FACTORS INFLUENCING THE USE OF METHAMPHETAMINE BY DENTAL PATIENTS IN THE UNITED STATES

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ABSTRACT

Aim: This literature review explores the multiplicity of issues affecting the use of methamphetamine by dental patients in the United States. Current sources investigating trends in availability of methamphetamine from nontraditional (non-dental) resources are presented. Strategies for communicating with addicted patients are presented.
Summary: Issues of addiction and recovery from this highly addictive drug are explored, as well as its well-known destructive effects on the dentition.
Key Learning Points: The review draws from current literature in the fields of addiction, substance abuse and recovery, dentistry and psychology. Treatment recommendations are drawn from evidence in interprofessional fields.
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1. Introduction

To effectively address the methamphetamine issue in our health care settings, we must have a thorough understanding of the drug's historical progression, and its impact on the United States. Amphetamine was initially synthesized in Germany in the late 1880's. Several years later, Japanese pharmacologist Nagayoshi Nagai's advancements with ephedrine allowed for the production of substances containing amphetamines on a larger scale. Amphetamine-type stimulants (ATS) gained global prominence during WWII. Soldiers were administered ATS in order to increase alertness, reduce fatigue, and diminish appetite.[1] After the war had ended, Amphetamine use gained social prevalence in several countries, including the United States. During the 1960's, manufactured ATS pills were commonly used by young adults, college students, and truck drivers to increase mood and alertness. The widespread use of substances that contained amphetamines began to shed light on the damaging psychological and physiological impacts to the body. In response, the United States government attempted to halt the progression of ATS by implementing the Comprehensive Drug Abuse Prevention and Control Act of 1970, which regulated the use of drugs containing amphetamines to medical settings. This caused a sharp decline in use of the drug's most common form of methamphetamine; curtailing its presence of meth to the western regions of the United States. Unfortunately, the following decades witnessed the rise of Wild West of Meth, fueled by the triad of Mexican drug cartels, biker gangs, and high volume of the production of methamphetamine via rural "meth labs". Inevitably, methamphetamine use began to geographically spread and reached epidemical levels across the nation. Between 1992 and 2002, an alarming spike in treatment admissions for amphetamine-related instances rose by 920% in the Midwest, 560% in the South, 455% in the West, and 45% in the Northeast.[2,3] Social outcry and public health concerns caused the government to again attempt to stamp out the issue of methamphetamine use in America. The Combat Methamphetamine Epidemic Act of 2005 was incorporated into the Patriot Act, and signed into law by former President Bush in March 2006. The Combat Methamphetamine Epidemic Act regulates over the counter purchases of products containing ephedrine, pseudoephedrine, and phenylpropanolamine in hopes of deterring the production of methamphetamine in meth labs. While recent federal regulations have decreased methamphetamine production by individuals in the United States, the roles of producer and distributor have been aggressively seized by Mexican drug cartels. John Carnevale, an economist who formerly

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worked for the White House Office of National Drug Control explains that the impact of U.S. regulations has increased of drug flow from neighboring countries saying, "We've just created incentives for non-US producers to make more."[4] Gary Hill, a Drug Enforcement Administration assistant special agent in charge of the San Diego area reports similar findings. Hill describes the process by which the methamphetamine trade has evolved. He reports a recent shift of methamphetamine manufacturing to Mexico, Hill estimates that, "About 90 percent of meth now comes from outside of the US."[4] The drugs are then stashed in large California metropolitan areas such as Los Angeles and San Diego counties, before being distributed across the country. The Mexican Drug Cartel influence has undoubtedly changed the landscape of drug presence in the United States.

