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भाग 6 नाभिकीय औषधि

**Nuclear Energy, Nuclear
Technologies, and Radiological
Protection — Vocabulary
Part 6 Nuclear Medicine**

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NATIONAL FOREWORD

This Indian Standard (Part 6) which is identical with ISO 12749-6 : 2020 'Nuclear energy, nuclear technologies, and radiological protection — Vocabulary — Part 6: Nuclear medicine' issued by the International Organization for Standardization (ISO) was adopted by the Bureau of Indian Standards on the recommendation of the Nuclear Energy for Peaceful Applications Sectional Committee and approval of the Chemical Division Council.

This part of IS 16902 provides terms and definitions for nuclear medicine, the medical discipline whereby radionuclides as unsealed sources are administered to patients, in order to carry out diagnostic exams, therapeutic treatments for various pathologies and to monitor the evolution of the disease.

This Indian Standard is published in several parts. The other parts in this series are:

Part 1 General terminology

Part 2 Radiological protection

Part 3 Nuclear fuel cycle

Part 4 Dosimetry for radiation processing

Part 5 Nuclear reactors

The text of ISO Standard has been approved as suitable for publication as an Indian Standard without deviations. Certain conventions and terminologies are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

- a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'; and
- b) Comma (,) has been used as a decimal marker in the International Standard, while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

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Introduction

This document provides terms and definitions for nuclear medicine, the medical discipline whereby radionuclides as unsealed sources are administered to patients, in order to carry out diagnostic exams, therapeutic treatments for various pathologies and to monitor the evolution of the disease.

This multidisciplinary activity is fundamentally made up of medical, radiopharmaceutical and medical physics components, although it also relies on nuclear science, biology, biochemistry, radiochemistry, nuclear chemistry, electronics, electro-mechanics, computing, metrology of ionizing radiation and dosimetry. It involves tasks relating to support, research and development as well as staff training, which are all carried out intensively in this field.

The specific areas of most relevance to nuclear medicine are oncology, cardiology, endocrinology and neurology. However, its reaches practically every medical specialty.

The professional and technical staff who work in nuclear medicine are highly specialized, carrying out their activities in highly complex facilities, using a large range of equipment, within a strict healthcare and radiological regulatory setting.

These activities produce a large amount of documentation such as reports, publications, legal documents and teaching texts, all of which require the use of precise, coherent and unambiguous terms and definitions. Therefore, it becomes essential to harmonize the terminology used by all of the above-mentioned sectors and professions.

Conceptual arrangement of terms and definitions is based on concepts systems that show corresponding relationships among nuclear medicine concepts. Such arrangement provides users with a structured view of the nuclear medicine sector and will facilitate common understanding of all related concepts, see also [Annex A](#). Besides, concept systems and conceptual arrangement of terminological data will be helpful to any kind of user because it will promote clear, accurate and useful communication.

Indian Standard

NUCLEAR ENERGY, NUCLEAR TECHNOLOGIES,
AND RADIOLOGICAL PROTECTION — VOCABULARY
PART 6 NUCLEAR MEDICINE

1 Scope

This document contains the terms, definitions, notes to entry and examples corresponding to the frequently used concepts which apply to diagnostic and therapeutic nuclear medicine.

It comprises the minimum essential information for each nuclear medicine concept represented by a single term. It provides the reader with the information required to approach this multidisciplinary speciality, such as medical, radiopharmacy and medical physics point of view. It is intended to facilitate communication and promote common understanding.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1 Basic terms related to nuclear medicine

3.1.1

nuclear medicine

field of medicine in which unsealed radioactive sources, namely *radiopharmaceuticals* (3.4.3), are used for diagnosis or therapy

3.1.1.1

diagnostic nuclear medicine

scientific and clinical discipline in which radiopharmaceuticals, administered by different routes, are used for diagnostic purposes

Note 1 to entry: Diagnostic nuclear medicine is mainly carried out through imaging but may also be measurements of the global or regional function of an organ.

Note 2 to entry: Diagnostic nuclear medicine also includes quantitative imaging and patient monitoring for the follow-up of both the disease progression and the treatment response.

3.1.1.2

therapeutic nuclear medicine

scientific and clinical discipline in which radiopharmaceuticals are administered for therapeutic purposes

3.1.2

theranostics

theragnostics

treatment strategy based on personalized medicine, which allows selecting the most appropriate therapy according to the diagnostic images

Note 1 to entry: In nuclear medicine, the specific targeted diagnostic test and therapy can be made sequentially with the same radiolabelled molecule (i.e. radiopharmaceutical) or with the same molecule and different label radionuclides or with different molecules with similar physiological properties.

