

:2-Deoxy-2-fluro-D-glucose  
(2-FDG) commonly referred to as FDG.

:Activity

The average number of spontaneous nuclear transitions from a particular energy state occurring in an amount of radionuclide in a small time interval, divided by that time interval. The SI unit of activity is the becquerel (Bq); the non-SI unit is the curie (Ci).

:Alpha particle

Positively charged subatomic particle emitted spontaneously from some radioactive substances in their change from one element into another. It consists of two protons and two neutrons and ionizes heavily due to its relatively large charge and mass. Alpha particles are emitted with high energy, typically between 3 and 7 meV. Due to their heavy mass and double electronic charge, they interact strongly with surrounding atoms giving a very high ionization density and linear energy transfer along their track.

:Antecubital

In front of the elbow; at the bend of the elbow.

:Apex of the heart

The rounded tip of the heart forming the left ventricle. The apical portion of the ventricular myocardium is thinner than other portions.

:Aseptic

Free from infection or germs, antiseptic.

:Atom

The smallest unit of an element consisting of a single nucleus surrounded by one or more orbital electrons. The number of electrons is normally sufficient to make the atom electrically neutral. Adding or removing one or more electrons turns the atom into a negative or positive ion, but this is regarded as a state of the same atom. The atom is characterized by its nucleus which can only be changed by a process that requires very much more energy than changing the state of the atom. The atom of a given element is identified by its atomic number, for example, the number of protons in the nucleus, or the number of electrons about the nucleus.

:Atresia

Closure or absence of a normal passage, orifice, or cavity.

:Atrophy

A wasting away or decrease in size of a part; the result of a failure or abnormality of nutrition.

:Attenuation

The process by which a beam of radiation is reduced in intensity when passing through matter. It is the combination of absorption and scattering processes and leads to a decrease in flux density of the

beam when projected through matter. A general term to denote a decrease in magnitude in transmission from one point to another. This can also refer to attenuation of sound in tissue, which is the physical process by which the intensity of the ultrasound beam diminishes through tissue by reflection, scatter, and absorption in that tissue.

:Attenuation correction

Attenuation correction is the ability to compensate for photons which have been absorbed in the patient, never reaching the detector. Since activity located deeper in the body is attenuated more than activity near the surface, attenuation manifests itself in an emission tomographic transaxial slice by artifactually decreasing the counts near the center of the body. The relatively higher counts near the edges of the radionuclide distribution are known as a "hot rim" artifact. The two methods most commonly used to correct radionuclide distribution are the Sorenson preprocessing method and the Chang postprocessing method.

:Autologous

An immunologic term for "derived from self" (for example, skin graft, blood cells). WBCs for white blood cell labeling are autologous WBCs because they are from the patient.

:Background counts

In any form of nuclear detector giving electrical pulses, unwanted background counts may be recorded due to radiations other than those arising from the process under observation.

:Becquerel

The SI unit of radioactivity. One becquerel (Bq) is equivalent to one nuclear disintegration per second. The conventional unit for radioactivity is the curie.

:Bergonie-Tribondeau law

The radiosensitivity of a tissue is directly proportional to its reproductive capacity and inversely proportional to its degree of differentiation.

:Beta decay

The transformation of nuclei either by the spontaneous emission of electrons or positrons, or by the capture of an orbital electron from the K-shell, is known as beta-decay.

:Biliary system

System including liver serving both a digestive and an excretory function.

:Bilirubin

Bile pigment; breakdown product of hemoglobin, causes yellow color in serum and tissues.

:Biological half-life

The time required for the body to eliminate one half of an administered dose of any substance by regular processes of elimination. This time is approximately the same for both stable and radioactive isotopes of a particular element.

**:Blood brain barrier**

(BBB) Typically described as the tight endothelial junctions at the capillary wall that restrict transport and diffusion from blood to brain or brain to blood of some natural body substances, drugs, and chemicals circulating in the blood.

**:Bolus**

A quantity of opaque medium or radiopharmaceutical introduced into an artery or vein at one time. In NMR method of blood flow measurement, the bolus consists of a certain volume of blood whose protons have been tipped by the radiofrequency (rf) pulse.

**:Bowman's capsule**

( Glomerular capsule) The blind funnel-like end of a nephron that surrounds a glomerulus.

**:Brain scan**

The study of changes in cerebral perfusion in various neurological conditions using radioisotopic procedures. The term was initially coined when rectilinear scanners were used for brain scintigraphy. However, the term scan is now used generically for any of the recently developed brain-imaging techniques. There are mainly two types of brain scans: some focus on the structural aspects and include computer-assisted tomography (X-ray scanning), traditional scintigraphy, and nuclear magnetic resonance imaging. Others concentrate on the functional aspects and give a picture of the cerebral metabolism and cerebral blood flow, whether normal or pathological. These techniques include positron and single photon emission tomography (PET & SPECT).

**:Bremsstrahlung**

The electromagnetic radiation produced when a charged particle is accelerated in the coulomb field of a charged body. The radiation means an energy loss of the electron and is produced, for example, when an electron passes near a nucleus and is deflected from its path, this deflection being an acceleration toward the nucleus, The name ( braking radiation) originates in the radiation produced when electrons are stopped in an absorber.

**:Buffy Coat**

The thin upper layer of leukocytes on sedimented red blood cells.

**:Capillary blockade**

Blockage of a fraction of a capillary bed by metabolizable particles injected downstream towards the capillary bed, for diagnostic or therapeutic purposes. Lung scanning is accomplished by intravenously injecting macroaggregates which are trapped in the pulmonary capillary bed and, thus, lung perfusion is visualized. Starch microspheres can be used to block the capillaries of a segment of a diseased organ, to enhance or retain within that segment a therapeutic agent.

**:Carcinoembryonic antigen**

(CEA) An antigen that is present on fetal endodermal tissue and is reexpressed on the surface of neoplastic cells, particularly in carcinoma of the colon.

**:Cardiac output**

Cardiac output is the volume of blood ejected from the left ventricle into the systemic circulation or from the right ventricle into the pulmonary circulation. It is conventionally measured in liters per minute, while in physiological studies the concept of cardiac index is employed.

**:Cardiomegaly**

Hypertrophy, or enlargement, of the heart, usually due to disease that increases the cardiac workload.

**:Cardiomyopathy**

A term which usually refers to a disease of the heart muscle or myocardium.

**:Carrier**

A substance in ponderable amount which when associated with a trace of another substance will carry the trace with it through a chemical or physical process, especially a precipitation process. If the added substance is a different element from the trace, the carrier is called a nonisotopic carrier. A transmission signal upon which other signals can be piggy-backed (modulated) for transmission. A carrier signal is a continuous signal transmitted over some medium at a particular frequency that is capable of being amplitude or frequency modulated to carry other signals containing data or information. An immunogenic substance that, when coupled to a hapten, renders that hapten immunogenic. An individual who harbors and shed pathogens but who lacks overt symptoms of disease.

**:Carrier free**

A preparation of a radioisotope to which no carrier has been added, and for which precautions have been taken to minimize contamination with other isotopes. Material of high specific activity is often loosely referred to as "carrier free", but more correctly this should be termed material of high isotopic abundance. In the strict sense the term means that all atoms of a given element present in a product are radioactive.

**:Catalyst**

A substance which affects the speed at which a chemical reaction occurs without affecting the end point of the reaction and without being changed itself by the reaction.

**:Catheter**

A rubber or plastic tube. The two most commonly used types are the hollow catheter and the electrode catheter. The hollow catheter has at least one lumen connecting a hole at or near the tip of the catheter to an external port through which fluid samples may be withdrawn, pressures may be measured, and fluids (drugs, radiopaque, radiopharmaceutical) may be injected, or to keep a passage open. The electrode catheter usually has no lumen, and has one or more platinum electrodes on its surface near to the tip, through which the heart's electrical activity may be recorded and electrical stimuli transmitted.

**:Cerebrospinal fluid (CSF)**

The fluid secreted by the choroid plexuses fills the brain ventricles and subarachnoid space surrounding the brain and spinal cord, to be after circulation, reabsorbed into the large venous sinuses, through special structures, the arachnoid villi (granulation).

**:Characteristic X-ray emission**

When an electron is removed from one of the inner shells of an atom, an electron from outer shell promptly moves in to fill the vacancy, and energy is released in the process.. The energy released when an electron drops from an outer to an inner shell is exactly equal to the difference in binding energies between the two shells. The energy may appear as a photon or electromagnetic radiation. Electron binding energy differences have exact characteristic values for different elements; therefore the photon emissions are called characteristic radiation or characteristic X-ray emissions.

**:Chelate**

Ligand that has two or more potential bonding sites.

**:Chelate compounds and chelating agents**

When a metal ion combines with a group containing an electron donor, a coordination compound is formed. If the substance which combine with the metal contains two or more donor groups, or if the metal is already combined with another atom in the molecule containing the donor atom so that one or more rings are formed, the resulting structure is said to be a chelate and the attached molecule a chelating agent. Although a large number of chelating agents are known, the donor atoms are commonly restricted to nitrogen, oxygen and sulfur.

**:Chemical bond**

The directed attractive force between two atoms in molecule. A common type of chemical bond arises when two atoms share a pair of electrons

**:Chemical purity**

Chemical purity is the fraction of the total mass present in the stated chemical form. Chemical impurities arise from the production process. In generator-produced radionuclide, the most probable contaminant is the column material, e.g., aluminum.

**:Cholecystokinin**

Hormone secreted by the small intestine; stimulates contraction of the gallbladder.

**:Choroid plexus**

A vascular fold of the pia mater in the third, fourth, and lateral ventricles of the brain that secretes cerebrospinal fluid.

**:Chromatography**

This method of chemical analysis uses a group of methods for separating a mixture of substances into their component parts. Chromatography is a misnomer for the technique since the color of the components is not really used for identifying substances in modern techniques. There are four basic

types of chromatography using one phase or substrate which may be liquid or solid through which the test substance (gas or liquid) moves. A common feature of these methods is that the difference in rate of movement of the components of the test sample (plus reagents) is used to identify the separate components.

:Circumflex coronary artery

The branch of the left coronary artery that normally supplies the posterior wall and a portion of the inferior and lateral walls of the left ventricle.

:Cisternography

Delineation of the cerebrospinal fluid flow and spaces surrounding the brain after intrathecal instillation of a suitable radiopharmaceutical.

:Coincidence

The occurrence of counts in two or more detectors simultaneously or within an assignable time interval: a true coincidence is one that is due to the incidence of a single particle or of several genetically related particles. An accidental, chance, or random coincidence is one that is due to the fortuitous occurrence of unrelated counts in the separate detectors.

:Coincidence imaging

Any method or organ imaging, principally employing positron emitters, that suppresses background or possibly nonfocal counts by recording only simultaneous events.

:Collimator

A collimator is a device for restricting and directing X-rays or other radiation by simply passing the rays through a tube (or set of parallel or divergent tubes), a cone, diaphragm, or grid made of metal which strongly absorbs the rays. In nuclear medicine collimators are described as a metal (usually lead) attachment to the crystal in a gamma camera. Gamma rays are directed through holes and absorbed in the metal. A crude focusing can be effected by arranging tapered holes so that only rays from a single point can reach the crystal.

:Colloid

An intimate mixture of two substances, one of which, called the dispersed phase (or colloid), is uniformly distributed in a finely divided state through the second substance, called the dispersion medium (or dispersing medium). The dispersion medium may be a gas, a liquid, or a solid, and the dispersed phase may also be of these, with the exception that one does not speak of a colloidal system of one gas in another. Also called colloidal dispersion, colloidal suspension.