1.1. Background

Conventional wisdom would lead one to believe that the January 2016 re-capture of infamous drug lord Joaquín "El Chapo" Guzmán would disrupt the cartel's operations. However, research conducted by the U.S. Customs and Border Protection found that the arrests or death of key Drug Trafficking Organization (DTO) leadership shows no discernable impact on overall drug flow in the United States. The research report explains that DTO operations have created a built in redundancy, personnel, and protocol to mitigate the impact of the removal of any one person.[5] It is clear that the regulatory measures have done little to address the issue of methamphetamine abuse in the United States. Instead, preventative measures may be more effective than punitive responses. Discussing how to deal with the methamphetamine problem in the U.S., Carnevale stresses the need for a comprehensive approach to combat the issue stating, "We need to focus heavily on prevention and education efforts to teach people about long-term effects. Meth use needs to be brought back into the national dialogue."[4]

2. Prevalence

On a global scale, methamphetamine use trends have continued to climb in the past several years. According to the United Nations Office on Drugs and Crime, there are an estimated 25 million abusers of methamphetamines worldwide. These figures exceed both cocaine and heroin, which were estimated to be 14 million and 11 million respectively.[6] A possible explanation for the increase prevalence of methamphetamine is the ability to produce the drug with commonly accessible synthetic chemicals as compared to the natural derivatives of heroin and cocaine. Nationwide estimates show that number of persons aged 12 or older who were current nonmedical users of stimulants was 1.4 million, which was higher than estimates in 2012 (1.2 million) and 2011 (970,000). Methamphetamine abuse mirrored the upward trend of stimulant use for persons aged 12 or older. In 2013, estimates of methamphetamine were 595,000, which were higher then estimates for 2012 (440,000) and 2011 (439,00).[3] Furthermore, the number of methamphetamine initiates (first time users) among persons aged 12 or older was 133,000 in 2012, which was similar to estimates in 2011, and up from 2010 (107,000).[6]

3. Demographics

A variety of factors contribute to methamphetamines and stimulants use across multiple demographics. A 2004 study in New York's club scene found that significantly higher proportion of Caucasian individuals reported lifetime use of methamphetamine compared to African American and Hispanic individuals.[7] In a second study, several of the same authors found differences in other illicit drug use between ethnic groups in New York City, such as higher rates of injected drug and ecstasy use amongst Caucasians; along with increased rates of heroin use for Caucasians and Hispanics compared to African Americans.[8] While these findings were isolated to a specific region, they do point out that methamphetamine use rates vary depending on the setting and situation.

Methamphetamine use is prevalent across genders. Treatment samples indicate that nearly as many women enter treatment for methamphetamine abuse as men. Some women have reported using methamphetamine to cope with issues such as depression, and in attempt to lose weight.[9] Research of adolescent rates of methamphetamine use found that female youth were more likely to use than their male counterparts.[10] Data also suggests women methamphetamine users are more likely to report previous exposures to trauma, including physical and sexual abuse.[11] Messina et al. study revealed that women reported violence and sexual coercion in their relationships where methamphetamine use was present. Further research found that men engaged in more risky sexual behavior than women.[12]

Another group that has been shown to be deeply impacted by methamphetamine use has been the Men who have sex with men (MSM) population. Several studies have found that the MSM population is more likely to use methamphetamine, and to have increased rates of risky behaviors associated with methamphetamine use.[1,13,14] A study conducted in San Francisco in 2005 found that rates of HIV tripled for MSM population that used methamphetamine as compared to MSM population who did not use.[13] The increased rates of infectious disease transmission may be due to unsafe sexual practices in combination dangerous injection use amongst active users of methamphetamine.[15,16]

Like many illicit drug use patterns, methamphetamine use is consistently prevalent in areas where individuals of lower socio-economic status (SES) reside.[3,17,18,19] The SES measure refers to an individual's occupational status, income, wealth, and educational attainment relative to other members of their society.[17] Rather than applying methamphetamine use to a specific population, ethnic group, or race; SES may be the most accurate indicator of increased risk of drug use, and poorer health outcomes. In a study of socioeconomic disparities in health behaviors, Pampel et al. suggest that unhealthy behaviors are directly linked to distinct

differences related to an individual's social position and SES.[19] Methamphetamine users who belong to lower SES backgrounds may lack the resources and support to break their cycle of addiction.

