METHAMPHETAMINE: EPIDEMIOLOGICAL AND RESEARCH IMPLICATIONS FOR THE LEGAL FIELD

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I. INTRODUCTION

The methamphetamine epidemic continues to spread across the United States, which signifies an increasing need for effective treatment. In addition to the already-documented physical effects of the drug, preliminary evidence suggests methamphetamine dependence may cause long-term neuronal damage. Recently abstinent users have been found to do poorly on tests of attention and motor skills, which are factors that can adversely affect treatment outcomes. Methamphetamine use is also implicated in aggression and violence and it also affects the children and adults who are exposed to the behaviors of methamphetamine users as well as to toxic chemicals at laboratory sites. Outpatient treatment programs, such as the Matrix Model, are effective.

II. THE EPIDEMIC OF METHAMPHETAMINE ABUSE

A. TYPES OF METHAMPHETAMINE

The methamphetamine epidemic is characterized both by type and location. Methamphetamine is made from ephedrine or pseudoephedrine.[1] In many parts of the United States, the problems first began with the "home cooking" of methamphetamine using cold allergy products which contained pseudoephedrine.[2] Methamphetamine produced in this powder form is

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1. Jane Carlisle Maxwell, *Emerging Research on Methamphetamine*, 18 CURRENT OPINION IN PSYCHIATRY 235, 235 (2005).

2. *See id.* (identifying California as a source of methamphetamine).

usually inhaled, injected, or swallowed.[3] According to the United States Drug Enforcement Administration (DEA), the price of a gram of powder methamphetamine has declined from $20-$600 in 2002 to $20-$300 in 2005.[4]

The production of powder methamphetamine in small laboratories has decreased with the recent state and federal regulations limiting access to large quantities of over-the-counter pseudoephedrine products.[5] However, the locally-produced methamphetamine has been replaced with large quantities of higher-purity methamphetamine powder and crystalline "Ice" from Mexico.[6] Ice, also called "Crystal Meth," "Shards," or "Tina," looks like pieces of glass or rock candy, without significant powder present. The price of a gram of Ice across the United States has decreased from $120-$700 in 2002 to $30-$700 in 2005.[7] With the increasing presence of the purer forms of methamphetamine, the DEA reports the average purity has increased from 49% to 69% between 2002 and 2005.[8]

Ice is usually smoked in a pipe, or the vapors are inhaled as the Ice smolders on tinfoil held over heat.[9] The increasing popularity of Ice is shown by the fact that smoking has become the most common route of administration reported by individuals entering treatment with a primary problem with any form of methamphetamine.[10] In 1994, only 15% of methamphetamine admissions smoked the drug, but by 2004, 59% were

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3. *Id.*

4. Drug Enforcement Admin., Domestic Strategic Unit, U.S. Dep't of Justice, Cocaine and Methamphetamine Price and Purity: 2002 to 2005 11 (Oct. 25, 2006) [hereinafter Price and Purity] (unpublished manuscript on file with author).

5. *See* USA PATRIOT Improvement and Reauthorization Act of 2005, Pub. L. No. 109-177, 120 Stat. 192 (providing federal legislation on methamphetamine); OFFICE OF NAT'L DRUG CONTROL POLICY, PUSHING BACK AGAINST METH: A PROGRESS REPORT ON THE FIGHT AGAINST METHAMPHETAMINE IN THE UNITED STATES (2006), http://www.whitehousedrugpolicy.gov/publications/pdf/pushingback_against_meth.pdf (describing the status of legislation in each of the fifty states and comparing the state restrictions to the Combat Methamphetamine Epidemic Act Standards of 2006).

6. NAT'L DRUG INTELLIGENCE CTR., U.S. DEP'T OF JUSTICE, PUBL'N NO. 2006-Q0317-004, NATIONAL METHAMPHETAMINE THREAT ASSESSMENT 2007 2 (2006), *available at* http://www.usdoj.gov/ndic/pubs21/21821/index.htm.

7. Price and Purity, *supra* note 5, at 14.

8. *Id.* at 9.