:Color flow imaging Doppler

In color flow imaging, the blood flow is superimposed on a two-dimensional image and displayed in real time. Flow towards the transducer is depicted as shades of red and flow away as shades of blue. Turbulent flow is depicted by the addition of green giving a mosaic pattern. This relatively new technique shows great promise as a means for assessing regurgitant valvular lesions and demonstrating shunt flow in congenital heart disease.

**:Column generator**

Column device of a generator using a parent radionuclide absorbed to a medium on the column; the daughter radionuclide is usually obtained by elution of the column with a solution that washes the daughter but not the parent off the column.

**:Compartmental localization**

The distribution of an injected radiopharmaceutical in a specific body space or compartment.

Example:Labeled human serum albumin remains in the intravascular compartment for a sufficient time to allow blood pool imaging.

**:Compounding**

To form by combining parts, to form a whole, to put together. A pharmacy term describing the making of a drug or radiopharmaceutical.

**:Compton effect**

Absorption or attenuation effect observed for X and gamma radiation in which the incident photon interacts with an orbital electron on the absorber atom to produce a recoil electron and a photon of energy less than the incident photon. When gamma rays fall on an organic crystal scintillation spectrometer, they generally interact in this manner and the pulse height spectrum observed for a monoenergetic gamma ray line corresponds to the energy distribution of the Compton electron. This is generally called the Compton spectrum of the gamma rays.

**:Computerized axial tomography**

(CAT or CT) A radiographic technique in which X-ray images representing slices through a patient are reconstructed by means of computer programs. This produces an image on a cathode ray tube (CRT) screen of a section through the body, with each point on the image having a brightness corresponding to the X-ray absorption properties of the point represented. The scanner comprises one or more X-ray sources collimated to produce very thin X-ray beams which pass through the patient to a scintillation detector. The overall attenuation of the X-ray beam as it passes through the body is calculated from the intensity reaching the detector. Similar attenuation measurements are made thousands of times as the position and direction of the X-ray beam are changed. A computer with suitable programs calculates the attenuation occurring at each point within the section being scanned, which would be necessary to account for the measured overall attenuations.

**:Concentration**

The amount of a substance in weight or moles present in unit volume of a solution. Strength of substance in a solution.

**:Confidence limits**

In statistics, the two limits within which a given parameter or characteristic has a specified probability of being found.

**:Contamination**

Accidental spread of unwanted radioactivity to an area where it does not belong.

:Contrast media

Compound used to produce density differences in tissues, organs, or vessels to permit their imaging. X-ray contrast media are largely iodinated organic molecules that are either selectively excreted by a particular organ after intravenous injection or are injected intravascularly; their high iodine content strongly absorbs X-rays and attenuates the beam.

:Converging hole collimator

The converging hole collimator allows relatively small objects to have increased image size. This is particularly useful with large field of view ( large diameter detector) gamma cameras where organs such as the heart, thyroid, testes, and brain can be visualized more easily with improved sensitivity. The field of view over the zone near the collimator decreases with increasing object distance and results in a reduction in spatial resolution.

:Conversion electron

Orbital electron that has been excited (ionized) by internal conversion of an excited atom.

:Coordinate covalent bond

Covalent bond formed by two atoms in which one atom dominates both electrons for the bond.

:Count

( Radiation measurements) the external indication of a device designed to enumerate ionizing events. It may refer to a single detected event or to the total registered in a given period of time. The term often is erroneously used to designate a disintegration ionizing event, or voltage pulse.

:Count rate

The rate at which decay events are seen by a detector. Also, the absolute rate (counts per second) of decay events for a standard source.

:Counting efficiency

Counts per minute per disintegrations per minute x 100 = efficiency.

:Counting rate meter

A device which gives a continuous indication of the average rate of ionizing events.

:Counting statistics

In counting radioactivity, this refers to statistical variability of counts or count rate.

:Covalent bond

A type of chemical bond which involves transfer of electrons between the atoms forming the molecule.

:Creatine phosphokinase

(CK) An enzyme important in phases of cellular metabolism found in many body tissues, but in highest concentrations in heart and skeletal muscle. Rapid elevation in serum levels occurs in a number of conditions, including muscle injury and infarction.

:Critical organ

The organ or tissue that receives the largest dose of radiation in a procedure; this depends on radionuclide concentration by the organ, geometric factors, and the effective retention in that organ. Organ of interest most affected by a technique.

:Crohn's disease

Chronic inflammation of the lower part of the ileum.

:CT or CAT

Computerized Axial Tomography. A radiographic technique in which X-ray images representing slices through a patient are reconstructed by means of computer programs.

:Curie

A non-SI unit of radioactivity defined as  $3.70 \times 10^{10}$  disintegrations per second. One gram of radium has an activity of 1 Ci. The curie has now been superseded by the SI unit, the becquerel (one disintegration per second).

:Cutie pie

( Colloquial) Portable ionization chamber for determining relatively stable dose rates.

:Cyclotron

Since its invention by E. O. Lawrence in 1931, the cyclotron has been the nuclear particle accelerator of choice for the production of radioisotopes by charged-particle-induced nuclear reactions. Nuclear reactors, which produce neutron-rich radioisotopes by neutron bombardment, supplanted cyclotrons in the 1950's and 1960's as the major producers of radioisotopes, but the latter are still the dominant producers of neutron-deficient radioisotopes. As a result of significant improvements in cyclotron technology, the number of cyclotrons in dedicated use in biomedical applications has increased rapidly. This trend to increased utilization of cyclotrons has been reinforced by the recent development of positron emission tomography, a procedure which enables complex physiological and biochemical processes to be studied in vivo.

:Cystography

A catheter is placed through the urethra into the bladder and contrast material is allowed to enter and fill the bladder to capacity (cystogram). This outlines the interior of the bladder and is helpful in evaluation of bladder size and in looking for the presence of reflux of urine to either ureter. This latter abnormality is associated with recurrent episodes of kidney infection.

:Dacryocystogram

Dacryocystography is the evaluation of the nasolacrimal (tear) duct that connects the eye with the nose and which is responsible for drainage of tears from the eye.

**:Daughter product**

A nuclide formed by the decay of a radionuclide. A daughter product may be either radioactive or stable. Synonym for decay product.

**:Decay**

When a radioactive atom disintegrates it is said to decay. What remains is a different element. Thus, an atom of polonium decays to form lead, ejecting an alpha particle in the process. In a mass of a particular radioisotope a number of atoms will disintegrate or decay every second -- and this number is characteristic of the isotope concerned. The spontaneous transformation of a radionuclide, resulting in a decrease with time of the number of radioactive events in a sample.

**:Decay constant**

The fraction of the number of atoms of a radioactive nuclide which decay in a unit time.  $\lambda = 0.693 / T_{1/2}$  is the half life of a radionuclide. It may also be noted that  $\lambda$  is the reciprocal of the mean average life of the radioactive nuclide.

**:Decay scheme**

Diagram showing the decay mode or modes of a radionuclide.

**:Decontamination**

This term is commonly used to denote the removal of radioactive contaminating material from surfaces of one kind or another. It is rarely used in connection with the cleaning up of gases or liquids. Everyday examples of decontamination requirements include the surfaces of laboratory benches, floors, and walls, laboratory apparatuses, including glove boxes and hot cells, and the skin, usually the hands of personnel.

**:Dee**

A D-shaped hollow metal electrode used in the cyclotron and synchrocyclotron particle accelerators to obtain the necessary electric field for acceleration.

**:Depleted uranium**

Uranium having less than the natural content, namely, 0.7% of the easily fissionable uranium, the residue from a diffusion plant or reactor.

**:Diapedesis**

The outward passage of cells through intact vessel walls.

**:Diaphysis**

Portion of long bone between the articulate end; shaft

**:Diastole**

The stage of the cardiac cycle during which the ventricles fill with blood. The relaxation, or period of relaxation, of the heart, especially of the ventricles.

**:Diastolic blood pressure**

The pressure of blood in the arteries during diastole. The average diastolic pressure in the brachial artery of a young adult is 70 to 90 mmHg.

**:Diethylenetriaminepentaacetic acid**

(Pentetate, Pentetic acid, DTPA) Chelating agent used for scintigraphy (renography).

**:Diphosphonate**

Organic phosphate compound used for bone scintigraphy.

**:Distal**

Farthest from the center from a medial line or from the trunk. Away from the point of origin. Remote; opposite of proximal.

**:Diuretic**

An agent that promotes the excretion, or increases the amount of urine.

**:Diverging hole collimator**

The diverging hole collimator has been principally used with small field of view (small diameter detector) gamma cameras to enable large organs to be visualized on a single image. Larger objects can be encompassed within the increasing field of view but the spatial resolution is not constant with increasing object distance.

**:Doppler echocardiography**

Analysis of intracardiac or intravascular flow by ultrasonic techniques involving the Doppler effects with or without a spatial reference by A-mode, M-mode, two-dimensional imaging, or auditory signals for the localization of the site being sampled.

**:Dose**

The radiation delivered to the whole human body or to a specified area or volume of the body. A general term denoting the quantity of radiation or energy absorbed in a specified mass. For special purposes, its meaning should be appropriately stated, e.g., absorbed dose. The SI unit of absorbed dose is the gray (Gy). The term is also used loosely for the amount of radioactivity administered. In competitive binding assay, the amount of test substance added to any given reference standard.

**:Dose equivalent**

(H) the absorbed dose multiplied by factors to allow for the different biological effect produced, for the equal energy absorption, by different types of radiation as well as other modifying effects. Thus, the dose equivalent H is defined as  $H = DQN$ , where D is the absorbed dose, Q is the quality factor, and N is the product of all other modifying factors ( currently assigned the value 1).

**:Dose rate**

The dose of radiation received per unit of time.

**:Dose rate meter**

An instrument for measuring radiation dose rate. Such instruments commonly comprise an ionization chamber followed by an electrometer valve circuit feeding an output microammeter graduated to read the dose rate in gray per second. Instruments of this type are used for providing detailed information about the radiation intensities in different parts of laboratory where radioactive materials are handled, or where machines producing ionizing radiations are in use. They may be used in a fixed position ( they are then called installed dose rate meters), or they may be portable and used for the measurement of radiation dose rate at a variety of different locations. Instruments of this latter type are often called survey meters.

**:Dose response curve**

Curve indicating percent response to a specified (log) dose or less. The curve may represent an increasing percentage of animals responding to a drug or an increasing magnitude of response within an individual animal or tissue. The graphic relationship between counts bound and amount of standard added in a radioimmunoassay; a standard curve.

**:Dosimeter**

Instrument used to detect and measure an accumulated dosage of radiation; in common usage it is a pencil-size ionization chamber with a built- in self-reading electrometer; used for personnel monitoring.

**:Dosimeter charging unit**

Condenser pocket ionization or chambers and quartz-fiber electroscopes are used for the measurement of total dose received during a period of time ( usually a working day). In order to use these devices the ionization chambers must be charged by connecting the electrodes of the chamber momentarily to a battery, or other source of voltage.

**:Dosimetry**

The measurement of the quantity of radiation absorbed by a substance or a living organism. Instruments used for such measurements are known as dosimeters. In many cases it is not possible to make a direct measurement of the dose and resort must be had to calculation which may range from a simple approximation to the precise computation of isodose curves which is used in radiotherapy.

**:Dual-head gamma camera**

Dual-head gamma cameras have been designed to assist in single photon emission computed tomography and whole body area scanning. Gamma cameras with dual heads can be used either to decrease imaging times, or conversely to improve quality of images for similar imaging times. The setting-up procedures, however, are more complex.

**:Dynamic radionuclide image acquisition**

A dynamic acquisition is a series of images that are recorded to reflect changes within the radioactive distribution with time. The acquisition may monitor changes in concentration of the

radiopharmaceutical, transfer of radioactivity, changes in shape or volume of organs, transient perfusion effects, or the excretion of a radionuclide. Dynamic studies may follow changes in radioactive distribution in time ranging from second to many hours, and introduce an extra dimension into imaging.

