INDIANA UNIVERSITY

BORKENSTEIN COURSE

Center for Studies of Law in Action

Physiology, Pharmacology, and Toxicology of Alcohol

by
A.W. Jones

PHYSIOLOGY, PHARMACOLOGY, AND TOXICOLOGY OF ALCOHOL

Glossary of Terms

Complied by A.W. Jones, B.Sc., Ph.D., D.Sc.

This glossary contains a selection of acronyms, words and phrases often encountered in articles and books dealing with the physiology, pharmacology and toxicology of alcohol and other drugs. The glossary has been compiled over many years and is being continuously updated. I have found it useful to provide this material as a handout during my lectures and presentations on the subject of forensic aspects of alcohol and toxicology of abused drugs.

Absorption. Absorption describes the uptake of a drug or poison (e.g. alcohol) from outside of the body into the bloodstream. For small non-ionized molecules absorption occurs by passive diffusion through cell membranes. In the case of ethanol this process starts in the stomach immediately after drinking but occurs much faster from the upper part of the small intestine (duodenum and jejunum), owing to the larger absorption surface provided by the microvilli. On reaching the portal vein, absorbed alcohol is transported to the liver, then via the hepatic vein onwards to the heart and lungs and thereafter throughout the entire body water. The rate of absorption and time of occurrence of C_{max} depends on factors influencing gastric emptying, e.g. food in the stomach, type of beverage consumed, anatomy of the gut, concomitant drug use, smoking, time of day etc.

Abstinence. The state or condition of remaining free of alcohol or other drugs (abstainers).

Accreditation. Accreditation of a laboratory represents a formal recognition by an authorized agency that the work performed meets high standards and the management and laboratory staff have appropriate qualifications, are trained and competent to perform the tasks required.

Accuracy. Is a measure of the closeness of agreement between the result of analysis and the true value of the quantity being measured or the discrepancy between the true value and the result obtained by measurement.

Acetaldehyde. This is the first product of ethanol metabolism by all known enzymatic pathways. Acetaldehyde (CH_3CHO) is produced in the liver and this metabolite is toxic and more chemically reactive than the parent drug ethanol.

Acidosis. Too much acid (low pH) in the blood and body fluids (opposite = alkalosis).

Acute tolerance. This is the development of tolerance to alcohol or other psychoactive drug during a single exposure to the drug and is sometimes referred to as the Mellanby effect, after the British pharmacologist who first identified the phenomenon.

Addictive drug. The name given to a drug, medication or chemical agent often self-administered usually without a medical prescription, repeatedly and compulsively.

Adulterate. Means to contaminate by addition of another substance or to make impure but still maintain the same appearance as the original, e.g. dilution of a constituent of the urine, such as a drug of abuse or its metabolites, by adding another liquid, such as water. In connection with the illegal manufacture and sale of illicit drugs, the pure drug e.g., cocaine or heroin is often blended with some other cheap inert substances in a process known as “cutting” before sold to consumers.

Agonist. An agonist is a chemical substance, drug or other molecule that binds to a receptor to produce an effect or start a sequence of events leading to a physiological response.

Agreement. The extent to which two different tests or methods give the same results or two different observers agree with each other when measuring the same thing.

Alcohol abuse. A pattern of alcohol consumption leading to clinically significant impairment or distress, such as a failure to fulfill major commitments related to work, school or the family. Showing

disregard for others, exhibiting poor judgment and self-control after drinking alcohol, e.g. driving under the influence (BAC > 0.08 g%), or personal relationships worsened because of alcohol consumption.

Alcoholism (alcohol dependence). This is a more serious drinking problem, which includes craving and continuing to drink despite experiencing physical, mental and social harm. Not being able to stop drinking once started and consumption of alcohol the first thing in the morning to relieve a hangover, or to counteract withdrawal symptoms, as is typical of those dependent on alcohol.

Alcohol tolerance (acute). This term implies a progressive adaptation to feelings of inebriation as well as objective measures of alcohol-induced impairment during a single exposure to the drug. The signs and symptoms of alcohol influence are more pronounced on the rising limb of the blood-alcohol curve compared with several hours after C_{max} is passed (descending limb). By this time a marked recovery occurs and signs and symptoms of intoxication are no longer evident. Another name for acute alcohol tolerance is the Mellanby effect (see later).

Alcohol tolerance (chronic). This refers to a decrease in response to a specified dose of alcohol after repeated exposure. The person needs to consume more alcohol on each occasion to achieve the same desired state of inebriation that was originally produced by lower doses.

Alcohols. Plural of alcohol is a collective name for a class of organic compounds containing carbon, hydrogen and oxygen and one or more hydroxyl (-OH) groups. Mono-hydroxy (methanol), di-hydroxy (ethylene glycol), tri-hydroxy (glycerol) and poly-hydroxy (mannitol) means the alcohol contains one, two, three or several hydroxyl groups in the molecule.

Alcoholism. A primary chronic disease with genetic, psychosocial, and environmental factors influencing its development and manifestations.

Alcohol dehydrogenase (ADH). The enzyme (actually class I ADH) catalyzing the conversion of primary alcohols into aldehydes and secondary alcohols into ketones. Thus, ethanol is oxidized into acetaldehyde and isopropanol becomes acetone.

Alcohol withdrawal. The unpleasant and sometimes life-threatening physiological and psychological disturbances that result after termination of a period of heavy drinking.

Aldehyde dehydrogenase (ALDH). An oxidative enzyme mainly located in mitochondria (low k_m) that converts acetaldehyde to acetate. A mutant form of ALDH is inherited by many people of Asian descent, which means they are less capable of oxidizing acetaldehyde making them sensitive to alcohol consumption. They show symptoms of facial flushing, palpitations, tachycardia and nausea after drinking small amounts of alcohol.

Alkaloid. A naturally occurring organic compound produced by plants or shrubs that contain one or more nitrogen atoms in the molecule and have a basic (alkaline) character. Many alkaloids are pharmacologically active with important medicinal applications - atropine, cocaine, strychnine, nicotine, morphine to name just a few examples.

Allele. One or two or more variants of a gene or other DNA sequence. Different alleles of a gene generally serve the same function e.g. code for proteins that determine eye color, but may produce different phenotypes (e.g. blue, green or brown eyes). Some alleles may be defective and produce a protein (e.g. an enzyme) that has no function at all or an abnormal function.

Alveolar. Pertaining to the alveolar sac - the air cells - the site of gas exchange in the lungs.

Alveoli. Plural of alveolus the extreme ends of the branches of the bronchial tree, the air sacs at the base of the bronchioles where gases and volatile substances, such as oxygen, carbon dioxide and ethanol, can enter and leave the pulmonary circulation.

Alveolar air. Alveolar air is end-expired air representing that fraction of the exhaled breath remaining after air from the dead-space region of the lungs (mainly nose and upper airway) has been ventilated out. For determination of alcohol in breath at least 1.5 liters of a prolonged exhalation should be discarded prior to sampling and analysis of the alcohol content.

Amino acids. Organic compounds containing both an acid and amino group, e.g. carboxylic acid (-

COOH) and amine (-NH_2) groups. Twenty amino acids are important in human nutrition and biology and they are the building blocks of proteins.

Amylase. An enzyme produced in the pancreas to catalyze the digestion of carbohydrates (sugars).

Analgesic. A term derived from the Greek word *algos* which means pain and is the ability of a drug or other treatment to deaden or alleviate pain.

Analyte. The specific component or substance measured in a chemical analysis.

Analytical specificity. Ability of a measurement procedure to determine solely the desired substance it purports to measure without responding to any others.

Analytical sensitivity. The ability of a method or instrument to discriminate between samples with different concentrations of substance or containing different amounts of the analyte. The slope of the analytical calibration function (plot) is one index of the methods sensitivity.

Analytical toxicology. Is the detection, identification and quantitative analysis of foreign compounds (xenobiotics) in biological and related specimens. The substances analyzed include industrial chemicals, pesticides, prescription drugs and drugs of abuse as well as plant and animal toxins.

Analytical wavelength. Any wavelength at which an absorbance measurement is made for the purpose of the determination of a constituent of a sample.

Analytical run. A set or series of measurements carried out successively by one analyst using the same measuring system, at the same location, under the same conditions, and during the same period of time, usually the same day.

Anaerobic. A biological process not requiring oxygen.

Anemia. A deficiency of hemoglobin in the blood which can result from a decrease in the proportion of erythrocytes - an abnormally low number of red blood cells.

Anorexia nervosa. A serious mental illness associated with a diminished appetite for food in a relentless pursuit for thinness. Usually shows itself during adolescence primarily in women with sometimes fatal consequences. The disorder is associated with substantial psychological disturbances and symptoms overlap with other psychiatric illnesses – mood and anxiety disorders.