9. Maxwell, *supra* note 1, at 235.

10. OFFICE OF APPLIED STUDIES, SUBSTANCE ABUSE & MENTAL HEALTH SERVS. ADMIN., PUBL'N NO. (SMA) 06-4180, TREATMENT EPISODE DATA SET (TEDS) 1994-2004: NATIONAL ADMISSIONS TO SUBSTANCE ABUSE TREATMENT SERVICES 24 (2006) [hereinafter TREATMENT EPISODE DATA SET 1996-2004], *available at* http://www.dasis.samhsa.gov./teds04/tedsad2k4web.pdf; OFFICE OF APPLIED STUDIES, SUBSTANCE ABUSE & MENTAL HEALTH SERVS. ADMIN., PUBL'N NO. (SMA) 01-3550, TREATMENT EPISODE DATA SET (TEDS) 1994-1999: NATIONAL ADMISSIONS TO SUBSTANCE ABUSE TREATMENT SERVICES 26 (2001), *available at* http://www.dasis.samhsa.gov/teds99/1999teds_vpt._pdf. [hereinafter TREATMENT EPISODE DATA SET 1994-1999].

smoking it.[11] The proportion inhaling or snorting methamphetamine dropped from 43% to 14%, and injecting as the route of administration dropped from 29% to 21% in the same period.[12]

B. THE SPREAD OF THE METHAMPHETAMINE EPIDEMIC IN THE UNITED STATES

The methamphetamine epidemic began in the western states and continues to be a larger problem there. In California, the rate of treatment admissions per 100,000 went from 96 in 1994 to 204 in 2004, while in Wyoming, it went from 26 to 205 in the same time period.[13] Use has increased in the southern states, with the rate per 100,000 in Georgia going from three in 1994 to forty in 2004, and admissions are increasing in the eastern states, with the rate per 100,000 in Maine increasing from two in 1994 to five in 2004.[14]

Among all methamphetamine admissions in 2004, 33% were treated in large central metropolitan areas, 21% in large fringe metropolitan areas, 31% percent in small metropolitan areas, 9% in non-metropolitan areas with a city, and 6% in non-metropolitan areas without a city (rural).[15] The route of administration differed by rural/urban status: the percentage of admissions that smoked the drug was highest in the most urbanized areas (62%) and lowest in the most rural areas (48%).[16] In contrast, the percentage of admissions that injected the drugs was lowest in large metropolitan areas (between 14% and 15%) and highest in small and non-metropolitan areas (between 24% and 25%), which reflects the presence of Ice in the metropolitan areas and powder in the smaller and non-metropolitan areas.[17]

The National Survey on Drug Use and Health (NSDUH) reported that each year between 2002 and 2005, there are over a half million persons ages twelve and older living in households who had used methamphetamine in the past month.[18] This survey found that these users were becoming highly impaired, with the percentage reporting no abuse or dependence on illicit

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11. TREATMENT EPISODE DATA SET 1994-1999, *supra* note 10, at 42.
12. *Id*.
13. *Id*. at 92-93.
14. *Id*. at 92.
15. SUBSTANCE ABUSE & MENTAL HEALTH ADMIN., THE DASIS REPORT: METHAMPHETAMINE/AMPHETAMINE TREATMENT ADMISSIONS IN URBAN AND RURAL AREAS: 2004 27 (2006), *available at* http://www.oas.samsa.gv/2k6/methRuralTX/methRuralTX.pdf.
16. *Id*.
17. *Id*.
18. OFFICE OF APPLIED STUDIES, DEP'T OF HEALTH & HUMAN SERVICES, PUBL'N NO. SMA 06-4194, RESULTS FROM THE 2005 NATIONAL SURVEY ON DRUG USE AND HEALTH: NATIONAL FINDINGS 16 (2006), *available at* http://oas.samhsa.gov/nsduh/2k5results.pdf.

drugs dropping from 73% in 2002 to 50% in 2005.[19] On the other hand, the proportion abusing or dependent on methamphetamine rose from 11% to 20% between 2002 and 2005, and the proportion reporting abuse or dependence on other drugs rose from 17% to 30%.[20]

One of the problems in monitoring trends and patterns in the use of methamphetamine is that the distinctions between the different types of amphetamine type substances (ATS) and routes of administration are often not clear.[21] This is partially due to the fact that a toxicological screen is a rapid test that provides only a preliminary analytical result of the presence of a substance. A confirmatory test, which is a more specific chemical method, must be used in order to obtain a confirmed result. To differentiate methamphetamine from ATS such as ecstasy or amphetamine, a confirmatory test such as gas chromatography and mass spectrometry (GC-MS) is necessary.[22]

