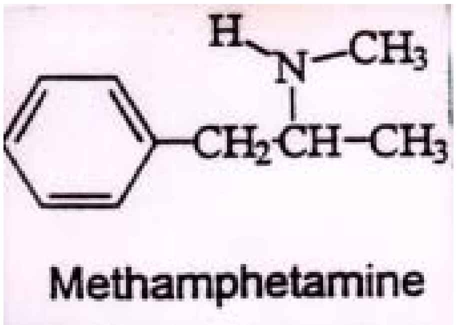

METHAMPHETAMINES:
an epidemic of clandestine labs and health risk

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September 28, 1999

METHAMPHETAMINE:
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Methamphetamine is an illegal, powerfully addictive central nervous system stimulant that is easily manufactured. It is made with relatively inexpensive over the counter ingredients and causing a nationwide epidemic. Commonly known as “speed,” “meth” or “chalk,” in its smoked form it is called “ice,” “crystal,” “crank,” or “glass.” It is a white, odorless, colorless, bitter tasting crystalline powder that is easily dissolved for intravenous use. Currently, methamphetamine (meth) is available by physician prescription for the treatment of attention deficit disorder, narcolepsy and obesity. However, much of the meth available on the street is illicitly manufactured in U.S. clandestine labs. Methods of manufacture are readily available, easily accessible and ever changing. Over the past several years, the number of illicit labs found by drug enforcement officials has dramatically increased.

Laboratories are found in household kitchens and bathrooms, vehicles, garages, hotels, apartments and other outbuildings. Many agents used in production are caustic, corrosive or create noxious and harmful fumes. The contaminants, exicipients and by-products of meth manufacture place the community and health/environmental agencies charged with their cleanup at risk. Although local building officials often condemn such properties after seizure, community and health officials often seek assistance in determining the safety of these sites for future occupants.

The number of meth related admissions to U.S. Emergency Departments increased from 4200 in the first half of 1996 to 8400 in the first time of 1997 in 21 major metropolitan areas (Contra Costa Times, 1999) thus becoming an area of great interest to the Emergency Physician.

Historical Perspective

Methamphetamine is a structural analog to amphetamine (phenylisopropylamine), a class of non catecholamine compounds producing strong central nervous system (CNS) stimulation. Meth is known to have more prolonged CNS effects than amphetamine. The basic amphetamine properties were first synthesized in 1887 by a German pharmacologist named L. Edeleano (Gorman, M., 1996). This substance was made from the drug Ephedrine which was discovered by K.K. Chen of China years earlier. Chen was looking for an adrenaline substitute as an anti- asthmatic, according to a 1937 issue of the Journal of the American Medical Association. Ephedrine is derived from the Ephedra plant, which is called ma huang in Chinese. During the 1920's, a shortage of naturally occurring ephedrine was apparent and the task of its synthesis was given to a British UCLA graduate student named Gordon Alles. Alles attempt to synthesize ephedrine was unsuccessful, but on the way he discovered the properties of a product later called dextroamphetamine. He found this substance to have potential for increasing alertness, alleviating fatigue and creating euphoria.

In 1919, a Japanese chemists named Ogata, working on the same problem of the ephedrine shortage, discovered d-phenylisopropymethalamine HCL. This substance is now known as methamphetamine. He took his discovery to Burroughs Wellcome, which produced and marketed amphetamine in the U.S. under the name Methedrine. The first medicinal use of amphetamine was in 1932 by Smith, Kline and French who marketed a nasal inhaler called Benzedrine (Stalcup). Each inhaler contained 350-mg of d-l-amphetamine, which was the equivalent of 560-mg of amphetamine sulfate. The inhaler was sold over the counter, but its stimulant effects were soon apparent (Stalcup).

Amphetamines quickly became the “cure all,” being used to treat many conditions such as urticaria, ‘caffeine mania’, multiple sclerosis, narcolepsy, Parkinson’s Disease, depression, sea sickness, sexual dysfunction, myasthenia gravis and asthma. In WWII, amphetamines were part of each soldier’s kit bag in the form of nasal sprays and Benzedrine tablets (Tripod.net). This kit was used by the Allied and Axis troops to improve soldiers’ performance. Japan was the first country to experience an epidemic of abuse in its factory workers and soldiers (Standard Operating Procedure No. 2220 -.1B).

The first laws to restrict its availability were passed in the 1940's. However, production by Smith, Kline and French continued. Their inhalers contained as much as 250-mg of amphetamine which abusers would open and chew or soak in drinks. Smith, Kline and French ran out in 1953 and production continued by Wyeth, Rexall, Squibb, Eli Lilly and WS Merrell (Alex). In 1952, the use of all meth drugs was outlawed by Japanese government and U.S. regulations soon followed. In 1959, the first U.S. report of intravenous injection of the contents of a Benzedrine inhaler for non-medicinal purposes was noted (Gorman). The FDA banned the use of Benzedrine inhalers later in 1959 and it was classified as a Schedule II controlled substance, drugs with medicinal use but significant abuse potential (Medical Toxicology, 1988). In 1965, amphetamines and meth were controlled under the Drug Abuse Act of 1965 and legal drug manufacturers removed these products from the market. In 1971, the last non-prescription inhaler was removed from the U.S. market pursuant to the Controlled Substances Act of 1970 (Gorman). This spawned the illicit manufacture of the drug due to the vacuum in the market. Amphetamines were prescribed for a number of medical conditions until the mid 1970's when the FDA restricted its use to narcolepsy (sleep disorder), attention deficit disorder in children and weight reduction in those with morbid obesity. Currently, it is listed as having high potential for abuse and available only through prescription that cannot be refilled.

