meth as well as a post-treatment photo. There is a distinctive pattern of caries on the facial and proximal surfaces of teeth, especially the anterior teeth. It is an aggressive erosion of enamel accompanied by destruction of periodontal tissues. Teeth have been described as blackened, stained, rotting, crumbling or falling apart. The rampant caries resemble radiation caries, early childhood caries or “pop rot” but lacks the associated etiology. Through elimination of other causative agents, a differential diagnosis of meth mouth can be made.

Etiology of Manifestations

The etiology of this dental disease stems from the caustic nature of the drug and the lack of concern by the user for daily personal hygiene and professional dental care. The acidic ingredients used to make meth as well as the psychological and physiological changes induced by the drug result in a ‘perfect storm’: dry mouth, poor oral hygiene, consumption of sugar-laden soda and stress-induced grinding and clenching. The method in which the drug is administered was thought to play a role in the oral effects: when smoked, the drug emits toxic fumes that contain lithium and muriatic and sulfuric acids, ether, red phosphorous and lye. These highly toxic and corrosive vapors produce significant damage to the oral structures.⁵⁷ Nasal insufflations (snorting) can also have dental implications. The noxious substances proceed down the nasal pharynx into the back

of the throat and coat the oral cavity with the destructive substances. It would seem that smoking or snorting meth should result in more damage. A study reported in the *Journal of the American Dental Association* did not confirm this. Instead, IV meth users had a higher prevalence of dental disease and missing teeth that those who smoked meth, possibly due to more advanced addiction and greater self-neglect.¹

Caries

Meth mouth, or crank decay, is commonly observed in methamphetamine users.⁴⁰ The cause of meth mouth is multifactorial. Meth users commonly experience drug-induced cravings for high-calorie carbonated beverages.^{2,24} As a result, soft drinks containing high amounts of sugar and caffeine are often consumed to prolong the high and assuage the cravings.⁷³ Reports indicate that Mountain Dew™ is commonly ingested by meth users; as much as several liters per day.⁷³ The drug produces extreme xerostomia, reducing the amount of protective saliva and decreasing the pH thereby reducing the buffering capacity around the teeth.^{9,39,52} As a result of these behaviors, the oral bacterial levels can drastically increase, exacerbating the decay. The caustic nature of the drug, poor oral care and high sugar diet result in increased decay. This devastation can occur rapidly, in as little as one year. Conventional dental treatment is frequently of little value.^{8,21} Often, the caries are so significant and rampant that full-mouth extractions are indicated (Figure 7).



Figure 7. Significant and rampant caries.

Source: [pbs.org](https://www.pbs.org)



Figure 8. Declining periodontal health.

Source: [doctorspiller.com](https://www.doctorspiller.com)

Periodontal Disease

Methamphetamine users have an increased incidence of periodontal disease.⁵¹ The drug causes vasoconstriction of the vessels that supply blood to the oral tissues. With repeated use of the drug and repeated vasoconstriction, the blood vessels are permanently damaged and the oral tissues die. In addition, lack of proper daily oral hygiene further exacerbates the declining periodontal health (Figure 8).⁵⁰

Bruxism

Methamphetamine can cause users to feel anxious and nervous, resulting in clenching and grinding of the teeth. Signs of bruxism, including fractures of the teeth and severe attrition, are common. The vasoconstriction can also affect the vitality of the teeth, increasing the likelihood of enamel fractures.

Oral Ulcers and Infections

Oral ulcerations and infections are common among methamphetamine users. When smoked or snorted, the caustic ingredients of the drug bathe the oral cavity and irritate and burn the oral tissues. This leads to significant oral ulcerations and infections. This is also brought on by the severe dry mouth that accompanies the use of meth. Xerostomia is caused by the vasoconstriction and reduction of salivary gland function. The tongue and lining of the mouth can become raw and irritated without the surfactant action of saliva. This can lead to secondary infections and limited ability to speak and eat.^{21,31}

Recommendations for the Dental Team

No other illicit drug's oral effects have been so pronounced or have received so much attention as methamphetamine. When methamphetamine use is suspected, dental professionals need to document all relevant oral findings; provide appropriate and safe treatment; and encourage medical evaluation, intervention and follow-up as well as subsequent dental visits.

Many meth users fail to adequately care for their teeth or regularly visit the dental office. The dental team is urged to become educated on the signs and symptoms of meth use as well as the precautions required when treating a meth abuser. Conventional dental treatment is frequently of little value. The results of methamphetamine abuse may take up to two years after the patient has stopped using meth to manifest in the oral cavity.^{8,21}

Treatment of meth mouth should include preventive measures, such as oral hygiene instruction, dietary restrictions, nutritional counseling, daily prescription fluoride treatments, remineralization therapies and products for xerostomia and oral lesions.⁹ Nutritional instructions should include the consumption of water and introduction of xylitol products in favor of sugar-laden carbonated beverages.

Fluoride varnish and glass ionomer self-adjusting materials containing fluoride may

offer some protection until the patient is in recovery and enough time has passed to determine the outcome of use. Temporary crowns, bridges, and veneers can be utilized to give the patient a temporary “smile” until definitive treatment can be delivered. Each case must be evaluated individually. The amount of wear and micro-fractures on the teeth from grinding, the degree of periodontal involvement and severity of tooth decay has to be taken into consideration before determining treatment. At some point dental restorative care may include, as appropriate, extractions, amalgam/composite restorations, veneers/crowns, and/or partial/complete dentures.²¹

It is vital that the patient have a complete physical exam and evaluation of current drug use before dental treatment begins. Caution should be used when administering local anesthetics, sedatives, general anesthesia or nitrous oxide and when prescribing narcotics.³⁶ These treatments could cause severe or fatal hypertensive episodes or cardiac arrhythmias. Methamphetamine abusers typically are resistant to local anesthetics, have an increased risk of adverse events related to drug interaction and are less able to metabolize local anesthetics than the general population. These patients will require a larger than normal dose of local anesthetic, without vasoconstrictors. If you are unsure whether a patient has taken meth within the last 24 hours, do not give local anesthetic as this could cause a severe reaction.²⁶ Refer the patient for evaluation of drug use and consult with the health care provider prior to future appointments. For pain control in dentistry the first drug of choice is an anti-inflammatory such as ibuprofen.²¹ Use acetaminophen with caution as the user may have compromised liver function due to detoxification of meth and high body temperatures resulting from meth use.