III. THE ADVERSE EFFECTS OF METHAMPHETAMINE USE

A. EFFECTS ON USERS

The motivations for using methamphetamine reported by 28% of clients admitted for treatment in Los Angeles County included the belief that methamphetamine was a better, cheaper, and safer alternative than other stimulants on which they had been dependent.[23] An additional 28% used methamphetamine as a crutch to help them cope with mental illness, distress, or trauma so that they felt "normal."[24] Twenty-three percent primarily used the drug to stay awake longer and to gain strength and energy, while 11% used it to enhance sexual experience and performance. For 10%, methamphetamine was used as a tool to lose weight.[25]

In the short-term, methamphetamine causes increases in heart rate, blood pressure, temperature, rate of breathing, constriction of blood vessels,

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19. OFFICE OF APPLIED STUDIES, DEP'T OF HEALTH & HUMAN SERVICES, METHAMPHETAMINE DEPENDENCE/ABUSE AND TREATMENT tbl.2, *available at* http://www.oas.samhsa.gov/methTabs.htm (last visited June 25, 2007).

20. *Id*.

21. JANE CARLISLE MAXWELL, UNIV. OF TEX. CTR. SOC. WORK. RES., IMPLICATIONS OF RESEARCH FOR TREATMENT: METHAMPHETAMINE 1 (2005), *available at* http://www.utexas.edu/research/cswr/gcattc/Methamphetamine.pdf [hereinafter MAXWELL, RESEARCH FOR TREATMENT].

22. *See generally* Maxwell, *supra* note 1, at 235-42.

23. Christine Von Mayrhauser et al., *Use Ecology and Drug Use Motivations of Methamphetamine Users Admitted to Substance Abuse Treatment Facilities in Los Angeles: An Emerging Profile*, 21 J. ADDICTIVE DISEASES 45, 33-54 (2002).

24. *Id*. at 54-55.

25. *Id*. at 56-57.

and cardiac arrhythmia.[26] Over longer periods of time, methamphetamine use is associated with health problems such as stroke, cardiac valve thickening, and decreases in lung function.[27] Prolonged use also causes pulmonary hypertension, changes to the brain, poor cognitive functioning, and poor mental health.[28]

A survey of "Ice" or "crystal meth" users in Sydney, Australia, found the users reported benefits that included alertness, energy, aphrodisiac effects, sociability, euphoria, and loss of inhibitions.[29] Although most people in the survey did not have extensive experience with Ice, they reported high rates of physical and psychological side effects, including "come-down," paranoia, inability to sleep, addiction, and aggression.[30] Compared with a sample of longer-term, heavier, and predominately injecting amphetamine users, crystal methamphetamine users appeared more likely to experience significant harms after a much shorter and lower level of use.[31]

The 2003 Australian Party Drug Survey found that Ice users, as compared to users of powder or other forms of methamphetamine, were significantly more likely to report that they had "binged" on stimulants in the past six months (i.e., used the drug continuously for more than forty-eight hours without sleep).[32] Similarly, Ice users reported that drug use caused social, work, and financial problems.[33] In addition, recent Ice injectors were significantly more likely to have sought treatment for mental health problems in the last six months, with the most common problems being depression and anxiety.[34]

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26. *See* Maxwell, *supra* note 1, at 235-42 (explaining that arrhythmia is an irregularity in the force or rhythm of the heartbeat).

27. *Id*.

28. Lisa Greenwell & Mary-Lynn Brecht, *Self-reported Health Status Among Treated Methamphetamine Users*, 29 AM. J. DRUG & ALCOHOL ABUSE 75, 75-104 (2003).

29. Louisa Degenhardt & Libby Topp, *"Crystal meth" Use Among Polydrug Users in Sydney's Dance Party Subculture: Characteristics, Use Patterns and Associated Harm*, 14 INT'L J. DRUG POL'Y 17, 17-24 (2002).

30. *Id*. at 23.

31. *Id*.

32. COURTNEY BREEN ET AL., NAT'L DRUG & ALCOHOL RES. CTR., AUSTRALIAN PARTY DRUG TRENDS 3 (2004), *available at* http://ndarc.med.unsw.edu.au/NDARCWeb.nsf/page/monographs (follow link to monograph 52).

33. *Id*. at 92.