Today, meth is dubbed “the crack of the 90's” and it is racing like prairie fields across the Midwest (Campbell, 1996). It has bypassed poor urban black youth and instead entrapped the rural and suburban working white class. Smoked in a similar manner to crack cocaine and at about the same cost, its appeal lies in its longer duration of action, enabling teen users to dance all night at parties.

Data from the Koch Crime Commission priced an ounce of meth at $1700, providing approximately 110 “hits.” The Idaho Post Register states that if the “cook” can stay away from the finished product, a $1000 investment in ingredients can be turned into $15,000 at $100/gram. In Kansas City, the prices are the same as crack $125/g and $1500/oz. (Campbell, 1996). Nationwide, the DEA reported meth selling for $6500-20,000 per pound, $500-2700 per ounce and $50-150 per gram.

The prices are influenced mainly by the supply of precursors and the purity (DEA, 1997). Crystal meth or “ice” is of the highest purity (95-100%) and a user gets 10-15 “hits” per gram. Although initially reported in 14 key states in the southwest: Minnesota, Wyoming, North and South Dakota, Kansas, Missouri, Arkansas, Montana, California, Utah, Colorado, Illinois, Nebraska and Iowa, meth is turning up on the east coast as well. The newer production methods make it possible to manufacture it in the inner cities reaching epidemic proportions across the U.S. according to Justice Department data. Research in 1996 indicated that 4.8 million people have used meth in their lifetime (NHSDA). Dr. Alex Stalcup, Medical Director of the New Leaf Treatment Center in Concord, CA, reported that in 1994, 4.4% of high school seniors had tried meth versus 2.7% in 1990. No reports of current statistics were available.

Outlaw biker gangs historically dominated the trafficking of methamphetamine, but the current market includes local producers and Mexican resources. The majority of the meth available in the U.S. today is believed to be manufactured in Mexico or major California and Southwestern U.S. labs (Criminal Investigations Bureau of Utah). Mexican traffickers are utilizing well established smuggling routes to move meth and bulk ephedrine into the U.S.

The North American Federal Trade Agreement makes this process easier. It states that commercial trucks crossing Mexican borders into the U.S. are inspected only once, then free to go back and forth without further inspection (Willow Springs Police Department, 1996). Aware of the growing problems, legislation has been passed restricting the availability of precursors. In Utah, state legislatures restricted the base ephedrine/pseudoephedrine product to 12g versus 24g tablets, which is the nationwide standard. They also limited the purchase of iodine crystals to 2oz per single purchase.

The Facts about Meth

Methamphetamine is the most common drug in clandestine manufacture. The ice form is the meth what crack is to cocaine. It can be snorted, swallowed, injected or smoked. Meth has many different names in the street, depending on geographical location, ethnic group or method used. Outlaw biker gangs gave birth to meths most popular nickname by carrying it in the crank cases of the motorcycles during transport. When meth is sniffed or swallowed, it is called “speed” or “crystal”; “crank” when it is injected; “ice” when it is smoked; “shabu” in Japan referring to the swishing sound it makes during production; “hirropon” in Korea; and “batu” in Filipino youth gangs referring to its similarity to small rocks in the Philippine dialect of Ilocano.

According to a California source, 52% of users snort, 21% inject and 18% smoke meth. Smoking meth is actually an incorrect term because ice is vaporized and inhaled, not actually burned. It appeals to drug abusers because it increases metabolism, produces euphoria, increases alertness and gives the abuser a sense of increased energy and sexual drive (leading to “marathon” sexual interactions) (Starkey, 1988). It comes in three forms: dextro-methamphetamine (d-meth), dextro-levo-methamphetamine (dl-meth) and levo-methamphetamine (l-meth). (U.S. DOJ) D-meth is the most potent, has the fewest side effects and most widely abused form in the U.S.

Meth is known to alter moods in different ways depending on the route of administration, dosage (amount taken), personality characteristics of user and the mood of the individual at the time and throughout the duration of effect. (Starkey, 1998) Immediately after smoking or iv injection, the user experiences an intense “flash” or “rush” lasting only a few minutes. These two methods produce the fastest effects, often within 5-10 seconds.

Snorting or ingesting produces euphoria but no rush. Snorting produces effects within 3-5 minutes and oral ingestion within 15-20 minutes. As with similar stimulants, meth is used most often in a “binge and crash” pattern as reported by the National Institute on Drug Abuse. Tolerance occurs within minutes. This means that the pleasurable effects disappear even before the drug concentration in the blood falls significantly and users try to maintain the high by bingeing on the drug. (NIDA)

Methamphetamine has many short and long-term effects with its most intense activity on the CNS. It enhances the release and blocks the reuptake of catecholamines and may also have some direct effects on catecholamine receptors (Goldfrank’s Toxicologic Emergencies, 1994). Through several studies methamphetamine has been linked to the neurotransmitter dopamine and at high doses causes release of serotonin. The anorexic effects, alerting effects and some locomotor stimulating effects are related to increased norepinephrine at the locus ceruleus.

An increase in central dopamine mediates stereotypical behavior and some of the locomotor activities (Goldfrank's Toxicologic Emergencies, 1994). Alteration of perception and psychotic behaviors are linked to the effects of dopamine and serotonin at the mesolimbic system. Dopamine regulates movement, emotion, motivation and feelings of pleasure. Serotonin regulates mood, personality, affect, appetite, motor function, temperature regulation, sexual activity, sleep induction and other basic functions. The amphetamines have a sympathomimetic effect, imitating the effects of adrenaline and noradrenaline. They cause an increase in blood pressure, heart rate, bronchial dilation, dilation of blood vessels to the skin, dilation of pupils, increased alertness and loss of appetite.

