

Speed: The Story of Amphetamines

"You become, after that first hit of speed, gloriously, brilliantly, vigorously awake."¹

FROM EPHEDRA TO AMPHETAMINE

The leafless *Ephedra* bush grows throughout the desert regions of Asia and North America. It has a horsetail appearance, with stems that can be dried and boiled in water to make a stimulating tea. *Ephedra* has been used for thousands of years in China in medicines such as Ma Huang to help treat asthma and other breathing problems. At the same time, other species of *Ephedra* were used by the native peoples of the western United States. When Mormons traveled to Utah in 1847, they discovered the stimulating properties of this beverage and substituted this "Mormon tea" for coffee and tea, which were forbidden by their religion.

In 1892, a team of Japanese and Chinese scientists isolated ephedrine from *Ephedra*, and it was developed for production in the 1920s by the Eli Lilly Company. The new drug soon became the standard treatment for asthma.

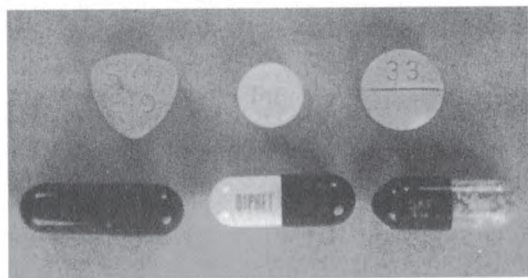
Interest in ephedrine was also kindled by researchers studying adrenaline, the body's natural stimulant. Ephedrine is chemically similar to adrenaline (see *Chapter 6: The Amphetamine Family*), but while adrenaline is an unstable chemical and must be injected—limiting its potential as a medication—ephedrine is very stable and can be taken by mouth.

Research on adrenaline and ephedrine produced a new synthetic drug, amphetamine. It was first discovered in Germany in 1887, but received little attention until 1927, when the UCLA researcher Gordon Alles investigated its therapeutic potential. The good scientist was not averse to using his product. He went on to research, and frequently sample, later amphetamines and variations such as MDA.



"Within a few minutes, I realized that a notable subjective response was going to result."

—Gordon Alles, discoverer of amphetamines, and personal user



Prescription amphetamines. (Source: DEA.)

Amphetamine was first marketed in 1932 as an over-the-counter nasal inhaler, Benzedrine, to treat asthma and to raise low blood pressure. By 1937, amphetamine preparations were also available in tablet form to treat the sleeping disorder narcolepsy, as well as the behavioral syndrome then called minimal brain dysfunction (MBD) and now known as attention deficit hyper-

activity disorder (ADHD). People quickly discovered that amphetamines increased energy and took away fatigue, hunger, and the need for sleep. Abuse of the popular new drugs started almost immediately and continued until the FDA banned over-the-counter sales in 1959.

Amphetamine is a combination of two molecular forms that are mirror images of each other. The “left-handed” molecule, *l*-amphetamine (also called levoamphetamine) has effects on the nasal passages but does not enter the brain. The right-handed form, *d*-amphetamine (dextroamphetamine), has very strong effects on the brain. In the 1930s, pure dextroamphetamine was synthesized for medical use as an improved, more stimulating form, of amphetamine. It was followed by the even stronger methylated version, methamphetamine.

The potency of these newer amphetamines became widely appreciated during the Second World War. Pills were handed out along with food and cigarette rations to improve endurance, delay sleep, and perhaps to increase aggression. Soldiers in the Allied, German, and Japanese forces took amphetamines in enormous amounts. By the end of the war, Japan reported 200,000 cases of amphetamine psychosis among its servicemen.



The Luftwaffe used amphetamines—“blitz”—to make their pilots as high as their new airplanes could fly.²



Not to be outdone, Americans started packing it into ration kits. Second World War total use amounted to one pill per soldier per day.³

It was not only the soldiers who relied on the stimulants, but also their leaders. Churchill used both amphetamines and barbiturates to get himself through the long nights, and Hitler eventually was injecting himself with methamphetamine eight times a day.