3.1. Comorbidity

Methamphetamine use is often compounded by existing mental health disorders, and may induced psychiatric disorders. Salo et al. conducted a sample study of 189 individuals with a history of methamphetamine abuse. The study found that a substantial number of participants also met criteria for the Diagnostic and Statistical Manual for Mental Disorders, Fourth Edition (DSM-IV) diagnoses for psychotic disorders, mood disorders, and/or other substance abuse disorders. Of the sample population, 28.6% a psychotic disorder, about a fourth of the psychotic disorders were substance-induced. 13.2% had methamphetamine-induced delusional disorders, and 11.1% had methamphetamine-induced hallucinations.[20] Previous studies share similar findings, a 106 methamphetamine participant study found a correlation between methamphetamine abuse and reported lifetime history of hallucinations (38%) and paranoia (63%). Another 247 participant study of methamphetamine dependent individuals found that 45% of participants experienced their first episode of paranoia while using the drug.[21,22] Salo et al. study also found that participants reported a significant number of lifetime mood disorders (32.3%) such as depression and anxiety.[20] Moreover, previous research has highlighted the comorbid nature of methamphetamine and mood disorders. The National Epidemiologic Survey on Alcohol and Related Conditions (NESARC) conducted a 43,093 subject analysis finding that the prevalence of mood disorder among participants with amphetamine dependence was 64%.[23,24] In a 2012 study, Weber et al. highlighted the psycho-social impact that methamphetamine dependency and depression have on employment outcomes. The study consisted of 63 participants who had used methamphetamine, 15 who were employed, and 48 that were unemployed. Of the unemployed participants, 30 (62.5%) were either currently diagnosed, or had a lifetime diagnosis of Major Depressive Disorder.[25] Weber et al. study highlights the psycho-social and occupational impairment that methamphetamine use has on lives.

An overarching commonality for methamphetamine is the comorbid abuse of other substances. Referring back to Salo et al. study, 81% of the participants met the criteria for a second substance abuse disorder along with their methamphetamine use. The most common past comorbid drug dependence diagnoses were alcohol (33%), cocaine (27%), and cannabis (15%).[20] The research indicates that cigarette use very strongly linked to methamphetamine use. A 2009 review of the data regarding the prevalence of cigarette use amongst methamphetamine users found that users reported rates of smoking between 87% - 92%.[26]

3.2. Public Health Costs

The gripping comorbid nature of methamphetamine abuse has substantial public health costs in the United States. Publically funded substance abuse treatment programs where methamphetamine was the primary substance addiction being treated increased 255% from 1997 to 2007.[3,20] According to a national report compiled by the RAND Corporation, methamphetamine use cost the United States roughly $23.4 billion dollars in 2005.[27] An Oregon State University Hospital Emergency Department (ED) study tracked 15,038 ED visits in which 383 were methamphetamine related over a 20-week period. Of the methamphetamine related cases, patients presented with psychiatric conditions (18.6%), trauma (18.6%), skin infections (11.0%), and dental disorders (9.6%). Weekly costs for methamphetamine-related ED visits averaged $133,181 dollars, and an estimated annual total of $6.9 million dollars in hospital expenses.[28] The public costs for methamphetamine abuse extends beyond primary care settings. Law enforcement agencies across the country spend substantial amounts of resources to address methamphetamine related incidences of crime. In 2015, The National Drug Early Warning System (NDEWS) published community profiles of several regions areas across the United States. The NDEWS profiles collected drug seizure data provided by the National Forensic Laboratory Information System (NFLIS), and Drug Enforcement Administration (DEA). Methamphetamine related drug reports ranked first in the following major communities: Atlanta-Metro (30.2%), Los Angeles (38 %), Denver-Metro (27.7), and Seattle-King County (29.5%). While in San Francisco, methamphetamine (10.7%) related drug reports ranked second to cannabis (11.3%).[29] The interrelated nature of the methamphetamine abuse, mental health issues, and crime have detrimental systemic costs that burden individuals and communities across the nation.