At the cellular level, they are known to interact presynaptically with the dopamine terminals, indirectly facilitating dopamine activity involving the D1 receptors. This is the basis for the psychotic action of the drug. More than 20 years of animal research shows that high doses of meth damages neuron cell-endings which don't die but nerve endings (terminals) are cut back with limited regrowth (Infofax, NIDA).

The abuse has been reported to have three patterns: low intensity (no psychological addiction), binge, and high intensity. The binge cycle has several stages as reported by rehabilitation programs.

- Rush (5-30 min) - due to adrenal gland release of adrenaline (epinephrine) putting the body into "fight or flight" mode and the explosive release of dopamine; effects are tachycardia, increased metabolism, hypertension, palpitations; euphoria likened to the intensity of 10 orgasms
- High (4-16 hrs) - follows the rush and sometimes called the shoulder; feelings of aggression and heightened intellect
- Binge (3-15 days) - continuation of the high but due to tolerance; larger doses required to achieve same intensity until no rush or high felt; physical and mental hyperactivity
- Tweaking - at the end of the binge when nothing will take away the feelings of emptiness and dysphoria; often alcohol and heroin used during this time to ease the bad feelings; most dangerous state of cycle for law enforcement and medical personnel
- Crash (1-3 days) - body's epinephrine depleted so long period of rest to replenish; no threat posed, lifeless and sleepy
- Normal (2-14 days) - return to normal state slightly deteriorated from pre use
- Withdrawal (30-90 days) - no immediate distress evident but slow progression to depression, lethargy, cravings, suicidal thoughts; meth use during this period can alleviate feelings of unpleasantness

The most commonly noted clinical effects of meth can be listed by organ system. They are similar to those resulting from cocaine use and may often be indistinguishable except for the longer duration of effect. Meth lasts up to 24 hours versus 20-30 minutes with cocaine. Fifty percent of meth remains in user body 12 hours after consumption versus 50% removal in one hour with cocaine.

- CENTRAL NERVOUS SYSTEM

  hyperthermia (up to 108 F), seizures, intracerebral hemorrhage, headache, euphoria, choreoathetoid movements (writhing jerky or flailing movements), hyperreflexia, convulsions

- PSYCHOLOGICAL
  resembling schizophrenia, anger, panic, paranoia, hallucinations (auditory and visual), formication (delusions of parasites or insects on the skin), homicidal and suicidal thoughts, aggression, agitation, anxiety
- RESPIRATORY SYSTEM
  tachypnea, pulmonary edema
- CARDIOVASCULAR SYSTEM
  chest pain, hypertension, tachycardia, dysrhythmias (mostly ventricular), myocardial ischemia, cardiomyopathy, vasospasm
- GASTROINTESTINAL SYSTEM
  anorexia, diarrhea, constipation, dryness of the mouth, unpleasant taste, nausea, vomiting
- CUTANEOUS
  urticaria, diaphoresis, erythematous painful rashes, ecthyma (infected deep ulcerations), dry itchy skin
- HEENT
  mydriasis (dilated pupils), slowly reactive to light, bruxism (teeth grinding)
- GENITOURINARY
  rhabdomyolosis in overdose, difficult micturition
- LABORATORY ABNORMALITIES
  leukocytosis, hyperglycemia, elevated CPK, elevated LFT's, myoglobinuria
- LONG TERM EFFECTS
  fatal kidney and lung problems, irreversible brain and liver damage, coagulopathy, chronic depression, malnutrition, weight loss, immune suppression, stroke, disturbance of personality and behavior

The Materials

"An exerp from the Betty Cranker Cookbook:

Take a pinch of red phosphorous, a smidgen of ephedrine, a dash of iodine and a skosh of lye. Add some distilled water and simmer for a few hours and hope it doesn't explode and kill you."

Paul B. Johnson
Post Register, Idaho

The production of methamphetamine is a relatively simple process and can be carried out by individuals without special knowledge or expertise in chemistry. Recipes number in the hundreds and are constantly evolving. They are passed along in bars, jails and even over the internet. Methods range from commercial-scale labs in Mexico and California to smaller operations using jars, microwaves, bathtubs, crockery cookers, blowtorches and hot plates (Campbell, Kansas City Star).

There are well over 300 substances that can be used to produce meth depending on the method used (Campbell, The Star). Some of the more common materials are: acetone, ephedrine, hydriodic acid, hydrochloric acid, iodine, methyl ethyl ketone, phenylacetic acid, phenyl-2-propanone, pseudoephedrine, red phosphorous, sodium hydroxide, sulfuric acid, toluene, anhydrous ammonia, lithium metal, sodium metal, coleman fuel, and methanol.

Modifications based on availability are the norm, including;

- ★ Ephedrine: Pseudoephedrine, Efidac, Sudafed, Mini-thins
- ★ Organic Solvents: toluene, coleman fuel or camp fuel, ether, acetone, white gasoline
- ★ Corrosive alkalines: calcium, potassium or sodium hydroxide; caustic soda

Many of these agents alone or in combination with others are highly volatile. They can be found in local hardware stores or hobby shops and many are found in ordinary household agents such as lighter fluid or drain cleaner. Each agent and products formed during chemical reactions have potential hazards but many also have legitimate uses as well.