Antagonist. A chemical substance (drug) that binds to a receptor to block or reverse the action of another drug or chemical substance; Naloxone is an opiate antagonist that blocks the action of morphine at its receptor.

Anthropometric data. Measurements of body height, weight, age, and skin-fold thickness to provide an indirect assessment of body composition, body size and development.

Antibody. An antibody is a large protein molecule produced by the body's immune system to recognise and bind foreign molecules such as viruses.

Anticoagulants. These are drugs or chemicals that delay or stop blood from clotting either in-vivo or in-vitro in specimen tubes after sampling blood. Heparin is a natural anticoagulant in the body and the drug warfarin is also used to counteract thrombosis. Typical in-vitro anticoagulants include potassium oxalate, citrate, EDTA, and sodium fluoride, substances that prevent clotting by binding calcium ions or blocking an enzyme needed for the clot reaction.

Antidiuretic hormone (ADH). A hormone produced in the posterior pituitary gland that promotes the conservation of body water by its effect on the kidney thus influencing the production of urine.

Antigen. A molecule that binds to an antibody.

Antipyretic. A word derived from the Greek word *pyresis,* which means fire and is used to characterize a drug that reduces fever by lowering body temperature.

Apoptosis. Refers to a series of biochemical reactions occurring in a cell to cause damage and so

that cells undergo a process of self destruction also known as programmed cell death.

Artery. An artery is a blood vessel that carries oxygenated blood from the heart and lungs to the rest of the body.

Artifact. A term used in conjunction with chemical analysis to indicate an artificial (false) result, such as something introduced during processing the tissue specimen. In analytical toxicology this implies a substance not naturally present in biological specimens but which was an impurity in the reagents used in the analysis or produced by some metabolic process after sampling or after death in medical examiner cases.

Ascites. Is the pathologic accumulation of fluid in the peritoneal cavity. This condition is often associated with alcoholism and develops as one consequence of chronic liver disease (cirrhosis). The volume of ascites fluid might reach 10 liters or more.

Asthma. A common respiratory disease causing difficulties in breathing, owing to narrowing of the airways. Asthma is a chronic inflammatory disorder, which causes obstruction of airflow and a marked reduction in a person's forced expiratory volume. Those suffering from asthma might not be able to fulfill the sampling requirements (time-pressure-volume) of some breath-alcohol analyzers.

Ataxia. Inability to coordinate voluntary muscle movements, owing to various influences (drugs or diseases) acting on on the cerebellum.

Atrophy. Is the wasting away or shrinkage of tissue caused by cell death.

Autopsy. The word autopsy comes from a Greek word meaning "to see for oneself." In Great Britain necropsy is used as an alternative word to autopsy, which also comes from the Greek "seeing a dead body." In USA autopsy is synonymous with postmortem examination by a medical examiner.

Bariatric surgery. Bariatric comes from the Greek words *baros,* which means weight and *iatric* which means treatment. Hence bariatric surgery is an operation for treatment of being severely overweight (obesity) and usually involves making the stomach smaller by gastric banding or a gastric bypass.

Basal metabolism. The total energy output of the body at rest after a 12 h fast amounting to 1.0 kcal/kg/h for men (0.9 for women). For a 150 lb (68 kg) man the energy requirement for basal metabolism is 1632 kcal/day.

Baseline measure. An observation or quantitative measurement made before administration of a drug or an experimental treatment. When evaluating results, the post-treatment measures are usually compared with the baseline measure.

Beer's law. The absorbance of a homogeneous sample containing an absorbing substance is directly proportional to the concentration of the absorbing substance.

Bias. Refers to a more or less persistent tendency for the measurements as a group to be too large or too small and is therefore a systematic error of measurement often expressed as the difference between the expected result of a measurement and a true value (compare with accuracy).

Bibliometrics. The quantitative study of published articles and books and their evaluation in terms of authorship, readership and number of times cited.

Bile. A greenish-yellow secretion produced in the liver and collected and stored in the gallbladder until needed. Bile is an emulsifier which promotes mixing and digestion of fatty foods.

Binge drinking. There are two definitions of binge drinking in current use. One considers this to be consumption of 4-5 drinks over 2 hours to reach blood-alcohol concentration of 0.08 g% or more. The other, and perhaps a more realistic definition of binge, entails an extended period of drinking, lasting several days, during which time the individual neglects other activities or commitments in order to continue to drink.

Bioavailability. Refers to the propensity of a drug or other chemical to become absorbed into the body after administration and to reach the systemic circulation where it exerts its effects. Bioavailability is only 100% after intravenous administration and is always lower after oral intake

owing to degradation or first-pass metabolism, which occurs in the gut or liver before the blood reaches the heart and the systemic circulation.

Biological specimen. A material of human or animal origin commonly used for identification of the individual (DNA) or forensic or clinical laboratory analysis of endogenous or exogenous substances.

Biomarker. This refers to the analysis of an endogenous substance that can be used to measure the prognosis of developing a disease, exposure to a chemical or the effect of a treatment. An alcohol biomarker refers to a chemical or physiological indicator of acute or chronic exposure to alcohol. Elevated levels of certain enzymes in the blood are indicative of liver damage caused by long-term over-consumption of alcohol.

Biopsy. Removal and laboratory examination of tissue from a living body, e.g. liver biopsy is the gold standard for investigating liver cirrhosis.

Bipolar disorder. A psychiatric disorder formally referred to as manic depression. Today this ailment is known as bipolar disorder, because the illness involves two phases, an “up” or manic phase and a “down” or depressive phase. Lithium as its carbonate salt is a common treatment for this disorder.

Bland-Altman plot. Martin Bland and Douglas Altman two British statisticians, who published a simple and intuitive way of comparing the results of two methods of clinical measurement. This entailed plotting the individual differences ($x_1 – x_2$), which is a measure of bias, against the mean result of the two methods $(x_1 + x_2)/2$. The resulting Bland and Altman plot shows the magnitude of bias and the degree of scatter. A multiple of the standard deviation of the differences (± 2 x SD) is a parameter that reflects the 95% limits of agreement between the methods.

Blind (masked) sample. A test of proficiency in which the analyst or participating laboratory is unaware of the origin of the test sample at the time of the analysis. An undeclared proficiency trial entails submitting samples for analysis blinded or masked.

Blinding. This term is often used in connection with clinical trials of drug treatments in which knowledge of intervention assignments is hidden from participants and investigators, or outcome assessors. The term “double blinding” denotes a trial in which the participants, investigators, and assessors all remain unaware of the intervention assignments throughout the trial. The term “single blind” denotes a trial in which the participant but not the investigator remains ignorant about the treatment received, whether placebo or active substance.

Blood-brain barrier. A permeable barrier consisting of cells and small blood vessels with the important task of controlling passage of endogenous and exogenous substances from the bloodstream into the brain and cerebrospinal fluid.

BMI. Is an acronym for body mass index and combines the weight and height of an individual to give a useful measure of the degree of obesity. BMI is derived by dividing the person’s weight in kg by the height in meters squared, hence the units (kg/m^2). Normal BMI ranges from 18.5 to 24.9, overweight spans from 25-29.9, obesity (grade 1) is from 30-34.9, obesity (grade II) is 35-39.9 and morbid obesity (grade III) is > 40. BMI furnishes a simple clinical tool for use by health care professionals to demonstrate a person’s risk for certain diseases, diabetes type II and cardiovascular disease.

Bolus. The amount of drug swallowed at one time.

Box plot. A box plot is an increasingly common way to display information about the shape of a distribution, without showing individual values. For example, the box might extend from the 25^{th} to 75^{th} centiles of the frequency distribution and contain a line representing the median value. Lines projecting from the box (whiskers) are often added to show the extreme values of the distribution.

Bronchi. The large air-tubes or conducting airways of the lungs (one such tube is a bronchus).

Bronchioles. Small subdivisions and tiny branches of air tubes within the bronchi of the lungs.

Calibration. A process or sequence of steps in which an analytical instrument or method is standardized to perform quantitative measurements. This is usually done by analysis of know strength standards of the target analyte to establish response of the instrument at increasing concentrations of the substance. This gives a calibration curve and appropriate response factors suitable for

determining the concentration of substance in the specimens.

Candida Albicans. An yeast or fungi sometimes found in living humans (skin, mouth, gut, vagina), that can utilize glucose to produce ethanol.

Capillary. A small blood vessel that branches from an artery; capillaries connect arteries to veins. Exchange of oxygen, nutrients and waste material takes place across capillary walls.

Carbohydrates. Organic compounds containing carbon, hydrogen and oxygen atoms in the molecule. Simple carbohydrates are sugars that are generally classified as monosaccharides, disaccharides and polysaccharides depending on the number of molecules in the chain. Examples of more complex carbohydrates are starch and fiber (cellulose). Carbohydrates are important nutrients that supply energy to the body actually 4 kcal/g.