After the war, amphetamines were given to factory workers with the intention of making them more productive. The Soviet Union in particular

encouraged their use.⁴ But in the long run, as many countries found, this was ineffective. Production by workers on amphetamines was shoddy and uneven as they swung on a hormonal pendulum from overstimulation to exhaustion.

Amphetamine use in the military remained common and continues to be so today. Always looking for a new kick, American servicemen stationed in Korea and Japan in the early 1950s invented the "speedball," an injectable mixture of amphetamines ("splash") and heroin.⁵ In the later stages of the Vietnam War, soldiers consumed 200 million doses of amphetamines and more servicemen were evacuated for drug problems than for battlefield wounds.

On the home front, dozens of amphetamine preparations were marketed to housewives as diet pills and for depression. Speed became the drug of the 1960s. Amphetamines helped truckers to drive their long hauls without falling asleep, athletes to push harder and train longer, students to study later, and many to lose weight and feel more alive. American annual legal production in 1962 was estimated to be 8 billion tablets.⁶ This eventually peaked in 1971 with 12 billion tablets, much of it diverted for recreational use.



Both Hitler and Goering were addicted to methamphetamine.



Each year in the 1950s, the United States alone produced 50 doses of amphetamines for every man, woman, and child, and amphetamines accounted for 20 percent of all prescriptions.

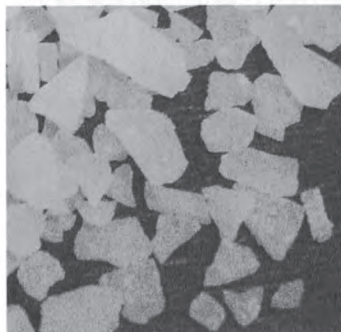
Most of this production was pushed by the medical industry. As the use of prescription amphetamines grew, so did their abuse. The speed epidemic began in California and quickly spread throughout the country. When the pills were no longer enough, "speed freaks" began to inject powder ("crystal") methamphetamine.

Federal food and drug laws were amended in 1965 to remove many amphetamine products from the market and to make it more difficult for doctors to prescribe those that remained. As a result, clandestine laboratories sprang up to meet demand, ranging from shady pharmaceutical operations to crude kitchen-chemistry setups run by motorcycle gangs. On the West Coast, in particular, methamphetamine laboratories proliferated.



"Crank" came from the Hells Angels' habit of hiding their amphetamines in the crank cases of their Harleys.

Currently, both dextroamphetamine and dextromethamphetamine are Schedule II controlled substances, indicating that they have recognized medical use but also a very high abuse potential. A variant of methamphetamine, *l*-methamphetamine, does not have psychoactive effects and is the active ingredient in Vicks Inhaler, an over-the-counter nasal decongestant. To avoid confusion, the manufacturer identifies it by the alternative name desoxyephedrine.⁷ Other amphetamines are still prescribed to treat narcolepsy, attention deficit disorder, depression, and for the short-term management of obesity.



Ice is to methamphetamine as crack is to cocaine.⁹

ICE

A new form of methamphetamine, a base version of dextromethamphetamine, was made in Asia in 1985. This form gives off vapors when heated, which can produce a rapid and intense intoxication lasting up to 14 hours. It has the appearance of shattered ice or broken glass, and is called ice, glass, batu, or shabu. Like crack, ice is usually smoked in a glass pipe or an empty light-bulb, leaving a milky or black residue depending on the way it is made.⁸ One gram is enough for 10 to 25 hits.

This smokable form of methamphetamine is very popular in Japan and Korea. It spread to Hawaii in 1988, and then to the West Coast of the United States, where distribution is dominated by Asian gangs.