Acetone (dimethyl ketone): a colorless, mobile, flammable liquid with a mildly pungent and somewhat aromatic odor (Hazardous Materials Toxicology, 1992); highly volatile and flammable; toxicity usually by ingestion and inhalation with no reported fatal exposures in industrial settings (Medical Toxicology, 1988); vapor is irritating to eyes and nose in high concentrations; inhalation of the vapor may cause dizziness, narcosis and coma; liquid is irritant to eyes and may cause severe damage; ingestion may cause gastric irritation, narcosis and coma; legitimate use as a solvent and chemical intermediary for a variety of substances such as paints, lubricants, nail polish remover, glues, rubber cement and varnish removers

Anhydrous Ammonia: poisonous gas; ignites on exposure to air (air concentrations' 15-20%), attacks mucous membranes of the body, inhalation hazard leading to pulmonary edema and asphyxia (Intelligence Bulletin, Washington State, 1996); legitimate uses include fertilizer and refrigerant; commonly stolen from 1000 gallon tanks in fields; sold in gas cylinders, green in color; unapproved tanks will be discolored (Det Jeff Seever, Jackson County Drug Task Force, MO)

Ephedrine (a-{Methylamino)ethyl}-benzene-methanol: salts are white crystals; harmful if swallowed in large quantity; hazardous warnings include not breathing dust and avoiding contact with skin and eyes; legitimate uses in medicinal preparations as a bronchodilator; no manufacturers in the U.S.; the primary precursor used in clandestine meth production

Hydriodic Acid (hydrogen iodide): corrosive acid which is colorless when freshly prepared; with light exposure, it turns yellow to brown; vapors are irritating to the respiratory system, skin and eyes; can dissolve flesh, liquid causes severe burns to eyes and skin; if ingested, may cause severe internal irritation and damage; legitimate uses are in the manufacture of organic and inorganic iodo compounds; the main reducing agent in meth synthesis

Hydrochloric Acid (muriatic acid, hydrogen chloride): corrosive, colored to light yellow liquid from traces of iron, chlorine and organic matter; fumes in air; also available in gas form; legitimate uses include production of chlorides and hydrochlorides; neutralization of basic systems; catalyst and solvent in organic syntheses, bleaching agents, dye and chemical synthesis (Medical Toxicology, 1988); acids are essential to the production of water soluble salts of controlled substances

Iodine: bluish-black scales or plates; it has a characteristic odor, a sharp acrid taste and produces a violet corrosive vapor; vapors are irritating to the respiratory system and eyes; solid irritates the eyes and may burn the skin; if ingested there may be GI upset, GI bleeding, anuria or circulatory collapse (Goldfrank's Toxicologic Emergencies, 1994); legitimate uses include manufacture of iodine solutions, germicides, fungicides, and topical antiseptics (Goldfrank's Toxicologic Emergencies, 1994); when combined with water and hydrogen sulfide produces hydriodic acid which is used to make meth; can also be mixed with red phosphorous to form hydriodic acid

Phenylacetic acid (a-toulic acid): white powder with a disagreeable pungent odor, salts usually sold as 50% aqueous solutions, available as sodium or potassium salts; moderately toxic by ingestion; teratogen; when heated to decomposition it emits acrid smoke and irritating fumes; legitimate uses include the manufacture of perfumes, herbicides, penicillin and flavoring agent for beverages and sweetened foods; it is used in the two most frequently employed methods to synthesize P2P

Phenyl-2-propanone (phenylacetone, methyl benzyl ketone): clear, moderately viscous liquid that is irritating to the skin and eyes; uses include the production of amphetamine, methamphetamine and propylhexedrine in organic syntheses; prior to 1980, was the most widely used precursor in the synthesis of amphetamine/methamphetamine

Phosphine (hydrogen phosphide): colorless gas and odorless when pure; fishy or garlic-type odor generally associated is associated with the presence of diphosphine and other impurities (Willers-Russo, 1998); toxicity usually via inhalation (Medical Toxicology, 1988); exposure results in headache, fatigue, weakness, thirst, chest pain or pressure, shortness of breath, gastrointestinal upset, convulsions or coma (Hazardous Materials Toxicology, 1992); formed during ephedrine/hydriodic acid/red phosphorous method when iodine and red phosphorous are combined in aqueous media forming phosphoric acid; when heated above 180 degrees Celsius, acid is thermally unstable and decomposes to phosphine gas; legitimate uses of phosphine include insecticide and rodent deterrent during shipping or storage of grain

Pseudoephedrine (1-phenyl-1-hydroxy-2-methylamino-propane): base and salts are crystalline materials. Other hazards and uses are similar to ephedrine

Red phosphorous : red to violet powder, insoluble in organic solvents; vapor from ignited phosphorous irritates the nose, throat, lungs and eyes; versus yellow phosphorous is nonvolatile, insoluble and nor absorbed in the GI tract (Goldfrank's Toxicologic Emergencies, 1994); legitimate uses in the field of pyrotechnics, manufacture of matches, fertilizers, pesticides, smoke bombs and tracer bullets; three forms: white (yellow), black and red; only the red form is used

Sodium hydroxide (caustic soda, soda lye):white powder of flakes, plates, pellets or sticks, rapidly absorbs water from the air, available in several concentrations concentrated material very corrosive to human tissues, generates considerable heat when dissolved in water or when mixed with acid; solids and strong solutions cause severe burns of the eyes and skin; ingestion may cause internal irritation and damage; legitimate uses include solutions to neutralize acids and make sodium salts, making plastics, hydrolyze fats and form soaps; it is one of a number of alkaline substances used in clandestine labs

Sulfuric acid (hydrogen sulfate): clear colorless, odorless, oily liquid; concentrated acid is extremely corrosive to skin; causes severe burns; when mixed with other liquids should be added slowly, stirring constantly; when diluting always add acid to water, never water to acid; reacts with water and steam to produce heat; legitimate uses include manufacture of fertilizers, explosives, dyestuffs, paper and glue, toilet bowl and drain cleaners, antirust compounds and car battery fluids

Toluene (methylbenzene): refractive liquid solvent with a benzene-like odor (Medical Toxicology, 1988); flammable and highly volatile; readily absorbed after inhalation, slowly absorbed percutaneously and from GI tract (Medical Toxicology, 1988); may burn or irritate mucous membranes, eyes and respiratory tract; severe exposure may result in pulmonary edema; vapors may cause dizziness; used in the manufacture of benzoic acid, explosives, dyes and other organic substances; solvent for paints, thinners, lacquers; gasoline additives; can contaminate soil and water in waste sites (Hazardous Materials Toxicology, 1992)

<u>Manufacture</u>

Today it seems that anyone who can read a recipe can manufacture meth. Recipes are passed in bars, on the streets, during periods of incarceration and on the Internet. According to Dave Morris, a private contractor for clan lab cleanups in the state of Washington, due to the meth induced paranoia "cooks" don't use recipes off the internet because they are worried about DEA planted traps that would result in explosions if used.