34. COURTNEY BREEN ET AL., NAT'L DRUG & ALCOHOL RES. CTR., CRYSTALLINE METHAMPHETAMINE (ICE) USE IN THE 2003 IDRS 3 (2004), *available at* http://ndarc.med.unsw.edu.au/NDARCWeb.nsf/resources/BulletinIDRS_2004/$file/IDRS+bulletin+Apirl+2004.pdf.

B. PSYCHIATRIC EFFECTS AND VIOLENCE

Methamphetamine abuse adversely impacts social support and social networks and behavioral functioning.[35] It produces a variety of effects: irritability, physical aggression, hyperawareness, hypervigilance, and psychomotor agitation, are only some of its several effects.[36] Chronic intoxication can produce a psychotic paranoid state with frightening delusions that may result in aggressive acts.[37] With increased dosage and duration of administration, amphetamines can produce delirium, which is manifested by disorientation, confusion, fear and anxiety.[38] During high-dose use, individuals can experience stimulant-induced psychosis characterized by delusions, paranoid thinking, and compulsive behavior.[39] There is also substantial evidence to associate the effects of its use with violence.[40]

The Methamphetamine Treatment Project (MTP) in California found that participants had high levels of psychiatric symptoms, particularly depression and attempted suicide, as well as anxiety and psychotic symptoms.[41] The MTP reported high levels of problems among participants, such as controlling anger and violent behavior, with a correspondingly high frequency of assault and weapons charges.[42]

Past and current interpersonal violence is a characteristic of the lifestyles of the majority entering treatment for methamphetamine dependence.[43] Persons in treatment for methamphetamine reported high rates of being victims of violence (85% of reporting women and 69% of reporting men).[44] For women, the most common source of violence was their partner (80%), while for men it was a stranger (43%).[45] These clients also had a

35. Margaret Cretzmeyer et al., *Treatment of Amphetamine Abuse: Research Findings and Clinical Directions*, 24 J. SUBSTANCE ABUSE TREATMENT 267, 268 (2003).

36. *See* MAXWELL, RESEARCH FOR TREATMENT, *supra* note 21, at 1 (providing that hypervigilance means the condition of maintaining an abnormal awareness of environmental stimuli).

37. *Id*.

38. *Id*.

39. *Id*. Psychosis—a mental and behavioral disorder in which reality is grossly distorted. Symptoms can include seeing, hearing, smelling, or tasting things that are not there; paranoia; delusions. Psychosis can occur as a result of brain injury or disease, and is seen particularly in schizophrenia and bipolar disorders. STEDMAN'S MEDICAL DICTIONARY 1478 (27th ed. 2000).

40. Sharon M. Boles & Karen Miotto, *Substance Abuse and Violence: A Review of the Literature*, 8 AGGRESSION & VIOLENT BEHAV. 155, 160 (2003).

41. Joan E. Zweben et al., *Psychiatric Symptoms in Methamphetamine Users*, 13 AM. J. ADDICTION 181, 181 (2004).

42. *Id*. at 185.

43. Judith B. Cohen et al., *Abuse and Violence History of Men and Women in Treatment for Methamphetamine Dependence*, 12 AM. J. ADDICTIONS 377, 380 (2003).

44. *Id*.

45. *Id*.

history of being the victim of sexual abuse (57% of reporting women and 16% of reporting men).[46]

A study of methamphetamine users paroled from California state prisons found methamphetamine use to be significantly predictive of self-reported violent criminal behavior and general recidivism (i.e., a return to custody for any reason).[47] However, it was not significantly predictive of being returned to custody for a violent offense.[48] Methamphetamine users may differ significantly from non-methamphetamine users and may be in need of more intensive treatment interventions and parole supervision than other types of offenders who use drugs.[49]

C. ADDITIONAL RISKS FOR THE USER

Methamphetamine at higher doses impairs driving skills and may cause hypersomnolence at the end-of-binge.[50] In addition, younger drivers were more often judged impaired than older drivers who had similar blood amphetamine concentrations.[51]

Many methamphetamine users are at high risk of sexually transmitted and blood-borne diseases.[52] A study of 139 HIV-negative methamphetamine-dependent heterosexuals found they used the drug to get high, to get more energy, and to party.[53] Those studied reused syringes, shared needles, drank alcohol daily, used other drugs, had unprotected sex, had multiple sex partners (the average was 9.4 in the past two months), and engaged in marathon sex.[54]

Use of methamphetamine, and particularly Ice, has increased among men who have sex with other men.[55] Ice appears to be especially sexually arousing and causes loss of inhibitions; it is strongly associated with sexual

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46. *Id*.