:Dynode

An electrode in a photomultiplier tube that undergoes secondary emission upon bombardment by electrons.

:Dyskinesia

Impairment of motor function or activity.

:Dysphagia

Inability to swallow or difficulty in swallowing.

:Dysplasia

An abnormal development of tissue in the body.

:Dyspnea

Labored breathing; breathing is difficult and conscious effort is involved.

:Dysuria

Pain upon urination.

:Echocardiography

Examination of the heart by diagnostic ultrasound, principally using M-mode and real-time cross-sectional displays. An ultrasonic record of the dimension and movement of the heart and its valves.

:Edema

An excessive accumulation of fluid in the intracellular tissue spaces of the body due to a disturbance in the fluid-exchanging mechanism.

:Effective half-life

Time required for an administered dose to be reduced to one half due to both physical decay and biologic elimination of a radionuclide.

:Efficiency

The percentage of decay events from a standard sample that are seen and stored by the multichannel analyzer (MCA) system. Used to calibrate the MCA system for quantitative analyses. Also used to specify germanium detectors, here being the relative efficiency of the germanium detector when compared to a standard NaI(Tl) detector. (Counters): A measure of the probability that a count will be recorded when radiation is incident on a detector. Usage varies considerably so that it is well to make sure which factors (window transmission, sensitive volume, energy dependence, etc.) are included in a given case.

**:Effusion**

Escape of fluid into a part, as the pleural cavity, such as pyothorax (pus), hydrothorax (serum), hemathorax (blood), chylothorax (lymph), pneumothorax ( air), hydropneumothorax (serum air), and pyopneumothorax ( pus and air).

**:Ejection fraction**

A measure of the ability of the left ventricle to expel blood. The ejection fraction equals the stroke volume divided by the end-diastolic volume. A normal left ventricular ejection (LVEF) fraction is approximately 0.67, a value that indicates that the left ventricle can expel two thirds of its volume into the aorta with each contraction. The ejection fraction falls with the onset of heart failure, and it may reach as low as 0.10 in the more severe cases.

**:Electrocardiogram**

(ECG or EKG) A graph, recorded over time, of variations in voltage produced by the heart during different phases of the cardiac cycle; the record of the heart's electrical activity.

**:Electromagnetic radiation**

Electrical and magnetic energy in the form of waves of energy called photons traveling through space at the speed of light; the spectrum of electromagnetic radiation ranges from long-wavelength, low energy radio waves to very high-energy, short wavelength X-rays and Gamma rays.

**:Electron**

A fundamental particle with negative charge constituent of all atoms. Electrons take up most of the volume of the atom but little of the mass.

**:Electron capture**

Radioactive transformation in which an inner orbital electron is captured by an atom's nucleus. The capture of an electron by the nucleus leaves a vacancy in one the inner electron shells. As a result the product atom, and not the nucleus, has an energy above the ground state. This excess energy is lost either by the emission of the characteristic X radiation of the daughter, or by the transfer of the excess energy to an outer electron thereby ejecting it as an Auger electron.

**:Electron shell**

A set of atomic energy levels with approximately equal energies, denoted by the letters K,L,M,N,etc.

**:Electron-multiplier tube**

A device by which small light flashes (photons) are amplified electronically by a cascade process employing secondary emission of electrons. This device detects and amplifies the scintillations produced by the interactions of gamma rays and the crystal in a scanner. Also called a photomultiplier tube.

**:Electronvolt**

(eV) A unit of energy equivalent to the amount of energy gained by an electron in passing through a

potential difference of 1 V. Larger multiple units of the electronvolt are frequently used, viz, keV for thousand or kiloelectronvolts; MeV for million or megaelectronvolts.

:Elution

A method of extraction of an absorbed substance from a solid adsorbing matter ( such as ion-exchange resin) with a liquid. Elutriation.

:Embolism

Blocking of a blood vessel by a clot or air bubbles that have been transported through the blood.

:Embolus

A relatively large blood clot released from a blood vessel and lodged in a smaller vessel so as to obstruct blood circulation. An embolus can also be an abnormal particle of air or fat disrupting blood flow.

:Emission

The process in which photons from any particular radionuclide leave the place in which the radionuclide is deposited.

:Emission computed tomography

(ECT) Tomographic projections are nothing more than a series of planar images taken at different angles around the patient. These images are then backprojected into transaxial images.

:End-diastolic volume

A value representing the amount of blood in the left ventricle just prior to contraction. With the onset of heart failure end-diastolic volume increases as the ventricle dilates. End-diastolic volume is an index of preload.

:Eosinophils

Circulating granulocytes characterized by large eosinophilic cytoplasmic granules; They migrate to sites of anaphylactic reactions where they release histaminase and prostaglandins that modulate mast cell degranulation. Eosinophils kill certain animal parasites by a C-unrelated antibody-dependent contact mechanism.

:Epiphysis

Wide end of long bones just before the joint; usual region of growth.

:Equilibrium

The stage in a reaction where the concentration of the reactive species is no longer changing.

:Erythropoiesis

The production of red blood cells by red bone marrow.

:Erythema

An abnormal redness of the skin due to congestion of the capillaries with blood. It can be caused by many different agents; e.g., heat , certain drugs, ultraviolet rays, ionizing radiation.

:Erythrocytosis

Increase in red blood cells from a known stimulant.

:Excitation

Transference of energy into the spin system: process by which nuclei are put into a higher energy state. If a net transverse magnetization is produced, the response of an excited system can be observed (NMR); A stimulation which is followed by increased activity.

:Excited state

If the internal energy of an atom, molecule, or nucleus exceeds the minimum possible value, it is said to be in excited state.

:Excretion

The elimination of waste products.

:Exercise or stress EKG test

Measurement of the electrocardiogram and other cardiovascular functions during exercise. It is usually performed on a treadmill or bicycle with gradual increase in the level of exercise performed.

:Exophthalmos

Protrusion of the eyeballs from the orbit.

:Exponential decay

A decay process in which the decay decreases exponentially with time

:Exposure

A measure of the ionization produced in air by X or gamma radiation. It is the sum of the electrical charges on all the ions of one sign produced in air when all electrons liberated by photons in a volume element of air are completely stopped in the air, divided by the mass of the air in the volume element. The SI unit of exposure is the coulomb per kilogram (C/kg). A person is said to be subject to radiation exposure if he/she is in a situation where his/her body or part of it has radiation incident on it. If the radiation can reach all or most of the body it is said to be whole-body exposure and if only certain parts are exposed, such as an organ or the extremities, it is partial exposure. Exposure can be from radiation arising outside the body or from material that has been taken into the body by ingestion or inhalation or through a wound. Depending on its duration it may be acute exposure or chronic exposure.

:Extracellular

Situated or occurring outside a cell or the cells of the body.

:F(ab')<sub>2</sub>

A fragment obtained by pepsin digestion of immunoglobulin molecules containing the 2H and 2L chains linked by disulfide bonds. It contains antigen-binding activity. An F(ab')<sub>2</sub> fragment and an Fc fragment comprise an entire monomeric immunoglobulin molecule.

:Fab

An antigen-binding fragment produced by enzymatic digestion of an IgG molecule with papain.

:Fc fragment

A crystallizable fragment obtained by papain digestion of IgG molecules that consists of the C-terminal half of 2H chains linked by disulfide bonds. It contains no antigen-binding capability but determines important biologic characteristics of the intact molecule.

:Fibrin

An insoluble protein formed from fibrinogen (coagulation factor I) during normal clotting of blood. Fibrin is the essential portion of the blood clot.

:Fibrinogen

A protein found in blood plasma which is converted by thrombin into fibrin.

:Fibrosis

An abnormal increase in the amount of fibrous connective tissue in an organ or in the skin; the narrowing or closing of minute arteries and capillaries by inflammatory internal fibrosis.

:Field of view

The area which can be "seen" by an optical system. It may be expressed as an angle or as a diameter; it defines the volume from which emitted activity may be detected.

:Film badge

A simple type of personnel radiation monitor that can be issued to individuals likely to be exposed to significant radiation doses. It consists of a metal or plastic case with a clip or pin for fastening to the outside of protective clothing and holding a piece of photographic film (similar to that used for dental X-ray) wrapped in a light tight envelope. Part of the film is covered by a thin metal screen. The unscreened portion is affected by beta, gamma, and x-rays, while the screened part containing a set of absorber filters is affected by the more energetic gamma and x-rays. When the film is developed, the blackening of the two parts due to radiation exposure enables an estimate to be made of the beta dose and the gamma plus x-ray dose to which the wearer has been exposed. Films are usually issued for a fixed period such as a week or a month, after which they are collected, processed, and radiation doses calculated with the aid of a densitometer by measuring the degree of blackening of the film.

:Fission

The splitting of a heavy nucleus into two (or, very rarely, more) approximately equal fragments- the fission products. Fission is accompanied by the emission of neutrons and the release of energy. It can be spontaneous, or it can be caused by the impact of a neutron, a fast charged particle, or a

photon. This process provides the energy of the atomic bomb and nuclear reactors.

:Fissure

Term for cleft or groove in organ.

:Fistula

An abnormal opening or passageway generally caused by disease or radiation necrosis between one hollow organ and another or to the skin.

:Fluid thioglycollate

Medium that provides conditions for growth of aerobic and anaerobic bacteria; used in microbiologic sterility testing of radiopharmaceuticals.

:Fluoroscope

A fluoroscope is a screen device for use with an X-ray generator to make visible an X-ray shadowgraphy similar to that obtained by the photographic process. It consists essentially of a card of suitable size coated on the viewer's side with a material, such as zinc sulfide, which fluoresces under the action of the radiation. In order to protect the viewer from the radiation the fluorescent screen is covered with a sheet of transparent lead-bearing glass.

:Fluoroscopy

Fluoroscopy is the use of a fluoroscope either in medical diagnosis or for industrial inspection purposes. When handling of the patient or object is necessary, lead-bearing rubber gloves should be worn or, in industrial work where the X-rays energy is usually greater, it may be necessary to provide some form of remote handling equipment or viewing on a TV screen after intensification.

:Fontanelle

The soft space in the skull of an infant. The spot ossifies completely within the first 1 or 2 years of life.

:Forced expiratory volume

The volume of air expired per unit time during forced expiration following full inspiration.

:Fossa

A small depression in the surface of a part of the body, especially in bone.

:Free radical

Any atom or molecule which possesses one unpaired electron. Such a radical usually exhibits considerable additive properties and high reactivity.

:Freeze-drying

(Lyophilization) The process of rapidly freezing a solution and removing the solvent by sublimation under vacuum.

**:Frequency**

Characteristic quantity of a magnetic or electrical field which is changing its direction alternatively at a regular interval. It is equal to the reciprocal of the period of this periodic motion. It is measured in hertz (Hz) which is 1 cps. Number of individuals with value X ( or in the xth class interval). A weighting factor in calculations.

**:Full width at half maximum or full width at tenth maximum.**

(FWHM or FWTM) Of the line spread function (LSF) or point spread function (PSF). Is usually used to specify spatial resolution of scintillation and positron cameras.

**:Fundus**

The posterior portion of the interior of a body cavity; the bottom or base of an organ, or farthest from the entrance.