3.3. Biopsychosocial/ Neurological Effects

Methamphetamine use has been linked to an array of physiological health issues. Once in the blood stream, methamphetamine induces an adverse concentration of monoamine neurotransmitters dopamine, norepinephrine, and serotonin that adversely impact the functioning of the central nervous system. These neurotransmitters are crucial to behaviors and cognition, and play a various roles on behavior such as motivation, attention, arousal, concentration, movement, memory, and learning. When taking the drug, methamphetamine users report feelings of euphoria, abundance of energy, increased motivation, alertness, increased self-confidence, and decreased appetite.[1,30,31] However, the prolonged toxicity of methamphetamine results in excessive stimulation of the sympathetic nervous system, resulting in physiological effects such as elevated heart rate, increase blood pressure, hypertension, hyperthermia, pupil dilatation, sweating, insomnia, and psychomotor agitation.[1,31] Excessive exposure to methamphetamine has also has been linked to chronic health risks such as coronary heart disease, cardiomyopathy, pulmonary edema, stroke, and seizures.[31,32,33] Other effects of methamphetamine use include, dermatological infections, skin ulcerations,

anorexia, and dental carries.[1,33]

3.4. Pharmacology

The lipid soluble nature of methamphetamine assists its rapid movement across the blood brain barrier initiating powerful neurocognitive reactions. Not only does methamphetamine cause an extreme rush of pleasure by releasing dopamine and norepinephrine into nerve terminals, it also inhibits the natural reuptake process, resulting lasting effects of the drug.[1,31,34] This process explains the lengthy half-life of methamphetamine which is 10 and 12 hours, which substantially longer than other stimulants such as cocaine (~90 minutes).[1,30,31] Rothman et al. conducted in-vitro studies finding that methamphetamine has the potential to release twice the amount of noradrenaline as dopamine, and 60 times the amount of noradrenaline release than serotonin.[35] The exponentially powerful effects of methamphetamine give insight to the extremely addictive nature of the drug.

Prolonged use of methamphetamine has been shown to cause chronic health issue. After repetitive drug use, nerve terminals experience neurotoxicity caused by oxidative stress and neuro-inflammation resulting from increased intra and extracellular concentration of dopamine.[31,34,36] The deterioration of these terminals and depleted supply of dopamine impairs the brain's ability to naturally feel pleasure, resulting anhedonia. As a result, risks for methamphetamine abuse greatly rises as individuals increase frequency of use, dosage, and alter routes of administration in attempts to reach previous highs. Once common routes of methamphetamine administration such as smoking and oral ingestion fail to yield desired effects, methamphetamine users often shift to intravenously injections because of the superior bioavailability of the drug in the body's system.[30,31] The elevated concentration and increased potency of intravenous administration accelerates the decline of dopomergenic synapsis while exasperating physiological effects.[30,33,37] Long-term recovery outcomes are adversely affected by intravenous use due to the invasive effects throughout the body. A 3-year follow up study of methamphetamine users in recovery found that individuals who injected the drug reported significantly more severe symptoms of depression than smokers and intranasal users.[38] While dosing characteristics vary between methamphetamine users, binge episodes consisting of persistent and excessive administration of the drug typically last for several days.[30] During binge episodes, individuals often suffer from anxiety, hyper-arousal, and insomnia.1. Methamphetamine users often engage in detrimental personal health practices by consuming sugary food/drinks, and neglecting personal hygiene particularly during binge episodes.[1,33,39]