Often these labs are operated on a very irregular basis in homes, apartments, hotels, garages and out of vehicles. With a click of the mouse, anyone can obtain access to a variety of recipes. One site divides the recipes into "synthesis that suck " and "synthesis that don't suck". Sites have regular would-be chemists such as "Doc Aliquot", "Elusis" "Popeye", and "Yogi". They warn of potential hazardous mixtures, provide alternative reagents and methods, and in the interest of public safety, often list disclaimers. One site states verbatim, "it seems the Holy Grail in meth synthesis is to be a cheap bastard, not stink up the neighborhood, corrode the sewers too bad or blow your apartment complex up".

Some of the texts sited on the net include the Journal of Forensic Science, Forensic Science International, Uncle Fester's Secret of Methamphetamine Manufacture (a favorite) and many general chemistry and organic chemistry books. With more than 200 production methods in circulation, a complete list would be exhaustive given that most are a variation of a few basic steps. A few common methods are listed along with its source.

RS Frank, The Clandestine Drug Lab Situation in the United States

- ★ This review occurred from 1978-1981 and found three popular methods of meth manufacture with variations
- ★ a mixture of P-2-P, methylamine, mercuric chloride and aluminum metal in alcohol
- ★ products of an acetaldehyde/methylamine reaction were refluxed with benzylmagnesium chloride to form meth
- ★ using the Leuckart reaction, P-2-P is refluxed with either methylamine and formic acid or n-methylformamide to form n-formylmethamphetamine intermediate and then refluxed the intermediate with hydrochloric acid to form meth
- ★ P-2-P mixed with methylamine then reduction of the intermediate 1-phenyl-2-methyliminopropane to form meth
- ★ hydrogenating ephedrine in acetic acid and perchloric acid with palladium on barium sulfate to form meth
- ★ P-2-P and methylamine in the presence of sodium cyanotrihydroborate at a slightly acidic pH

Resources courtesy of Detective Jeff Seever, Jackson County Drug Task Force

- ★ Sodium-Ammonia ("Nazi") Method
- ★ Pseudoephedrine tablets are ground up and stirred in denatured alcohol
- ★ Undissolved solids are filtered from tablets using coffee filters

★ Excess alcohol is evaporated off using hot plates or heat lamps to concentrate pseudoephedrine
★ Separately, small pieces of sodium are added to condensed anhydrous ammonia in thermos jug
★ With stirring, pseudoephedrine in alcohol is gradually added to the sodium-ammonia solution over approximately a 10-minute period
★ The condensed ammonia is allowed to warm to room temperature and evaporate off
★ Water is added to the remaining solution; ethyl ether (starting fluid) is also added
★ After stirring, the ether layer is drawn off into a separate container
★ HCL gas is bubbled into the ether solution to produce methamphetamine HCL

The finished meth product ranges from hard crystallized amber to whitish rock to crumbly brownish pebbles or powder. (Campbell, 1996). Strict regulations on precursors have made way for new innovative methods to make meth. If there is a crackdown in one particular area involving one of the precursor chemicals, they simply modify or use a little different recipe according to Lt. Richard Coffey of the Missouri Highway Control (Campbell, 1996).

The "Nazi" or cold-method is the up and coming recipe of choice for manufacture. It is named for its German inventors from WWII. They even added it to a chocolate bar called "schokakola" (Joseph, ABC News, 1998) It is gaining popularity because of its high conversion rate, low cost of ingredients, high quality of finished product, and the potential for high profits (Intelligence Bulletin, 1996). Most important, the turn around time is as low as 20 minutes.

With "free" anhydrous ammonia (liquid fertilizer), often stolen from local farmers, and roughly $100 worth of ingredients, a batch of meth worth at least $2,000 is produced. "A moron can learn it in a very short time" according the DEA agent Dennis Moriarty, which is why they call them Beavis and Buttlead (MTV cartoon) labs.

The Clandestine Lab

The clandestine or illegal drug laboratories are supplying controlled drugs for the illicit market. (Frank, 1999) They were typically located in rural America, but new methods with less production of noxious fumes have moved these labs right next door. The clan lab product often contains impurities resulting from incomplete reactions and inadequate purification of intermediates in final synthetic products (Noggle, 1985). It is therefore important that knowledge of these impurities and their hazards be known at the time of clean up. As quickly as the lab is set up, products are produced and operations relocate in an attempt to evade law enforcement.

Laboratories are seized during many stages of production. This puts environmental and law enforcement persons at risk of exposure, explosions and in many cases, firearm attack. Weapons of all kinds are encountered at labs including: knives, crossbows, automatic weapons, shotguns, handguns and explosives according to Washington State Ecology Spill Prevention, Preparedness, and Response. The paranoia produced by the meth inspires many manufacturers to acquire firearms as a means of protection. Many of those who participate in clean up have reported large weapon arsenals among the many things found in these labs.

The DEA has estimated that 5-6 pounds of hazardous waste are generated for each pound of finish product. These are often dumped on the ground, discarded in dumpsters or along a highway, or flushed down the sewer. Even after adequate removal of the chemicals and waste, residual amounts of substance may persist on building surfaces and furnishings according to the Standard Operating Procedure No. 2220.1B of the Environmental Protection Agency, Region 7. The DEA and many local authorities are using private contractors to provide clean up services.