**:Fusion**

If an isotope of a heavy element (uranium or plutonium) is encouraged to break up into two medium mass elements, the combined mass of which is less than the original mass, then the process is known as fission. The energy is released in the form of energetic neutrons and ultimately appears as heat which can be abstracted from reactor by more or less conventional means. Since the medium mass nuclei are the most tightly bound (i.e., have the smallest ratio of actual to nominal atomic weight), then it is possible to release energy also by fusing together lighter elements. The results of this fusion process when it is carried out rapidly and with the release of energy are represented by the hydrogen bomb. The major problem in the practical peaceful applications of this process is to release the energy slowly and in a controlled way. Naturally, this is the way that immense energy is generated in the sun.

**:Gadolinium**

Element symbol Gd, atomic number 64, atomic weight 157.25.

**:Gallium**

Element symbol Ga, atomic number 31, atomic weight 69.72. Gallium-67 is a radiopharmaceutical useful in tumor localization and infectious imaging.

**:Gamma camera**

An imaging apparatus used to visualize the distribution of radionuclides within the body.

**:Gamma radiation**

Electromagnetic radiation of a short wavelength that is emitted by the nucleus of a radionuclide during radioactive decay.

**:Gas-filled detector**

Type of ionization detector that converts absorbed radiation into electrical current. Includes chamber (i.e., dose calibrator), proportional counters, and Gieger-Muller counters (survey meters).

**:Gastrin**

A hormone secreted by the pyloric mucosa of the stomach.

**:Gated image**

An image made from data acquired only over a brief, selected, physiologic interval, usually a selected portion of the cardiac cycle, such as end-systole or end-diastole; the image data acquisition is triggered or gated by the R wave for short 10- to 40- periods at a selected interval or intervals from the R wave to coincide with end-systole (downslope of T wave) and end-diastole (r wave itself); sufficient cycles are repetitively gated to build up data for a diagnostic image. This provides for removal or organ motion artifacts by imaging only during specific portions of the organ cycle.

**:Geiger-Muller counter**

(G-M tube) A highly sensitive gas-filled tube with collecting electrode (anode) maintained at high voltage to collect, multiply, and measure the ions produced by entering ionizing radiation. It is based upon the avalanche effect which is observed when ions are accelerated by an electric field under appropriate conditions.

**:Generator**

A device in which a short-lived daughter is separated chemically and periodically from a long-lived parent absorbed on adsorbent material (usually an inorganic resin).

**:Geometry**

Refers to the geometric relationship between the detector and activity to be measured which determines the fraction of total emitted radiation that can be detected.

**:Glomerular filtration rate.**

The volume of plasma filtered through the glomerular capillaries of the kidneys per minute.

**:Glomerulus**

A tuft of fine blood capillaries in the nephron, which acts as a filter.

**:Glove box**

A form of protection enclosure used when working with certain radioactive materials. Gloves fixed to parts in the walls of a box allow manipulation of work within the box. The box is usually kept under slight negative pressure and ventilation is through high-efficiency filters.

**:Glucoheptonate**

Chelating molecule that can bind  $^{99m}\text{Tc}$  and be used as an imaging agent.

**:Goiter**

Any enlargement of the thyroid gland beyond normal size. The goiter may be diffuse (generally homogeneous enlargement) or nodular. Goiter may be associated with normal (euthyroid goiter), decreased, or increased thyroid function.

**:Granulocyte**

Granule-containing cells, especially the leukocytes with basophil, eosinophil, or neutrophil granules in their cytoplasm.

**:Gray**

The SI unit of absorbed dose of ionizing radiation; 1 gray (Gy) = 1 J/kg.

**:Gray matter**

Tissue of the central nervous system containing nerve cell bodies, dendrites, and the cell synapses.

**:Half-life**

( $T_p$  or  $T_{1/2}$ ) A unique characteristic of a radionuclide, defined by the time during which an initial activity of a radionuclide is reduced to one half. It is related to the decay constant wavelength of electromagnetic radiation by  $t_{1/2} = 0.693$  wavelength of electromagnetic. Half-lives may vary from less than a millionth of a second to millions of years, according to the isotope and element concerned. Biologic refers to the time for the body or an organ to eliminate one half the original material; physical refers to physical radioactive decay of nuclei to one half their original numbers; effective refers to the combined effects of biological elimination and physical decay, which result in an observed half life shorter than either of these two values individually.

**:Half-value layer**

(HVL) The thickness of any absorbing material required to reduce the intensity or exposure of a radiation beam to one half of the initial value when placed in the path of the beam. Synonym for half-thickness. This thickness  $T$  may be related to the linear absorption coefficient  $\mu$  by the equation  $T=0.693/\mu$ .

**:Health physics**

A division of occupational health dealing particularly with protection of personnel from the harmful effects of ionizing radiation.

**:Heart block**

A state in which the atrium and ventricle beat unnaturally and independently owing to inefficient conduction of electrical stimuli along the specialized conduction tissue of the heart.

**:Hematoma**

A swelling or mass of blood ( usually clotted) confined to an organ, tissue, or space and caused by a break in a blood vessel.

**:Hematopoiesis**

Formation of blood cells.

**:Hematuria**

The presence of blood or red blood cells in the urine.

**:Hemocytometer**

Instrument used to count blood cells.

**:Hemothorax**

Blood fluid in the pleural cavity caused by the rupture of small blood vessels, owing to inflammation of the lungs in pneumonia and pulmonary tuberculosis, to a malignant growth, or trauma. .

**:Heptasulfide**

Technetium heptasulfide  $^{99m}\text{Tc}2\text{S}_7$  coprecipitates with colloidal sulfur particles stabilized with gelatin in  $^{99m}\text{Tc}$ -sulfur colloid preparation.

**:High resolution collimator**

A collimator designed to maximize spatial resolution by using small, long holes; as a result, sensitivity is reduced.

**:Hot**

A colloquial expression commonly used to mean "radioactive".

**:Hot cells**

Heavily shielded enclosure or laboratories to protect personnel working with large amounts of substances emitting gamma radiation.

**:Hot spot**

Focal area of increased activity in scintigraphy.

**:Human albumin microspheres**

(HAM) Previously used for lung perfusion scanning before MAA.

**:Human serum albumin**

(HSA) When labeled by a radioactive substance can be used for radionuclide compartmental scintigraphy and in vitro studies.

**:Hybridoma**

Transformed cell line or clone of hybrid cells grown in vivo or in vitro which is a somatic hybrid of two parent cell lines and contains genetic material from both.

**:Hydrolysis**

A process in which a compound splits into two components by reacting with water when water is used as the solvent.

**:Hydronephrosis**

Distention of the renal urinary collecting system caused by an obstruction to urinary drainage in the outflow tract.

**:Hydroxyapatite**

A natural mineral structure similar to the crystal lattice of bones and teeth  $\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2$

**:Hyperemia**

Excess blood in any part of the body; congestion.

**:Hyperthyroidism**

The result of a hyperplastic, overactive thyroid gland that secretes an excess of hormone into the circulation.

**:Hypertrophy**

Enlargement or overgrowth of an organ due to increase in size of its constituent cells.

**:Hypothyroidism**

A clinical state resulting from deficiency in thyroid activity and lack of thyroid hormone.

**:Hysterosalpingography**

The fallopian tubes (salpinges) are connected to the uterus at its sides and allow for the passage of ova from the ovaries to the uterine cavity. One of the known causes of infertility is an obstruction to the fallopian tubes. To evaluate the tubary patency an iodinated contrast can be injected into the system and flow studied by X-rays. A radionuclide ( usually  $^{99\text{m}}\text{Tc}$ -macro aggregate albumin) can be used to evaluate the patency of the fallopian tubes in a more functional and less invasive way by following the pattern of flow ( of the radiopharmaceutical) from images obtained with gamma camera.

**:Idiopathic**

Relating to any disorder that is of unknown origin or apparently of spontaneous origin; self-originating.

**:Image artifacts**

The accuracy and level of confidence in interpreting an image is reduced when artifacts are introduced into an image. Image artifacts can originate from several distinct source. It should be part of an overall quality assurance program that operators of equipment reduce to a minimum the possibility of image artifacts occurring, while the diagnostician should recognize and allow for the possibility of artifacts being present in an image. These are some of the circumstances that may generate image artifacts; malfunction of equipment, incorrect operation of equipment, lack of quality control, patient-generated artifacts, technique-generated image artifacts.

**:Image matrix**

Depending on the type of scanner, the image matrix may be composed of 64 x64, 128x128, 256x256, or 512 x512 picture elements , or pixels, arranged in rows and columns, and is usually quadratic. The individual pixels are unequivocally defined by the coordinate system. By general agreement, pixels on the axes (x,y) are counted from the top left-hand corner of the matrix.

**:Iminodiacetic acid**

(IDA) Chelating group capable of binding technetium so that it can be attached to biologically active molecules, such as "hepatic" N,N'-(2,6 dimethylphenyl) carbamoylmethyl iminodiacetic acid (HIDA), para-isopropyl iminodiacetic acid (PIPIDA), diethyl iminodiacetic acid (DIDA), diisopropyl iminodiacetic acid (DISIDA), or parabutyl iminodiacetic acid (BIDA) which are all used as hepatobiliary radionuclide imaging agents.

**:Immunoglobulin**

A glycoprotein, isolated from the globulin fraction of serum having a characteristic shape and the ability to bind to molecules that are not endogenous to the species producing the immunoglobulin. All antibodies are immunoglobulins, but it is not certain that all immunoglobulins have antibody function.

**:Immunoscintigraphy**

The ability to image abnormal tissue using radiolabeled monoclonal and polyclonal antibodies directed against specific antigens. Examples of this technique are the visualization of some types of tumors, inflammatory lesions, or myocardial infarction, by directing radiolabeled antibodies against tumor antigens, human granulocytes, or myocardial myosin, respectively.

**:In vitro**

Observable in a test tube; removed from the natural state.

**:In vivo**

Within the living body.

**:Indium**

Element symbol In, atomic number 49. Indium-111 is available as In-111 oxine for WBC labeling, In-111 chloride for labeling peptides and MAb, and In-111 DTPA for cysternography.

**:Inguinal**

Relating to the groin region.

**:Intrathecal**

Within a sheath, particularly within the meninges into the subarachnoid space. Applied to the cerebrospinal fluid cavity.

**:Intrinsic factor**

A substance normally present in the gastric juice of humans. Its presence makes absorption of vitamin B12 possible. Absence of this factor leads to vitamin B12 deficiency and pernicious anemia.

**:Inverse square law**

Rule by which the radiation intensity of any source decreases inversely as the square of the distance between the source and the detector.

**:Iodohippurate**

(Hippuran) Orthoiodohippurate salt excreted by the kidneys via tubular secretion with ~80% efficiency and used to measure effective renal plasma flow. The remaining ~20% is excreted by glomerular filtration.

**:Iodothyronines**

Iodinated thyronines formed through the oxidative coupling of the precursor iodothyrosines, monoiodotyrosines (MIT) and diiodotyrosines (DIT), in varying combinations. The principal iodothyronines are thyroxine (T-4) and triiodothyronine (T-3).

**:Ion exchange**

A chemical process involving the reversible interchange of ions between a solution and a particular solid material, such as an ion exchange resin consisting of a matrix of insoluble material interspersed with fixed ions of opposite charge. The process is used for purifying water ( removing hardness), or in a radioisotope generator, i.e.,  $^{99}\text{Mo}$ - $^{99\text{m}}\text{Tc}$ .

**:Ion pair**

Two particles of opposite charge, usually referring to the electron and positive atomic or molecular residue resulting after the interaction of ionizing radiation with the orbital electrons of atoms.

**:Ionization**

The process in which an atom or molecule separates into two parts (ions) which have opposite electrical charge.

**:Ionization chamber**

Ionizing radiation can be detected by the small electric current which can be made to flow between two electrodes when particles of the gas between them become ionized. The electrodes and gas are often in a sealed glass envelope to allow the gas pressure to be reduced, which makes the device more sensitive. The Geiger-Muller (GM) tube is a special type of ionization chamber which contains low-pressure neon or argon, and a very high voltage is applied between specially shaped electrodes, ionization chambers are used to measure X-ray and gamma ray radiation levels.