Current research shows a strong connection between methamphetamine use and a litany of psychological issues that often stem from decrease neurological functioning. Methamphetamine damages neurological processes and is expressed via maladaptive mood, behavior and cognitions. Common psychological effects of methamphetamine include hallucinations, delusions, paranoia, psychomotor agitation, while mood disorders typically manifest as depression, anxiety, and in some cases, bipolar disorders.[1,20,34] Emerging research has been able to explain how the neurological effects of methamphetamine inform the psychological pathology associated with the drug. Scott et al. published an extensive meta-analysis of the neurological effects of methamphetamine use. The review incorporated 18 studies consisting of a total of 951 participants, including 487 participants with a history of methamphetamine use, and 464 normal comparison participants. The meta-analysis aimed to identify the regions of the brain, and neurological functioning that were altered due to methamphetamine use. Scott et al. found that significant deficits were associated to neurological processes related to frontostriatal and limbic circuits. The presence of methamphetamine to these regions of the brain cause cognitive deficits to episodic memory, and executive functioning.[33] Several studies within the meta-analysis highlight the harmful effects of methamphetamine use to episodic memory. Individuals who are dependent on the drug are unable to consciously recall experiences and negative symptoms associated with prior methamphetamine use. Diminished episodic memory may be a reason that the individual repeats past mistakes associated with their drug use.[31,33] Another finding of the meta-analysis was that executive dysfunction is closely related with methamphetamine use. Participants who were dependent on methamphetamine show impairments in executive functioning involving inhibition, decision making, delayed gratification, and attention.[31,33] Other neurological issues associated with methamphetamine addiction include psycho-motor delays and verbal-learning deficits.[37] Debilitated cognitive processes such as working memory and decision-making increase the likelihood for methamphetamine dependency, risky behaviors, and poorer overall health outcomes.

Methamphetamine use has disastrous effects on the brain and body, yet there is evidence to suggest that if an individual can work towards recovery, they have the potential to have positive health outcomes. Research shows that the brain is extremely resilient. Individuals who are recovering from methamphetamine addiction have shown significant decrease of psychological symptoms, and increase in cognitive functioning. In a study involving 34 methamphetamine participants in recovery, Bagheri et al. found that after a just three weeks of abstinence, participants reported a decrease in symptoms of depression, and increase in quality of life.[40] Research indicates that not only mood disorders may be alleviated, but also neuro-cognitive performance has been shown to increase when in recovery. Several studies on participants in recovery found that abstinent individuals were able to improve neurological functioning close to baseline standards.[37,41] Individuals who were in recovery, and/or had achieved abstinence from methamphetamine use displayed marked improvements in assessments

Table 1. Interventions for those patients in the extreme risk category.

