Drugs and Forensic Toxicology

Forensic Science
Unit 11
What is toxicology?

- **Toxicology** is the study of drugs and poisons, and their interactions with or effects on the body.

- **Forensic Toxicology** is the application of toxicology to the law, including:
  - Workplace or Forensic Drug Testing
  - Postmortem Toxicology
  - Human Performance Testing
History of Toxicology

- Socrates was one of the earliest reported victims of poisoning, by hemlock, in 399 BC.

- By the 17th century, it was not uncommon for rich European families to use poisoning as a means of settling disputes.
  - Arsenic became known as “inheritance powder.”
History of Toxicology

- **Mathieu Orfila** (1787-1853) is considered one of the fathers of toxicology as he helped to develop a method of chemical analysis to identify arsenic and other toxins in human tissue.

- Today, less than 0.5% of all homicides result from poisoning.
Role of the Toxicologist

- Studies body fluid, tissue, and organs for drugs and/or poisons
- Must detect, identify, quantify, and assess toxicity
  - May have extremely minute quantities to test
- May conduct postmortem pathological examinations, and examination of personal effects and empty containers, etc.
Collecting Toxicological Evidence

- When possible, collect both **blood** and **urine**
  - Collect two voids (samples) of urine in separate specimen containers
  - Collect a sample of blood if a physician or registered nurse (RN) is available
“Drug” can mean different things…

- **Illicit or illegal drugs** that have no accepted medical use in the US

- **Controlled substances**: legal drugs whose sale, possession, and use are restricted because of their effects and the potential for abuse.

Drugs can fall into one of several different classes: narcotics, hallucinogens, depressants, stimulants, club drugs, and steroids.
Types of Drugs: Narcotics

- Narcotics reduce pain by suppressing the central nervous systems ability to relay pain messages to the brain
  - Pain relievers are called analgesics

- Narcotics induce sleep and depresses vital body functions such as blood pressure, pulse, and breathing
Types of Drugs: Narcotics

- Varieties of narcotics:
  - Opiates: derived from the Asian Poppy
    - Herion, morhpine, codeine
  - Synthetic opiates: man-made
    - Methadone: given to heroine addicts to try and break their addiction
    - Oxycodone (OxyContin or Percocet)
    - Hydrocodone (Vicodin)

- Overdose on narcotics can result in difficulty breathing, low blood pressure, loss of consciousness, and possibly coma and death.
Types of Drugs: Hallucinogens

- **Hallucinogens** alter the user’s perceptions, thinking, self-awareness, and emotions.

- Some hallucinogens can cause panic attacks, seizures, headaches, and sometimes psychosis that can last for weeks.

- Many hallucinogens, particularly PCP, increase the user’s heart rate, which could lead to heart failure.
Types Of Drugs: Hallucinogens

- Varieties of Hallucinogens
  - Marijuana (from cannabis plant)
    - The most widely used illicit drug in the U.S.
    - Contains tetrahydrocannabinol (THC)
    - Has medical uses such as treating glaucoma and relieving nausea due to chemotherapy
  - MDMA ("Ecstasy")
  - Mescaline (from Peyote cactus)
  - LSD (Lysergic Acid, or simply "Acid")
  - PCP (phencyclidine or "Angel Dust")
  - Mushrooms (contain psilocybin)
Types of Drugs: Depressants

- **Depressants** are used to relieve anxiety and produce sleep.
- Depressants reduce body functions such as heart rate.
- Overdose can cause coma and death.
- Mixing depressants with other drugs or alcohol can increase their effects and health risks.
Types Of Drugs: Depressants

- Varieties of Depressants:
  - Alcohol
  - Barbiturates: “downers” such as Phenobarbital and Methaqualone (also called Quaaludes, illegal)
  - Anti-psychotic and anti-anxiety drugs including benzodiazepines such as Diazepam (Valium)
  - Inhalants (“huffing”)
  - Sedatives, muscle relaxers, etc.
  - Marijuana and opiates (like morphine) are also considered depressants.
Types of Drugs: Stimulants

- **Stimulants** increase feelings of energy and alertness while suppressing fatigue and appetite.
- Also called “uppers.”
- Depression often results as the drug wears off.
- Stimulants are highly addictive.
- Overdose can result in irregular heart beat, heart attack, stroke, seizures, coma, and death.
Types of Drugs: Stimulants

- Varieties of Stimulants
  - Amphetamines, also called “speed.”
  - Cocaine, including crack cocaine
    - Derived from the South American coca plant
    - Addictions to cocaine are very difficult to overcome
  - Methamphetamines, also called “meth.”
    - Typically methamphetamines are more potent and dangerous than amphetamines
Meth Addiction

2005© "Faces of Meth"

2.5 Years Later
Types of Drugs: “Club Drugs”

- **Club drugs** are called such because they are most often used at nightclubs, bars, and raves (all night dance parties).