**:Irradiation**

A term meaning exposure to radiation. Irradiation may be accomplished by exposure of the sample to the radiation from a radioactive substance, the radiation from a particle accelerator, or in the case of neutron irradiation by placing the sample in a nuclear reactor. Applications of a radioactive source for therapy or diagnosis.

**:Ischemia**

The state of a tissue that is receiving insufficient blood to meet its metabolic needs. Ischemia may be reversible or irreversible depending upon the cause of the insufficiency.

**:Isobar**

One of a group of nuclides having the same atomic mass number (A) so that the total number of

particles (neutrons and protons) in the nucleus is the same, but with these particles so proportioned as to result in different values of Z; for example,  $3\text{H}$  and  $3\text{He}$ , therefore, there are different elements.

:Isomer

One of two or more nuclides having the same mass number (A) and atomic number (Z), but existing for measurable times in different states of energy. The state of lowest energy is the ground state. Those of higher energy are metastable states. It is usual to indicate the metastable isomer by adding the letter m to the mass number in the symbol for nuclide (Tc-99m).

:Isomeric transition

(IT) The process by which a nuclide decays to an isomeric nuclide of lower energy state. Isomeric transitions proceed by gamma ray and /or internal conversion electron emission.

:Isonitriles

Hexakis (alkylisonitrile)  $99\text{mTc}$  complexes such as  $99\text{mTc}$ -carbomethoxyisopropyl isonitrile (CPI) or  $99\text{mTc}$ -methoxyisobutyl isonitrile (MIBI) are used to study myocardial blood flow for the scintigraphic assessment of coronary artery disease and myocardial infarction.

:Isotone

Any one of several nuclides having the same number of neutrons in the nucleus but differing in the number of protons and therefore a different mass number.

:Isotonic

Descriptive of solutions having identical concentrations of solvent and solute molecules and hence the same osmotic pressure as the solution with which it is compared. Having the same tone : a muscle acts isotonicly when it changes length without appreciably changing the force it exerts.

:Isotope

One of several nuclides having the same number of protons in their nuclei, and hence having the same atomic number, but differing in the number of neutrons, and therefore in the mass number. Almost identical chemical properties exist between isotopes of a particular element, for example,  $11/6\text{C}$ ,  $12/6\text{C}$ ,  $13/6\text{C}$ ,  $14/6\text{C}$  are isotopes of carbon. The use of this term as a synonym for nuclide is not recommended. Nuclides are distinct nuclear species, while isotopes are nuclides of the same element.

:Isotopic labeling

It refers to a compound in which an atom has been replaced by an isotope of the same element, in the same position, and without any other change in the molecule; it also refers to compounds in which more than one atom has been replaced under the same conditions.

:Jaundice

Yellowness of skin, secretions, and mucous membranes because of bile pigments in the blood.

:Ketosis

An excess of ketone bodies in blood, characteristic of diabetes mellitus and starvation.

:Krypton-81m

Short, 13-s-half-life radionuclide of the inert gas krypton, which can be obtained from a  $^{81}\text{Rb}/^{81\text{m}}\text{Kr}$  generator and used in studying and imaging the ventilation of the lungs. In solution in dextrose it can be injected intravenously or intraarterially to define the extent of perfusion of the tissues drained or supplied by the infused blood vessel.

:Kupffer cells

Fixed mononuclear phagocytes of the reticuloendothelial system that are present within the sinusoid of the liver.

:Lamellae

One of the bony concentric layers surrounding the Haversian canals in bone

:Lateral

Toward the outer margins of the body.

:Lead

Element symbol Pb (plumbum), atomic number 82, atomic weight 207.19.

:Lesion

Any change in the structure of a bodily part due to injury or disease.

:Leukocyte

White blood cell or corpuscle; numerous functional types; leukocytes.

:Leukocytosis

Abnormal increase in the number of leukocytes (white blood cells), usually reflecting the presence of an acute inflammation or infection.

:Leukopenia

Less than the normal number of white blood cells.

:Ligand

An atom or small molecule binding to an atom or molecule of interest. The binding can be either covalent binding (e.g., nitrogens or oxygen to a metal ion) or noncovalent binding of a small molecule to a big molecule (e.g., binding of a substrate to an enzyme). In radioimmunoassay, ligand usually means an antigen or small molecule that binds to a native carrier protein.

:Limulus test

A lysate of the circulating amebocytes of the horseshoe crab. (*Limulus polyphemus*). It reacts with Gram-negative bacterial endotoxins in low concentration to form an opaque gel. In vitro test for pyrogens, particularly suitable for testing short-lived radiopharmaceuticals. Also known as the

**Bacterial Endotoxin Test (BET)****:Linear energy transfer**

(LET) Energy deposited by radiation per unit length of matter through which the radiation passes. Its usual unit is keV/um.

**:Lugol's solution**

An iodide-saturated solution. Used in nuclear medicine in some circumstances to block the thyroid from accumulating radioactive iodine.

**:Lumen**

The cavity or channel of a tubular device, organ, or duct.

**:Luminescence**

Many substances emit radiation in the form of light when suitably excited; this property is known as luminescence, and can be excited by light itself, by X-rays, alpha, beta, and gamma rays, cathode rays, positive rays, high- frequency radiation, etc.

**:Lymph node**

A rounded body consisting of accumulation of lymphatic tissue found at intervals in the course of lymphatic vessels. Lymph nodes vary in size from a pinhead to an olive and may occur singly or in groups. Produces lymphocytes and acts as a filter to localize bacteria and viral infections and entrap wandering malignant cells.

**:Lymphangiography**

Lymphangiography is a study of the lymphatic vessels and their associated parenchymal components, the lymph nodes. Lymph nodes are frequently involved in malignant disease; an estimate of their size, shape, and distribution is useful prior to initiating therapy for the disease. The procedure involves the isolation of lymphatic vessels ( approximately 1 mm diameter) below the region to be studied followed by an injection of an iodine-containing contrast material which is concentrated in the lymph nodes.

**:Lymphocyte**

A mononuclear white blood cell without cytoplasmic granules, which participates in the immune response. They normally number from 20 to 50% of total white cells.

**:Lymphoscintigraphy**

Functional imaging of a regional lymphatic system obtained by injecting a radioactive minicolloid into the soft tissue drained by that system. Usually performed with filtered Tc-99m sulfur colloid.

**:Lyophilization**

A process by which a liquid substance is rapidly frozen and then dried or dehydrated under high vacuum.

**:Lysis**

Separation of adhesions binding different structures; destruction of a cell by a specific agent; abatement of disease symptoms.

**:Macrophage**

Large phagocytic cells occurring in the walls of blood vessels and connective tissue; eats foreign particles.

**:Magnetic resonance imaging**

(MRI) A technique for forming tomographic images of the density or behavior of hydrogen atoms in the body.

**:Malignant**

Becoming progressively worse and leading to death; invasive and metastasizing. Term used commonly when referring to terminal cancer tumors.

**:Mass number (A)**

The mass number of a nuclide is the nearest integer to the actual or exact mass of a nucleus in atomic mass units (a.m.u.). There can be no ambiguity in this definition because the difference between the exact mass and the nearest integer is always very small. Since the exact masses of both the neutron and the proton in a.m.u. are both very close to unity, the mass number A gives the number of nucleons ( neutrons and protons) in the nucleus.

**:Matrix**

An array of numbers ordered in terms of indices. The number of indices determines the number of dimensions in the matrix. In nuclear medicine, images are stored in two dimensional matrices ( in picture elements or pixels) in which the indices correspond to the position of an element in the image. Image sizes are often 64 x 64, 128 x 128, 256 x 256, or 512 x 512.

**:Mediastinum**

The area separating the two lungs, between the sternum in front and the vertebral column behind. It contains the heart and its great vessels in addition to the other structures and tissues.

**:Membrane resting potential**

The potential difference that exists across the membrane of the normal cell at rest. In myocardial cells, the membrane resting potential is -70 to -90mV.

**:Metastable state**

An unstable excited nuclear state having a finite and measurable half-life that decays to a more stable state by gamma emission without change in the atomic number; abbreviated by the letter m . Also known as an isomeric state. ( The prefix meta derives from the Greek word for "almost"). In a quantum mechanical system such as a nucleus, the only truly stable state is the ground state of the system where the total energy has its minimum value. Most excited states decay very rapidly to the ground state by radiation and internal conversion and are said to be unstable.

**:Metastasis**

The transfer of a disease from its main site to another distant part of the body. It is particularly associated with the transfer of tumor cells via the lymphatic system and blood flow from a primary site, and the subsequent formation of malignant tumors.

**:Micturition**

Urination; voiding of urine; emptying of the bladder.

**:Mitochondria**

Small organelles within the cytoplasm containing enzymes controlling oxidation; they are the site of ATP production.

**:Molybdenum-99**

The relatively long half-life parent 65h, of  $^{99m}\text{Tc}$ , used to make  $^{99}\text{Mo}$ - $^{99m}\text{Tc}$  generators.

**:Monoclonal antibody**

A specific immunoglobulin molecule which recognizes, and binds to, a single antigenic determinant ( a specific marker site on the surface of an antigen) and which can be reproduced indefinitely at will.

**:Monocyte**

White blood cell having one rounded nucleus that increases in number during certain types of infections.

**:Multichannel analyzer**

(MCA) This could refer to any type of analyzer (e.g., chemical analyzer or frequency analyzer) and the term is sometimes applied to devices used in nuclear medicine to collect the number of counts occurring at different pulse heights ( different gamma ray energies). In this latter case a graph or histogram may be plotted showing count rates resulting from different isotopes.

**:Multicrystal gamma camera**

The majority of gamma cameras are of the single crystal format, i.e., one scintillator embracing the field of view. However, some gamma cameras have been manufactured that consist of multicrystal detectors. The multicrystal system can function more favorably at high count rates and offers superior count rate performance over single crystal systems. However, the trade-off is generally poorer energy and intrinsic spatial resolution, as well as high cost.

**:Multiple-gated acquisition**

Composite study of cardiac contractility and wall motion. The blood pool is rendered radioactive; the cardiac cycle is divided into usually 16 to 32 (but can be more) equal time intervals from R to R waves, and counts from each interval are stored as they are recorded in computer frames corresponding to each interval; each R wave triggers the acquisition in a synchronized process again until sufficient data are built up in each frame to form diagnostic image. Multiple (16 to 32) images are formed, processed, and displayed in cine format. Ejection fractions from individual cardiac chambers, as well

as other indices of cardiac function, can be derived. Lung ventilation functional studies can also be acquired by synchronizing the patient's respiration movements.

**:Myelography**

This is a general term describing a radiographic procedure in which contrast material is introduced into the spinal tap in order to evaluate the spinal cord and its appendages and their relationship to the body spinal canal.

**:Myocardial infarction**

The death of an area of heart muscle due to the area being insufficiently supplied with blood because of coronary artery obstruction.

**:Myocardial ischemia**

Obstruction or constriction in the coronary arteries resulting in a deficiency of blood to the heart muscle.

**:Myocardium**

The muscular middle layer of the heart wall; often used to refer to the entire tissue mass of the heart. The myocardium is the tissue whose perfusion is actually distinguished by 201 Tl imaging.

**:Myoscintigraphy**

A radionuclide imaging technique based on radiolabeled monoclonal antibody (MAb) specific to cardiac myosin. Because the MAb binds solely to the intracellular myosin that is exposed on cell death, offering a high concentration only in necrotic cells, it is possible to localize precisely unsalvageable myocardium following an infarction.