Carbohydrate Deficient Transferrin (CDT). Transferrin is a glycoprotein normally present in serum which helps to transport and deliver iron to the body. The analysis of CDT (a carbohydrate deficient form) has proven to be a sensitive and specific biological marker of heavy continuous drinking. After drinking about 80 g ethanol per day for men and 60 g per day for women for 7 continuous days CDT levels are elevated.

Case-control study. A type of study design in which individuals with a certain disease or condition of interest (the cases) are selected and compared to a control or reference group of individuals without the disease. The Grand Rapids study evaluating the risk of a motor-vehicle crash as a function of the driver's blood-alcohol concentration was an example of a case-control study. Those drivers who crashed their car were the cases and the non-crash drivers were the controls.

CEDIA. Is an acronym for Cloned Enzyme Donor ImmunoAssay, which has become a widely used analytical technique in clinical and forensic laboratories. CEDIA is a rapid and fairly cheap method of analysis often applied to the determination of drugs of abuse in urine and other biofluids. The results serve as a preliminary screening analysis although positive test results need to be verified by more specific methods, such as GC-MS.

Central nervous system (CNS). The central part of the nervous system consisting of the brain and spinal cord.

Cerebellum. The structure at the base of the brain involved in the control of muscle tone, balance, and sensorimotor coordination.

Cerebral cortex. This is the outer layer of gray matter covering the cerebellum. The cerebral cortex processes sensory information for the control of motor functions, speech, higher cognitive functions, emotions, behavior, and memory.

Cerebrospinal fluid. The clear fluid that fills the cavities (ventricles) that surround the brain and spinal cord.

Chain-of-custody. The procedure used to document how laboratories receive and handle specimens from the moment of collection, during transport, arrival at the laboratory, and during the testing process.

Chromatography. A laboratory method widely used to separate compounds in a mixture based on their differential rates of movement through a two-phase system (e.g. gas-liquid, liquid-liquid, solid-liquid). The speed of movement of the molecules is determined by various physicochemical properties, such as size, solubility, boiling point, electric charge and various functional groups.

Chromosomes. Microscopic rod-shaped structures composed of double stranded DNA and proteins and located within the cell nucleus. There are normally 46 chromosomes 23 inherited from each parent.

Chronic tolerance. The gradual decrease in degree of intoxication at the same blood alcohol level in the course of repeated exposures.

Cirrhosis. Advanced liver disease in which the liver cells have died, hardened and turned an orange

color – cirrhosis comes from the Greek word for orange-yellow.

Clandestine Laboratory. A clandestine laboratory is a secret and unlawful facility for production of narcotic drugs. These labs take many forms and might be a kitchen, garage, bathroom, or out-house equipped with the necessary glassware, apparatus, chemicals, organic solvents, and other materials necessary for the synthesis, isolation, or purification of drugs of abuse.

Clinical laboratory science. This entails examination of some part of the living patient – his excreta, or blood or secretions – to help the physician reach a diagnosis or provide a better treatment.

Cognition. The term cognition involves all the mental functions through which information and knowledge is processed. It includes global functions such as consciousness, drive and attention as well as specific functions like memory, language and calculations.

Collagen. The major protein of fibrous connective tissue e.g. tendons and ligament involved in the production of scar tissue produced in the liver.

Concentration. The quantity of substance contained in a unit quantity of sample. When working with solutions, the recommended unit of concentration is grams of solute per liter of solution.

Confidence interval. This refers to the interval within which the true value of a summary statistic (e.g. median or median) is contained with a given probability.

Confirmatry tests. Such tests are used to verify (confirm) the presence of a particular compound in a biological specimen and usually involve some type of chromatography to separate closely relation substances followed by detection and quantitation of a target analyte by mass spectrometry or other highly sensitive and selective conclusive method.

Confounding. Extraneous variables causing effects that obscure or exaggerate the “true” effect of an intervention or treatment.

Congeners. Substance or thing of the same kind or form, e.g. the other constituents of alcoholic beverages besides ethanol and water, such as other alcohols, aldehydes and esters.

Correlation coefficient. A statistic measuring the strength of the relation between two methods of measurement (association), but not whether two methods agree. It is important to note that high correlation does not necessarily mean good agreement.

Controls. Tests performed in parallel with experimental samples and designed to demonstrate that a procedure worked correctly.

COPD. Is an acronym for **C**hronic **O**bstructive **P**ulmonary **D**isease, one of the most common lung disorders in adults worldwide. COPD is characterized by limitations in air-flow caused by chronic bronchitis and emphysema owing to inflammation and excess mucus that decreases airflow. Those suffering from COPD have reduced forced expiratory volumes and might be unable to satisfy the breath-sampling requirements with some breath-alcohol analyzers. COPD ranks as one of the leading causes of death in developed nations in both men and women and smoking is one of the primary causes.

Creatinine. Is a waste product of the body derived from creatine, which is a substance synthesized from amino acids mainly in muscle cells. Creatinine is excreted in the urine without being reabsorbed and blood and U-creatinine analysis is therefore used as a test for impaired renal function. Creatinine concentration is also used as an indicator of the dilution of the urine specimen in connection with urine-drug testing. A U-creatinine concentration below 0.2 g/L (20 mg/100 mL) indicates a highly dilute specimen and thus possibly manipulation by addition of water or drinking water just before voiding. Dilute urine specimens with U-creatiine < 0.2 g/L are not unusual after drinking alcohol owing to the well-known alcohol-induced diuresis.

Cross reactivity. This refers to the response in an assay caused by a substance other than the target drug being analysed. Usually an antibody for an immunoassay recognises only a part of the target drug by binding to a specific functional group or structure in the molecule.

Cutaneous. Associated with the skin – subcutaneous = beneath the skin.

Cytochrome P450. A family of enzymes found in animals, plants and bacteria that play an important role in drug metabolism. P450 enzymes metabolize (detoxify) foreign chemical substances that enter the body as well as many endogenous species. The P450 enzymes are found in the microsome fraction of cells especially liver cells (hepatocytes). The particular P-450 enzyme that metabolizes ethanol is denoted CYP2E1 or P450IIE1.

Cytoplasm. Or cytosol is the soluble fraction, the fluid or jelly-like substance within cells and outside the nucleus where many of the cell's biochemical reactions take place.

Delirium. Is the word used to describe a disturbance of consciousness characterized by altered or shifting mental status, changes in cognition and disturbances in perception, sometimes with hallucinations, abnormal speech and movements.

Dementia. This refers to a clinical syndrome characterized by a cluster of signs and symptoms manifested by difficulties in memory, disturbances in language and articulation, psychological and psychiatric changes and impairment in the normal activities of daily life. Dementia is a consequence of Alzheimer's disease, which effects about 6% of the population aged over 65 y and increases with incidence during aging.

Depressants. These represent a class of psychoactive drugs, both licit and illicit, that relieve anxiety by depressing the central nervous system (CNS). Such drugs have a high abuse potential and ethyl alcohol is the prime example along with barbiturates and the sedative hypnotic chloral hydrate.

Diabetes. Is a chronic medical condition related to impaired carbohydrate metabolism that results in elevated levels of blood sugar (glucose). Severe complications form diabetes might include heart disease, vascular disease and neurological disorders. There is no known cure for diabetes but the disease can be managed by careful control of blood sugar (see type I and type II diabetes).

Digestive system. The organs responsible for getting food into and out of the body consisting of the esophagus, stomach, liver, gallbladder, pancreas, small intestine, colon and rectum.

Distribution. The transport of absorbed drug or alcohol by the blood-stream to all parts of the body. The distribution of alcohol follows the distribution of body water and the rate of distribution depends on the rate of flow of blood to various organs and tissue.

Diuretic. A drug that promotes water excretion through an increase in the volume of urine.

DNA. Acronym for deoxyribonucleic acid, a family of large molecules located within the nucleus of a cell that carry genetic information by specifying the amino-acid sequence and hence the structure of proteins. DNA is a double-stranded helical molecule that encodes genetic information and is composed of the sugar deoxyribose, phosphate groups and the bases adenine (A), thymine (T), guanine (G) and cytosine (C). A run of three nucleotides called a triplet encodes one amino acid.

Dopamine. An important catecholamine neurotransmitter mainly found in basal ganglia of the central nervous system. Major physiological functions include inhibition and excitation of peripheral muscles, cardiac excitation and metabolic, endocrine and central nervous system actions such as pleasure and well-being. An underproduction of dopamine is seen in people suffering from Parkinson's disease and a common treatment is to administer the amino acid L-DOPA, a dopamine precursor. An overproduction of dopamine is seen in conditions such as schizophrenia.

Drug. Any chemical substance that influences body function.

DUI. Acronym for driving under the influence (usually under the influence of alcohol DUIA).

DUID. Acronym for driving under the influence of drugs.

Duodenum. The first part (~12 inches) of the small intestine extending from the pylorus to the jejunum.