47. Jerome Cartier et al., *Methamphetamine Use, Self-Reported Violent Crime, and Recidivism Among Offenders in California Who Abuse Substances*, 21 J. INTERPERSONAL VIOLENCE 435, 438-39 (2006).

48. *Id*. at 440.

49. *Id*. at 443.

50. *See* Ingebjorge Gustavsen et al., *Impairment Related to Blood Amphetamine and/or Methamphetamine Concentrations in Suspected Drugged Drivers*, 38 ACCIDENT ANALYSIS & PREVENTION 490, 493 (2006) (providing that hypersomnolence means excessive sleepiness, especially in daytime).

51. *Id*.

52. MAXWELL, RESEARCH FOR TREATMENT, *supra* note 21, at 2.

53. Shirley Semple et al., *The Context of Sexual Risk Behavior Among Heterosexual Methamphetamine Users*, 29 ADDICTIVE BEHAVS. 807, 807-08 (2004).

54. *Id*.

55. Steven P. Kurtz & James A. Inciardi, *Crystal Meth, Gay Men, and Circuit Parties*, 3 L. ENFORCEMENT EXECUTIVE FORUM 97-114 (2003).

behaviors that put users at risk for HIV infection.[56] Homosexual and bisexual men may use Ice to "initiate, enhance, and prolong sexual encounters and intoxication can lead to lapses in judgment with regard to safe sex."[57] Methamphetamine and sex are not only integrally connected, but participants report that sex while on methamphetamine is "compulsive" and "obsessive," and causes loss of control over sexual expression.[58]

In addition, methamphetamine is sometimes used in combination with a wide variety of other drugs including alcohol, cocaine, ecstasy, ketamine, and gamma hydroxybutyrate (GHB), which increases the risk of overdose and other adverse events.[59] Medical complications for methamphetamine abuse in HIV-infected patients include hypertension, hyperthermia, rhabdomyolysis, and stroke, and psychiatric problems in methamphetamine abusers with HIV infection include acute psychotic reactions and long-term depression.[60]

Furthermore, methamphetamine use during pregnancy may affect the developing fetus.[61] The first large-scale investigation is underway to report the prevalence of methamphetamine use during pregnancy and the outcomes associated with prenatal methamphetamine exposure.[62] Therefore, caution should be exercised in inferring the extent of harm until this National Institute on Drug Abuse-funded study on prenatal methamphetamine exposure and child development is completed.

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56. *Id*.

57. Antonio Urbina & Kristine Jones, *Crystal Methamphetamine, Its Analogues, and HIV Infection: Medical and Psychiatric Aspects of a New Epidemic*, 38 CLINICAL INFECTIOUS DISEASES: HIV/AIDS 890, 890 (2003).

58. Cathy Reback et al., *Changes in the Meaning of Sexual Risk Behaviors Among Gay and Bisexual Male Methamphetamine Abusers Before and After Drug Treatment*, 8 AIDS BEHAV. 87, 90 (2004).

59. Michael Ross et al., *Club Drugs and Sex on Drugs are Associated with Different Motivations for Gay Circuit Party Attendance in Men*, 38 SUBSTANCE USE AND MISUSE 1173, 1174 (2003).

60. *Id*. Hypertension means high blood pressure. STEDMAN'S MEDICAL DICTIONARY, *supra* note 39, at 855. Hyperthermia means exceptionally high fever. *Id*. at 856. Rhabdomyolysis means the breakdown of muscle fibers with leakage of potentially toxic cellular contents into the circulation system. *Id*. at 1564.

61. *See generally* Lynne Smith et al., *Effects of Prenatal Methamphetamine Exposure on Fetal Growth and Drug Withdrawal Symptoms in Infants Born at Term*, 24 J. DEVELOPMENTAL BEHAV. PEDIATRICS 17 (2003).

62. *See generally* Amelia Arria et al., *Methamphetamine and Other Substance Use During Pregnancy: Preliminary Estimates from the Infant Development, Environment, and Lifestyle Study*, 10 MATERNAL & CHILD HEALTH J. 293 (2006) (offering preliminary results of the first large scale prenatal study).