THE RISE OF RITALIN

Methylphenidate is a chemical relative of the amphetamines. Known by the trade name Ritalin, it is used mainly in the treatment of attention deficit hyperactivity disorder (ADHD) or attention deficit disorder (ADD) in children and, increasingly, in adults. About 10 percent of boys and 3 percent of girls in the United States are diagnosed with ADD. It may seem a contradiction, but many stimulating drugs have a calming effect if taken in small doses. (For example, coffee usually makes people more alert, but helps some people calm down or go to sleep.) In children in particular, amphetamines can help focus attention and control hyperactivity. By 1997, 2.5 million schoolchildren were being prescribed Ritalin in the United States, which accounted for 90 percent of the world's production.¹⁰

Like other amphetamines, methylphenidate may also be abused. Its stimulating effects are similar to those produced by methamphetamine or cocaine. Long-term methylphenidate abuse can also cause a paranoid psychosis identical to that of chronic methamphetamine abuse. As with other amphetamines, people who take Ritalin can become addicted, develop tolerance, and use increasing amounts to try to bring about the same effect. Some users switch to snorting or injecting the crushed pills to try to recapture the original effects. In a survey in Wisconsin and Minnesota, one third of students who use Ritalin said they had been asked to sell or trade their medications.¹¹



Smoking ice in an empty lightbulb.



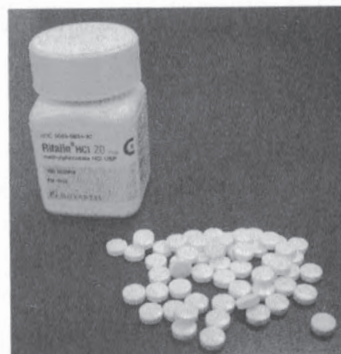
Over the Rainbow

Judy Garland was taking 40 Ritalin tabs a day in 1968. The *Wizard of Oz* star died of a drug overdose on June 15, 1969.

OTHER AMPHETAMINE-LIKE DRUGS

Fenethylline, sold as Captagon, was also used to treat hyperactive children. It was marketed internationally for 23 years before the World Health Organization became alarmed at its widespread abuse and discouraged its production.¹² It is now illegal.

Methylaminorex, chemically known as $(\pm)$ -*cis*-4-methylaminorex, was first marketed in 1962 as a weight loss drug. It was followed in 1966 by a derivative, aminorex, which was sold in Europe, also as a weight loss drug. Both of these were withdrawn in 1968 when they were discovered to cause death from pulmonary hypertension, a form of heart-lung disease.¹³ After their removal, they were made illegally by clandestine labs, who were less concerned about this fatal side effect.¹⁴ Why would anyone take aminorex or methylaminorex if they are so hazardous? Both drugs produce effects identical to dextro-amphetamine. Studies in rats¹⁵ and monkeys show that they cannot distinguish between aminorex and dextro-amphetamine, and become equally addicted to them.¹⁶



Three to 5 percent of all school children in the United States are being treated with Ritalin.¹⁷



Because methylphenidate is readily available by prescription, it is not clandestinely produced.

Phenmetrazine and phendimetrazine are amphetamine-like weight loss drugs. In controlled tests, users cannot tell the difference between these and dextroamphetamine, although they do not appear to have the psychoactive or addictive characteristics of amphetamine.¹⁸ Phenmetrazine continues to be marketed under the trade name Preludin.



Amphetamines cause weight loss by decreasing appetite. Other weight loss drugs decrease body water or impair the absorption of nutrients. No drugs can "burn fat." Advertisements that make this claim are fraudulent.

YOU CAN NEVER BE TOO THIN

For millions of years, the greatest fear of most people was starving to death. It is still the major concern for about half the world's population. The other half now faces the opposite problem: an epidemic of obesity. It is estimated that almost two-thirds of the American population is overweight, and a large number are clinically obese, meaning they are more than 20 percent above their ideal weight.

Obesity is not just a health problem. Fat people are made fun of, considered unattractive, and discriminated against in many subtle ways. Because of these social issues, fear of obesity has resulted in an obsession with thinness. A 1999 study showed that the winners of the Miss Universe beauty pageant have become progressively thinner over the past decades. Female Hollywood movie stars also are increasingly underweight. By today's standards, Marilyn Monroe seems almost chubby. Her ideal of beauty has been replaced by the anorexic look of Ally McBeal, who would provoke sympathy from a starving African villager.