Dental Team Considerations

1. Because this drug affects every organ in the body it is important to refer the patient for a complete physical including a blood panel before the treatment begins.
2. Lung function: Do not administer nitrous oxide until appropriate lung function has been determined by a primary health care provider.

3. Kidney and liver function: Do not prescribe medication or use anesthetic until appropriate function has been determined by a primary health care provider.
4. Evaluation of cardiovascular system for need of premedication and precautions. Do not administer epinephrine or prescribe narcotics until cardiovascular status has been determined.
5. Find out the history of use and physical results including strokes, heart considerations, etc.
6. Involve the patient’s drug counselor, pastor or probation officer in treatment decisions including pain management, appointment considerations, etc.

It is imperative to educate the patient about the various risks associated with meth or other illicit drug use. It is the dental professional’s obligation to encourage the user to seek a medical evaluation. Offer the patient the name and contact information for local treatment programs.²³ If it is suspected that a child is living in the environment of a meth lab, reporting of this suspected child endangerment is mandatory.⁵

Special Considerations

Keep in mind the following six safety tips for approaching a methamphetamine abuser, known as a “tweaker”.⁵⁴

- Keep a safe distance. Coming too close can be perceived as threatening.
- No bright lights. Bright lights may cause them to react violently.
- Speak slowly, using a low voice.
- Use slow movements. The patient may misunderstand sudden movements.
- Keep hands visible. The patient may feel threatened and become violent.
- Keep the patient talking. A methamphetamine user who falls silent can be extremely dangerous. Silence often means that paranoid thoughts have altered their perception of reality, and anyone present can become the object of the delusions.

Response to the Problem

A major victory in the battle against methamphetamine has been achieved. Since 2006, all states have passed laws requiring

that products containing pseudoephedrine be placed behind the counter. Oklahoma was the first state to do so. In 2004, after 3 state highway patrol troopers were killed by meth users, Oklahoma enacted some of the country's toughest anti-meth laws such as a mandatory two-year prison sentence for possession of meth and life imprisonment for manufacturing meth with intent to distribute. Current federal law requires customers to show a photo ID to buy pseudoephedrine-containing products. The legal limit for purchases is 9 grams per month or approximately 30 tablets of 24-hour Claritin™ or Aleve Cold and Sinus™ or 84 tablets of Sudafed™. Several states including Arkansas, Kentucky, Missouri, Oklahoma, and Washington are using an electronic tracking and block of sale system that uses real time data to track purchases. Purchase information is immediately available within the state, and depending on the tracking system used, across state lines. If the purchase limit has been reached, the retail outlet is notified and can deny the sale. Law enforcement can then investigate, do preliminary interviews and determine if there is a reasonable suspicion of criminal activity.¹¹ Retail purchases of pseudoephedrine (PSE) have been limited to 9 grams per 30 days. Several states, including Arkansas, Iowa, Indiana, Minnesota and Wisconsin, have implemented more stringent laws restricting the retail purchase of PSE to 7.5 grams, or as in the case of Indiana, 7.2 grams per 30 days and Minnesota, 6 grams per 30 days. The maximum daily dose of PSE is 240 mg, thus if a person requiring PSE takes the maximum dose every day for 30 days, a quantity of 7.2 grams would be needed for the 30-day supply. Restricting quantities to a maximum of 7.2 grams per day should have no impact on persons purchasing PSE for legitimate self-care uses. Additional states are considering legislation to restrict purchase quantities to similar limits.¹¹ In keeping with their tough anti-meth focus, Oklahoma is the only state to date to block the sales of PSE to those with previous meth-related convictions.¹¹

Through 1975, a prescription was needed to purchase pseudoephedrine products. In 2006, Oregon became the first state to again require a prescription to purchase pseudoephedrine

products. Oregon has experienced a significant decrease in meth incidents and meth arrests and few consumer complaints about the prescription requirement since the passage of this law. In 2010, Mississippi passed similar laws. Arkansas requires a prescription for out-of-state residents only.¹¹ Other states are considering implementing the need for a prescription for purchasing these products.^{11,34} Phenylephrine, a nasal decongestant, is still available on the shelf but many believe it is not as effective as pseudoephedrine.

The restricted access to pseudoephedrine and ephedrine products has led to an increase in a different meth production method called P2P, from the precursor chemical phenyl-2-propanone (benzyl methyl ketone), that does not require pseudoephedrine.³⁰ While phenyl-2-propanone is highly restricted and closely monitored, it is easy to make from phenylacetic acid and its derivatives.³⁰

Access to fertilizer is restricted and may contain ultraviolet coloring agents to identify its use in meth production. Iowa uses federal funds to purchase locks for fertilizer tanks to reduce the theft of anhydrous ammonia.

Inconsistent state laws and voluntary actions may be insufficient to curb meth's widespread abuse. One possible solution is a national standard regarding pseudoephedrine-containing products. *The Patriot Act*, which contains the *Combat Methamphetamine Epidemic Act 2005* (CMEA), could create a uniform national policy. Highlights of the CMEA's provisions regarding the manufacture, distribution and use of methamphetamine include the following:¹⁹

- Access to cold medicines with pseudoephedrine would be controlled by store personnel.
- Limits on how much pseudoephedrine-containing product a person can purchase would be imposed.
- Signature and identification would be required for purchase of this drug.
- The Act would authorize \$585 million for enforcement, training and research into treatment. Twenty million dollars is to be used to assist and educate children that

have been affected by the production of meth.

- More manufacturers and dealers would be assigned “king pin” legal status and subjected to harsher penalties.