These services may involve: removal of surface material layers; use of encapsulants and fixative sealers; neutralization of corrosives; steam cleaning; use of industrial steam and pressure washers; use of detergent washers; use of chemical neutralizers/cover-ups and “bake-out’ of a property (Irvine, 1991) Dave Morris, a private contractor working with meth labs for more than 10 years in the state of Washington, stated that the residue is usually volatile organic material. He is specifically worried about corrosive contacts such as acids and alkalis, so they do a complete sweep measuring pH’s all over the spill areas. The private contractor is responsible for public safety, not crime according to Mr. Morris. He stated that they can always clean up a property, but the value after clean up is a real concern. In most situations, surfaces can be cleaned, but soft material such as furniture has to be discarded and often the property will no longer be available for occupancy.

After any lab seizure, properties should be marked warning of the potential for hazardous substances or wastes. A web site by the Stop Drugs Organizations posts pictures and provides clues to identifying a meth lab in your neighborhood and how to report this activity to the authorities. The Washington State Department of Ecology reports the removal of at least 1,500 pounds of hazardous waste and debris every month from meth labs, costing thousands of dollars to dispose.

In some cases, cleaning up a large lab can cost up to $150,000, according to a study by the United State Attorney’s Office. Under state law in Washington, Ecology is responsible for handling and disposing all hazardous substances found at illegal drug-lab sites, but this may vary from state to state. Many states have formed special units to combat the problem of clean up and disposal.

The Iowa Department of Public Safety has a Clandestine Laboratory Emergency Response Team (CLERT) which is comprised of specially trained law enforcement officers from the Division of Narcotics Enforcement, the Iowa State Patrol, and the Fire Marshall’s Office as well as chemists from the Division of Criminal Investigation. All CLERT members are certified by the DEA in the investigation, dismantling, and removing of clandestine narcotics laboratories.

In Arkansas, the crime laboratory has a team of Forensic Chemists train to respond to meth labs. Clean up poses a problem for many states because biological dumps won’t accept chemicals and chemical waste dumps won’t accept biological wastes, so often expenses soar due to the separation process according to many private contractors. As the methods and recipes change, new challenges will be posed to decontamination agencies. Dave Morris stated that “there is no rule book on these labs, the standards are being written now as you go”.

Health Effects

In 1999, personal protective gear is available to shield law enforcement and environmentalists from the hazardous fumes and residues found in clandestine meth labs. Unfortunately, many local agencies cannot afford all the necessary equipment and in years past did not utilize what was available. Law enforcement has found that this equipment also limits mobility, which could be dangerous during a struggle (Barr, Campbell 1996). Primary routes of exposure are inhalation and contact with the skin and eyes (Irvine, 1991).

Often, even agents wearing protective clothing have complained of headaches, dizziness, irritation and nausea (Barr, 1996). The properties of these chemicals have been known for years, but the often volatile mixtures found in these makeshift labs pose a new threat. To date, there is a paucity of research in the area of health risk, either to law/environmental agencies or the general populous.

According to the training manual of the Clandestine Laboratory Investigators Association, waste and products from meth labs can cause skin burns, cancer, respiratory failure or death. Chemicals involved in explosions of meth labs are likely to cause cancer, liver, kidney, lung and central nervous system damage. (Campbell, 1996)

The Oregon Department of Resources stated that there is any combination of the following: irritation to the skin and eyes, nose, throat and lungs causing burning, lacrimation, coughing, chest pain, and shortness of breath; conjunctivitis and corneal injury; pulmonary edema and hemoptysis; nausea, dizziness, headache, anxiety and lethargy. In 1988, there was no published scientific evidence that human health risk continued once a site was properly decontaminated and there is little to refute that today.

Over the years there have been reported incidents of adverse health effects to law enforcement officials. A Missouri web site, listed several incidents:

- Officers reported those that gathered evidence in the early 80's are now ill
- One officer now suffering from non-Hodgkin's lymphomas stated "we'd come out and we'd be coughing and lightheaded and had skin rashes and burns"
- An officer states, "one of the officers used to wear latex gloves to the lab, but the chemicals would just eat them away and the gloves would flop back"
- A police pension board granted service-connected disability claims filed by two officers; one with Multiple Myeloma and the other with Emphysema. After conducting an extensive investigation, the board traced their health problems to their exposure to drug lab chemicals such as metals, solvents and acids
- An administrator in Portland's Fire and Police Disability and Retirement Fund stated that "in the research we have done, there is a strong indication their illnesses were caused by their exposure years ago before protective equipment was used".
- Other officers in Portland reported thyroid and kidney cancer as well as Hodgkin's Lymphoma
- A police chief in Oregon suffers from chemical bronchitis he related to acid compounds from meth lab raids
- In Redding, CA, a special agent for the Department of Justice traces his thymoma cancer to unprotected lab raids years earlier
- Some reported that in some of the labs the acid vapors were so thick in the air that they would burn their nasal membranes and they suffered nose bleeds

Of special interest in regard to the health effects are their impact on children being raised in the clandestine lab. This can spell neglect or potential health problems for the kids involved. A study done by the Drug Endangered Children Program in the state of Washington, stated that exposure to toxic chemicals could damage kidneys, liver or spleen and result in emotional and behavioral problems leading to violent or paranoid behavior. Mark Miller, MD, MPH, a Preventive Medicine Resident in California's research reported that in the state of California as many as 30% of labs were in home having residing children at the time of seizure. He reported children to be particularly susceptible to clinical hazards due to their physiologic status (growth, development, and metabolism) and behaviors (hand to mouth).

