Research Report

Crystalline Methamphetamine:

Recreational Synthetic Drug Facts

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INTRODUCTION

Crystalline methamphetamine ($C_{10}H_{15}N$) is the concentrated formulation of methamphetamine with the chemical name n-methyl-1-phenyl-propan-2-amine and the common name crystal meth. Although difficult to distinguish by its name, the drug comes entirely from synthetic chemicals making it potent and hazardous. The crystalline form of meth is white, odorless and bitter tasting that immediately affects the central nervous system providing an intense euphoric high. The sale and possession of crystal meth is illegal with its popularity peaking when governments throughout the world placed limits on medical prescriptions of methamphetamine and similar addictive stimulants. Today, crystal meth has international attention due to its prevalent use, numerous adverse effects, and hazardous laboratory waste.

HISTORY

DISCOVERY

Crystal meth is the third derivative or adaptation from the ephedra plant, which grows throughout Asia and the Americas. In 1887, a Japanese chemist, Nagai Nagayoshi, isolated the ephedrine compound, an amphetamine, from the plant and in 1893, the same chemist synthesized methamphetamine from ephedrine. Shortly after, in 1919, pharmacologist, Akira Ogata, using iodine and red phosphorous, reduced methamphetamine to form crystalline methamphetamine. At this time, crystal meth had no medical purpose, as its stimulant effects were unknown.

MILITARY APPLICATION

During World War II, circa 1938, the German public and Third Reich military forces began using methamphetamine tablets, under the label Pervitin, produced by the German pharmaceutical company Temmler (Ulrich, 2005). Allied bomber pilots also took methamphetamine, during the war effort, to increase their focus and stamina, although they became too edgy. Thus, they chose an amphetamine alternative dextroamphetamine permitting stimulant use in the military prevailed for years. In fact, U.S. troops used this drug, specifically Air Force pilots, until the 2003 Persian Gulf War (Miller, 2003).

MEDICAL USE

It was in 1944 that Abbott Laboratories received U.S. Federal Drug Administration (FDA) approval to treat depression, alcoholism, hay fever symptoms, Parkinsonism, and sleeping disorders, such as narcolepsy, with methamphetamine. Additionally, between 1940 and 1950, methamphetamine sold to laborers in an attempt to increase their productivity at work in Japan under the label Philopon by Dainippon Sumitomo Pharmaceuticals. By the mid-1950s, legal prescriptions in the Japan, Canada, Germany and the U.S. saw an influx of prescriptions of methamphetamine for the treatment of obesity, sinus inflammation and similar ailments.

REGULATIONS

From 1951 to 1954, Japan, Canada and the U.S. began to limit availability of prescriptions. Each country placed a series of regulations on the production of stimulants; however, criminal organizations saw an opportunity and learned to produce similar drugs, crystal meth, to meet public demand. Individuals who could not legal obtain a prescription for methamphetamine secured one unlawfully or turned to crystal meth. It is at this time, the crystal meth industry took form.