In 2010, the *Combat Methamphetamine Enhancement Act* was enacted and places restrictions on distributors and retailers who sell products used in the illegal manufacture of methamphetamine. Distributors may only sell such products to those who are registered with the DEA. Retailers must comply with regulations that limit the amount of product that can be sold to an individual.¹¹

Many states have child abuse or endangerment laws that specify stiffer penalties for meth related crimes in the presence of a child. In 20 states, the manufacture or possession of methamphetamine in the presence of a child is a felony. Nine states have enacted enhanced penalties for any conviction for the manufacture of methamphetamine when a child was on the premises where the crime occurred.⁶³ Children in homes with meth labs are exposed to toxic chemicals and commonly experience physical, sexual or emotional abuse or neglect by parents experiencing a high or coming down from one or by others coming into the home as a result of meth use or sales.¹⁶ Living in or around a meth lab constitutes a hazardous lifestyle for a child and subjects them to explosions, fires, booby traps, loaded guns and other weapons, and dangerous animals. Living quarters are frequently substandard and include unclean conditions; exposed wiring; lack of heating, cooling, refrigeration, clean water and sanitary facilities; poor ventilation, and play areas infested with rodents and insects. Parents who abuse meth are unable or unwilling to provide an appropriate child rearing environment. This may cause stress and trauma to the child. Consequences can include emotional problems, delinquency and isolation. Without intervention, these children may themselves become drug abusers.⁵⁷ Children are present in approximately 10% of all meth-related seizures and accidents.

A second generation meth detection device, a hand held, battery operated scanner, is

able to detect meth on skin, clothes, plastic, wood, metal and masonry. The original device was introduced in 2004-2005 and had a high number of false positives. The newer version has eliminated this problem.¹⁵ Despite the wide variety of ingredients used to cook meth, the resulting meth molecule emits a unique spectral signal. Legal questions remain: Does this constitute plain sight or does this scanning need a warrant? Is the presence of meth evidence of criminal activity? Trace amounts of drugs show up on everyday items, such as paper money. An investigation into the reason meth is detected is necessary to determine criminal conduct. Current users of the device include home inspectors, housing authorities, hotels, drug treatment centers, prisons, parole officers and the Bureau of Indian Affairs.¹⁵ Law enforcement agents can use the scanner without opening baggies or waxed paper thus reducing their exposure to meth. Since small amounts of meth are absorbed through the pores, this represents a health benefit over time.

Rehabilitation Programs

As a percentage of all drug abuse treatment admissions since 2002, meth admissions peaked in 2005 at 9.1%. There has been a steady decline in admissions to a low of 5.8% in 2011.³³ A SAMHSA report states the meth recovery is about 5% and the life expectancy of an addict is 7 years.²² Although meth abuse has been an issue for more than 70 years, it is only recently that treatment approaches have been investigated and are therefore in the early stages of development and evaluation. Most are borrowed from successful cocaine dependence therapy programs.⁴⁴ Effective treatment of methamphetamine-dependent patients poses many challenges, some of which are unique. For instance, poor treatment engagement and high treatment dropout rates, severe or ongoing paranoia or psychotic symptoms, high relapse rates, and intense protracted cravings, dysphoria (unease or dissatisfaction with life), and anhedonia (inability to feel pleasure) are among the commonly cited obstacles to success.⁴⁴ Many of the challenges of meth addiction treatment stem from the effects of the drug itself. Meth abuse results in cognitive impairment such as deficits in attention, impulse control and task performance. These deficits make it

difficult or impossible for the abuser to benefit from programs that focus on motivations for abstinence, strategies for avoiding drug use or promoting relapse prevention as these require the patient to attend sessions, comprehend information and remember skills presented.⁴⁴ In addition, determining the most effective treatment components is further complicated by the special needs of methamphetamine-using subgroups such as women and gay or bisexual men.⁴⁴ Special needs of female meth addicts include high frequency of personal and social disadvantage, psychiatric illness, and a history of sexual and/or physical abuse. Failure to address these issues and related disorders (for instance, post-traumatic stress from sexual abuse) may contribute to resumption of meth use. For gay or bisexual men, meth use is deeply intertwined with sexual and social behavior and rates of abuse can be as high as 20 times the general population.⁴⁴ Meth use is known to increase the frequency and duration of sexual encounters and result in the abandonment of safe sex practices. Group treatment sessions that cover such topics as sexual risk reduction, sexual behavior and recognizing meth use in sexual partners yet include heterosexual men could increase the likelihood of poor treatment engagement and early dropout for both groups.

The recommended treatment for methamphetamine abuse is cognitive-behavioral intervention in an intensive outpatient setting.⁵ This type of treatment teaches clients to recognize the conditioned cues that lead to methamphetamine use and the subsequent cravings produced. Once clients understand and identify their personal cues, they may use the following strategies to avoid meth use: extensive relapse-prevention activities, participation in 12-step programs, urine testing, individual therapy, family therapy and social support groups. The typical treatment protocol lasts 8-16 weeks, and uses a chronic illness model, where monitoring and management is provided for long periods of time, perhaps a lifetime. Shorter treatment intervals show less positive outcomes. Longer treatment times are more successful.¹²

A cognitive-behavioral intervention program, *The Matrix Model*, was developed by Richard Rawson, a leading expert on meth addiction. It is specifically designed for those addicted to

stimulants such as meth. The Matrix Model is a 16-week comprehensive behavioral treatment approach that combines behavioral therapy, family education, individual counseling, 12-step support, drug testing and encouragement for non-drug-related activities.³⁰ Methamphetamine recovery support groups also appear to be effective adjuncts to behavioral interventions that can lead to long-term, drug-free recovery.¹³

Adding Contingency Management – using behavioral principles to reinforce the occurrence of the targeted behavior – is effective in rates of abstinence, completion of recovery-related activities and treatment completion.⁴³ The ‘fishbowl’ version uses a variable ratio reinforcement schedule instead of a fixed ratio. Each time the desired behavior occurs, the participant draws a prize voucher. The longer the behavior continues, the more vouchers are drawn. Although each voucher may not equal a tangible prize (much less expensive to do) the chance to collect enough vouchers to exchange for a desired prize is still motivating.^{42,71} Vouchers can be exchanged for non-cash goods and services that promote a drug-free lifestyle such as food, clothes, housing, electronics and sports equipment.