**:Myosin**

A protein found in cardiac and skeletal muscle. It interacts with actin to form actomyosin, the constituent of muscle fiber responsible for muscle contraction and relaxation.

**:Myxedema**

A condition due to hypothyroidism and characterized by dry skin, swelling face and limbs, loss of hair, sensitivity to cold, mental dullness, and reduced metabolic rate.

**:Nadir**

The lowest point, or time of greatest depression.

**:National Bureau of Standards**

A radioactive source standardized and/or certified by the National Bureau of Standards.

**:Nebulized drugs**

Drugs administered to the patient in the form of a fine spray.

**:Necrosis**

Death of tissue as a result of loss of blood supply usually as individual cells, groups of cells, or in small localized area, generally followed by sloughing of tissue; may leave fluid-filled cavity.

:Nephron

The urine-forming unit situated in the cortex of the kidney, consisting of a filtering unit (glomerulus) and along tubule specialized in various regions to reabsorb substances from the urine that passes through it.

:Neutron

Elementary nuclear particle with a mass approximately the same as that of a hydrogen atom and electrically neutral; its mass is 1.008986 mass units. Outside a nucleus a neutron is radioactive, decaying with a half-life of about 12 min to give a proton and an electron. Neutrons are commonly divided into subclassifications according to their energies as follows; thermal around 0.025 eV; epithermal, 0.1 to 100 eV; slow, less than 100 eV; intermediated, 102 to 105 eV; fast greater than 0.1 MeV. Since it has no charge it does not ionize and therefore has no fixed range in matter. It travels in straight line until it is either scattered or absorbed by a nucleus. A neutron with very little kinetic energy can interact very strongly with a nucleus since it is not repelled electrostatically by the positive nuclear charge.

:Neutrophil

White blood cell with three to five lobes connected by chromatin and cytoplasm containing fine granules.

:Nuclear medicine

" Nuclear medicine is taken to embrace all applications of radioactive materials in diagnosis or treatment or in medical research with the exception of the use of sealed radiation sources in radiotherapy" ( World Health Organization Report Series No. 492 of 1972.) " Nuclear medicine is the clinical and laboratory medical specialty that employs for diagnosis, therapy, and research the nuclear properties of radioactive and stable nuclides to evaluate metabolic, physiologic, and pathologic conditions of the body" ( American Board of Nuclear Medicine). " Nuclear medicine is devoted to the diagnosis, treatment, research and prevention of disease by making use of unsealed radioactive sources and of the properties of stable radionuclides" ( Council of Europe and the Society of Nuclear Medicine Europe). It is clear and significant from the above definitions that they all include: radioactivity, diagnosis, therapy, and research.

:Nuclear reactor

A structure in which a self sustaining fission chain reaction can be maintained and controlled. It usually contains a fuel, coolant, moderator, and control absorbers and is most often surrounded by a concrete biological shield to absorb neutron and gamma ray emission. A nuclear reactor produces large amounts of energy as well as high neutron fluxes by nuclear fission. Radioisotopes with an excess of neutrons, and thereby exhibiting beta decay, are principally produced by reactor irradiation.

:Nuclide

The term nuclide indicates a species of atom having specified numbers of protons and neutrons in its

nucleus. Nuclides of one and the same chemical element, i.e. nuclides with the same number of protons and differing only in the number of neutrons, are known as isotopes of the element concerned. Because of this, the term is often used erroneously as a synonym for "isotope".

:Occipital

Referring to the back part of the head.

:Occupational exposure

The exposure which is incurred as the result of a person's work with radiation sources or radioactive materials.

:Osmolarity

An expression of solute concentration which takes into account the number of osmotically active particle in the solution.

:Osteoblast

Cell arising from a fibroblast that as it matures, plays a role in the production of bone.

:Osteoclast

Large multinuclear cell associated with destruction of bone.

:Osteogenesis

Formation and development of bone taking place in connective tissue or in cartilage.

:Osteoporosis

Disease of the bone, occurring chiefly in older people, characterized by loss of calcium and supporting tissues and resulting in loss of bone strength density and mass.

:Palliative treatment

Limited treatment designed in general to improve the quality of the rest of the patient's life, but not a cure, i.e., to relieve symptoms such as pain, bleeding, or cough arising from primary or secondary tumoral growth.

:Paper chromatography

When two immiscible solvents are shaken together any solute will reach equilibrium between the two phases: the ratio  $\text{conc n in A} / \text{conc n in B}$  is a constant, the partition coefficient. One phase may now be held stationary by absorbing onto an inert column material such as silica gel, or onto paper. The other phase is either allowed to run down the paper by gravity or up by capillary action. In either case the ratio of the distance traveled by the solvent front past the initial spot of material, to the distance traveled by the material is the  $R_f$  value ( relative flow value) and will be constant for the same substance under similar conditions.

:Parallel hole collimator

The parallel hole collimator is perhaps the most basic and important gamma camera collimator used

in radionuclide imaging. It is essentially a disk of lead or heavy metal alloy in which a number of parallel holes have been drilled or cast. The cross section of the holes can be square, hexagonal, or circular. Those gamma rays which enter the collimator parallel to the holes pass through and can interact with the detector, while those traveling in any other direction hit the walls and are absorbed.

:Parathyroid glands

Four small endocrine glands, on the lateral aspect of the lobes of the thyroid, that control calcium and phosphorus metabolism.

:Parent

A radionuclide that upon disintegration yields a specified nuclide, the daughter, either directly or as a late member of a radioactive series.

:Parent-daughter decay

Relationship between two radionuclides, the parent and its decay product, the daughter.

:Parenteral

A term indicating the route of drug administration other than oral. Examples are intrathecal, intravenous, interstitial, and intramuscular.

:Periosteum

The fibrous membrane that forms the investing covering of the bones except at their articular surfaces.

:Peristalsis

A progressive wavelike movement that occurs involuntarily in hollow tubes of the body, especially the alimentary canal, by which the contents are moved forward. It is characteristic of tubes contracting and relaxing longitudinally and circular layers of smooth muscle fibers.

:Peritoneum

The serous membrane reflected over the viscera and lining the abdominal cavity.

:Personal dosimeter

An integrating dosimeter that is not direct-reading and from which the dose equivalent is determined after a fixed wearing period,

:Pertechnetate

$^{99m}\text{TcO}_4^-$  The form in which generators; the technetium in the molecule may be reduced and made reactive to label a variety of other compounds.

:Phosphonates

Phosphate analogs with a P-C-P linkage replacing the P-O-P linkage; they may be labeled with  $^{99m}\text{Tc}$  and serve as bone-imaging agents.

**:Photoelectric effect**

A process by which a photon ejects an electron from an atom. All the energy of the photon is absorbed in ejecting the electron and imparting kinetic energy to it; a characteristic X-ray ( or Auger electron) is subsequently produced when the vacated shell is filled by another orbital electron.

**:Photomultiplier tube**

(PMT) Photomultiplier tubes produce electric currents which are proportional to light intensity, and can detect extremely low levels of light. An important use is in scintillation counters. In this application they detect the flashes of light occurring in a scintillation crystal due to ionizing radiation. These flashes cause the release of one or more electrons at the tube cathode and these are drawn toward the next electrode (dynode) by a high positive voltage. When these electrons strike the dynode more electrons are displaced by " secondary emission" and they are attracted to the next dynode, and so on. By the time this sequence has been repeated several times the number of electrons is large enough to be measured The construction of a photomultiplier tube is a series of curved dynodes ( sometimes called Venetian blind construction) in an evacuated glass envelope. They require a very stable high voltage supply since the output pulse height is dependent on the energy of the original radiation and on the voltage applied to the tube.

**:Photon**

A quantum of electromagnetic energy having no charge and characterized by its wavelength or frequency. Its energy content is the product of its frequency and Plank's constant, the equation from which is  $E=h\nu$ .

**:Photoppeak**

The energy of the predominant gamma spectrum released during decay of the radionuclide as measured by a scintillation detector. (99mTc=140keV)

**:Physical half-life**

( $T_{1/2}$ ,  $T_p$ ) The amount of time required for a radionuclide to reduce its radioactivity to one half of its original value.

**:Pig**

A container used to store or ship radioactive substances usually made of lead.

**:Pinhole collimator**

This collimator has a small circular aperture at the end of a conical lead shield and it projects an inverted image of the distribution of activity on the detector. The field of view in this case can be varied by changing the distance between the area to be scanned and the collimator hole. Geometric efficiency increases with increases in the area of the hole, whereas resolution decreases. As the image is a conical projection of the distribution of activity viewed, the magnification, the spatial resolution, and the geometric efficiency all vary markedly with the distance between the radiation source and the collimator.

**:Pixel**

Acronym for a picture element; the smallest discrete part of a digital image display. Digital images are composed of a grid of picture elements (pixels). Each pixel is characterized by its position in the grid and by the density or color it will display.

:Planar imaging

Imaging technique in which image of a plane is built up from signals received from the whole plane.

:Planes of the body

The median of sagittal plane passes longitudinally through the body from front to back and divides it into right and left halves: the transverse plane passes horizontally through the body at right angles to the median plane and divides the body into upper and lower portions; the coronal or frontal plane passes longitudinally through the body from side to side, at right angles to the median plane, and divides the body into front and back parts.

:Plasma

Pale-yellow fluid component of blood, containing proteins and mineral salts in which the blood cells are suspended.

:Polymorphonuclear neutrophil

A highly motile phagocyte of the granulocytic series of white blood cells characterized by fine neutrophilic cytoplasmic granules.

:Positron

A transitory nuclear particle similar to the electron, but positively charged. The rest masses of the electron and positron are equal, and their electric charges are equal in magnitude but opposite in sign.

:Positron decay

Accelerator-produced radionuclides have an excess of protons and achieve stability by the conversion of a proton to a neutron. A positron( $e^+$ ) and a neutrino  $\nu$  are emitted during the process, i.e.,  $p$  yields  $n + e^+ + \nu$ .

:Positron emission tomography

(PET) a noninvasive, investigation procedure used in clinical research for the study of regional tissue physiology and biochemistry and pharmacology. It is based on the in vivo detection and imaging of positron-emitting radioisotopes that are introduced as tracer elements into the physiological systems of interest. A positron is a positively charged but otherwise "beta-like" particle which travels, in tissue, no more than a few millimeters from its source atomic nucleus. Within this distance it is captured by an electron, whereupon both particles are annihilated. Two photons, each of 511 KeV energy, are emitted which leave the point of capture in approximately opposite directions. It is these simultaneously emitted gamma rays that make PET feasible, the gamma radiation being detected outside the body by suitably mounted radioactivity counter.

:Potentiometer

A variable resistor for control of current or voltage.

:Preload

A term describing the initial stretch of the left ventricle just prior to contraction. Normally, the ventricle can increase its stroke volume by increasing its preload over a moderate range ( this is the ascending limb of the Frank-Starling mechanism, in which the heart output per beat is related to the diastolic filling pressure).

:Prinzmetal angina

In 1947 Prinzmetal described for the first time a type of pain which occurs mostly during the night, is unrelated to effort, lasts longer than the typical anginal attack, and produces ST segment elevations in the electrocardiogram. The findings made today through coronary angiography suggest that this type of pain is due to a reversible coronary vasospasm which is usually caused by a preexisting atheromatosis of the coronaries but which occasionally occurs also when the coronary vessels are anatomically normal.

:Proptosis

Forward displacement of any organ. (Patients with hyperthyroidism may exhibit proptosis of the eyes)

:Protective clothing

Worn by personnel handling radioactive material for two reasons: (1) to protect the wearer, and (2) to prevent the spread of radioactive contamination.

:Ptosis

A drooping or falling down of a part or organ, such as the eyelid, the kidney, stomach, and intestine.