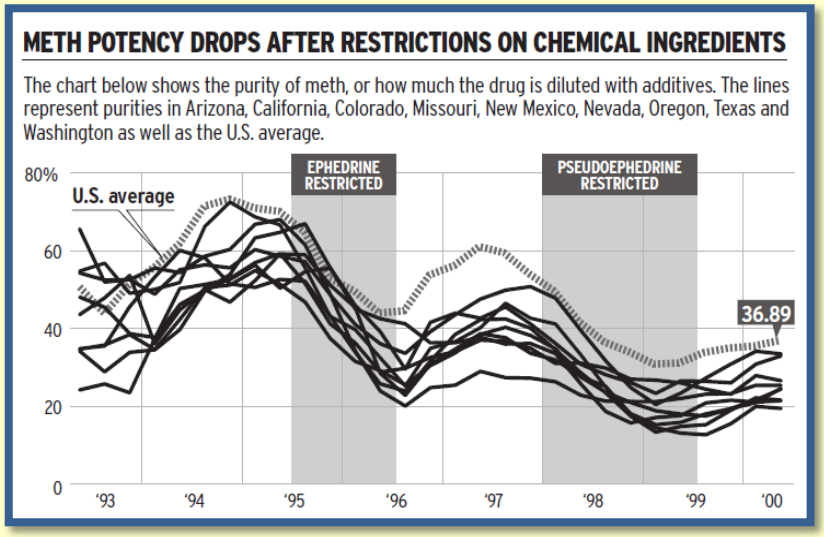

Figure 1: Crystal meth potency varies with restrictions. Source U.S. Drug Enforcement Administration; Suo, Steve, The Oregonian

Beginning in the 1960s, there was an increase in illegal manufacturing of crystal meth mostly by motorcycle gangs, such as the Hell's Angels and the Mongols, in California and Hawaii. In 1983, the U.S. and Canadian governments passed laws prohibiting the possession of chemicals, equipment and activities related to the production of crystal meth. These laws lead to limited access to ephedrine, which shifted crystal meth producers to use pseudoephedrine, found in over-the-counter medications like Sudafed, which makes a weaker form of crystal meth (Figure 1).

Even with the regulations on chemicals and equipment, both continue to be in ample supply in the U.S., giving way to the development of numerous portable and strategically placed large labs. Large or super labs in other countries, such as China, Mexico, Germany, the Czech Republic and India, feed the North American corridor with supplies and crystal meth (Cowden & Suo, 2004). In conclusion, crystal meth continued to expand throughout the United States, regardless of the regulations. A recreational drug once popular in California and Hawaii is now prevalent in Oregon, Washington, Montana, South Dakota, Idaho, Colorado, and Arizona.

USES

Medical methamphetamine has U.S. FDA approval for specific uses including the treatment of attention deficit hyperactivity disorder (ADHD), obesity, depression, and narcolepsy. It also falls under Schedule II of the U.S. Controlled Substance Act, which means methamphetamine, although approved for medical use, has a potential for abuse and can lead to dependence.

Alternatively, crystal meth differs chemically and is a prohibited recreational drug in the U.S. The substance provides individuals with fast-acting stimulation, a feeling of euphoria, improved

focus and energy, and temporary weight loss. Similar to the usages of medical methamphetamine, some crystal meth users start using the drug to decrease appetite, increase activity levels, improve attention, decrease fatigue, and deal with symptoms of depression. However, crystal meth is far more potent, addictive, unreliable, and individuals build a tolerance to the drug faster.

Adverse Effects

Crystal meth has numerous adverse side effects worth highlighting, as the drug purity and potency is inconsistent due to varying chemicals and laboratory procedures (Table 1).

While crystal meth may cause a rise in the levels of the neurotransmitter, dopamine, it also damages its neurons or receptors in the brain. For this reason, many long-term users will display diminished cognitive abilities, including memory, judgment, motor control, and symptoms similar to Parkinson's disease. Some damage is reversible if drug usage ends, as the dopamine receptors re-grow within 12 to14 months. However, in most cases, cognitive skills do not improve and some crystal meth users are unable to produce their own dopamine (Frontline, 2006). A dopamine deficiency further leads to symptoms of depression making it more difficult for the individual to stop the use of crystal meth.

Adverse Effects May Include:

Addiction
Nausea and diarrhea
High blood pressure
Insomnia
Dry mouth/tooth decay
Seizures and stroke
Memory loss
Paranoia
Hallucinations
Kidney damage
Cardiac arrest

Table 1: Adverse effects. Source Volkow, Nora, M.D. (NIDA)

A unique side effect of crystal meth is the rate at which users become tolerant to the drug, lessening the dopamine effect. It can take just six weeks for individuals to require more of the substance is to achieve the original high. Often, the effects of the drug subdue within minutes while a considerable amount of crystal meth remains in their system. This situation most often causes overdoses in users.