Research has verified that frequent 15-minute sessions are more effective for meth treatment than the longer, less frequent sessions commonly employed for treating other addicts. This is due to the short attention span of most meth addicts.¹⁴

Another rehabilitation concept is a meth boot camp. In Minnesota, addicts spend 6 months detoxifying prior to spending an additional 6 months in a regimented schedule of exercise, literacy, education and military drills followed by reintroduction to the community. A version of this program called Challenge Incarceration Program (CIP) is being used by prison systems. The goal of CIP is to help the inmate gain the resources needed to return to the community drug- and crime-free. Results are promising and costs are less than or equal to non-CIP participants.

All treatment programs should provide testing for HIV/AIDS, hepatitis B and C and other infectious diseases. Counseling can help

patients adjust behaviors to reduce the risk of infection for themselves or others. Those already infected should be treated.

The use of technology – computers, websites, mobile devices – has the ability to enhance the power, reach and cost-effectiveness of behavioral treatment.³¹ Patients who live in remote areas or have limited mobility will have easier access to treatment. Patients who cannot or will not attend live sessions may benefit from computer programs designed to teach relapse-avoidance skills, for example. Supplement or emergency support can be provided via telephone or the web.

Currently, there are no specific pharmacological treatments that counteract the specific effects of meth or that prolong abstinence from and reduce the abuse of meth by an addicted individual.³⁰ Strategies for effective pharmacotherapy include targeting the depressed mood and drug cravings associated with withdrawal, using drugs that elicit an aversive response when meth is ingested, using agents that block the positive effects of meth, treating the co-morbid conditions, and providing agonist therapy. The agonist approach attempts to substitute a drug with less negative side effects that targets the same receptors in the brain, in an attempt to gradually eliminate drug dependence.⁴⁴ The existing pharmacological approaches are borrowed from experiences with treatments of cocaine and opioid dependence. Unfortunately, these approaches have provided minimal success since no single agent has proven effective in controlled clinical studies. Antidepressant medications are helpful in combating the depressive symptoms frequently seen in meth users who recently have become abstinent. Bupropion, commonly known as Wellbutrin is showing some promise in meth recovery of low to moderate users. It is hypothesized that it reduces the methamphetamine induced “high” as well as drug cravings elicited by drug-related cues. In a small study, bupropion helped the user feel better as well as prolonging periods of drug abstinence. Fluoxetine (Prozac®) has decreased drug cravings in short-term treatment. Imipramine (Tofranil™) has increased the duration of adherence to treatment in medium-

term treatment. Modafinil (Provigil®) is a drug indicated for use in patients with excessive daytime sleepiness secondary to narcolepsy or sleep apnea. Modafinil (Provigil®) acts as a dopamine agonist and may help normalize brain dopamine function and improve abstinence rates in meth abusers. Naltrexone (Revia®) is an opiate receptor antagonist commonly used to treat alcohol and opiate dependence. In a small study, naltrexone was shown to reduce cravings and relapse in meth addicts. These treatment options need further research to verify efficacy in meth addiction treatment.^{7,32,44}

Novel treatment approaches are being researched and tested. Under study is the idea of using the body’s immune system to neutralize the drug in the bloodstream before it reaches the brain.^{30,37} This approach includes injecting the meth user with antimeth antibodies, such as monoclonal antibody mAb7F9, or a vaccine that would stimulate the body to produce its own antimeth antibodies. A second approach centers on the glial cells which function in the brain like the immune system functions in the body. A drug, AV411 or ibudilast suppresses the neuroinflammatory actions of glial cells and has been shown to inhibit meth self-administration in rats. Research is promising and is being fast-tracked to establish its safety and efficacy in humans.³⁷ A third approach is looking at the role of gamma-aminobutyric acid (GABA) neuron whose function is to decrease dopamine transmission, possibly decreasing the reinforcing effects of meth. In a small study, recipients of the GABA agonist baclofen (Gablofen®) exhibited great numbers of meth-negative urine samples suggesting a small but positive effect in reducing meth use.³⁷

Emergency department treatments focus on the immediate symptoms including control of agitated, hyperactive or violent behavior; airway maintenance; management of cardiac conditions such as ischemia and tachycardia; using ice baths to bring down the dangerous hyperthermia; treating heavy metal toxicity; and administration of anticonvulsants. Patients are then referred for methamphetamine abuse treatment.

Meth Labs

There are many ways law enforcement agents discover a meth lab. They can be discovered during the course of everyday law enforcement work, investigations, and traffic stops; inadvertent discovery during unrelated enforcement actions such as domestic calls or disputes between neighbors; during human services related investigations or when responding to a fire, explosion or odor complaint.

The signs that an illegal meth production lab – clandestine or ‘clan’ lab – is in operation include:

- Excessive traffic, especially at unusual times
- Windows covered with foil, plywood or cloth
- Reinforced doors
- Unusual security such as video surveillance, alarm systems or guard dogs
- Strong chemical odors such as ether or ammonia
- Renters who pay the rent in cash
- Weapons ranging from a single handgun to an arsenal of high powered weapons and explosives
- Excess trash especially empty containers from antifreeze, lantern fuel and drain cleaner
- Lack of signs of routine living such as no mail or newspaper delivery or little or no furniture
- Laboratory glassware or other paraphernalia like rubber tubing either being carried into the residence or loaded in vehicles

Conversion labs are those labs that convert liquid meth to a crystalline substance. The liquid meth is heated to evaporate the liquid. Something as available as a turkey fryer can be used to evaporate the liquid. These labs still have the potential to be dangerous due to fire and explosion possibilities. Additionally, due to the concentration of the liquid meth, inadvertent ingestion and overdose is possible.

Meth labs can be found in a number of locations including outbuildings, moving and parked vehicles, storage units, wooded/secluded areas, houses, hotel/motel rooms... just about anywhere (Figure 9).