"You can never be too rich or too thin."—the Duchess of Windsor

It is almost impossible to achieve the current ideal of thinness with dieting, unless the person is either extremely masochistic or mentally ill. Using drugs to lessen appetite is a much easier method. Amphetamines began to be promoted as an appetite suppressant during the period of economic affluence after the Second World War. Various formulations were developed as research came closer to targeting the key appetite center in the brain.

Weight loss drugs hit a peak with the development of fenfluramine and phentermine. Both of these were marketed individually. Then, in the 1990s, their popularity skyrocketed when they became sold in a combination called Fen-Phen. Clinics popped up everywhere to sell the weight loss combo, even to those not overweight at all—including rail-thin teenage girls who still didn't feel slender enough. With over six million users, it became one of the most popular, and undeniably effective, weight loss remedies as long as the user stayed on it. Unfortunately, the weight came back quickly once the user was off the drug.

In September 1997 the bottom fell out of the market: Fen-Phen was discovered to cause heart valve disease and it was immediately withdrawn. It was the product liability lawyers' turn to get rich.



Veins scarred from repeated injections. (Harm Reduction Project, reprinted with permission.)



Fen-Phen was a weight loss sensation—until it was found to cause heart disease. Its manufacturer, American Home Products, has agreed to a \$3.75 billion settlement with users.

Who Is Using Amphetamines?

Amphetamines are generally swallowed as a pill, smoked or snorted as a powder, or mixed with water and injected. Powdered methamphetamine is white, yellow, pink, or green, depending on its method of manufacture, and may have an odor of rotten eggs. It is quite easy to make with simple instruments and ingredients.

Amphetamines are used for a wide variety of purposes. Truck drivers,

athletes, soldiers, and students use them to increase attention and prolong endurance. Children, and increasingly adults, take them for ADD. People struggling to lose weight take them to reduce appetite. Amphetamines are also taken by people who interact poorly in social settings and have difficulty internalizing new experiences. These drugs reduce the need for external stimulation by increasing internal arousal mechanisms.¹⁹

A 1991 survey in the United States showed that 7 percent of the total population had used amphetamines for non-medical reasons at some time, with 1.3 percent reporting current use. About 2 percent of the adult population was addicted to, or had abused, amphetamines at some time in their lives.²⁰

Methamphetamine use in the United States is most common in the large western and southwestern cities. The typical user is a male, aged 26 to 44, who takes it in combination with alcohol, heroin, cocaine, or other drugs.

Eighty percent of all methamphetamine now sold in the United States is either manufactured in Mexico or produced in the United States by Mexican drug traffickers. The rest of the production comes from unskilled chemists ranging from individual addicts to motorcycle clubs, Asian and Mexican gangs, and organized crime syndicates.



"The drug is like a companion telling you that you're good enough, handsome enough and smart enough, banishing all the little insecurities to your subconscious, liberating you from self-doubts yet making you feel totally and completely alive."²¹

Internationally, methamphetamine has become the drug of choice for young people, particularly in nightclubs, throughout Southeast and East Asia. It is produced by large drug trafficking organizations in Myanmar (Burma), Thailand, and Laos. In February and March 2000, several shipments of over 20,000 Southeast Asian methamphetamine tablets were seized in Sacramento. The small reddish-brown tablets had been sent by mail from Laos, heralding a new trend of inexpensive methamphetamine imports to the United States. These tablets have an average weight of 90 milligrams (about one-fourth the size of an aspirin), and contain 23 milligrams of methamphetamine and 45 to 65 milligrams of caffeine. Some also contain theophylline, a caffeine-like stimulant.

In Thailand, the wholesale price is about U.S. 50 cents per tablet, and consumers pay about \$3 per tablet. Once the shipment has reached the United States, the price increases to \$5–\$10 per tablet.

METH LABS

The production of methamphetamine in small home operations—"meth labs"—first began in California in the 1950s and proliferated throughout the Southwest in the 1960s. By 1999, manufacturing was taking place in most states, and new labs were discovered in Massachusetts and New York.



Ephedrine and pseudoephedrine are structurally mirror images of each other, and both can be used to manufacture methamphetamine.