DWI. Acronym for driving while impaired (usually taken to mean impairment caused by alcohol).

Dystonia. Is a disorder of the central nervous system causing variable muscle tone and recurrent

muscle spasm. Dystonia is amovement disorder that causes sustained muscle contractions, repetitive twisting movements, and abnormal postures of the trunk, neck, face or arms and legs.

Ecstasy. Is the popular name for the drug 3,4-methylenedioxymethamphetamine (MDMA). Like amphetamine and methamphetamine, MDMA is a central nervous stimulant.

Edema. Excess accumulation of fluid in body tissues usually resulting in swelling.

EIA = Acronym for Enzyme ImmunoAssay.

Electromagnetic spectrum. This constitutes the range of all possible frequencies of electromagnetic radiation or energy from very high energy (short wavelength) such as gamma rays to very low energy (long wavelength) such as radio waves. Other examples of electromagnetic radiation include X-rays (0.5-1.5 angstroms), ultraviolet, visible (4000-7000 angstroms), infrared, and microwaves. Note that 10 billion angstroms = 1 meter.

Elimination. The term used to denote removal of a drug (e.g. alcohol) from the body. The process of elimination involves both metabolic breakdown (biotransformation) and removal in an unchanged form, such as in breath, urine, and sweat (excretion).

ELISA Is an acronym for Enzyme Linked ImmunoSorbent Assay a method of analysis of widely used as a preliminary screening test for drugs of abuse testing in urine or other body fluid.

EMIT. Is an acronym for Enzyme Multiplied Immunoassay technique a widely used analytical method in urine drug testing programs. EMIT is a homogenous assay and a major advantage is that a prior clean-up or extraction of analyte from the biological matrix prior to analysis is not necessary. EMIT involves an antibody-antigen reaction where a candidate drug in the biological specimen (urine or blood) and the same drug labelled with the enzyme glucose-6-phosphate dehydrogenase compete for binding sites on the antibody.

Endocrinology. This is the study of hormones and their effects and the system of organs or glands that produce hormones.

Endocrine glands. Glands that secrete hormones (chemicals) directly into the bloodstream and typical examples include pituitary, adrenal, and thyroid glands.

Endogenous. Substances produced or originating within the body by natural processes, such as metabolism.

Endoplasmic reticulum. Membrane structure an organelle within the cytoplasm of cells.

Enzymes. Protein molecules that serve to speed-up chemical reactions in the body - An enzyme acts as a catalyst for promoting biochemical reactions.

Epidemiology. Derived from the Greek *epidemia* or prevalence of disease. The branch of medical science concerned with the incidence and distribution of disease.

Epilepsy. The term epilepsy applies to a group of central nervous system disorders characterized by recurrent seizures, which are sometimes called convulsions. Seizures can affect vision, speech or movement.

Erythrocytes. The name given to the red blood cells.

Error. In the field of metrology “error” does not mean mistake but is a technical term denoting deviation of the measured value from an average or some computed quantity. Such deviations are considered to be either “random” or involve the notion of a “constant error” or a bias (see accuracy and precision).

Esophagus. A tube connecting the pharynx with the stomach.

Ethyl glucuronide. Often abbreviated EtG is a non-oxidative metabolite of ethanol formed in the liver by a phase II enzyme catalyzed reaction involving glucuronic acid. EtG is eliminated from the body

more slowly than ethanol itself and this has proven useful as a biomarker of recent drinking.

Ethyl sulfate. Often abbreviated EtS is a non-oxidative metabolite of ethanol formed in the liver by a phase II enzyme catalyzed reaction involving sulfate and ethanol. EtS is eliminated in the urine over a much longer time than ethanol itself and has thus been used as another biomarker of recent drinking.

Excretion. Is the removal of a drug or alcohol in an unchanged form in body excreta - urine, breath, sweat, stools, and saliva (if not swallowed).

Exogenous. Produced or originating outside the body.

External proficiency test. A test of the proficiency of analytical laboratories intended to control their performance quality and such tests have become an important element in laboratory accreditation. Aliquots of the same specimen (spiked samples) containing known concentration of various analytes are sent for analysis to different participating laboratories, e.g. clinical chemistry or toxicological laboratories. Most proficiency tests are declared trials in which participating laboratories are aware that they are being tested. A blind proficiency trial requires that the specimens sent for analysis are masked and as such is a much more challenging exercise.

Extravascular. Outside of the blood stream.

Extracellular fluid. Fluid outside the cells (interstitial fluid and plasma) amounting to about 20% of body weight.

Exocrine glands. These are glands that secrete their product out of the gland through a duct and into a cavity; the enzyme producing glands of the pancreas are typical examples.

False positive rate. This represents the proportion of healthy subjects who give a positive test result when screened for a certain disease state.

False negative rate. This is the proportion of subjects with the disease but who give a negative test result.

Fatty liver. An accumulation of fat in the liver (steatosis) represents the first stage of deterioration of this important body organ often the result of a period of heavy drinking. Fatty liver is reversible on termination of drinking and a period of abstinence.

Fatty acid. A compound made up of a hydrocarbon chain (either saturated or unsaturated) terminating in a carboxylic acid group.

Fatty acid ethyl ester (FAEE). These are compounds formed in the body in enzyme catalyzed reactions between ethanol and short chain fatty acids, such as ethyl palmitate, stearate, oleate, linoleate and arachidonate. Analysis and identification of FAEE have been suggested as biomarkers of heavy drinking and organ damage.

Fermentation. An enzymatically controlled anaerobic decomposition of carbohydrates to produce ethanol and liberate carbon dioxide.

Fibrosis. The formation of fibrous (scar) tissue another intermediate stage of liver deterioration.

First-pass metabolism. This refers to the metabolism (removal) of part of the dose of a drug such as alcohol when administered orally before it reaches the systemic circulation. First-pass metabolism can occur either in the stomach or in the liver and for some substances also in the lung.

Forensic. From the Latin word *forensis* meaning of the forum. In ancient Rome the forum was where debates took place and as such served as the courtroom.

Forced vital capacity (FCV). This is the maximum volume of air exhaled from full inspiration to forced maximum expiration. The values are usually expressed as a percentage of the normal predicted value for healthy individuals.

Forced expiratory volume in one second (FVC1). This represents the volume of exhaled air in the first second of a forced exhalation. The result is usually expressed as a percentage of the expected

value for healthy individuals.

FPIA Acronym for Fluorescence Polarization ImmunoAssay an analytical method used to determine drugs in body fluids such as in urine-drug testing laboratories

Free radicals. Molecular intermediates that have a single unpaired electron and often produced during oxidation reactions. They are highly reactive and readily attack other molecules.

GABA. Gamma aminobutyric acid is a major inhibitory neurotransmitter in the brain that acts to reduce the activity of the signal-receiving nerve. GABA applies the brakes on the brain. The GABA receptor is a so-called ligand-gated ion channel and when an agonist binds there is a flow of chloride ions into the adjacent cell. Drugs that depress the central nervous system, such as ethanol, barbiturates, and benzodiazepines have binding sites on the GABA receptor.

Gas Chromatography. An analytical technique widely used for separating volatile substances on the basis of their solubility and partition between a gas and a liquid phase (GLC) or a gas and solid phase (GSC).

Gastrectomy. Surgery to remove part of the stomach.

Gastric bypass. A surgical procedure used in the treatment of morbid obesity that involves bypassing the duodenum and other segments of the small intestine. The operation involves dramatically reducing the size of the stomach and is the most effective way to restrict food intake and to go down in weight.

General anesthetic. An agent (drug) that renders a person unconscious and oblivious to pain, examples include nitrous oxide, chloroform diethyl ether and halothane.

GERD. Abbreviation for gastroesophageal reflux disease which is a clinical syndrome that manifests as heartburn and regurgitation, owing to reflux of gastric contents into the esophagus.

Gene. A DNA segment consisting of a series of paired nucleotides at a particular location on a chromosome that together constitute a unit capable of expressing the information needed to synthesize a protein.

Generic. A nonproprietary drug name usually describing the drug's chemical structure and not protected by a trademark.

Genotype. The entire genetic makeup of an individual. The fundamental constituents of an organism in terms of its hereditary factors.

Gestational diabetes. A medical state characterized by glucose intolerance of variable severity that begins or is first diagnosed during pregnancy and usually resolves not long after delivery. A smell of acetone on the breath might be evident in women with this condition. It is important to distinguish this condition from type 2 diabetes

GLP. Is an acronym for **G**ood **L**aboratory **P**ractice, which implies that the work performed by a laboratory is of high quality. This entails, among other things, proper training of the staff, which are required to follow written instructions and use approved equipment and to see that all records and results are verified and authenticated and retained. An independent quality assurance unit and staff should be maintained to check that work is done in accordance with internal procedures.