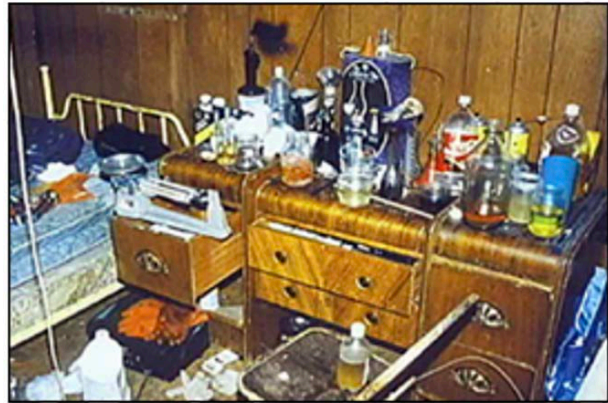


Figure 9. Meth lab.

Source: activerain.com

Meth labs are dangerous for many reasons despite the fact that the ingredients seem to be safe household items. When the ingredients are mixed and heated, explosions and fires can result, toxic fumes can lead to breathing problems, and the resulting waste contains heavy metals, corrosive liquids and acid vapors. Meth cookers have very little, if any, chemistry training and pay little attention to proper chemical storage.

If you find a meth lab, your personal safety is the primary consideration. Notify the appropriate authorities immediately. Be aware of wind direction to avoid exposure to chemical vapors. Inform authorities if you believe you have been contaminated. Being nosy can cause serious harm or death (Figure 9).

In order to clean up meth labs and dump sites, personnel must have special training. The DEA facilities in Quantico, Virginia, and a newer facility near Kansas City provide 3 levels of training:

1. The most basic level of training is one week long and is designed for state and local law enforcement. These seminars are held around the country as well.
2. The second level is a two week course for DEA agents that covers investigative techniques as well as chemical safety.
3. The most advanced course is available only to DEA agents who have completed the two-week course. This advanced level course is one week long.

Since the inception of these training programs no DEA agents have been seriously hurt or killed in a clan lab investigation. Annual recertification is required to maintain efficiency and safety, as well as learn the latest techniques and information. Annual medical and physical evaluations are performed to be certain the agents are protected from the hazardous chemicals. Graduates of the program receive personal protective equipment including boots, clothing, goggles, gloves and respirators. A typical cleanup can take 8-15 hours. The typical cleanup used to cost an average of \$17,000 but due to improved techniques, the cost has dropped to approximately \$5,000. One cost-saving measure is the *Container Program* piloted by the DEA in Kentucky. Trained law enforcement officers package and transport hazardous waste to a secure central location, resulting in dramatically reduced costs to the state. Federal funding for meth lab cleanup is diminishing and impacting such states as Tennessee, Alabama, Michigan, Mississippi and Arkansas. Finding money in already stretched budgets is a challenge and may result in the decline of proactive meth lab searches. Several states, including Georgia, Indiana, Kansas and Tennessee, participate in the *Container Program*. In 2014, Indiana was the top meth lab state with 1,471 meth lab seizures.⁶⁶

At this time, there are no federal regulatory standards, and few state standards, to identify levels of contamination that can be safely tolerated by individuals reoccupying a former meth lab. It is generally too expensive to decontaminate cars, mobile homes, campers

and other types of mobile residences so they are usually destroyed. There are no national regulations dealing with how to clean up a former meth lab although the EPA does publish voluntary cleanup guidelines. It is generally agreed that areas where meth has been smoked are less contaminated than production labs but these areas would benefit from the use of these cleanup guidelines.⁷⁵ The following procedures are recommended for residences previously used as meth labs: several days of ventilation; disposal of carpeting, wallpaper, paneling, furniture, and drapes; washing of all surfaces twice; sealing and painting ceilings, walls and wood floors; cleaning furnaces, air conditioners and ducts. Plumbing should be inspected to determine if products were dumped in sinks, drains or toilets. Residual products can give off fumes. Check to see if the septic system has been contaminated. If yard contamination due to dumping is suspected, contact the local health department or department of natural resources for advice. It is suggested that states enact laws covering cleanup of former meth labs as well as disclosure if real estate or cars were former meth labs. Local law enforcement or health departments may maintain a list of former meth labs.

Conclusion

Methamphetamine abuse is a topic of national concern and its use is continuing within the general population. It is essential that the dental professional be aware of the indications of meth use, have the knowledge to appropriately treat dental concerns, and refer the patient for necessary medical intervention.

Course Test Preview

To receive Continuing Education credit for this course, you must complete the online test. Please go to: www.dentalcare.com/en-us/professional-education/ce-courses/ce332/test

- 1. Federal legislation regarding meth began in the _____.**
 - A. 1920s
 - B. 1950s
 - C. 1970s
 - D. 1990s
- 2. Street names for meth include _____.**
 - A. tips
 - B. syrup
 - C. crystal
 - D. quartz
- 3. Users of meth are known as _____.**
 - A. cookers
 - B. crankers
 - C. speeders
 - D. tweakers
- 4. The pill form of meth can be _____.**
 - A. blue
 - B. green
 - C. pink
 - D. All of the above.
- 5. What is the most common manner that methamphetamine is ingested?**
 - A. Orally (in pill form)
 - B. Optically
 - C. Injected
 - D. Smoked
 - E. Snorted
- 6. The following crimes are often associated with meth users and producers _____.**
 - A. domestic violence
 - B. identify theft
 - C. rape
 - D. All of the above.
- 7. It is estimated that approximately 23.4 billion dollars are spent yearly in the U.S. due to meth abuse. Which of the following are the reasons for this burden?**
 - A. Drug treatment expenses
 - B. Criminal justice expenses
 - C. Loss of productivity
 - D. Protecting children
 - E. All of the above.