Clandestine labs are sprinkled throughout urban and rural areas of the West but, for some reason, they are most common in the straitlaced state of Utah. Every year, 250 to 300 labs are busted at a cost of millions of dollars. A minor industry has grown up in Salt Lake City just to dispose of the leftover hazardous chemicals, which include highly flammable ether, acetone, red phosphorous, caustic sodium hydroxide, cancer-causing chloroform, and extremely poisonous chemicals such as mercuric chloride, phosphane gas, hydrochloric acid, sulfuric acid, iodine gas, and cyanide gas. Cleanup costs average \$4,000 for each location.

Methamphetamine is easily made from recipes learned from friends or taken off the Internet. Until 1980, most illegal methamphetamine was made by the P2P amalgam method, using phenyl-2-propanone (P2P) and methylamine as the primary precursors, along with mercuric chloride, hydrochloric acid, aluminum, isopropanol, and sodium hydroxide. P2P can be made by reacting lead acetate with phenylacetic acid. This material can cause severe lead poisoning,²² with symptoms such as abdominal pain, nausea, vomiting, weakness, weight loss, or lower back and leg pain.

In 1980, P2P was designated a Schedule II drug and became very difficult to obtain. Now, the most common method uses the reduction of ephedrine or pseudoephedrine. In this process, over-the-counter cold and allergy tablets containing ephedrine or pseudoephedrine (for example, Sudafed) are placed in water, alcohol, or another solvent for a few hours until they dissolve. Hydrogen chloride gas is



2,155 meth labs were raided in the year 1999.²³



then used to chemically reduce the ephedrine (or pseudoephedrine) to methamphetamine.

The entire process can be done using only common household products and utensils. Certain brands of drain cleaner, for example, have a high concentration of sulfuric acid. When this powder is mixed with table salt or rock salt, hydrogen chloride gas is produced.

The final product often shows how it was made. Pink methamphetamine indicates that red-colored pseudoephedrine tablets were used. A bluish tint may come from the use of camper fuel. Green meth was probably made from green gun scrubber, purchased in sporting goods and hardware stores.

Meth lab chemicals . . .

Ephedrine
Pseudoephedrine
Alcohol
Toluene
Ether
Sulfuric acid
Methanol
Lithium
Trichloroethane
Anhydrous ammonia
Sodium hydroxide
Red phosphorous
Iodine
Sodium metal

are obtained from²⁴

cold and allergy medicine
cold and allergy medicine
rubbing alcohol
brake cleaner
engine starter
drain cleaner
gasoline additive
camera batteries
gun scrubber
farm fertilizer
lye
matches
veterinary products
can be made from lye

Other materials

Table salt or rock salt
Kerosene
Gasoline
Muriatic acid
Campfire fuel
Paint thinner
Acetone
MSM (cutting agent)

Because the materials for methamphetamine are so readily available, it is difficult to control its manufacture. In 1992, less than two percent of seized amphetamine laboratories used pseudoephedrine, but this had grown to 55 percent by 1996. To plug this loophole, Congress passed the Comprehensive Methamphetamine Control Act of 1996, placing pseudoephedrine under the same regulations that apply to ephedrine. A single sale is limited to 24 grams of pseudoephedrine. Some stores, such as Wal-Mart, limit sales of all cold medicines to three packages per customer. A way around these restrictions is to buy large quantities of "herbal extract" pills. They may be loaded with ephedrine but do not come under the pharmaceutical regulations because they are herbs.²⁵

The law also amended the Chemical Diversion and Trafficking Act to restrict the sale of iodine, red phosphorus, and hydrochloric gas. These three chemicals are used to make hydriolic acid, a key ingredient in the ephedrine reduction method of making methamphetamine.



PURE SPEED?

Meth lab operators tend to be uneducated and usually have a very poor understanding of chemistry or quality control. Amphetamine by-products and other drug variants such as N-methamphetamine (MA) and N,N-dimethylamphetamine (NNDMA) sometimes appear in police confiscations.²⁶ They are synthesized unintentionally by sloppy manufacturing.

Many of these meth lab "cooks" are violent because they use their own product. Addicts can go without sleep for up to 15 days, making them delusional and aggressive. Police have been attacked with scissors, chain saws, and even firebombs.