According to Jeff Burgess of the University of Arizona, it is hard to differentiate the harmful effects versus chronic exposure. In 1996 he, along with Scott Barnhardt, MD, MPH and Harvey Checkoway, Ph.D., both of the University of Washington, published a paper reporting adverse medical effects of clandestine drug labs in law enforcement personnel. The retrospective study of 59 personnel involved in 2,800 investigations found no characteristics consistently associated with a significantly elevated relative risk of adverse effects (Burgess, 1996).

At that time no published information was available. Results were interpreted cautiously due to a small sample size and response rate. However, using questionnaires to query the subjects the following illnesses were reported: headaches (60%), sore throats (60%), nose irritation (40%), cough (35%), breathing difficulty (20%), eye irritation (15%), skin burns/irritation (15%), dizziness (15%), chest pain (10%), abdominal pain (10%), nausea (5%), lung damage (5%), and other (15%).

This study concluded that the illnesses reported were subjective in nature. It could not be concluded whether factors such as prolonged respirator use, or heat stresses were responsible for the complaints. Currently, unpublished data by Jeff Burgess is examining pulmonary function tests in a similar study group, which should be available in the coming year. He stated that future monitoring should include pulmonary function tests and liver function tests but it would be difficult to distinguish end organ effect versus exposure. Urine could, however, be used as an indicator of exposure.

Many by-products of meth production are hazardous, including phosphine gas, produced with mixing of ephedrine, hydriodic acid and red phosphorous. A study by Lynn J. Willers-Russo, B.S. in 1999 reported three fatalities involving phosphine gas produced during meth manufacture. In the presence of impurities, this gas has the odor of garlic or fish, but the strength of the odor is stated to give no indication of its concentration.

Specific symptoms of its exposure in previous literature are: headache, fatigue or weakness, thirst, pain or pressure in the diaphragm or chest, shortness of breath, nausea, vomiting, convulsions and coma. In this report, three victims were found dead in a motel meth lab. The coroners' report listed "phosphine gas toxicity by inhalation" as a cause of death for all victims secondary to pulmonary edema per the pathologist report. This agent is of particular concern for those entering meth labs without the appropriate breathing apparatus.

There are special concerns to many private contractors like Dave Morris of Washington State who enter the sites often days after law enforcement. Property owners who would like to salvage the investment contract these companies. Their major health concern is the sharps often left in the meth labs, some with mixtures of blood and meth still in the syringe, increasing the risk of hepatitis or HIV transmission. Some properties are no longer fit for occupancy or its value isn't worth the cost of clean up, so they are destroyed by demolition or fire department practice burns. It has been his experience that by the time he enters the premises, many chemicals have already neutralized themselves and therefore pose less threat.

Solutions

The most important tools to combat the epidemic of methamphetamine are education and public awareness. Meth is readily available and rapidly spreading across the United States. Many states combating this problem have web sites and hotlines to take anonymous tips regarding clandestine labs. The public is being told how to identify a lab in their neighborhood, how to approach a tweaker and the hazards of some of the chemicals. Many states are restricting the availability of common ingredients used to illegally manufacture meth and passing tougher legislation to prosecute those involved.

The newer, faster methods and ever changing recipes are making it more difficult for law enforcement. This continues to place public officers, the general public and our youth at risk of exposure to hazardous chemicals. The incidence of methamphetamine abuse is exponentially increasing. Therefore, more communities, law enforcement personnel, children and environments are being exposed to hazards from its production. We are in need of research to address exposure issues, both acute and chronic, scientific data to address the safety of reoccupancy once labs are seized and a mechanism to control availability of precursors and products.

APPENDIX 1

Chemicals Found in Illicit Methamphetamine Labs
Goldfrank's Toxicologic Emergencies

METAL.SALT REAGENTS
Aluminum foil
Barium sulfate
Calcium chloride
Iodine
Lead acetate
Lithium aluminum hydroxide
Magnesium
Manganese oxide
Mercuric chloride
Palladium
Potassium cyanide
Red phosphorous
Sodium acetate/cyanide
Thionyl chloride
Thorium oxide

PRECURSORS
Acetaldehyde
Benzyl chloride/cyanide
Diethylmalonate
Dimethylformamide
Ephedrine
Ethanol
Ethyl acetate
Formic acid
Hydrogen gas
Hydrogen peroxide
Methylamine
Nitroethane
Phenylacetic acid
Phenyl-2-propanone (P-2-P)

BYPRODUCTS AND CONTAMINANTS WITH EPHEDRINE METHOD
Iodine
Chloropseudoephedrine
Phosphine
Yellow Phosphorous

SOLVENTS
Acetone
Benzene
Chloroform
Ethyl ether
Freon
Hexane
Isopropanol
Methanol
Pyridine
Toluene

ACID-BASE REAGENTS
Acetic acid/anhydride
Ammonia
Hydrochloric acid
Hydrogen peroxide
Hydriodic acid
Sodium carbonate
Sodium hydroxide
Sulfuric acid

BYPRODUCTS AND CONTAMINANTS WITH THE P-2-P METHOD
a-benzyl-N-methylphenethylamine
Acetic acid
Aluminum hydroxides/oxides
Amphetamine
Benzyl methyl ketone benzylimine
Di-(1-phenylisopropyl) amine
Di-(1-phenylisopropylmethylamine
Dibenzyl ketone
Enol acetate of P-2-P
Lead oxides
Mercury
N,N-dimethylamphetamine
Tri-(-phenylisopropyl) amine

APPENDIX 2

Amphetamine Toxicity
Goldfrank's Toxicologic Emergencies

Acute

Cardiovascular system
- Hypertension
- Tachycardia
- Dysrhythmias
- Myocardial ischemia
- Cardiomyopathy
- Vasospasm (coronary and peripheral)