8. **Programs such as Ohio's Face:Meth program _____.**
A. identify the methamphetamine users by the formication marks on their face
B. educate employees to spot purchases that indicate someone is gathering ingredients to make meth
C. educate police to safely confront methamphetamine users
D. None of the above.
9. **The main ingredient in meth is _____.**
A. phenylephrine
B. pseudoephedrine
C. pseudomonas
D. psyllium
10. **Meth labs can be found in such areas as National Parks because _____.**
A. unpleasant odors may be less noticeable
B. raw ingredients are more easily obtained
C. meth producers tend to live in rural areas
D. All of the above.
11. **What country is the major supplier of methamphetamine to the United States?**
A. Mexico
B. Canada
C. Dominican Republic
D. Cuba
12. **The typical meth user is _____.**
A. male
B. female
C. between the ages of 19-30
D. a college student with a low GPA
13. **The following regions in the United States have the highest rate of methamphetamine use _____.**
A. Mid-Atlantic and Western
B. Great Lakes and Northeast
C. West Coast and Hawaii
D. Southeast and Midwest
14. **Meth has legitimate medical uses including _____.**
A. the treatment of narcolepsy
B. short-term treatment of obesity
C. Both A and B
D. Meth has no legitimate medical uses.
15. **A unique manifestation of methamphetamine abuse is punding. Punding involves _____.**
A. excessive sleepiness
B. non-goal-directed repetitive activity for prolonged periods of time without any apparent gain
C. infliction of pain to oneself
D. delayed reaction to external stimuli

16. **Short-term effects of meth use include _____.**
- A. narcolepsy
 - B. increased salivation
 - C. hyperactivity
 - D. lethargy
17. **Effects of long-term meth use include _____.**
- A. asthma
 - B. stroke
 - C. depression
 - D. narcolepsy
18. **_____, also called speed bumps or meth sores, are lesions and scabbing on the face, arms, torso and legs. They are commonly found on users who scratch at imaginary insects.**
- A. Pimples
 - B. Formication
 - C. Hives
 - D. Blemishes
19. **Indications of meth use include _____.**
- A. sudden mood swings
 - B. bizarre behavior
 - C. repetitive motor activity
 - D. All of the above.
20. **Smoking meth is damaging to the oral cavity because _____.**
- A. the caustic vapors are drawn into the mouth
 - B. meth users don't attend to oral hygiene needs
 - C. users consume sugared beverages
 - D. All of the above.
21. **Oral indications of meth use include _____.**
- A. caries only
 - B. caries and periodontal diseases
 - C. bruxism only
 - D. caries, bruxism and lichen planus
22. **Dental treatment of the patient with meth mouth should include preventive measures such as _____.**
- A. nutritional counseling
 - B. prescription fluoride treatments
 - C. oral hygiene instruction
 - D. xerostomia products
 - E. All of the above.
23. **Safety tips for dealing with a meth user include _____.**
- A. keep your hands visible to the user
 - B. talk loudly to keep their attention
 - C. get close to the user to keep them in control
 - D. All of the above.

- 24. Treatment options for meth abuse include _____.**
- A. cognitive-behavioral intervention
 - B. use of Methadone as indicated
 - C. medications that increase dopamine in the brain
 - D. All of the above.
- 25. Signs of a meth lab include _____.**
- A. unusual security like video cameras and guard dogs
 - B. obvious signs that someone is inhabiting the house
 - C. renters who are early with rent payments
 - D. All of the above.
- 26. Meth labs may be found in _____.**
- A. hotel/motel rooms
 - B. public storage units
 - C. wooded or secluded areas
 - D. All of the above.
- 27. Meth labs are dangerous because _____.**
- A. the ingredients for making meth are very dangerous
 - B. mixing and heating the ingredients can cause explosions
 - C. the ingredients in meth give off toxic fumes
 - D. All of the above.
- 28. The preparation needed to clean up a meth lab includes _____.**
- A. graduation from specific DEA courses
 - B. use of protective clothing and respirators
 - C. annual recertification and medical evaluation
 - D. All of the above.
- 29. What state had the most meth lab seizures in 2014?**
- A. Ohio
 - B. Texas
 - C. Indiana
 - D. California
- 30. Decontamination of vehicles used as meth labs include _____.**
- A. ventilation for two days
 - B. shampooing the upholstery
 - C. sanitizing the air conditioning/heating systems
 - D. None of the above.

References

1. American Dental Association. Oral Health Topics. Methamphetamine use and oral health (meth mouth). 2014. Accessed November 5, 2019.
2. Beistle KS. Recognizing and treating "meth mouth." *J Pract Hyg* 2006; March: 27-28.
3. Brunsman B. Education program targets meth. *Associated Press. The Cincinnati Enquirer*. August 6, 2010.
4. CBS News. Teen died after drinking liquid methamphetamine. Jan 15, 2014. Accessed November 5, 2019.
5. Center for Substance Abuse Treatment. Treatment for stimulant use disorders. HHS Publication no. SMA 99-3296. 1999.
6. Chang L, Ernst T, Speck O, et al. Additive effects of HIV and chronic methamphetamine use on brain metabolite abnormalities. *Am J Psychiatry*. 2005 Feb; 162(2):361-9. doi: 10.1176/appi.ajp.162.2.361.
7. Courtney KE, Ray LA. Methamphetamine: An update on epidemiology, pharmacology, clinical phenomenology, and treatment literature. *Drug Alcohol Depend*. 2014 Oct 1;143:11-21. doi: 10.1016/j.drugalcdep.2014.08.003. Epub 2014 Aug 17.
8. Curtis EK. Meth mouth: a review of methamphetamine abuse and its oral manifestations. *Gen Dent*. 2006 Mar-Apr;54(2):125-9; quiz 130
9. Di Cugno F, Percec CJ, Tocci AA. Salivary secretion and dental caries experience in drug addicts. *Arch Oral Biol*. 1981;26(5):363-7.
10. Discovery Place. Stages of addiction. 2015. Accessed November 5, 2019.
11. Freeman PR, Talbert J, Troske, S. Impact of state laws regulating pseudoephedrine on methamphetamine trafficking and abuse. A white paper of the National Association of State Controlled Substance Authorities. 2016 Apr. Accessed November 5, 2019.
12. Gonzales R, Ang A, Marinelli-Casey P, et al. Health-related quality of life trajectories of methamphetamine-dependent individuals as a function of treatment completion and continued care over a 1-year period. *J Subst Abuse Treat*. 2009 Dec;37(4):353-61. doi: 10.1016/j.jsat.2009.04.001. Epub 2009 Jun 23.
13. Hazelden Publishing. The Matrix Model. Accessed November 5, 2019.
14. Holley M. How Reversible is Methamphetamine-related Brain Damage? *ND Law Review*. 2006; 82:1135-1149. Accessed November 5, 2019.
15. Hood, R. Meth guns: New technology for correctional settings. *CorrectionsOne.com*. October 11, 2011. Accessed November 5, 2019.
16. Irvine GD, Chin L. The environmental impact and adverse health effects of the clandestine manufacture of methamphetamine. *NIDA Res Monogr*. 1991;115:33-46.
17. Johnson M. What is methamphetamine and methamphetamine lab dangers? *Northeast Community Challenge Community Education*. May 2006.
18. Juozapavicius J. Meth method harder to catch. *Associated Press. The Cincinnati Enquirer*. August 25, 2012.
19. Kellman L. Meth crackdown part of Patriot Act. *The Associated Press. USA Today*. March 7, 2006. Accessed November 5, 2019.
20. Kelly BC, LeClair A, Parsons JT. Methamphetamine use in club subcultures. *Subst Use Misuse*. 2013 Dec;48(14):1541-52. doi: 10.3109/10826084.2013.808217. Epub 2013 Jul 12.
21. Kelsch N. Meth mouth and dental considerations, *Journal of the California Dental Hygienists' Association*. 2006. Jan; 22(2):18-26.
22. Kelsch N. Methamphetamine abuse-oral implications and care. *RDH*. 2010 Feb; 30(2):72-78. Accessed November 5, 2019.
23. Kelsch N. Why meth? Not in my town. *RDH*. 2009 Jan: 62-68, 81. Accessed November 5, 2019.
24. Majewski RF. Adolescent caries: a discussion on diet and other factors, including soft drink consumption. *J Mich Dent Assoc*. 2001 Feb;83(2):32-4.
25. Measure urges tracking of cold-medicine sales. *Associated Press. The Cincinnati Enquirer*. March 17, 2012.