Glucagon. A hormone secreted by cells of the pancreas in response to low blood sugar. This hormone promotes an increase in blood sugar levels by initiating the breakdown of liver glycogen to produce glucose.

Gluconeogenesis. Is the synthesis of glucose from non-carbohydrate precursors, such as protein and fat. This process begins when blood glucose levels are diminished and cellular levels of carbohydrates such as glycogen stores are depleted.

Glutamate. An amino acid that serves as the major excitatory neurotransmitter in the brain.

Glutathione (GSH). An antioxidant molecule found naturally in the body, composed of three amino acids, glutamate, cysteine and glycine.

Glycogen. A polysaccharide and the principle carbohydrate reserve in the body. Excess glucose is converted to glycogen and is stored in the liver and muscle. Glycogen can be converted easily into glucose when more energy is required, however these reserves are short-lived and glucose then needs to be synthesized from endogenous substances such as proteins.

Glycogenesis. Formation of glycogen from glucose molecules.

Glycogenolysis. Hydrolysis of glycogen to glucose.

Glycolysis. A sequence of biochemical reactions involved in the metabolic breakdown of glucose, which is converted to either lactate or pyruvic acid.

Gout. The clinical syndrome of gout arises from deposition of urate crystals (salt of uric acid) in joints, where they cause an inflammatory response. One of the factors that increase serum urate levels leading to attacks of gout is heavy drinking. During metabolism of alcohol one of the metabolic disturbances is a preferential convertion of pyruvate to lactate and lactacidosis. The latate competes in the kidney for excretion with ureate and this causes an elevated of serum urate concentrations.

G-Proteins. G-proteins are involved in neural signal transduction through the cell membrane and have the ability to activate different cellular amplifier systems. They get their name because they bind guanosine triphosphate (GTP). Various aspects of alcohol addiction, such as development of tolerance and dependence, may depend on altered signaling via G-proteins. Credit for the discovery of G-proteins and elucidation of their function was recognized by the award of a Nobel prize in Medicine or Physiology for 1994 to two US scientists Gilman and Rodbell.

Halitosis. Halitosis comes from the Latin word *halitus* meaning breath and describes any unpleasant breath odour. Halitosis is usually known as bad breath and is a common complaint in adults and children caused by poor oral hygiene, ulcers and infections in the mouth. Some cases of halitosis are the result of gastrointestinal conditions or respiratory tract infections or metabolic diseases.

Hallucinogens. Are substances that bring about a state of dreaming or wandering of the mind characterized by an altered perception of sight and hearing. Hallucinogens e.g. LSD (lysergic acid diethylamide) are psychoactive substances often occurring naturally in various plants or fungi and if taken alter mood and perceptions of reality.

Helicobacter pylori. *H Pylori* is a common bacterium found in the mucous lining of the stomach in millions of people worldwide (50% of people over 60 y in USA). *H Pylori* is the primary cause of gastric ulcers and also duodenal ulcers. The discovery of *H Pylori* by two Australian scientists was rewarded with a Nobel Prize in Physiology or Medicine in 2005. Previously ulcers were thought to be the result of stress or poor diet such as by eating foods high in acid content.

Hematocrit. The percentage of blood volume occupied by erythrocytes, normal values often cited are 44-54% for men and 38-48% for women. Blood with a lower hematocrit contains more plasma and accordingly a higher percentage of water per unit volume blood.

Hemolysis. This term used to describe the bursting or breakage of red blood cell (RBC) membranes, causing the release of hemoglobin and other constituents into the surrounding fluid. A reddish coloration of the serum or plasma fraction gives evidence that a blood specimen has undergone hemolysis.

Hepatic vein. This is the vein that receives blood after it passes through the central veins of the liver transporting blood into the inferior vena cava of the heart.

Hepatitis. Generalized inflammation of the liver, often accompanied by tissue death and fibrosis (scar tissue).The name derives from *hepat* the Greek word for liver and *itis* the Greek word meaning inflammation. Many different agents including drugs and alcohol are able to inflame the liver. Alcoholic hepatitis can prove fatal but is usually reversible on abstinence.

Hepatocyte. The name of the principal cells within the liver responsible for most of the metabolic activity.

Heritability. The proportion of observed variation in a particular trait that can be attributed to inherited

genetic factors as opposed to changes brought about by environmental factors.

Histogram. A histogram is a graphical method used to display the frequency of continuous date, such as a person's height, age or concentration of a substance in blood, divided into suitable intervals. The horizontal axis displays the limits that are used for each interval and above these a rectangular column rises from the mid-point. The vertical axis measures the number of values (frequency) that fall within each interval or if desired the percentage thus giving a relative frequency distribution.

Homeostasis. The maintenance of a relatively constant internal body condition; a state of equilibrium within the body with respect to functions and chemical composition of body fluids and tissues.

Hormone. A chemical messenger produced in an organ or tissue and transported to another part of the organism where it produces a behavioral or physiological response (effect).

HPLC = High Performance Liquid Chromatography a widely used analytical technique in forensic and other laboratories for separation and quantification of chemical substances such as drugs of abuse in bio-fluids. The liquid chromatography part (LC) is often used in combination with mass spectrometry (MS) to give hyphenated LC-MS a very powerful analytical combination.

Hydrophilic. Attracts water - water liking

Hydrocarbon. A class of organic compounds only containing hydrogen and carbon atoms in various proportions.

Hyperglycemia. A medical condition resulting when there is an excessive amount of glucose in the bloodstream.

Hypertension. High blood pressure.

Hypoglycemia. A potentially dangerous medical condition characterized by an abnormally low concentration of glucose in the bloodstream.

Hypoventilation. The term hypoventilation defines a condition in which alveolar ventilation is insufficient to meet the metabolic demands of the individual and this results in an inappropriate tension of carbon dioxide.

Hypoxia. A lower than normal level of oxygen in the blood or tissue.

Impairment. A condition associated with the effects of alcohol or drugs manifested by the persons decreased ability to perform a skilled tasks, such as driving.

Incidence. The number of new cases of a variable (condition, symptoms, disease, or trait) occurring during a particular period of time. Incidence is the measure of new cases in a given time period (rate) and has the units of cases per population at risk per unit time (i.e. the number of new cases of a specific disease occurring during a certain period).

Inflammation. A defensive response to local tissue injury or infection, serving to prevent the spread of injury and activate the immune system.

Infrared. Pertaining to the region of the electromagnetic spectrum from approximately 0.78 to 300 microns.

Insulin. A hormone produced in the islets of Langerhans or cells in the pancreas as a response to elevated blood sugar levels. The hormone permits the metabolism and utilization of glucose. Insulin in fairly pure form was prepared first at the University of Toronto and led to successful treatment of diabetes. Two of the scientists involved (Banting and Macload) shared a Nobel Prize for their work.

Interfering substance. A chemical compound or substance other than the substance of interest (e.g. ethanol) to which the measuring instrument responds to give a falsely elevated result.

Inter-individual variation. The distribution of a measurement or a quantity in a given sample of individuals.

Intra-individual variation. The distribution of measured values of a quantity in a given individual over time.

Intravascular. Within the blood vessels.

Intracellular fluid. Fluid within the cells making up about 40% of body weight.

Interstitial fluid. Fluid between the cells.

In-vivo. From the Latin meaning **in the living body** a term commonly used to signify tests made with living subjects (humans or animals).

In-vitro. From the Latin meaning **in glass** a term commonly used to signify experiments in a test tube or flask as opposed to in the living organism.

Ischemia. A condition in which blood flow to a body organ or tissue is restricted.

Isozyme or isoenzyme. Is an enzyme with the same function as another enzyme but having a slightly different composition of amino-acids and kinetic properties.

Isotopes. Represent any of the different forms of a chemical element that differ in atomic mass (mass number). Isotopes contain the same number of protons in the nucleus but a differing number of neutrons. Substances with isotopes introduced in the molecule are widely used in clinical and biomedical research as biomarkers and for other applications. Examples are deuterium oxide $^{2}H_2O$, which contains a stable isotope of hydrogen (deuterium) and tritiated water $^{3}H_2O$, which contains the radioactive isotope of hydrogen or tritium.

Jejunum. Pertaining to the second part of the small intestine from the duodenum to the ileum.

Ketogenesis. The production or synthesis of ketone bodies consisting of acetone, acetoacetate, beta-hydroxybutyrate.

Ketosis. A condition characterized by the enhanced production of ketone bodies, e.g. during starvation or in disease states such as diabetes mellitus.

Ketonuria. Excess ketone bodies in the urine

Ketonemia. Excess ketone bodies (acetone, acetoacetate and ß-hydroxybutyrate) in the blood.

Ketone bodies. These are the end-products of lipid (fat) metabolism whereby triglycerides are transformed to free fatty acids and then acetylCoA, which is a precursor of acetoacetate . The latter undergoes non-enzymatic decarboxylated to acetone and also becomes reduced enzymatically to beta-hydroxybutyrate.