:Pulmonary embolism

Obstruction of one or more of the pulmonary arteries, usually caused by fragments of a thrombus from a leg vein. Pulmonary embolism is a common complication of long confinement to bed, abdominopelvic surgery, diabetes, obesity, hypertension, cigarette smoking.

:Pulse height analyzer

The amplitudes of pulses from a scintillation detector used in nuclear medicine vary according to the energy of the incident rays. A pulse height analyzer is an electronic device employed to identify and select those pulses falling between two preset amplitude levels which may relate only to the product of a single isotope photopeak and rejects pulses due to scattered radiation above and below the photopeak; the range of energies which are accepted constitutes the window of the analyzer or discriminator. A number of pulse height analyzers may be operated in parallel and the results collected by a multichannel analyzer show count rates from a number of isotopes simultaneously.

:Pyrogen

The metabolic product of bacteria yeasts, and fungi and can therefore be present as a result of actual, recent, or past microbiological contamination. Sterility is not an indication of freedom from pyrogen.

When given an injection, pyrogens is achieved by using pyrogen-free container, sterile materials, and aseptic procedures throughout the production process.

:Quality assurance

The term "quality assurance" refers to all of those aspects ( including administrative techniques and training) of a diagnostic program that contribute directly or indirectly to the quality of the imaging procedure in any of its final or user-oriented forms.

:Quality control

The set of operations ( programming coordinating, carrying out) intended to maintain or to improve quality. As applied to a diagnostic procedure, it covers monitoring evaluation, and maintenance at optimum levels.

:Quality factor

(Q) In radiation, a dimensionless variable weighting factor to be applied to the absorbed dose to provide an estimate of the relative human hazard of different types and energies of ionizing radiations. Values of Q are selected from experimental values of the relative biological effectiveness (RBE), which is the ratio of X or gamma -ray dose to that of the radiation in question giving the same kind and degree of biological effect.

:Radiation

The emission and propagation of energy through a material medium in the form of waves; for instance, the emission and propagation of electromagnetic waves, or of sound and elastic waves. Briefly, the term radiation refers to " Energy in transit". In nuclear medicine, two specific forms of radiation are of interest: (1) particulate radiation, consisting of atomic or subatomic particles ( electrons, protons, etc.) which carry energy in the form of kinetic energy of mass in motion; and (2) electromagnetic radiation , in which energy is carried by oscillating electrical magnetic fields traveling through space at the speed of light.

:Radiation safety

Methods of protecting workers and the general population from the deleterious effects of radiation.

:Radioactive

Possessing or pertaining to radioactivity. The term " radio" is used as an abbreviation of radioactive.

:Radioactive contamination

The deposition of radioactive material in any place where it is not desired, and (particularly) in any place where its presence can be harmful.

:Radioactive decay

This is the spontaneous transformation with a measurable half-life of a nuclide into one or more different nuclides. The process involves the emission from the nucleus of alpha particles, electron, positrons, gamma rays or the nuclear capture or ejection of orbital electrons or fission

**:Radioactive iodine uptake**

A thyroid function test based on the gland's ability to take up an administered tracer dose of iodine as I-131 or I-123.

**:Radioaerosol**

Radioactive compound nebulized into an aerosol for inhalation.

**:Radiobiology**

That branch of biology which deals with the effects of ionizing upon biological material. Research in this field is usually relevant to two important practical issues, the improved use of radiation in the treatment of cancer, and the safeguarding of the health of the community from the hazards that may arise from the increasing use of radiation and radioactive materials.

**:Radiochemical purity**

Radiochemical purity of a radiopharmaceutical has been defined as the fraction of the stated radionuclide present in the stated chemical form. The diagnostic value of the radiopharmaceutical depends on the differences in their kinetic and metabolic behavior in normal and diseased conditions: the radiochemical impurities in the compound, either present in the beginning significantly with the results. Diverse methods have been used for the detection and estimation of impurities; the most commonly used procedure is based on chromatography and gel filtration techniques.

**:Radiochromatography**

Chromatography using a NaI crystal for detection of substances labeled with a radioisotope.

**:Radiography**

The process of generating shadow images on photographic emulsion by the action of ionizing radiation. The image is the result of the differential attenuation of the radiation in its passage through the object being radiographed.

**:Radioimmunoassay**

(RIA) An assay using competition between a radiolabeled antigen and the same antigen in the serum for antibody binding sites; during equilibrium, the more unlabeled serum antigen present, the less radiolabeled antigen will be bound to the antibody; the serum level is measured by determining the bound/free ratio it produces compared with known standards in the same system.

**:Radioisotope**

Synonym for radioactive isotope. Any isotope which is unstable, thus undergoing decay with the emission of a characteristic radiation.

**:Radionuclide**

A nuclide of artificial or natural origin that exhibits radioactivity. For example,  $^{131}\text{I}$  is a radionuclide, whereas  $^{127}\text{I}$  is a stable nuclide. Radionuclides are radioactive nuclides.

**:Radionuclide purity**

Radionuclide purity is defined as the percentage of the total radioactivity present as the stated radionuclide. This is not a constant value, but will depend on the relative half-lives of the stated nuclide and any contaminant nuclides. Contaminants with longer half-lives than the stated nuclides are potentially more hazardous because they will increase the radiation dose to the patient. They must therefore be reduced to an acceptable level at the time of production. Contaminants with a shorter half-life than the stated nuclide are less of a problem because storage will reduce the contaminant to a level acceptable for clinical use.

:Radiopharmaceutical

A sterile, pyrogen-free radionuclide or radioactively tagged compound administered to a patient for diagnostic or therapeutic purposes. A radiopharmaceutical has no pharmacological effect because of the small amount of material administered.

:Radiopharmacy

Laboratory preparation and dispensing of solutions labeled with radioisotopes for therapeutic and diagnostic purposes.

:Radioresistance

Relative resistance of cells, tissues, organs, or organisms to the injurious action of radiation. The opposite of radiosensitivity. The term may also be applied to chemical compounds or to any substance.

:Radiosensitivity

The relative susceptibility of cells, tissues, organs, organisms, and any substances to the injurious action of ionizing radiation. Radioresistance and radiosensitivity are usually employed in a comparative sense, rather than in an absolute one.

:Radium

Element symbol Ra, atomic number 88, atomic weight 226.025.

:Radon

Element symbol Rn, atomic number 86, atomic weight ~222.

:Receptor

A chemical compound on a cell membrane or in a cell that binds other chemicals, e.g. hormones: neurotransmitter anatomical structures that respond to stimuli such as heat, touch pressure pain.

:Reconstruction image

An image representing a two-dimensional slice of a structure, reconstructed from data obtained via any of the tomographic techniques.

:Reference source

A radioactive source used as a reference for setting up assay equipment.

**:Region of interest**

(RIO) Outlined area on a computer-processed image, defined automatically or manually with a joystick or light pen to obtain the accepted events in that area. Time-activity curves result when the ROI is sequentially measured in multiple images of a study.

**:Relative biological effectiveness**

(RBE) An expression of the effectiveness of absorbed doses of different types of radiation, e.g., X-rays, neutrons, alpha particles. In general, the RBE may vary with the kind and degree of biologic effect considered, the duration of the exposure, and other factors.

**:Relaxation**

A process by which atoms or molecules in an excited state return to their ground state ( or lower energy state).

**:Reliability**

The extent to which a system yields the same results on repeated trials.

**:Renal clearance**

The rate of removal by the kidneys of a substance from the plasma per unit of concentration of the substance.

**:Renin**

An enzyme-like substance secreted by the kidney.

**:Renogram**

Plot of radioactivity measured by an external detector vs. time as a radiotracer transits through the kidneys;

**:Repolarization**

The return of the cell membrane potential to the negative resting potential following depolarization; recharging of myocardial cells so they may again respond to stimulation.

**:Resection**

Excision or removal of a portion of an organ or structure.

**:Resolution**

Ability of a detection system to separate, or discriminate, quantities very close to each other. Example: a gamma-ray spectrometer separating energy levels (lines); an optical system or radioisotope imaging system distinguishing between a single source and two neighboring sources. Resolution is a measure of how much detail a graphics device can print or display.

**:Restricted area**

Place in which there is a possibility of radiation or contamination at a level exceeding that which is permissible for exposure of the general public.

**:Reticuloendothelial system**

A mononuclear phagocytic system located primarily in the reticular connective tissue framework of the spleen, liver, and lymphoid tissues.

**:Rhenium**

Element symbol Re, atomic number 75, atomic weight 186.2.

**:Roentgen**

(R) A non-SI unit of radiation exposure. Defined as that quantity of X or gamma radiation such that the associated corpuscular emission per 0.001293 g of air produces in air ions carrying 1 ESU of quantity of electricity of either sign. For a wide range of radiation energies, 1 R will result in an absorbed dose in soft tissue of approximately 1 rad. The roentgen is equivalent to  $2.58 \times 10^{-4}$  C/kg air.

**:Roentgen equivalent man**

(REM) Non-SI unit of dose equivalent. The dose in rads multiplied by appropriate modifying factors aimed at expressing different types of radiation and different distributions to absorbed dose on a common scale related to the possible long-term radiation risks. For many radiations, including X-, gamma, and beta radiation, and for most dose distributions, the modifying factor is unity and rems and rads are numerically equal. 1 rem = 0.01 sievert (Sv).

**:Roentgen ray**

Electromagnetic radiation produced when a beam of high-speed electrons collides with a solid metal target, as in an X-rays and bremsstrahlung. Synonym for X-ray.

**:Roentgenography**

Radiography by means of X-rays.

**:Roentgenology**

That part of radiology which pertains to X-rays.

**:Rubidium**

Element symbol Rb, atomic number 37, atomic weight 85.4678.

**:Sagittal**

Plane or section parallel to the long axis of the body, arrowlike shape; in an anteroposterior direction.

**:Samarium**

Element symbol Sm, atomic number 62, atomic weight 150.36.

**:Scan**

Term originally referring to images made of radionuclide distribution obtained with a moving detector that scanned the area of interest by moving back and forth over the area(Scanning) in a

pattern like mowing a lawn; now refers in general to represent any type of imaging procedure in which anatomic or physiologic information is determined by the use of X-ray or gamma photons, ultrasound, or magnetic fields.

:Schilling test

Test for measuring the gastrointestinal absorption of vitamin B12 done by administering radiolabeled vitamin B12, giving a loading dose of nonradioactive vitamin B12, then measuring the radioactivity in a 24-h urine collection, if the test is done with concomitant administration of intrinsic factor, it is called a second-stage Schilling test and is used to distinguish malabsorption attributable to intrinsic factor deficit from other causes.

:Scintigram

An image of the distribution of activity obtained with a scintillation camera following the internal administration of a radionuclide.

:Scintigraphy

The process of obtaining an image or series of sequential images of the distribution of a radionuclide in tissues, organs, or body systems using a scintillation gamma camera, i.e., hepatic scintigraphy. Also known as a radionuclide scintigraphy.

:Scintillation

Name given to the production of light flashes emitted by luminescent substances when excited by high-energy radiation. The flashes can in turn liberate photoelectrons from photosensitive substances (for instance, cesium/antimony phosphors or some type of inorganic salt crystal such as NaI) (TI activated); the photoelectrons are amplified by means of a photomultiplier tube before being converted into current pulses. The pulse height depends on the energy of the original gamma or corpuscular radiation, and the pulses can thus be sorted by means of a discriminator (pulse height analyzer). By using different discriminator channels the different nuclide in a mixture of isotopes can be determined either successively or simultaneously.

:Scintillation crystal

A crystalline solid, such as sodium iodide containing trace amounts of thallium activator Na(Tl), which emits light scintillation when it absorbs ionizing radiation; essentially transforms invisible electromagnetic radiation or particles into visible photons.