26. Murphy DC, Wilmers S. Patients who are substance abusers. *N Y State Dent J*. 2002 May;68(5):24-7.
27. National Drug Intelligence Center. Oklahoma drug threat assessment. 2002 Oct. Accessed November 5, 2019.
28. National Drug Intelligence Center. Yaba fast facts: questions and answers. Accessed November 5, 2019.
29. National Geographic. World's most dangerous drug. DVD 2006.
30. National Institute on Drug Abuse. Methamphetamine. 2009. Revised May 2019. Accessed November 5, 2019.
31. National Institute on Drug Abuse. New tools and strategies to bolster behavioral therapy. 2010. Accessed November 5, 2019.
32. National Institute on Drug Abuse. Research Report Series. Methamphetamine. 2013. Accessed November 5, 2019.
33. National Meth Center. Drug information. 2015.
34. Office of National Drug Control Policy. Methamphetamine trends in the United States. 2010. Accessed November 5, 2019.
35. PBS.org. Meth and crime: a sheriff's insight. May 23, 2008. Accessed November 5, 2019.
36. Peterson D. Drug use and oral clues. February 6, 2008.
37. Petit A, Karila L, Chalmin F, et al. Methamphetamine addiction: a review of the literature. *J Addict Res Ther* S1:006. doi:10.4172/2155-6105.S1-006. Accessed November 5, 2019.
38. Prah PM. Methamphetamine: Are tougher anti-meth laws needed? *CQ Researcher*. 2005;15(25):589-61. Accessed November 5, 2019.
39. Ravenel MC, Salinas CF, Marlow NM, et al. Methamphetamine abuse and oral health: a pilot study of "meth mouth." *Quintessence Int*. 2012 Mar;43(3):229-37.
40. Rhodus NL, Little JW. Methamphetamine abuse and "meth mouth." *Pa Dent J (Harrisb)*. 2008 Jan-Feb;75(1):19-29.
41. Rippeth JD, Heaton RK, Carey CL, et al. Methamphetamine dependence increases risk of neuropsychological impairment in HIV infected persons. *J Int Neuropsychol Soc*. 2004 Jan;10(1):1-14.
42. Roll JM, Huber A, Sodano R, et al. A comparison of five reinforcement schedules for use in contingency management-based treatment of methamphetamine abuse. *Psychological Record, Win* 2006;56, 67-81. Accessed November 5, 2019.
43. Roll JM, Petry NM, Stitzer ML, et al. Contingency management for the treatment of methamphetamine use disorders. *Am J Psychiatry*. 2006 Nov;163(11):1993-9.
44. Rose M. Methamphetamine abuse and dependence. 2014. Continuing education. Accessed November 5, 2019.
45. Roussotte F, Soderberg L, Sowell E. Structural, metabolic and functional brain abnormalities as a result of prenatal exposure to drugs of abuse: evidence from neuroimaging. *Neuropsychol Rev*. 2010 Dec;20(4):376-97. doi: 10.1007/s11065-010-9150-x. Epub 2010 Oct 28.
46. Rusyniak DE. Neurologic manifestations of chronic methamphetamine abuse. *Psychiatr Clin North Am*. 2013 Jun;36(2):261-75. doi: 10.1016/j.psc.2013.02.005. Epub 2013 Apr 11.
47. Salter J. Meth victims burning money. Associated Press. January 25, 2012.
48. Salter J. Meth still flourishes despite tracking laws. Associated Press. January 10, 2011.
49. Seckman CH. The oral clues, Iowa program targets dental offices in the fight to identify and prevent drug abuse. *RDH* 2002;22(11):66,68,99. Accessed November 5, 2019.
50. Shaner JW, Kimmes N, Saini T, et al. "Meth mouth": rampant caries in methamphetamine abusers. *AIDS Patient Care STDS*. 2006 Mar;20(3):146-50.
51. Shetty V, Harrell L, Murphy DA, et al. Dental disease patterns in methamphetamine users: Findings in a large urban sample. *J Am Dent Assoc*. 2015 Dec;146(12):875-85. doi: 10.1016/j.adaj.2015.09.012.
52. Shetty V, Mooney LJ, Zigler CM, et al. The relationship between methamphetamine use and increased dental disease. *J Am Dent Assoc*. 2010 Mar;141(3):307-18.