RISK CATEGORY	RECARE EXAM	RADIOGRAPHS	SALIVA TESTING	FLUORIDE	XYLITOL	ANTIMICROBIALS, i.e., Chlorhexidine	CALCIUM PHOSPHATE	SEALANTS (Resin-based & Glass Ionomers)	pH Neutralizing
LOW	6+: Every 6-12 months <6: Annual	6+: BWX every 24-36 months <6: BWX every 12-24 months	6+ & <6: Optional at baseline exam	6+ Home: OTC toothpaste 2x daily 6+ In-office: F varnish optional <6 Home: OTC toothpaste; no in-office fluoride	6+ & <6: Optional	6+: If required <6: No	6+ & <6: If required Optional for foot sensitivity (adults)	6+: Optional on sound tooth surfaces <6: Optional on sound tooth surfaces	6+: If required <6: No
MODERATE	6+: Every 4-6 months <6: Every 3-6 months	6+: BWX every 18-24 months <6: BWX every 6-12 months	6+ & <6: Recommended at baseline and recafe exams	6+ Home: OTC toothpaste 2x day + OTC 0.05% NaF rinse daily 6+ In-office: Initially 1-3 applications F varnish & at recafe appt. <6 Home: OTC toothpaste 2x day <6 In-office: F varnish initial visit & recafe Caregiver: OTC NaF rinse	6+: 6-10 grams/day <6: Xylitol wipes & substitute for sweet treats of when unable to brush Caregiver: 2 sticks of gum or 2 mints 4x day (in total 6-10 grams of xylitol per day)	6+: If required <6: Recommend for caregiver	6+: If required Optional for foot sensitivity (adults) <6: Brush with smear (0-2 yrs) of pea size (3-6 yrs) 1x day, leave on at bedtime	6+: Optional on sound tooth surfaces <6: Fluoride-releasing sealants of glass ionomers on deep pits and fissures	6+: If required <6: No
HIGH 1 or more cavitated lesions is considered high risk	6+: Every 3-4 months <6: Every 1-3 months	6+: BWX every 6-18 months <6: Anterior PAX & BWX every 6-12 months	6+ & <6: Required at baseline and recafe exams	6+ Home: 1.1% NaF toothpaste 2x day 6+ In office: Initially 1-3 applications F varnish & at recafe appt. <6 Home: OTC toothpaste 2x day <6 In-office: F varnish initial visit & recafe Caregiver: OTC NaF rinse	6+: 6-10 grams/day <6: Xylitol wipes & substitute for sweet treats of when unable to brush Caregiver: 2 sticks of gum or 2 mints 4x day	6+: 0.12% CHX gluconate 10 ml rinse for 1 minute/day for one week each month Antimicrobial therapy should be done in conjunction with restorative treatment as needed <6: Recommend for caregiver	6+: If required <6: Brush with smear (0-2yrs) of pea size (3-6 yrs) 1x day, leave on at bedtime	6+: Recommended <6: Fluoride-releasing sealants of glass ionomers on deep pits and fissures	6+: If required <6: No
EXTREME (High risk plus dry mouth or special needs) 1 or more cavitated lesions plus hyposalivation is considered extreme risk	6+: Every 3 months <6: Every 1-3 months	6+: BWX every 6 months <6: Anterior PAX & BWX every 6-12 months	6+ & <6: Required at baseline and recafe exams	6+ Home: 1.1% NaF toothpaste 1-2x day & 0.05% NaF rinse when mouth feels dry & especially after eating or snacking 6+ In office: Initially 1-3 applications F varnish & at recafe appt. <6 Home: OTC toothpaste 2x day <6 In office: F varnish initial visit & recafe Caregiver: OTC NaF rinse	6+: 6-10 grams/day <6: Xylitol wipes & substitute for sweet treats of when unable to brush Caregiver: 2 sticks of gum or 2 mints 4x day	6+: 0.12% CHX gluconate 10 ml rinse for 1 minute/day for one week each month Antimicrobial therapy should be done in conjunction with restorative treatment <6: Recommend for caregiver	6+: Apply paste several times daily <6: Brush with smear (0-2yrs) of pea size (3-6 yrs) 1x day, leave on at bedtime	6+: Recommended <6: Fluoride-releasing sealants of glass ionomers on deep pits and fissures	6+: Acid neutralizing rinses/gum/mints if mouth feels dry, after breakfast, snacking, & at bedtime <6: No

Adapted from: Jenson L, Budenz AW, Featherstone JDB, Ramos-Gomez FJ, Spolsky VW, Young DA. Clinical protocols for caries management by risk assessment. J Calif Dent Assoc. 2007;35(10):714-723. Ramos-Gomez F, Crystal YO, Ng MW, Crall JJ, Featherstone JDB. Pediatric dental care: prevention and management protocols based on caries risk assessment. J Calif Dent Assoc. 2010;38(10):746-761.

of fine motor functioning, attention, processing speed, memory, mental flexibility, and verbal fluency.[32,37,41] Furthermore, longer-term abstinence has been associated with reports of discernable improvement in mood and reduction of emotional distress.[41] If abstinence from methamphetamine abuse is sustained, there is data to suggest that structural recovery of neurological composition may occur. Morales et al. found that methamphetamine dependent individuals who were able to attain abstinence for one month displayed an increase of gray matter in all of the cortical regions that were assessed.[42] Continued abstinence from methamphetamine use has been shown to correlate with increase gray matter density. A 2005 study found that participants who achieved long term abstinence (6 months or more) had greater prefrontal grey-matter density and less impairment of frontal executive functioning compared to participants who reported short-term abstinence (less than 6 months).[32] These findings provide strong evidence for individuals who suffer from methamphetamine addiction can recovery to become well-functioning both cognitively and physically.