- **Varieties of Club Drugs**
  - Methyleneedioxymethamphetamine (aka MDMA or Ecstasy)
    - Chronic use can cause body system breakdown, severe brain damage, memory loss, and seizures.
  - Ketamine or “Special K” is an animal anesthetic used by veterinarians.
Types of Drugs: “Club Drugs”

- **Date Rape Drugs** are called that because they are often associated with drug-facilitated sexual assault, rape, and robbery.
- These drugs can produce increased libido and depress the central nervous system, resulting in **loss of consciousness** and memory.
- Varieties include GHB and Rohypnol (also called “Roofies”).
Types of Drugs: Anabolic Steroids

- **Anabolic Steroids** promote cell division and tissue growth
- Athletes may take steroids to increase muscle mass
- Anabolic steroids are chemically related to testosterone
- Side effects include liver malfunction, cancer, breast development in males, masculinizing effects in females, diminished sex drive in males, unpredictable moods ("roid rage"), personality changes, depression, hypertension, and high cholesterol
Be careful…

- All of these drugs, even the legal ones, can have harmful side effects. Overdose can be deadly.
Poisons: Pesticides

- Pesticides are by definition poisons as they are used to kill organisms that threaten plants such as food crops
  - Example: DDT (for mosquitoes)

- These chemicals lead to an excess of the neurotransmitter acetylcholine
  - Overdose can lead to muscle spasms, seizures, anxiety, rapid heartbeat, sweating, diarrhea, and at high concentrations coma and death
Drug Control Laws

- There are varying levels and penalties based on:
  - manufacture vs. distribution vs. possession
  - type, amount, concentration
Controlled Substance Act

- The Controlled Substances Act – the federal law that establishes five classifications ("schedules") of controlled dangerous substances on the basis of a drug’s potential abuse, potential for physical and psychological dependence, and medical value.

- The U.S. Attorney General has the authority to add, delete, or reschedule a drug as needed.
Controlled Substances Act

Schedule I

- High potential for abuse
- no currently accepted medical use in the U.S.
- Examples: heroin, marijuana (some states), methaqualone, LSD
Controlled Substances Act

**Schedule II**

- High potential for abuse
- some accepted medical use with severe restrictions,
- potential for severe physiological and psychological dependence
- Examples: morphine, cocaine, methadone, PCP, most amphetamine preparations, most barbiturate preparations, and medical marijuana (some states)
Controlled Substances Act

Schedule III

- Less potential for abuse
- Currently accepted medical use
- Potential for low to moderate physiological and high psychological dependence
- All barbiturates not included in Schedule II, such as codeine preparations and anabolic steroids
Controlled Substances Act

**Schedule IV**
- Low potential for abuse
- Current medical use
- Examples: tranquilizers such as Valium

**Schedule V**
- Low abuse
- Medical use
- Less potential for dependence than Schedule IV
- Examples: Robitussin cough syrup, non-narcotic medicinal ingredients and some opiate drug mixtures in low concentrations
Criminal Penalties

- Schedule I and II have the most severe penalties
- The Controlled Substance Act controls substances that are chemically similar or related to controlled substances such as “designer drugs”
- It also regulates the manufacture and distribution of chemical compounds used by clandestine labs to make drugs
Testing For Drugs

- Bodily fluids and tissues might be tested for the presence of drugs, especially:
  - **Blood** (drug remains for 24 hours)
  - **Urine** (drug remains for 72 hours)
  - **Hair** (drug is permanently embedded in hair’s protein structure)

- Location along hair shaft gives clues to time of drug use. If drug is found closer to the root, use was more recent.
There are several types of tests to screen for the presence of drugs:

- **Screening test**: preliminary test that reduces number of possibilities

- **Confirmatory test**: a single test that identifies a specific substance

- **Color test**: changes color when a specific substance is present

- **Microcrystalline test**: identifies drug based on color and shape of crystals formed

- **Immunoassay**: uses drug specific antibodies to detect low concentrations of drugs
Testing For Drugs

- **Chromatography**: separates a chemical into its components (often different colors) so they can be identified.

- **Spectrophotometry**: Examines the wavelength and frequencies of light absorbed by a substance to identify it.