How it Works

Crystal meth stimulates the central nervous system, creating a rush of dopamine to the brain. This neurotransmitter or brain chemical is responsible for the feelings of pleasure. Crystal meth, being chemically similar to dopamine, mimics it in the brain reacting with dopamine neurons. Essentially, crystal meth tricks the brain into thinking it is dopamine causing the brain’s system of neurons to respond. Crystal meth increases dopamine approximately 1,250 units, which is significant when compared to the 350-unit rise caused by cocaine, and 200-unit rise caused by sex (Figure 2) (Volkow, 1998, P.3). The dopamine increase from crystal meth is distinctive and provides the powerful psychological and physical high making the drug highly addictive.

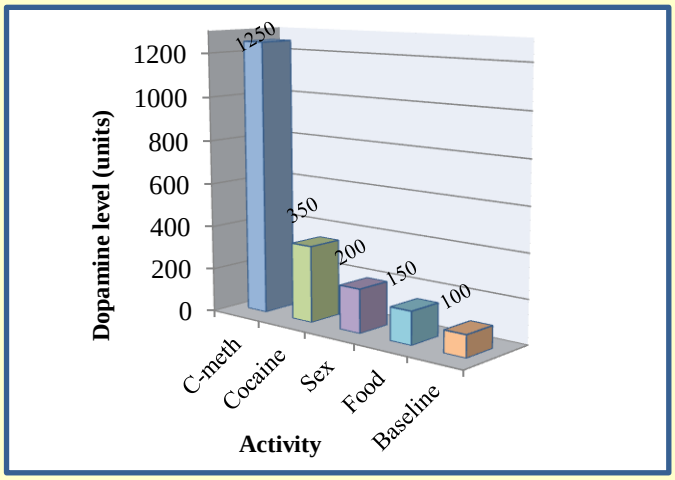

Figure 2: Graph of Dopamine level vs. Activity. Source DM Canonico

There are several ways individuals intake crystal meth, and each way provides a different kind of effect. Smoking or injecting crystal meth delivers the drug to the brain providing an immediate and intense rush of pleasure that lasts a few minutes with a general euphoric sensation lasting for hours. Nasal insufflation (snorting) or oral ingestion produces an initial euphoric sensation that lasts up to 20 minutes with an overall high lasting between six to 24 hours (Volkow, 1998, P.3).

PRODUCTION

Unregistered or amateur laboratories produce most of the crystal meth in the U.S. with the largest facilities, super labs, located in Mexico. Laboratories vary greatly, with some small enough to fit in cars and others large enough to locate in abandoned buildings. The equipment and knowledge vary among the amateur chemists. Many of the individuals who construct portable labs do it to meet their own crystal meth needs and have little experience. Those running large labs have better equipment and more knowledge.

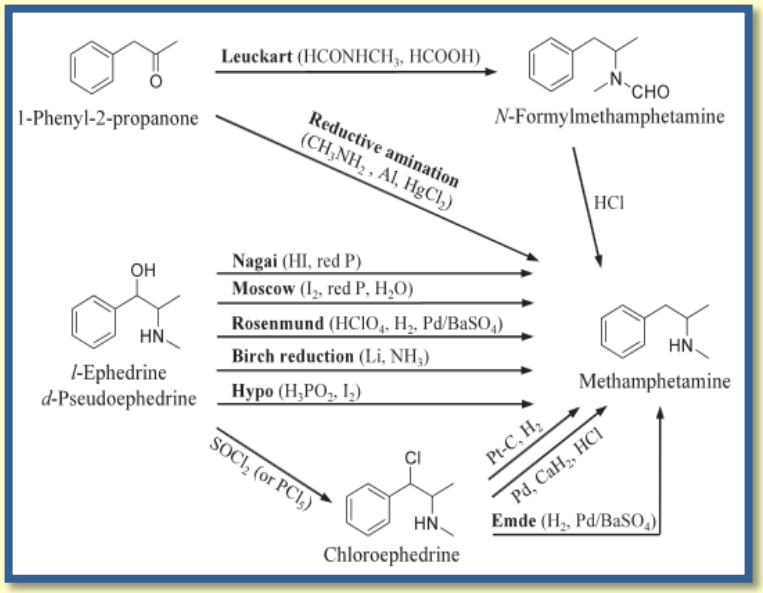

Figure 3: The 8 synthesis routes to the crystal form of meth. Source Journal of Health Science, Hiroyuki Inoue, et al.