4. Recommendations for dental treatment

As health care professionals, it is essential that we understand the powerful effects of methamphetamine abuse on the individual and on the community. An appreciation of the interrelated bio-psycho-social factors that contribute to the cycles of methamphetamine abuse is essential for comprehensive treatment. The harmful impact of methamphetamine use, such as neurological deficits in episodic memory, increase rates of psychological disorders, and serious physiological health concerns are interrelated. Moreover, health professionals should be aware of the comorbid nature of methamphetamine use with other psychological and substance abuse disorders.

When dealing with dental disease, it is valuable to know the adverse effects of methamphetamine on oral health. Contrary to common belief, research indicates that intravenous (injection) administration of methamphetamine has been linked with increased rates of dental disease as compared to smoking or inhaling.[39,43] Route of administration is pertinent information for dentists to gather when creating a treatment plan to combat dental disease with a person who is actively using methamphetamine. Thorough information gathering regarding daily activities, such as dietary habits, will also help lead to effective dental treatment. Methamphetamine users have reported increased consumption of sugary drinks, which has been known to cause to increased rates in dental carries with users.[39,43,44]

4.1. Empathetic communication throughout treatment enhances outcomes

This demographic also suffers from periodontal disease which may lead to tooth loss. All information received from a patient should be met with appreciation and empathy. In order to increase likelihood of consistent care, gather information

about the patient's experiences navigating through the health care system. Identify barriers to treatment along, with patient's strengths and concerns about their dental health. In a large urban sample of 571 methamphetamine users, Shetty et al. found that 40 percent of participants felt embarrassed about their dental appearance.[45] Promoting dental health and addressing aesthetic concerns can be a powerful tool to increase mood, confidence, and attitudes towards change. Collaboratively create a treatment plan that focuses on attainable goals centered on harm reduction.

The authors recommend the implementation of caries risk assessment protocols for "extreme risk" patients.[46] (Table 1)

Those patients who express the desire to recover from methamphetamine use are of course the individuals most likely to benefit from our interventions. It is helpful if the dental team can collaborate with the patient's physician to facilitate a referral to a drug treatment program/ facility. A letter tailored to high caries risk patients may be mailed to the patient as follow-up to the office visit. Additionally, the letter may be sent as a copy to the physician of record for the patient. These measures help to remind the patient as well as the physician of the interprofessional collaboration that is occurring on the patient's behalf, and to serve as reminders of the recommendations for home care.

If methamphetamine use continues any treatment rendered by the dentist will not have the probability of success. There is promise in the use of silver diamine fluoride as an agent to halt the progression of caries disease for patients in recovery or for those individuals who have already recovered from their addiction to this substance.[47,48,49] Prior to treatment of carious surfaces with SDF, informed consent must include a discussion of staining and discoloration of affected surfaces, as discussed by the authors.[48,49]

The patterns and severity of dental disease associated with methamphetamine use have been studied. Brown et al, in a project published in the Journal of the California Dental Association, found

Dear (Patient Z),

Our assessment indicates that you are at extreme risk of new dental decay in the near future because you have (fill in the blank) and you have severe "dry mouth" due to (fill in the blank). We want you to move to a safer situation to avoid new decay if at all possible. Please do the following right away:

- Complete a caries bacterial test with us today (as a base line before antibacterial therapy). We will know the results of this test in three days.
- Complete a saliva flow measurement to confirm your extreme dry mouth. This is a very simple test that we will complete today as part of the bacterial assessment.
- Review your dietary and oral hygiene habits with us and receive instructions about how to improve them both. The most important thing is to reduce the number of between-meal sweet snacks that contain carbohydrates, especially sugar. Substitution by snacks rich in protein, such as cheese, will also help as well as the xylitol gum or candies recommended below.
- Brush twice daily with a new strong toothpaste, either Control RX or Prevident Plus toothpaste (5,000 parts per million fluoride). We will provide you with some today. This is to be used twice daily in place of your regular toothpaste.
- Rinse for one minute, once a day with a special antibacterial mouthrinse that we will provide you with today. It is called Peridex or Periogard and has an active ingredient called chlorhexidine gluconate at 0.12 percent. You will use this once daily just before going to bed at night (10 ml for one minute), but only for one week each month. You must use this at least one hour after brushing with the 5,000 ppm fluoride toothpaste.
- Get a fluoride varnish treatment for all of your teeth every three months at your caries recall exams.
- Receive the necessary restorative work such as fillings and crowns, as needed, in a minimally invasive fashion.
- Suck or chew xylitol candies or gum four times daily. You can obtain supplies from us today or we can help you buy these elsewhere.
- Use a special paste that contains calcium and phosphate (e.g., MI paste). Apply it several times daily to your teeth. We will teach you how to do this properly.
- Obtain a thorough professional cleaning during your current visit.
- Get a sealant treatment on all of the biting surfaces of your back teeth to keep them from being reinfected with the bacteria that cause dental decay.
- Use a baking soda rinse (or similar neutralizing product) four to six times daily during the day. You can make this yourself by shaking up two teaspoons of baking soda in an eight-ounce bottle of water.
- Please return when called for a re-evaluation in about one month.
- Please return when requested for a caries recall exam in three months.
- Get new bitewing radiographs (X-rays) about every six months until no cavitated lesions are evident.
- Come in for another caries bacterial test at the three-month visit or sooner to compare results with your first visit to check whether the chlorhexidine is working satisfactorily.
- Receive a review of your use of chlorhexidine and Control RX/Prevident and oral hygiene at that visit.
- Come in for a thorough professional cleaning as needed for your periodontal health.
- Get another fluoride varnish treatment of all teeth again at three-month caries recall visit and another set of bitewing X-rays at six months.

We will provide you with a timetable to help you to remember all of these procedures.

Although this sounds like a lot of things to do and to remember, this intensive therapy is necessary to stop the rapid destruction of your teeth. It can really work, and if you are willing to put in the time and effort, you can clear up your mouth, gums, and teeth and avoid costly restorative dental work in the future. Please help us to help you.

Practitioner signature _____ Date_____

Patient signature _____ Date_____

that methamphetamine users had higher decayed, missing, and filled teeth (DMFT), and that the duration of use significantly increased this score.[50] Recent analysis of this demographic corroborates this finding, and adds to the current knowledge base by establishing that methamphetamine users were twice as likely to have untreated caries as a control group (non-users), and four times as likely to have "caries experience". The data published by this group also found, counter to the popular perception that smoking methamphetamine causes the most severe manifestations of "meth mouth", that injection users of MA had significantly higher rates of tooth decay compared with noninjectors.[51] Periodontal disease was also found to be "unusually high" among meth users. "Whereas 37% of adults aged 35 to 49 years in the US general population have total periodontitis, more than 89% of the MA users showed total periodontitis".[45] Xerostomia and dehydration associated with meth use (mediated by alpha-2 receptors in the brain) causes users to crave sugar, and these individuals crave and typically drink "large quantities of soft drinks".[43] Additionally, oral hygiene may suffer significantly during periods of heavy drug use.[43] Bruxism is reported by 68% of meth users in a study of the effects of chronic meth use on oral health.[5]

Author contributions

Equal contribution to the paper.

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Questions

Methamphetamine may be categorized as one of the following:

❑a. Hallucinogen;
❑b. Stimulant;
❑c. Sedative;
❑d. Opioid.

Methamphetamine may be synthesized:

❑a. Only in large commercial laboratories;
❑b. By amateur chemists in homes, garages, and makeshift laboratories;
❑c. From expensive pharmaceutical grade ingredients purchased from chemical warehouses only;
❑d. Only from precursor amphetamine substrates.

Adverse dental effects of methamphetamine include the following:

❑a. Periodontal disease;
❑b. Craving for sugary drinks;
❑c. Xerostomia;
❑d. All of the above.

Recovery from methamphetamine can be achieved through

❑a. Relatively easy withdrawal methods;
❑b. Difficult long-term substance abuse recovery methods over a period of months or years;
❑c. The use of medically prescribed drugs such as diazepam;
❑d. Immediate full-time employment and reintegration into family and social networks.

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