Kidneys. These are two bean-shaped organs about the size of a clenched fist located near the middle of the back and below the rib cage. The main function of the kidneys is to filter blood a process that takes about 30 min. Components that are useful are retained and waste products of metabolism and excess fluid are removed and transported to the bladder for excretion. Another function of the kidneys is to regulate blood pressure and the number of red blood cells.

Kinetic properties. The characteristics of an enzyme including speed of reaction, and affinity for the substrate.

Lactic acid. An organic acid produced from pyruvate during anaerobic metabolism.

Licit. Means lawful or permitted and is the term used to describe pharmaceutical preparations obtainable on prescription or over-the-counter as opposed to illicit or unlawful drugs listed under the controlled substance act such as heroin, methamphetamine and cannabis.

Lipase. A pancreatic enzyme that facilitates the digestion of fats.

Lipids. Fatty substances - a class of organic compounds that include fats, waxes, oils, (triglycerides) phospholipid and sterols (cholesterol) consisting largely of esters formed by combining fatty acids with

alcohols or other molecules.

Lipogenesis. The synthesis of lipids from glucose and amino acids.

Lipid peroxidation. The destructive metabolism of lipids (fatty substances) within cells by chemical oxidation leading eventually to the destruction of cell membranes.

Limit of detection (LOD). The smallest result obtainable by a given measurement procedure that can be accepted with a stated level of confidence as being different from the value of the measurable quantity obtained on blank material; by convention LOD = 3 x s_o where s_o is the standard deviation of measurements without the analyte present, e.g. blanks.

Limit of Quantitation (LOQ). The lower limit of concentration or amount of substance that must be present before a method is considered to provide quantitative results. By convention, LOQ = 10 x SD_o, where SD_o = the estimate of standard deviation at the lowest level of concentration measurable.

Linear regression. A mathematically method to describe the relationship between two or more variables and which entails calculating a best-fitting straight line to a set of data points, the x-variable is denoted as the independent and the y-variable the dependent.

Macronutrients. Refers to dietary nutrients as sources of energy and are required in large quantities, namely protein (4 Kcal per g), fat (9 Kcal per g) and carbohydrate (4 kcal per g).

Micronutrients. Refers to the vitamin and mineral constituents of the diet.

Malnutrition. A deficiency in protein and energy.

Matrix. The material that contains the analyte of interest, e.g. blood, urine or tissue.

Matrix Effects. Influence of a component in the analytical sample other than the component being investigated and how this impacts on the accuracy and precision of the measurements being made.

Mean corpuscular volume (MCV). Refers to the average size of a red blood cell. Abnormally high MCV is one indication of over consumption of alcohol.

Median. The middle value of a ranked set of measurement data.

Mellanby effect. Sir Edward Mellanby was a British pharmacologist who did pioneer work on the fate and actions of alcohol in the body. Based mainly on animal studies, he found that the impairment effects of alcohol were more pronounced on the ascending limb of the blood alcohol profile (absorption phase) compared with the descending phase (post-absorptive phase), even though the blood-alcohol concentration was the same at each time of measurement. See also acute tolerance.

MEOS. An acronym for microsomal ethanol oxidizing system refers to a family of oxidative enzymes in the liver cells (hepatocytes) that can oxidize drugs and foreign chemicals. The particular enzyme that oxidizes ethanol to acetaldehyde is denoted CYP2E1 where CYP stands for cytochrome.

Meta-analysis. A statistical method used to combine the results of different studies. A common application of meta-analysis is the pooling of results from a set of randomized controlled trials, none of which alone was powerful enough to demonstrate statistical significance.

Metabolism. A combination of chemical reactions occurring in a cell, an organ, or the body as a whole. The term is sometimes applied more narrowly to the breakdown of a particular substance e.g. the degradation of ethanol or some other drug by specific enzymes.

Metabolite. A compound produced by a chemical reaction taking place in the body, such as the metabolism of a drug or chemical dubstance; acetaldehyde is a metabolite of ethanol.

Metrology. The science of measurement.

Microsomes. A subcellular fraction of cells obtained by differential centrifugation of liver homogenates that contains fragments of the endoplasmic reticulum. The microsomes are rich in drug-metabolizing enzymes (e.g. CYP2E1, CYP2D6, CYP2C19) where CYP stands for cytochrome.

Microsomal enzymes. Detoxifying enzymes (cytochrome P450) associated with certain membranes (microsomes) within the liver cells.

Microvilli. Plural of villus, referring to small vascular protrusions growing on a mucous surface. The intestinal villi are the microscopic thread-like or finger-like projections covering the mucosa of the small intestine with main function to increase the absorption surface area of the cell.

Mitochondria. Small spherical rod-shaped structures within the cytoplasm that generate most of the cell's energy through the production of adenosine triphosphate (ATP).

Motor function. This is a general term and refers to movement, mobility and behavior.

MS Short for mass Spectrometry a powerful analytical technique used to identify compounds based on their mass to charge ratios. After separation from the biological matrix by chromatography drugs are commonly identified by mass spectrometry. This entails bombarding the molecules with electrons thus causing them to disintegrate into characteristic mass fragments, which are collected amplified and displayed in the form of a mass spectrum.

NAD. Nicotinamide adenine dinucletide (NAD^+) is an important cellular coenzyme that can bind with a hydrogen atom during biochemical reactions, such as the oxidative metabolism of alcohol. NAD is simultaneously reduced to NADH when ethanol is oxidized to acetaldehyde. The NAD-NADH couple moves hydrogen atoms back and forth between various oxidation-reduction reactions within the cell.

Necrosis. Cell death that occurs in response to adverse conditions in the cell's environment.

Neurotransmitter. A chemical agent or molecule released by a neuron on excitation that crosses the synaptic cleft to activate or inhibit an adjacent neuron.

Neuron. A nerve cell - the functional unit of the nervous system consisting of the nerve cell body, the dendrites and the axon.

NMDA. N-methyl-D-aspartate, a synthetic amino acid capable of activating certain glutamate receptors.

Nystagmus. Rhythmical oscillation (bouncing or jerking movement) of the eyeballs often involuntary. Gaze nystagmus occurs when the eyes gaze or move to the side along a horizontal plane.

Obesity. The word obesity is derived from the Latin word meaning "to overeat". Obesity is a medical problem and today means degree of over-weight or excess adiposity. The body mass index is the standard measure for obesity.

Ordinal scale. Ordered set of measurements consisting of words and or numbers indicating the magnitude of the possible values that a type-of-quantity can take.

Osmolality. This is a measure of the solute or particle concentration of a fluid, e.g. serum or urine. In a random urine sample osmolality might span from 50 to 1400 mOsmol/kg

Outlier. One value in a sample of measurements so far separated from the remainder as to suggest that it may be from a different population.

Oxidation. A chemical reaction that results in the loss of negatively charged electrons and often involves removal of a hydrogen atom from a molecule or adding an oxygen atom, or both.

Pancreas. Abdominal gland located behind the stomach that secretes pancreatic juice into the intestine and also manufactures the hormones insulin and glucagon that are released into the blood stream.

Pancreatitis. Pancreatitis is an inflammation of the pancreas and is a painful condition including nausea and vomiting. Chronic pancreatitis is often caused by excessive consumption of alcohol or gallstones.

Pathology. The word pathology comes from the Greek word *pathos*, suffering or distressed state or

the disturbance of vital processes.

Peptide. A molecule that contains a smaller number of amino acids as opposed to a protein, which might contain several hundred amino acids linked together. The endogenous opiates were discovered to be penta-peptides (5 amino acids) and were named enkephalines.

Per se alcohol limits. Statutory concentration limits of alcohol in blood, breath, or urine above which a motorist is in violation of the law.

Peer Review. The human judgment of something usually a scientific article or study (manuscript) by individuals "peers" having expertise and experience in the same or a closely related area.

Peroxisome. Membrane bound body within the cell containing enzymes (catalase) that either synthesis or decompose hydrogen peroxide.

Pharmacology. The word pharmacology is derived from the Greek words *pharmakon* (drug or poison) and *logos* (word or discourse) thus the science that deals with the fate pf drugs in the body and their actions on body functioning.

Pharmacokinetics. Is derived the Greek words *pharmacon* (drug or poison) and *kinesis* (movement) and therefore concerns studies on the movement of drugs in the body such as absorption, distribution, and elimination of drugs and their metabolites and the associated changes in these processes over time and how they might be defined in mathematical terms.

Pharmacodynamics. Is from the Greek words *pharmacon* (drug or poison) and *dynamikos* (force or power) and has to do with the action of drugs in the body; what the drug does to the body and the relationship between concentration in plasma and the pharmacological effect produced.