53. Stevenson M. Cartel ramps up meth production. Associated Press. August 28, 2011.
54. Stop Meth Addiction. Tweaker safety tips. Accessed November 5, 2019.
55. Substance Abuse and Mental Health Administration. The DAWN report: emergency department visits involving methamphetamine: 2007-2011. Rockville MD. June 19, 2014. Accessed November 5, 2019.
56. Substance Abuse and Mental Health Service Administration. Results from the 2008 National Survey on Drug Use and Health: National Findings. NSDUH Series H-36, HHS Publication No. (SMA) 09-4434. Rockville MD. 2009. Accessed November 5, 2019.
57. Substance Abuse and Mental Health Services Administration, Results from the 2010 National Survey on Drug Use and Health: Summary of National Findings, NSDUH Series H-41, HHS Publication No. (SMA) 11-4658. Rockville, MD. 2011. Accessed November 5, 2019.
58. Substance Abuse and Mental Health Services Administration, Results from the 2012 National Survey on Drug Use and Health: Summary of National Findings, NSDUH Series H-47, HHS Publication No. (SMA) 13-4805. Rockville, MD. 2013. Accessed November 5, 2019.
59. Substance Abuse and Mental Health Services Administration, Results from the 2014 National Survey on Drug Use and Health: Summary of National Findings, NSDUH Series H-50, HHS Publication No. (SMA) 15-4927. Rockville, MD. 2015. Accessed November 5, 2019.
60. Substance Abuse and Mental Health Services Administration, Results from the 2016 National Survey on Drug Use and Health: Summary of National Findings. 2016. Accessed November 5, 2019.
61. Substance Abuse and Mental Health Services Administration, Results from the 2017 National Survey on Drug Use and Health: Summary of National Findings. 2017. Accessed November 5, 2019.
62. The RAND Corporation. The Economic Cost of Methamphetamine Use in the United States, 2005. The RAND Corporation. Santa Monica, CA. 2009. Accessed November 5, 2019.
63. U.S. Dept. of Health and Human Services, Children's Bureau. Child Welfare Information Gateway. Parental drug use as child abuse. Accessed November 5, 2019.
64. United Nations Office on Drugs and Crime. World Drug Report 2011. United Nations Publication, Sales No. E.11.XI.10. Accessed November 5, 2019.
65. United Nations Office on Drugs and Crime. World Drug Report 2018. United Nations Publication, Sales No. E.18.XI.9. Accessed November 5, 2019.
66. U.S. Department of Justice. Drug Enforcement Administration. Drugs of Abuse: 2017 Edition. Accessed November 5, 2019.
67. U.S. Department of Justice. Drug Enforcement Administration. 2014 National drug threat assessment summary. DEA-DCT-DIR-002-15. November 2014. Accessed November 5, 2019.
68. U.S. Department of Justice. Drug Enforcement Administration. 2017 National drug threat assessment summary. DEA-DCT-DIR-040-17. October 2017. Accessed November 5, 2019.
69. U.S. Department of Justice. Drug Enforcement Administration. 2018 National drug threat assessment summary. DEA-DCT-DIR-032-18. October 2018. Accessed November 5, 2019.
70. Vearrier D, Greenberg MI, Miller SN, et al. Methamphetamine: history, pathophysiology, adverse health effects, current trends, and hazards associated with the clandestine manufacture of methamphetamine. *Dis Mon.* 2012 Feb;58(2):38-89. doi: 10.1016/j.disamonth.2011.09.004.
71. Walker R, Rosvall T, Field CA, et al. Disseminating contingency management to increase attendance in two community substance abuse treatment centers: lessons learned. *J Subst Abuse Treat.* 2010 Oct;39(3):202-9. doi: 10.1016/j.jsat.2010.05.010. Epub 2010 Jul 3.
72. Wheeler M. Researchers ID brain abnormalities in children exposed to methamphetamine in utero. UCLA Newsroom. March 16, 2010.
73. Williams NJ. The impact of methamphetamine abuse on oral health. University of Tennessee Health Science Center College of Dentistry. Continuing Education 2006.
74. Wilson FC, Uslan DZ. Delusional parasitosis. *Mayo Clin Proc.* 2004 Nov;79(11):1470.
75. Wisconsin Department of Health Services. Assessing and Ordering Meth Lab Cleanup. P-47411. February 2018. Accessed November 5, 2019.

Additional Resources

- American Council for Drug Education – Phoenix House - www.phoenixhouse.org
- A Student’s Guide to Recognizing Disorders, Seeking Help and Promoting Wellness - www.affordablecollegesonline.org/college-resource-center/college-student-mental-health
- Balancing Student Stress - www.affordablecollegesonline.org/balancing-student-stress
- Bipolar Disorder - www.healthline.com
- Centers for Disease Control and Prevention - www.cdc.gov
- Community Anti-Drug Coalitions of America - www.cadca.org
- Council for Prevention - www.councilforprevention.org
- Depression Guidebook for Students - www.affordablecollegesonline.org/college-resource-center/college-student-depression
- KCI: The Anti-Meth Site - www.kci.org
- Narconon International - www.narconon.org
- National Association of Chain Drug Stores - <https://www.nacds.org/pse/>
- National Institute on Drug Abuse (NIDA) - www.nida.nih.gov or www.drugabuse.gov
- NIDA for Teens - www.teens.drugabuse.gov
- Office of Community Oriented Policing Services - www.cops.usdoj.gov
- Office of National Drug Control Policy - www.whitehousedrugpolicy.gov
- Ohio Department of Mental Health and Addiction Services - <https://mha.ohio.gov>
- The Partnership for a Drug-Free America - www.drugfree.org
- Street Drugs - www.streetdrugs.org
- Substance Abuse and Mental Health Services Administration (SAMHSA) - www.samhsa.gov
- Substance Abuse in College - www.affordablecollegesonline.org/college-resource-center/substance-abuse-in-college
- U.S. Drug Enforcement Administration - www.dea.gov
- U.S. Environmental Protection Agency - <https://www.epa.gov/emergency-response/voluntary-guidelines-methamphetamine-laboratory-cleanup/>

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