"These folks are biohazards in and of themselves. They have open sores, chemical burns, higher incidences of HIV, TB, and hepatitis. They even sweat the by-products of these drugs." —Meth lab investigator²⁷

Methamphetamine is generally a white to tan powder. Drug seizures show an average purity of 54 percent, diluted with ingredients such as baking soda, lactose, Epsom salts, quinine, mannitol, procaine, ether, insecticides, MSG, photo developer, and strychnine. Heavy speed users may even prefer these additives because the impurities can give a more intense rush.²⁸



Busting meth labs is a hazardous occupation. According to a DEA spokesman, at least 40 percent of these labs are booby-trapped with explosives and nerve agents.

Some addicts crush prescription amphetamine pills and inject them. Beside the general hazards of intravenous drug use, this practice can cause additional physical problems. Amphetamine pills are often combined with other substances that are not meant to be injected. For example, some tablets use insoluble fillers that do not disperse in the bloodstream. Crushed tablets may look like a solution in water, but are in fact a mixture of tiny hard particles. When injected, these particles can block small blood vessels and cause serious damage throughout the body, especially in the lungs and the retina of the eye²⁹ (see *Chapter 4: Intravenous Drug Use*).

Chemical Characteristics

The effects of amphetamines, especially methamphetamine, are similar to those of cocaine, but their onset is slower and they last longer. Like cocaine, amphetamines cause a rapid release of serotonin and dopamine from nerve terminals. In high doses, amphetamines can

injure the serotonin nerve endings, and up to 50 percent of the dopamine producing cells, with the possibility of long-term brain damage.

The seemingly additional energy provided by amphetamines actually comes from using up the stores of neurotransmitters in the central nervous system. Rather than being released in short bursts as needed for the body's "fight or flight" response, amphetamines cause an enormous amount to be released at once. This release is inevitably followed by the feeling caused by depletion of these neurotransmitters—the sluggishness of withdrawal.

A single amphetamine dose may increase attention and performance, but exhaustion eventually takes over and performance deteriorates as the effects wear off. The worker on amphetamines is often nervous, suspicious, and hyperactive. His sense of increased work performance may actually be due to impaired judgment, rather than to increased intellectual ability. To others, he may appear to be a hard, aggressive worker, but at the same time he is on the brink of collapse.

The appetite-inhibiting effects of amphetamine probably result from the release of norepinephrine and serotonin. Amphetamines that release mainly serotonin—for example, dexfenfluramine—can effectively suppress appetite without producing addiction. However, serotonin-specific amphetamines have proved to be dangerous to the heart and were taken off the market.

Amphetamines, particularly methylphenidate, also affect the dopamine-producing nerves. Small doses block the reuptake of dopamine, but a higher dose may also block the post-synaptic dopamine receptors, resulting in spastic body movements. These movement disorders usually resolve after the drug has worn off.

Smokable amphetamines are stronger and more addictive than the snorted or the injected forms. When methamphetamine is smoked, other products can be formed by combustion. The smoke contains 14.5 percent of the initial methamphetamine. It also contains phenylacetone (3.1 percent), N-cyanomethylmeth-amphetamine (1.9 percent), trans-beta-methylstyrene (1.7 percent), N,N-dimethyl-amphetamine, and trans-beta-methylstyrene—all of which are intoxicating drugs on their own.³⁰ Together they make a distinctive, potent combination.

TESTING FOR AMPHETAMINES

Amphetamines are well absorbed from the nasal cavity, the lungs, and the gastrointestinal tract. When methamphetamine is used, nearly half of the dose is excreted in the urine unchanged, but a small percentage is demethylated to amphetamine. Therefore, tests will show both amphetamine and methamphetamine in the urine even though only methamphetamine might have been taken. This may have important legal implications if the user is suspected of taking amphetamines.