Central Nervous System
- Hyperthermia
- Agitation
- Seizures
- Intracerebral Hemorrhage
- Headache
- Euphoria
- Anorexia
- Bruxism
- Choreoathetoid movements
- Hyperreflexia
- Paranoid Psychosis

Other Sympathetic Symptoms
- Diaphoresis
- Tachypnea
- Mydriasis
- Tremor
- Nausea

Other Organ Systems
- Rhabdomyolysis
- Muscle Rigidity
- Pulmonary Edema

Chronic Toxicity
- Vasculitis
- Cardiomyopathy
- ? Permanent damage to dopamine and serotonin neurons

Laboratory Abnormalities
- Leukocytosis
- Hyperglycemia
- Elevated CPK
- Elevated LFT
- Myoglobinuria

APPENDIX 3

Effects of Methamphetamine
from the National Institute on Drug Abuse (NIDA)

SHORT TERM	LONG TERM
Increased attention and decreased fatigue	Dependence and addiction psychosis
Increased activity	* paranoia
Decreased appetite	* hallucinations
Euphoria and rush	* mood disturbances
Hyperthermia	* repetitive motor activity
	Stroke
	Weight loss

METHAMPHETAMINE vs.	COCAINE
Man-made	Plant-derived
Smoking high lasts 8-24 hours	smoking high lasts 20-30 minutes
50% of drug cleared from body in 12 hours	50% of drug cleared from body in 1 hour
Limited medical use	Used as local anesthetic in some surgical procedures

APPENDIX 4

Chemical Toxicity and Routes of Exposure (Skin and respiratory)
The environmental impact and adverse health effects of the clandestine manufacture of methamphetamines. Gary D. Irvine and Ling Chin

Cyanide

Substance	Form	Exposure
Sodium cyanide	solid	Skin, eyes
Potassium cyanide	solid	Skin, eyes
Benzyl cyanide	liquid	Skin, eyes, inhalation
Hydrogen cyanide	gas	Inhalation

Health Effects: highly toxic substances. If solid salt form mixed with acid, hydrogen cyanide gas will be released. Inhalation of hydrogen cyanide may result in rapid progression of symptoms to coma, respiratory failure and death.

Corrosives and irritants

Substance	Form	Exposure
Acetic acid	liquid	Skin, eyes, inhalation
Acetic Anhydride	liquid	Skin, eyes, inhalation
Benzyl chloride	liquid	Skin, eyes, inhalation
Hydriodic acid	liquid	Skin, eyes, inhalation
Methylamine	gas, liquid, solid	Skin, eyes, inhalation
Perchloric acid	liquid	Skin, eyes, inhalation
Phosphine	gas	Eyes, inhalation
Sodium metal	solid	Skin, eyes
Sodium hydroxide	liquid, solid	Skin, eyes
Thionyl chloride	liquid	Skin, eyes

Health Effects: vapors of volatile corrosives may cause eye irritation, lacrimation, conjunctivitis, and corneal injury. Inhalation may cause irritation of mucous membranes of the nose and throat and lung irritation, resulting in cough, chest pain, shortness of breath. Pulmonary edema and hemoptysis may occur in severe cases. High concentrations of vapor may cause skin irritation. Additional symptoms of vapor inhalation may include headache, nausea, dizziness, and anxiety. Direct contact with corrosives may result in severe eye or skin burns.

Solvents

Substance	Form	Exposure
Acetone	liquid	Skin, eyes, inhalation
Benzene		
Benzylchloride		
Chloroform		
Ethanol		
Ethyl ether		
Freon		
Hexane		
Isopropanol		
Methanol		
Petroleum ether		
Pyridine		

Health Effects: Inhalation of vapors at low concentrations may result in mild eye, nose and throat irritation. Symptoms of intoxication ,drowsiness and incoordination) or loss of consciousness may occur at high concentrations. Liver and kidney impairment also may occur at high doses. Freon spilled onto the skin may result in freezing injury to the skin.

Metals/Salts

Substances	Form	Exposure
Aluminum	solid	Skin, eyes
Magnesium		
Palladium		
Red Phosphorous		
Iodine		
Mercuric chloride		
Lead acetate		
Lithium aluminum hydroxide		
Sodium acetate		
Sodium hydroxide		
Sodium metal	solid in kerosene	
Potassium metal	solid in kerosene	
Thorium	solid	

Health Effects: Most metals and salts re stable solids with minimal potential for exposure unless ingested or unless the metal is present in the air as dust or fumes, if heated. Sodium and potassium metal and sodium hydroxide are extremely corrosive in the presence of moisture. Lithium aluminum hydroxide is extremely reactive. Thorium is an alpha-emitting radioactive material.

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METHAMPHETAMINES: an epidemic of clandestine labs and health apparent and the task of its synthesis was given to a British UCLA graduate Crystal meth or â€œiceâ€ is of the highest purity (95-100%) and a user gets 10-15 â€œhits â€.Â Brown RT, Amler RW, Freeman WS, et al. Review of Remediation Standards for Clandestine Methamphetamine Laboratories: Risk Assessment recommendations for a New Zealand Standard. 07 October 2016 Prepared by: J Fowles, PhD J Deyo, DVM, PhD, DABT J Kester, PhD, DABT. PREPARED FOR An Epidemic of Clandestine Labs and Health Risk. Methamphetamines. Support for selection of a methamphetamine cleanup standard in Colorado.Â Methamphetamine production for illicit use occurs in makeshift labs and is associated with the release of numerous chemicals, including methamphetamine residues. These methamphetamine residues may pose a health risk to residents who reoccupy these structures after property seizures. Several states have established technology-based cleanup standards for methamphetamine, but none have examined the health-protectiveness of these standards. In response to Colorado House Bill 04-1182, exposure intakes correlated with three technology-based standards were calculated for various groups of individuals