D. EFFECTS ON COGNITIVE/PSYCHIATRIC ASSOCIATIONS

Methamphetamine abusers have deficiency in the prefrontal cortex, which affects working memory and results in poor decision-making, impulsivity, and lack of insight.[63] Deficits are also found in the anterior cingulate gyrus, which causes selective attention spans and causes individuals to appear unmotivated.[64] In addition, changes in the temporal lobe from methamphetamine use cause episodic memory loss and depression, not only while withdrawing use from the drug, but also on-going after withdrawal.[65]

Methamphetamine-dependent individuals who had been abstinent for five to fourteen days performed significantly worse than control subjects on "neurocognitive measures sensitive to attention/psychomotor speed, on measures of verbal learning and memory, and on executive system measures sensitive to fluency."[66] "Recently abstinent methamphetamine-dependent subjects demonstrated quantitative EEG abnormalities that are consistent with a generalized encephalopathy."[67] This type of changes in brain electrical activity is commonly associated with a variety of cognitive and psychiatric abnormalities.[68]

There is some preliminary evidence suggesting that methamphetamine dependence may cause long-term neuronal damage and deleterious effects on cognitive processes such as memory and attention.[69] Methamphetamine abusers who remain abstinent for nine months or longer show modest improvement in performance on some tests of motor skill and memory and they appear to recover from some of the drug's damaging effects on

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63. Edythe London et al., *Mood Disturbances and Regional Cerebral Metabolic Abnormalities in Recently Abstinent Methamphetamine Abusers*, 61 ARCH. GEN. PSYCHIATRY 73, 73 (2004).

64. Thomas E. Nordahl et al., *Neuropsychological Effects of Chronic Methamphetamine Use on Neurotransmitters and Cognition: A Review*, 15 J. NEUROPSYCHIATRY AND CLINICAL NEUROSCIENCES 317, 321 (2003).

65. London et al., *supra* note 63, at 79-80. Depression is a mood disorder characterized by poor appetite or overeating, sleeplessness or hypersomnia, low energy or fatigue, low self-esteem, feelings of hopelessness, and difficulty concentrating or making decisions. STEDMAN'S MEDICAL DICTIONARY, *supra* note 39, at 477-78.

66. Ari D. Kalechstein et al., *Methamphetamine Dependence is Associated with Neurocognitive Impairment in the Initial Phases of Abstinence*, 15 J. NEUROPSYCHIATRY & CLINICAL NEUROSCIENCES 215, 215 (2003). Executive system functioning is associated with mental operations such as planning, working memory, and initiation and self-regulation of goal-directed behavior. MAXWELL, RESEARCH FOR TREATMENT, *supra* note 21, at 5.

67. Thomas F. Newton et al., *Quantitative EEG Abnormalities in Recently Abstinent Methamphetamine Dependent Individuals*, 114 CLINICAL NEUROPHYSIOLOGY 410, 410 (2003).

68. *Id.*

69. Nordahl et al., *supra* note 64, at 317.

metabolism in the thalamus.[70] Drug-related deficits appear to persist longer, however, in the striatum, which "could reflect long-lasting changes in dopamine cell activity and decreases in the nucleus accumbens that could account for the persistence of amotivation and anhedonia in detoxified" patients.[71] Methamphetamine users who had been abstinent six months or longer had significantly greater prefrontal gray matter density than short-term abstinent users, but less than healthy comparison subjects.[72]

Methamphetamine also produces long-term changes in dopamine neurons in the striatum.[73] Decreases were noted in several measures of cognitive function in former methamphetamine users as compared to controls.[74] However, the magnitude of the differences was small, which should lead to a more optimistic attitude on the part of treatment practitioners and those in recovery from methamphetamine abuse/dependence.[75]

Using magnetic resonance imaging (MRI) and new computational brain mapping techniques, Thompson demonstrated systematic brain structural deficits with chronic methamphetamine abuse in human subjects and related these deficits to cognitive impairment.[76] MRI-based maps suggest that chronic methamphetamine abuse causes a selective pattern of cerebral deterioration that contributes to impaired memory performance.[77]

One study of methamphetamine users found those users who had schizoid/schizotypical personalities prior to use of methamphetamine were predisposed to develop psychoses.[78] Those with psychosis were younger at first use, used larger amounts, and possessed significantly higher mean Premorbid Schizoid and Schizotypal Trait scores.[79] In addition, the meth-

70. Gene-Jack Wang et al., *Partial Recovery of Brain Metabolism in Methamphetamine Abusers After Protracted Abstinence*, 161 AM. J. PSYCHIATRY 242, 245 (2004).