The natural excretion of amphetamines from the body can be speeded up by certain diets. For example, consumption of large amounts of vitamin C, vinegar, and acidic fruit juices can increase the rate of amphetamine excretion. Amphetamines are chemically basic compounds. When the urine is acidic, amphetamines are leached out of the blood and absorbed by the urine and therefore excreted more quickly. With normal urine, about 30 percent of an amphetamine dose appears in the urine unchanged. But this can rise to 70 percent if the urine is acidic and can be as low as one percent if the urine is alkaline. Some illicit drug users drink vinegar or cranberry juice to acidify their urine and “cleanse” themselves of amphetamine. Even so, 10 milligrams of amphetamines generally produces a positive urine test for about 24 hours, depending on the individual. High-dose abusers can have positive urines for two to four days after the last use.³¹

LEGAL AND ILLEGAL AMPHETAMINES

Both amphetamine and methamphetamine can exist in two molecular forms: one has psychoactive effects and the other does not. The two forms are known as *d*- (dextro) and *l*- (levo) enantiomers, or stereoisomers. These molecules are mirror images of each other. The designators *d*- and *l*- can be remembered as “drug” and “legal,” but they actually indicate the direction (*d*=right and *l*=left) in which each enantiomer rotates a beam of polarized light. The *d*-isomer has a strong stimulant effect on the central nervous system, while the *l*-isomer acts primarily on the peripheral nerves (for example, it reduces nasal stuffiness but does not affect the brain). If a test for amphetamines is positive, a further test can be ordered to distinguish between *d*- and *l*- forms to see if the positive result was due to the use of an illegal or legal form.

The *d*- form of amphetamine in a positive test does not always indicate the use of illegal drugs, but can be due to a legal prescription of amphetamines. A number of medications metabolize to amphetamine or methamphetamine in the body. These include amphetaminil, benzphetamine, clobenzorex, deprenyl, dimethylamphetamine, ethylamphetamine, famprofazone, fencamine, fenethylline, fenproporex, furfenorex, mefenorex, mesocarb, and prenylamine, and can cause a misinterpretation of the test results.³²

Because amphetamine-like drugs contain such a wide variety of structurally similar chemicals, amphetamine immunoassay tests are often wrong. False-positive tests can result from the use of nonprescription drugs that contain ephedrine, pseudoephedrine, and phenylpropanolamine (e.g., Alka-Seltzer Plus, Dexatrim, Primatene Tablets, Triaminic) and the prescription drug Ritalin. If there is any question of the meaning of the test results, a Medical Review Officer (MRO) should be consulted.

Withdrawal Signs

A medical dose of amphetamines seldom exceeds 60 mg per day, and is unlikely to cause serious withdrawal symptoms when it is stopped. In contrast, heavy amphetamine users develop a tolerance to the effects and may need a dose up to 100 times greater than the original one. They may take more than 5,000 mg a day during a speed run lasting three to five days and then crash, to sleep for one or two days. Withdrawal causes a state of depression that may last for weeks unless more amphetamines are taken, resulting in a speed run/crash cycle.

Withdrawal from amphetamines generally produces the opposite of the stimulating effects. Physically, there can be muscular aches, abdominal pain,

chills, tremors, and voracious hunger. Apathy, long periods of sleep, increased appetite, fatigue, and a sense of sluggishness are common. Reaction times are slower and the whole body is less alert and responsive. There may also be irritability or agitation, disorientation, insomnia, and vivid and unpleasant dreams. Most users experience depression and some are brought to the point of suicide.

Amphetamine effect and . . . the withdrawal symptom³³

Stimulation	becomes sluggishness
Strength	becomes fatigue
Alertness	becomes apathy
Concentration	becomes disorientation
Loss of appetite	becomes voracious hunger
Euphoria	becomes depression
Feeling of vitality	becomes aches and pains

These withdrawal effects are not harmful to the body and disappear within days. One particularly unpleasant symptom of amphetamine withdrawal—that may *not* disappear as quickly—is anhedonia, or the inability to feel pleasure. When a stimulating drug is removed, so is its artificial stimulation of the brain's pleasure center. The result is a suppression of dopamine neuron activity during the withdrawal period, which can cause a very disagreeable feeling that can last for weeks, depending on the severity of the addiction. Even the memory of the good feelings associated with the drug, and the bad feelings away from it, can be enough to drive the user back to the drug.