Pharmacogenetics. Is from the Greek words *pharmacon* (drug or poison) and genetics and is the study of the role of inheritance on inter-individual variation in drug response. Pharmacogenetics entails studies of racial, ethnic, and genetic factors that alter kinetics and dynamics of drugs and related substances that could explain the observed variability in pharmacokinetic parameters.

Phase I reactions. This is a term used to describe various metabolic (detoxification) reactions whereby drugs and other chemical compounds foreign to the body are oxidized, reduced or hydrolyzed by the addition of polar groups rendering them less toxic and more soluble in water. However, some metabolic pathways produce a metabolite more toxic than the parent drug.

Phase II reactions. This is a term used to describe metabolic reactions whereby certain enzymes convert drugs or foreign chemicals entering the body into more water-soluble compounds to facilitate excretion in the urine. The main drug conjugates formed are glucuronide, sulfate, acetate, and reactions with various amino acids. A phase I reaction often precedes a phase II reaction

Phenotype. The observable properties, traits or physical appearance of an organism resulting from the interaction of the genotype with environmental factors.

Physical dependence. Is a state that develops in parallel with chronic tolerance and is revealed by the precipitation of serious physiological disturbances (abstinence) when intake of the drug is terminated.

Physiology. The scientific discipline that deals with the functions of the living body.

Phosphatidylethanol. Abbreviated PEth is an abnormal phospholipid formed in cell membranes in the presence of ethanol. The production of PEth is catalyzed by the enzyme phospholipase D. Analysis of PEth in blood and body organs and tissues and finding elevated levels has been suggested as a biomarker of hazardous drinking.

Placebo. From Latin *"I shall be acceptable or pleasing"* thus a preparation or medicine given to please the patient. Placebos are used in experiments as control treatments - a tablet or drink that might look, taste, and smell like the active drug but devoid of any pharmacological effect.

Plasma. The yellowish colored liquid component of blood in which the red cells or erythrocytes are suspended. The plasma volume in an adult is approximately 4 liters.

Polycythemia. An over abundance of erythrocytes (red blood cells) resulting in increased viscosity of the blood and abnormally high hematocrit.

Polymorphism. The presence of two or more alleles of a gene or other DNA sequence in a population. The existence of more than one form of a genetic trait,

Portal vein. A large blood vessel that collects blood from the stomach and intestine and transports nutrients to the liver.

Potentiation. The action of two drugs in which the combined effects are greater than the sum of the individual effects.

Precision. Closeness of agreement between independent results of measurements obtained by a procedure under prescribed conditions; the variation or scatter of the measurements about the mean. The precision is expressed by the standard deviation of the measured values. Near synonyms are reliability, repeatability, stability, consistency, and reproducibility.

Presumptive tests. These as preliminary analytical tests, mostly qualitative tests, often involving a color change of a chemical reagent after mixing with a test specimen. The main application of such tests is for broad screening analysis to identify a class of compounds, such as certain types of drugs and poisons. Enzyme immunoassays are widely used in the field of urine drug testing. Other classic screening tests include Trinder's test for salicylic acid derivatives, the Fujiwara test for trichlorcompounds (e.g. trichlorethanol) and the nitroprusside test for urinary ketones.

Prevalence. The frequency with which a variable (condition, symptom, disease, or trait) occurs in the population at a certain point in time. Prevalence is the measure of the number of cases at a single point in time and has no units.

Proficiency test. A test designed to evaluate the reliability of an analytical method or procedure and the overall quality performance of a laboratory.

Proteins. Large molecules composed of long chains of amino-acids. The shape and function of a protein is determined by the sequence of its amino-acids. Proteins help to maintain the cells structure and participate in many biological reactions as catalysts (enzymes).

Protein binding. A reversible binding of a drug or endogenous compound to the major proteins of plasma (e.g. albumin). The binding consists of weak ionic bonds, Van der Waals forces and hydrogen bonding.

Psychotropic drug. A drug with its main site of action in the central nervous system (brain) often associated with altered mood, thought processes and behavior. Results in euphoria and tolerance and dependence.

Psychomotor functions. Motor functions as a consequence of mental activity.

Pyruvic acid. An endogenous substance produced from glucose as the end product of glycolysis.

Pylorus. The sphincter muscle separating the stomach from the small intestine also called *pyloric sphincter*.

Quality assurance. Those planned and systematic actions necessary to provide confidence that the work done at a laboratory meets given requirements and high standards of performance.

Radioisotope. This is an element with radioactive properties. In analytical chemistry the radio immunoassay (RIA) was the first immunoassay introduced. There are three isotopes used in RIA, tritium (^{3}H), carbon-14 (^{14}C), and iodine-125 (^{125}I).

Randomized controlled trials. These are the mainstay of evaluating new medicines. In such trials, the participants who receive the treatment are assigned at random or by chance, which is essential to ensure that the outcomes are determine only by the treatment.

Range. The difference between the largest and smallest values in a collection of measurements.

Reaction time. The time interval between presentation of a stimulus and initiation of a response.

Receptor. A protein embedded in the wall of a neuron or other cell that recognizes and binds a neurotransmitter or other chemical messenger.

Recovery. A characteristic of an analytical method normally expressed as a percentage and refers to the amount of drug removed from the original sample, which reaches the end of the analytical procedure. Poor recovery can be compensated for by adding an internal standard to the bio-fluid before staring the analysis.

Reduction. This is a chemical reaction that usually involves removing an oxygen atom from the molecule, or adding a hydrogen to it or both.

Response latency. The time interval between presentation of a stimulus and making a response.

Reference standard. A sample prepared or purchased that has known properties in terms of identity, purity, chemical composition, and concentration. Reference standards are used for the purpose of calibrating analytical equipment and for use as a control in actual experiments.

Repeatability. The closeness of agreement between the results of successive measurements during a short time, defined as the within-run standard deviation).

Reproducibility. The closeness of agreement between the results of measurements of the same measurable quantity on different occasions (e.g. the between run standard deviation). Different observers, different calibrations, different locations, different times.

Respiratory membrane. The membrane within the lungs being only a few microns thick across which an exchange of gases takes place.

Retrograde extrapolation. The practice of estimating a person's blood or breath alcohol concentration at some time prior to the time of obtaining a specimen for analysis - back extrapolation, back- tracking.

RIA =_Radio ImmunoAssay is a highly sensitive analytical method used to determine drugs and endogenous substances in body fluids.

Ribosome. A small spherical body within cells where the synthesis of proteins occur.

Robustness. Robustness is the capacity of an analytical method to produce accurate and precise results despite small deliberate changes in test conditions and method parameters. In GC analysis of ethanol the addition of an internal standard helps to ensure the method is robust.

Ruggedness. Ruggedness is a measure of the degree of reproducibility of the analytical results when performed under varying tests conditions, such as when work is done by different technicians, instruments, source of reagents, laboratories, or even in different countries.

Saccadic eye movements. Rapid conjugate shifts of gaze when following a target.

Scatter plot. A scatter plot usually displays the relation between two continuous variables plotted on the x- and y-axes. A one-way or one-dimensional scatter plot may be used to display a single continuous variable.

Screening test. A test applied to a group of individuals or patients to diagnose the presence of a certain disease or condition, such as alcohol abuse and dependence.

Second messenger. A molecule produced within a cell that carries information to a site within the cell eventually eliciting a physiological response; an example is cyclic AMP.

Sensitivity of an analytical method. This is the measured detector signal per unit increase in the concentration of the analyte as reflected by the slope of the linear calibration plot.

Sensitivity of a diagnostic test. This is defined as the proportion of the patients having a disease and for whom the test results were positive.

Sensorimotor functions. Functions involving perception of information from the senses and the resulting physical reactions of muscles.

Serotonin. 5-hydroxytryptamine (5HT) an important neurotransmitter synthesized from the dietary amino acid L-tryptophan. 5HT is associated with mood, sleep, aggression, anger, and appetite and is the target for the mechanism of action of so-called SSRI drugs (selective serotonin reuptake inhibitors) exemplified by Prozac (fluoxetine) for treatment of major depression.

Serotonin syndrome. A potentially life-threatening adverse drug reaction by inadvertent combination of therapeutic drugs or intentional self-poisoning. As the name implies the syndrome results from excessive serotonergic agonism of central nervous system receptors and peripheral receptors. The widespread prescribing of SSRI drugs in today's society often in combination with other medication that impact on serotonin neurotransmission has made this syndrome clinically much more important.

Serum. The fluid portion of blood remaining after coagulation (removal of fibrin and blood cells).

Slurred speech. A clinical sign of intoxication e.g. after drinking alcohol or taking medication which is characterized by imprecise speech articulation including deviation in rate, pitch and intensity of speech and incorrect production of consonants and vowels.

SOP. This is an acronym for **S**tandard **O**perating **P**rocedure that refers to written instructions used by the personnel working at a laboratory to perform a test or analyze of a sample sent to the laboratory.