:Sealed source

A radioactive source sealed in a container or having a bonded cover, where the container or cover has sufficient mechanical strength to prevent contact with and dispersion of the radioactive material under the conditions of use and wear for which it was designed.

:Sensitivity

In diagnostic tests, the number of test results registered as true positives in relation to the actual number of positives in the group tested. The minimum signal that can be detected satisfactorily. Measure of the NMR signal strength obtained from a number of nuclei of a particular isotope relative

to that from an equal number of H nuclei. The lowest concentration of test substance measurable in an assay, or the minimal distinguishable by a given assay, usually a function of the steepness of the assay curve.

:Sequential imaging

A series of closely timed images, usually performed on a rapidly changing distribution of radioactivity.

:Sequestration

A process of separation of cells, such as removal of aged red blood cells by the spleen.

:Serial

Consecutive , one-by-one processing

:Shunt

A diversion or bypass of blood or cerebrospinal fluid from its normal path. May be caused by congenital defects, pathological processes, or surgical procedures.

:Shunt study

Study using a radionuclide to detect abnormal shunting of blood in the cardiopulmonary circulation, either from the left (systemic) side of the circulation to the right (pulmonary ) side of the circulation or from right to left; also refers to study of a shunt Placed surgically in order to divert body fluids (for example, a ventriculoperitoneal cerebrospinal fluid shunt).

:Sievert

(Sv) the SI unit of dose equivalent (J/kg). the absorbed dose in grays multiplied by the quality factor of the type of radiation. One Sievert equals 100 rem.

:Simple diffusion

The process by which radioactive material enters a cell membrane that has lost its integrity because of a disease process. Brain scanning presumably makes use of breakdowns in the blood-brain barrier.

:Single photon emission computerized tomography

(SPECT) Technique that uses a computer for tomographic reconstruction (in a variety of planes, transaxial, coronal, sagittal) of the distribution of a single photon gamma emitting radionuclide detected by a rotating scintillation camera.

:Single-channel pulse height analyzer

A pulse height selector is an electronic circuit which permits only those voltage pulses which have amplitudes between predetermined levels to be passed to the succeeding circuits. The difference between these two levels is referred to as the window or channel width. The lower reference level is called the threshold. A single-channel pulse height analyzer is an instrument incorporating a pulse height selector in which the channel width is preset and the threshold varied , either manually or automatically, to scan the amplitude spectrum of the incoming pulses.

**:Sodium-potassium pump**

The mechanism of active transport by which sodium is extruded from the interior of cells in order to maintain the normal higher extracellular concentration of sodium and higher intracellular concentration of potassium.

**:Spatial resolution**

Spatial resolution refers to the ability of an instrument to image two separate line or point sources of radioactivity as separate entities. The smaller the distance between the two sources that can be imagined, the better the spatial resolution.

**:Specific activity**

the activity per unit mass of an element or compound containing a radioactive nuclide. The SI unit of specific activity is the becquerel per kilogram (Bq kg<sup>-1</sup>) or becquerel per mole (Bq mol<sup>-1</sup>). the non-SI unit is the curie per kilogram, mole (Ci kg<sup>-1</sup>) Ci mol<sup>-1</sup>).

**:Specificity**

in diagnostic tests, the number of true-negative detections divided by the total number of negatives in the group tested. Ability of a substance to recognize and bind to only one other molecule.

**:Splanchnic**

Pertaining to the interior organs in any of the four great body cavities.

**:Stable isotope**

An isotope of an atom incapable of spontaneous disintegration; hence, not radioactive.

**:Stannous ion**

Ion of tin in the +2 valence state.

**:Stasis**

A slowing down or stopping, usually applied to blood lymph, cerebrospinal fluid, or urine flow.

**:Stenosis**

The constriction or narrowing of a canal or orifice usually as a result of a disease process.

**:Stress test**

Measurement of cardiac reserve, heart rate, blood pressure, EKG, oxygen consumption during strenuous exercises or myocardial perfusion usually measured with the subject being stressed on a treadmill or pharmacologic stress.

**:Stroke volume**

Amount of blood pumped during each heartbeat (diastolic volume of the ventricle minus the volume of blood in the ventricle at the end of systole).

**:Strontium**

Element symbol Sr, atomic number 38, atomic weight 87-62.

**:Supernatant**

Liquid lying above or floating on a precipitated material.

**:Supine**

Lying on back with face upward.

**:Survey meter**

A battery-powered portable device containing a gas ionization chamber for monitoring radiation levels.

**:Systemic**

Pertaining to or affecting the body as a whole.

**:Systemic vascular resistance**

An index of arteriolar constriction throughout the body. It is obtained by dividing the blood pressure by the cardiac output.

**:Systole**

The stage of the cardiac cycle at which contraction of a cardiac chamber occurs and blood is expelled. In the cardiac cycle, atrial systole precedes ventricular systole.

**:Systolic blood pressure**

The pressure of blood in the arteries during systole. The average systolic pressure in the brachial artery of a young adult is 110 to 130 mm Hg.

**:Tachycardia**

Rapid heart rate; usually applied to rates over 100 beats per minute.

**:Tachypnea**

Very rapid breathing.

**:Target heart rate**

Generally, that heart rate which defines activity intense enough to produce a training effect. Specifically, between 70 and 85% of the age-corrected maximum expected heart rate. (220-age in years.)

**:Technetium**

Element symbol Tc, atomic number 43, atomic weight 98.

**:Technetium-99m**

(99m Tc) Metastable form of technetium widely used as a label in nuclear medicine. Decays with a 6-

h half-life with emission of a monoenergetic 140-keV gamma ray.

:Thallium

Element symbol Tl, atomic number 81. Tl-201 is commonly used for cardiac perfusion imaging.

:Thermoluminescence

Luminescence produced in certain substances by heating. Many minerals show the effect: fluorite and quartz are examples. The effect is often shown more strongly after excitation by nuclear radiation.

:thermoluminescent detector

(TLD) Type of crystal used to monitor radiation exposure by emitting light; used in a film badge, or ring badge.

:Thin window

Part of a wall of a radiation detector is often made especially thin to enable weakly penetrating particles to get inside and be counted, e.g. for alpha and beta particles.

:Thrombosis

The formation of a blood clot in a blood vessel or cavity of the heart.

:Thyroid gland

An endocrine gland lying in front of the trachea. It secretes the thyroid hormones that control the rate of metabolism, growth, and development.

:Thyroid uptake study

(RAIU, radioactive iodine uptake) Measurement of percentage of administered radioiodine (<sup>131</sup>I, <sup>123</sup>I) taken up in the thyroid gland at a particular time interval.

:Thyroid-stimulating hormone

(TSH, thyrotropin, thyrotropic hormone) A hormone released by the anterior pituitary under thyroid hormone servomechanism which stimulates thyroid activity and elevates the level of circulating thyroid hormones. The concentration of TSH, expressed as microunits/milliliter is determined by a radioimmunoassay. Used in differentiating pituitary or hypothalamus-related hypothyroid states from a primary deficiency in thyroid gland secretion.

:Thyrotropin-releasing hormone

(TRH) A neurohumoral factor from the hypothalamus which helps regulate the release of thyroid-stimulating hormone (TSH) from the anterior pituitary.

:Thyroxine

(3,5,3',5'-L-tetraiodothyronine, T<sub>4</sub>, or levothyroxine) The more abundant of the two natural thyroid hormones. It differs from T<sub>3</sub> by having an iodine atom in the 5'-position.

**:Thyroxine-binding globulin**

(TBG) A serum protein which is the major binding protein of thyroxine (T-4). It also binds triiodothyronine (T-3). TBG is an interalphaglobulin, being the primary agent for transport of thyroid hormone.

**:Time-activity curve**

A histogram of the change in the count rate as a function of time.

**:Tin**

Element symbol Sn (stannum), atomic number 50, atomic weight 118.71.

**:Tomography**

The term that describes all types of body section techniques, since all these are bound by the same principles, that is a visual representation restricted to a specified section or "cut" of tissue within an organ or part of the body produced by an X-ray (transmission), photon (emission), or magnetic field technique. Computer processing of the data may or may not be employed in order to assist in generating the image. The term tomography is now so universally used and established that it has been chosen, although planigraphy and stratigraphy have priority, chronologically and historically.

**:Total-body dose**

Average radiation dose to the entire body obtained by averaging the dose to different tissues and organs.

**:Transition metals**

The metallic elements in the center of the periodic chart.

**:Transmission**

A general term used to apply to the movement of X-rays from the X-ray producing machine through body tissues and onto a recording medium.

**:Triiodothyronine**

(3,5,3',-L - triiodothyronine, T3, or liothyronine) The more calorigenically potent of the two major natural thyroid hormones. It is synthesized and secreted in part by the thyroid gland, and is also derived in part from tissue deiodination of T4 (thyroxine).

**:Tritium**

( $^3\text{H}$  or  $^3\text{T}$ ) the isotope of hydrogen of mass 3 (consisting of one proton and two neutrons). It is very rare, naturally radioactive, but can be made by neutron absorption in lithium and in deuterium or heavy water, and is present in fallout. Exhibiting beta decay, with a half-life of 12.3 years.

**:Tumor-associated antigen**

(TAA) cell surface antigens that are expressed on malignant but not normal cells.

**:Uniformity**

Uniformity refers to the ability of a scintigraphic instrument to reproduce with fidelity an image of a uniformly distributed radioactive source. When registered photographically, deviations from uniform count density across the field of view of less than 10% should generally not be discernible.

:United States Pharmacopeia  
(USP) Official listing of all drugs and medications.

:Valence  
Number representing the combining or displacing power of an atom; number of electrons lost, gained, or shared by an atom in a compound; numbers of hydrogen atoms with which an atom will combine, or which it will displace.

:Vasoconstriction  
Narrowing of the lumen of blood vessels, especially as a result of vasomotor action.

:Vasodilation  
Dilation or opening of blood vessel by vasomotor action.

:Venipuncture  
Placement of a needle within a vein.

:Venogram  
Radionuclide delineation of a portion of the venous system after downstream injection of an appropriate radiopharmaceutical. Radiography of the veins using a contrast medium; phlebography.

:WebCT  
 A tool for the creation of web-based learning environments.

:Well counter  
This is a special type of scintillation counter in which the scintillation crystal is shaped in the form of a well to receive a small vial containing the sample whose radioactivity is to be counted. The crystal must be covered in a thin aluminum can to exclude light, and so it is only suitable for counting relatively high radiation energy (greater than 20 keV of gamma rays). It is used in an autogamma counter in conjunction with an automatic sample changer.

:White blood cell  
(WBC) Type of blood cell (leukocyte) whose nucleus determines the type of cell; lymphocyte, monocyte, neutrophil, eosinophil, basophil.

:White blood cell study  
Procedure using Tc99m Exametzyme or 111 In oxine-labeled polymorphonuclear leukocytes to track their accumulation and thereby identify sites of pyogenic infection.

:Wipe test

Testing for removable contamination.

:X-rays

Penetrating electromagnetic radiation of wavelength shorter than those of visible light (less than  $10^{-7}$  cm). They were also called Roentgen rays, being first observed by Roentgen in Wurzburg in 1895. Because of their penetrating nature, X-rays have been used for many years in medical diagnosis (radiology). The transparency of various materials to X-rays depends strongly on their atomic number and density: thus bone and other regions of high density or atomic number are readily observed through the relatively transparent flesh.

:Xenon

Element symbol Xe, atomic number 54, atomic weight 131.29.

:Yttrium

Element symbol Y, atomic number 39, atomic weight 88.905

:Zipper effect

Overlap of two or more images.