71. *Id.* at 244-45. Anhedonia is the inability to gain pleasure from normally pleasurable experiences. STEDMAN'S MEDICAL DICTIONARY, *supra* note 39, at 88.

72. *Id.* Gray matter density is the neural tissue, especially of the brain and spinal cord, that contains cell bodies as well as nerve fibers, has a brownish gray color, and forms most of the cortex and nuclei of the brain, the columns of the spinal cord, and the bodies of ganglia. MAXWELL, RESEARCH FOR TREATMENT, *supra* note 21, at 5.

73. Chris-Ellyn Johnson et al., *Cognitive Function and Nigrostriatal Markers in Abstinent Methamphetamine Abusers*, 185 PSYCHOPHARMACOLOGY 327, 327 (2006).

74. *Id.*

75. *Id.*

76. Paul M. Thompson et al., *Structural Abnormalities in the Brains of Human Subjects who Use Methamphetamine*, 24 J. NEUROSCIENCE 6028, 6028-6036 (2004).

77. *Id.*

78. C. K. Chen et al., *Pre-morbid Characteristics and Co-Morbidity of Methamphetamine Users With and Without Psychosis*, 33 PSYCHOL. MED. 1407, 1407-1414 (2003).

79. *Id.*

amphetamine users maintained higher rates of depressive disorder, alcohol dependence, and antisocial personality disorders.[80]

E. EFFECTS OF METHAMPHETAMINE ON THE FAMILY

Maternal drug use, or use of drugs by mothers, is associated with risk factors such as poverty, chaotic and dangerous lifestyles, symptoms of psychopathology, history of childhood sexual abuse, and involvement in difficult or abusive relationships with male partners.[81] It is also associated with being single, less educated, having attended less than eleven prenatal visits if pregnant, and being on public financial assistance.[82] High-risk pregnant women should receive targeted interventions to reduce serious adverse outcomes associated with prenatal alcohol and tobacco use as well as methamphetamine use.[83]

Children are frequently found at the scene of methamphetamine laboratories and are exposed to toxic chemicals and fumes through absorption, inhalation, or ingestion.[84] In such cases, the homes maintain poor sanitation, hygiene, and nutrition.[85] Methamphetamine may also cause high incidence of developmental delays in children.[86] In these instances, the child welfare system often becomes involved and child protective services and other social work agencies need protocols to address the needs of the children and their parents, as well as those of the legal system.[87]

IV. METHAMPHETAMINE TREATMENT

A. OVERVIEW OF NEED FOR SPECIAL APPROACHES FOR METHAMPHETAMINE TREATMENT

A study of clients treated in a large state treatment system between 1992 and 2002, found risk factors for noncompletion and shorter treatment retention in both residential and outpatient treatments.[88] Some of these

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80. *Id*.

81. Trecka Wouldes et al., *Maternal Methamphetamine Use During Pregnancy and Child Outcome: What Do We Know?*, 117 NEW ZEALAND MED. J. 1, 1-10 (2004).

82. *Id*.

83. Arria et al., *supra* note 62, at 293-302.

84. MAXWELL, RESEARCH FOR TREATMENT, *supra* note 21, at 3.

85. *Id*.

86. Melinda Hohman et al., *Methamphetamine Abuse and Manufacture: The Child Welfare Response*, 49 SOC. WORK 373, 373-381 (2004).

87. *Id*.

88. *See generally* Mary-Lynn Brecht et al., *Methamphetamine Treatment: Trends and Predictors of Retention and Completion in a Large State Treatment System*, 29 J. SUBSTANCE ABUSE TREATMENT 295, 295 (2006).

include having lower than a high school education, being younger at admission, having a disability, having greater severity of methamphetamine use, and injecting drugs.[89] Clients with legal supervision at admission had higher completion rates and longer retention than those reporting no legal status.[90] Overall, clients with greater socioeconomic disadvantage and more severe problems required more services to be retained in treatment.[91]