Soporifics. Substances that cause or induce profound sleep, opium being the first substance used since ancient times until chloral hydrate was developed as a sedative-hypnotic in 1869 and the barbiturate sin 1902.

Specificity of a diagnostic test. This is defined as the proportion of healthy subjects in whom the test results were negative.

Spirometer. A device for measuring the volume of respiratory gases.

Spleen. The spleen is an organ situated behind the stomach on the left side of the abdomen. Old red blood cells and platelets are stored in the spleen, which also serves to clear and fight bacteria.

Stimulants. Represent a class of drugs that stimulate the central nervous system (CNS) by interfering with the brain's neurotransmitters. CNS stimulants cause stimulation of the sympathetic nervous system by altering neurotransmission of catecholamine such as dopamine, norepinephrine and serotonin. The abused drugs cocaine and methamphetamine are the prototype central nervous system (CNS) stimulants.

Stroke. Any condition during which the blood supply to the brain or regions of the brain is suddenly interrupted.

Student t-test. A widely used statistical test to compare variation between two groups of data. The name Student was a pseudonym for William Gossett who worked at the Guinness brewery in Ireland and was forbidden to publish under his actual name and the address where he worked. There are two forms of the t-test called one-sample and two-sample (paired and unpaired) test. When two measurements are made on the same person, the average difference is best assessed by a paired t-test (degrees of freedom one less than the number of differences). When the two sets of measurements are on different people the variation between individuals cannot be eliminated and the means of the two independent groups are compared (n_1 and n_2 in each group). The ratio between the difference between the two means and a pooled estimate of the within group variance is formed to make the test (degrees of freedom ($n_1 + n_2 – 2$).

Substrate. The substance (molecule) acted upon by an enzyme; its conversion to a particular product is catalyzed by a specific enzyme, e.g. ethanol is the substrate for alcohol dehydrogenase.

Symptom. Any subjective evidence of a disease or of a patient's condition.

Synapse. Region of a nerve-cell (neuron) from whcoih nerve signals are transmitted to neighboring neurons. The synapse is a microscopic gap (or cleft) separating pre-synaptic and post-synaptic neurons.

Synovial fluid. The fluid lubricant found inside synovial joints.

Therapeutic drug. A drug or chemical substance used to treat a disease or condition hence the term therapeutic drug monitoring (TDM) the subject of analyzing the concentrations of drugs in blood or plasma to monitor patient compliance and to ensure that correct and appropriate concentrations are maintained.

Tidal volume. The volume of air inspired and expired in a single breath being approximately 500 ml in adults.

Tolerance. A state that develops after long-term exposure to a drug. Metabolic tolerance infers a faster removal of the drug, e.g. by metabolic degradation in the liver. Functional tolerance infers a change in sensitivity of the brain to the effects of the drug after continual exposure.

Tolerance Interval. That range within which a specified percentage of individual values of a population are expected to fall with a stated level of confidence.

Toxicity. The ability of a substance to harm living organisms - all substances are toxic even water if ingested in large enough amounts.

Toxicology. The word toxicology derives from the Greek term “toxon”, which means a bow for shooting arrows. During antiquity poisons were often placed on the tips of arrows making them more deadly, giving rise to the word *toxicos* and *intoxicated,* which means made sick by poison. Hence toxicology is the study of how poisonous substances interact with living organisms.

Traceability. Traceability means that a result of measurement can be traced back, through an unbroken chain of comparisons, to a national or international standard value. The traceability of the ethanol standards used to calibrate the gas chromatography needs to be well documented.

Tracking. A laboratory test often used to measure impairment and which involves adjusting an instrument to maintain a desired value (compensatory tracking) or to follow a moving reference marker or object (pursuit tracking).

Transferrin. A protein found in the blood that helps transport iron (Fe^{3+}) to the cells such as the developing red blood cells.

Triglycerides. The chemical form in which fat molecules exist within the body. They are composed of a glycerol backbone with the three hydroxyl groups replaced by fatty acids.

Trypsin. An enzyme in the small intestine produced in the pancreas that digests proteins.

Type I diabetes. Insulin-dependent diabetes also known as juvenile-onset diabetes.

Type II diabetes. Non-insulin-dependent diabetes (the more common form) also called adult onset diabetes.

U-Creatinine. The creatinine content of urine can span over a wide range depending on the relative concentration of water in the specimen. A U-creatinine below 0.2 g/L is taken to indicate a highly dilute specimen, which might occur after drinking water or an alcoholic beverage before voiding.

Ultraviolet. Pertaining to the region of the electromagnetic spectrum from approximately 10 to 380 nm.

Uncertainty. The word uncertainty means doubt in something, such as the result of analysis. Analytical uncertainty is defined as a parameter associated with the result of a measurement, which characterizes the spread or dispersion of the results that could reasonably be attributed to the quantity being measured.

Unit of alcohol. In USA a unit of alcohol is the same as 14 gram ethanol or the amount contained in

a standard drink 5 oz table wine (12%), 1½ oz spirits (40%), 12 oz beer (5%) or 12 oz wine cooler.

Upper respiratory tract. That part of the lungs comprising the nasal cavity, pharynx and associated structures.

Uroscopy. This term refers to the examination of urine especially to observe its volume, appearance, smell, color and taste to aid in making a diagnosis. Uroscopy is considered the oldest clinical test to evaluate what was going on within the body.

Vasodilation. Increased diameter of blood vessels - the opposite of vasoconstriction.

Vasopressin. The antidiuretic hormone secreted from the pituitary gland in response to dehydration, which instructs the kidney to reduce urinary volume. Drinking alcohol inhibits the action of this hormone thereby resulting in an increased production of urine or alcohol-induced diuresis.

Vein. A vein is a blood vessel that carries blood back from body organs and tissue to the heart.

Viscera. Pertaining to the internal organs - the soft parts - the internal organs of the abdominal cavity.

Visible. Pertaining to radiant energy in the electromagnetic spectral range visible to the human eye corresponding to wavelengths from approximately 380 to 780 nm.

Vital Capacity (VC). This is defined as the total volume of air that can be expelled from the lungs after a maximum inspiration to maximum expiration. A healthy adult person might have a vital capacity of approximately 4600 ml, being less in women compared with men and markedly diminished in heavy smokers and those with lung disease.

Vitreous humor. (VH) Means literally glassy fluid and refers to a transparent jelly-like substance that fills the space between the lens and the retina of the eye and is a fluid commonly sampled for forensic analysis of ethanol in postmortem toxicology. The major advantage of VH is that there is less risk for contamination by bacteria spreading from the gut.

Wavelength. A property of radiant energy, such as IR, visible or UV. The distance measured along the line of propagation, between two points that are in phase on adjacent waves.

Widmark. Erik MP Widmark (1889-1945), a pioneer worker in forensic alcohol studies best known for his seminal work on the pharmacokinetics of alcohol as published in his 1932 monograph. Widmark was appointed Professor of Physiological and Medicinal Chemistry at the University of Lund, Sweden at the age of 31 y.

Widmark's ß-factor. This denotes the slope of the post-absorptive elimination phase assuming zero-order kinetics; the rate of alcohol elimination from blood slang = burn-off rate.

Widmark's rho-factor. Originally defined as a dimensionless ratio, this important pharmacokinetic parameter describes the distribution of alcohol between the body as a whole and the blood. The Greek letter rho is thought to have originated from the German term *"die reduzierte Körpermasse"* (the reduced body mass). This is a factor (less than unity) by which a person's body weight must be multiplied (lowered) to obtain the theoretical body mass with the same concentration of alcohol as the blood. The rho factor characterizes the distribution of alcohol in the body and is given by the quotient [alcohol in organism] to [alcohol in blood]. Today the rho factor is more commonly known as the volume of distribution (V_d) of alcohol and has units of L/kg, because dose is in g/kg and BAC is in g/L.

Xenobiotic. From the Greek *xeno* (foreign) is the name given to chemical substances (drugs) that enter the body from the environment or by ingestion. Xenobiotics are not normally present in the body and have no physiological role e.g. synthetic chemicals, environmental chemicals, drugs, and organic solvents.

Yeast infection. Fungal infection, such as genital candidiasis, caused by proliferation of C*andida albicans* common in women who suffer from diabetes.

Z-score. The Z-score is a mathematical device used to express the accuracy of the results obtained by a laboratory in an external proficiency test. The z-score is calculated as [(laboratory result - assigned or target value)] divided by the standard deviation (SD) of results from all participants. Note

that before SD is computed outlying values must be eliminated and statistical tests are used to identify outliers (e.g. range test).

Zero-tolerance law. Refers to a type of traffic-safety legislation whereby the presence of any amount of a controlled substance in a specimen of the driver's blood is a punishable offence. Zero-tolerance laws were introduced to simplify the prosecution of drug-impaired drivers because they avoid the need to produce clinical evidence of impairment. Another name for this legislation is zero-limit or limit of quantitation (LOQ) law.