There are eight historical methods of synthesizing crystal meth, such as Moscow, Birch reduction and Nagai, which require several hours to several days of processing (Figure 3). Recently, crystal meth users established a 7-step Shake ‘n Bake method, which processes the drug in a few hours, using small quantities of chemicals and materials from a hardware store, and 3 to 4 boxes of Sudafed or a similar product. Instead of durable equipment, one uses 2-Liter plastic bottles, plastic bags, coffee filters, AA batteries, aquarium tubing, and a stove or microwave. This method produces highly impure crystal meth, which delivers unpredictable side effects.

There are approximately 32 chemicals a crystal meth chemist can use to make the drug, most are explosive, one-third is toxic and most create hazardous byproducts (Table 1; P. 6). In fact, one pound of product generates 5 to 6 pounds of hazardous waste. Large labs can produce 15 pounds of substance per day creating a human and environmental hazard that can cost nearly $100,000 in hazardous material clean up. In general, cleanup cost of an average-sized crystal meth lab in the U.S. is $5,000 to $10,000 (Berlin Snell, 2001, P.1).

Laboratory explosions and poisonings are common with the leading source coming from improperly sealed, stored and ventilated chemicals. Harmful fumes collect where they can incapacitate lab workers or explode from a spark. Further, long-term exposure to the fumes causes brain damage and respiratory problems. Consequently, crystal meth labs, regardless of size or processing method, present a safety dilemma.

EXPERIMENTAL PROCEDURE – NAGAI METHOD

1. Reduce cold remedy tablets to a powder
2. Extract ephedrine/pseudoephedrine from the powder by adding alcohol or acetone
3. Place mixture over low heat to reduce
4. Cool to room temperature
5. Filter off inert liquid. Retain solids as this is pure ephedrine/pseudoephedrine
6. Dissolve pure ephedrine/pseudoephedrine into red phosphorus and hydriodic acid
7. Separation occurs. Remove acid and save to reuse
8. Neutralize remaining solution with lye
9. Add a binding agent, kaolin, to create a separation
10. Filter off the liquid methamphetamine
11. Gently bubble hydrogen chloride gas into the liquid to form a crystalline hydrochloride salt in solution
12. Pour the solution with solids through a filter. Discard liquid
13. Dry the solid crystal meth
14. Mix down the crystal meth with fillers to maximize profit (Table 2)

Primary Ingredients of Crystal Meth:	**Ingredients for extraction and reduction process:**	**Ingredients to reduce potency, increase batch size (improve profitability):**
Ephedrine or pseudoephedrine HCl	*Petroleum naphtha (Coleman Camp fuel)*	*Lithium hydride (battery acid)*
Iodine crystals/iodized salt	*Muriatic acid*	*Ether*
Red phosphorous	*Acetone*	*Freon*
	Isopropyl/denatured alcohol	*Ammonia nitrate (gel pack contents)*
	Sodium hydroxide (Red Devil Lye, Drano)	*Hydrochloric acetic/Sulfuric acid*
	Xylene	*Lead/Mercuric chloride*
	Methyl ethyl ketone (MEK)	*Benzyl chloride*
		Prozac or Ritalin
		Laxatives
		Epsom salt
		Protease inhibitors (HIV medication)

Table 2: Ingredients of crystal meth. Source Rizzo, Mike www.lagaycenter.org/meth

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Cover Photo: Crystalline methamphetamine, courtesy U.S. Drug Enforcement Administration