Treatment for methamphetamine abuse is based on previous treatment approaches for cocaine abuse.[92] But there are some aspects of methamphetamine-related disorders that are specific to the consequences of using that drug.[93] Given the cognitive problems seen in some methamphetamine users, law enforcement agencies and treatment providers should make certain specific efforts with methamphetamine users.[94] For instance, relevant information as to compliance, types of help, and possible consequences for compliance-failure should be made readily available to all interested parties, including the user.[95] Physicians and other health professionals should make certain that the patient understands the medical advice and also has "a method for remembering to take medications and to comply with suggested medical procedures."[96] Also, treatment providers should offer concrete and specific information as to the particular type of treatment.[97]

The development of treatments is particularly critical for a number of user groups including those who experience persistent psychosis, pregnant women and women with children, gay and bisexual men, and users involved in the criminal justice system.[98] Similarly, rural populations, Hispanics, and youths are groups of individuals particularly in need of special consideration.[99] For instance, a randomized controlled trial of methamphetamine-dependent gay and bisexual males found that treatment that focused on both drug use and risky sexual behaviors in a gay-friendly setting produced significant reductions in methamphetamine use and sexual

89. *Id*.
90. *Id*.
91. *Id*.
92. Cretzmeyer et al., *supra* note 35, at 267.
93. *See* Sara L. Simon et al., *Cognitive Performance of Current Methamphetamine and Cocaine Abusers*, 21 J. ADDICTIVE DISEASES 61, 71 (2002) (stating that methamphetamine users cognitive manipulation of information differs from that of cocaine users).
94. *Id*.
95. *Id*.
96. *Id*.
97. *Id*.
98. Richard A. Rawson et al., *Treatment of Methamphetamine Use Disorders: An Update*, 23 J. SUBSTANCE ABUSE TREATMENT 145, 148-49 (2003).
99. *Id*. at 145.

risk behaviors.[100] Drug treatment merits consideration as a primary HIV prevention strategy for this population.[101]

B. THE MATRIX MODEL

The Matrix Model is a comprehensive package that provides substance abuse treatment professionals with a year-long intensive outpatient model for clients and their families.[102] This model calls for sixteen weeks of structured programming and thirty-six weeks of continuing care.[103] Clients receive information, assistance in structuring a substance-free lifestyle, and support to achieve and maintain abstinence from drugs and alcohol.[104] The program specifically focuses on clients who are dependent on methamphetamine and cocaine, as well on the families of these clients.[105]

The Matrix Model calls for follow-ups at seventeen, twenty-six, and fifty-two weeks.[106] Between sixty-six and sixty-nine percent of clients who had been treated under the Matrix Model had methamphetamine-free urine samples.[107] The evaluations continue to support the value of integrated treatment for co-occurring conditions, and especially the importance of training counseling staff to handle psychotic symptoms when needed.[108]

The Matrix Approach was developed by the Matrix Institute in Los Angeles and adapted by the Substance Abuse and Mental Health Services Administration's (SAMHSA) Center for Substance Abuse Treatment.[109]

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100. Steven Shoptaw et al., *Behavioral Treatment Approaches for Methamphetamine Dependence and HIV-related Sexual Risk Behaviors Among Urban Gay and Bisexual Men*, 78 DRUG & ALCOHOL DEPENDENCE 125, 132 (2005).

101. Cathy Reback et al., *supra* note 58, at 96.

102. Richard A. Rawson et al., *A Multi-site Comparison of Psychosocial Approaches for the Treatment of Methamphetamine Dependence*, 99 ADDICTION 708, 710-16 (2004).

103. *Id.* at 710.

104. *Id.* at 709.

105. *Id.*

106. *Id.*

107. *Id.* at 716.

108. Zweben et al., *supra* note 41, at 188.

109. Copies of the treatment package are available free of charge from SAMHSA's National Clearinghouse for Alcohol and Drug Information at 800-729-6686 or electronically through www.ncadi.samhsa.gov.

V. CONCLUSION

The methamphetamine user poses a challenge for both the public safety and health sectors. Extensive evaluations have shown that treatment works, but the cognitive difficulties that many users exhibit after ceasing methamphetamine use must be acknowledged and worked with during the early stages of treatment. In addition, special programs and approaches should be developed for high risk populations such as women, people who are dually addicted to methamphetamine and sex, and adolescents. Public safety officials should be aware of the cognitive problem in their dealings with methamphetamine users.