"No one ever died from a few days without pleasure, but in the absence of any positive feelings, the temptation to use the drug to feel better becomes stronger and stronger. Anhedonia is thought to be a major reason why people start using stimulants after a period of attempted abstinence . . . the craving can last for months."³⁴

Long-term Health Problems

With repeated use, tolerance to the drug develops, and attempts to reduce the dose result in depression and lethargy. Eventually, users are caught between being overly stimulated when using the drug, and overly depressed if they have not taken enough. It is impossible to maintain a satisfactory balance.

Frequent use of amphetamines can produce a psychosis that resembles schizophrenia. This "amphetamine psychosis" is characterized by paranoia, picking at the skin, preoccupation with one's own thoughts, and auditory and visual hallucinations. Violent and erratic behavior is often seen among chronic

abusers.³⁵ Long-term users may get the feeling that insects are crawling under the skin, a sensation called formication. Picking at these imaginary bugs can lead to large wounds that become infected. Addicts have almost died trying to cut these “speed bugs” or “crank bugs” out of their skin.

Dopamine-related effects account for the odd behavior of some amphetamine addicts. As use increases, the bizarre, repetitive, stereotyped movements become more extreme. They can be very self-directed behaviors, such as saying the same thing over and over, or repeatedly assembling and taking apart equipment.

On a biological level, long-term amphetamine use alters the sensitivity of the post-synaptic membrane receptors in the central nervous system, eventually leading to neurochemical exhaustion. If only low doses are taken, nerve receptors will eventually regain their sensitivity when amphetamine use is stopped. High doses of amphetamine—methamphetamine in particular—cause permanent damage to the nerve endings of serotonin and dopamine neurons. The nerves do not die, but the nerve endings are “pruned” or cut back, leaving a permanent deficit in the density of nerve terminals and the amount of dopamine and serotonin. The effect of this may not be immediately obvious, since there are billions of such nerves. However, as people get older and experience the normal aging-related loss of dopamine and serotonin neurons, this deficit can start to become noticeable in the form of movement disorders such as Parkinson’s Disease, or mood disorders such as depression.

What to Do If There Is an Overdose

Thousands of people have died from amphetamine overdose. It is an emergency that requires immediate medical attention. Death most often has resulted from seizures or an irregular heartbeat causing heart failure.

It can be difficult to detect an overdose in a long-term user, as the signs of normal use and the signs of overdose are quite similar. The high energy and alertness can become jitteriness or even paranoia and hostility. The increased movement can become repetitive aimless activity, such as drawing closely spaced lines, taking watches apart and putting them back together, or talking constantly without listening. A mild increase in the pulse can become palpitations or chest pains as the heart rhythm is disturbed, and the skin becomes flushed as body temperature rises. Other overdose symptoms include headaches, from the amphetamine effects on blood vessels, and nausea and vomiting, usually from the impurities taken along with the drug.

Physical signs of overdose

Fever
Rapid or irregular heartbeat
Shallow breathing
High blood pressure
Enlarged pupils
Dry mouth
Sweating
Tremors
Stroke
Heart failure

Mental signs of overdose

Confusion
Agitation
Paranoia
Hallucinations
Impulsive behavior
Hyperactivity
Unresponsive coma

If there are only mild symptoms, drinking solutions of ascorbic acid (vitamin C) or ammonium chloride can help the body to get rid of the amphetamines by making the urine more acidic. Other stimulating medications should be avoided, including coffee or soft drinks with caffeine.



Amphetamine overdose can be fatal. If you suspect an overdose, call 911 or get to an Emergency Department.

Anxiety reactions without the physical signs of an overdose can be managed by reassurance. The user should recover within a few hours. Chronic anxiety reactions, particularly during the withdrawal period, may be helped by sedative medications, but this should be done under medical supervision.

If there is a fever or high blood pressure, the amphetamine user should be taken to the Emergency Department *immediately*. Doctors may use blocking agents such as propranolol or phentolamine, and may treat psychotic reactions with haloperidol (Haldol). Without these treatments, amphetamine overdose can cause permanent brain damage or be fatal.