EXAMPLE Personalized treatment of a patient with a positive somatostatin receptor image (neuroendocrine tumour) by a radiopharmaceutical composed of somatostatin analogs peptide labelled with an emitter suitable for molecular radiotherapy.

3.1.3

radiopharmacy

branch of pharmacy, that deals with the preparation, characterization and quality of radioactive drugs in nuclear medicine procedures

EXAMPLE The final stage or the preparation of the pharmaceutical and/or activity dispensing is carried out from commercial products in a hospital radiopharmacy or in centralized radiopharmacies and then delivered to a hospital radiopharmacy.

3.1.4

administered activity

activity (in MBq) of radiopharmaceutical that has been administered to the patient for diagnostic or therapeutic purposes

3.1.5

uptake

accumulation of administered activity to a particular organ or tissue at a particular time after administration

[SOURCE: NATIONAL COUNCIL ON RADIATION PROTECTION AND MEASUREMENTS. NCRP Composite Glossary. NCRP, Bethesda, 2011]

3.2 Terms related to diagnostic nuclear medicine

3.2.1

diagnostic nuclear medicine

(See [3.1.1.1](#))

3.2.2

nuclear medicine imaging

imaging performed after administration of a radiopharmaceutical

Note 1 to entry: Imaging is considered a non-invasive diagnostic technique, as opposed to a biopsy or exploratory surgery.

Note 2 to entry: PET and SPECT are the main type of nuclear medicine imaging, providing information about how certain tissues and organs are functioning. It is complementary to anatomical imaging, such as X-ray imaging.

3.2.3

molecular imaging

MI

imaging allowing the visualization, characterization, and measurement of biological processes at the molecular and cellular levels in humans and other living systems

Note 1 to entry: *Nuclear medicine imaging* ([3.2.2](#)) is one of the modalities of molecular imaging.

[SOURCE: Mankoff DA. A definition of molecular imaging. J. Nucl. Med. 2007 Jun;48(6):18N, 21N, modified.]

3.2.4

quantitative imaging

extraction and use of numerical/statistical features from medical images

Note 1 to entry: The chief method used in quantitative imaging is to delineate a region of interest on the image and determine the mean uptake in this region, but many other features can be extracted.

[SOURCE: Abramson RG, Burton KR, Yu JP, et al. Methods and challenges in quantitative imaging biomarker development. Academic Radiology 2015 Jan, 22(1):25-32].

3.2.5

diagnostic reference level

DRL

level used in medical imaging to indicate whether, in routine conditions, the activity of a radiopharmaceutical administered in a specified radiological procedure is unusually high or unusually low for that procedure

Note 1 to entry: In diagnostic nuclear medicine, DRL is a level of activity for typical examinations for groups of standardized patients.

[SOURCE: IAEA SAFETY STANDARDS SERIES No. GSR Part 3 (2014), modified.]

3.2.6

standard uptake value

SUV

value equal to the ratio of the image derived radioactivity concentration (in kBq/ml) to the whole body concentration (in kBq/kg)

Note 1 to entry: Mainly used in PET imaging, but also in SPECT imaging.

Note 2 to entry: There are other definitions of the SUV when substituting the body weight with the lean body weight or the body surface area. In addition, from a region of interest, several SUV values can be extracted (such as the maximum, the mean SUV-value, etc.).

3.3 Terms related to therapeutic nuclear medicine

3.3.1

therapeutic nuclear medicine

(See [3.1.1.2](#))

3.3.2

radiotherapy

radiation therapy

therapy that uses ionizing radiation to kill cells and shrink pathological tissues

Note 1 to entry: Radiation may be delivered by a machine outside the body (external-beam radiation therapy), or it may come from radioactive material placed in the body near cancer cells (brachytherapy) or from radiopharmaceutical administered to the patient (molecular radiotherapy).

3.3.3

molecular radiotherapy

radiation therapy that uses a radiopharmaceutical to kill pathological cells and tissues by the effect of ionizing radiation

3.3.3.1

metabolic radiotherapy

molecular radiotherapy using selective irradiation of a target zone by a radiopharmaceutical administered to the patient and that participates in the metabolism of tumour cells

EXAMPLE The most widely used form of molecular radiotherapy is for the treatment of thyroid pathologies (thyroid cancer and hyperthyroidism). Called radioiodine therapy, this treatment consists of an oral administration of iodine-131, which will primarily concentrate in the thyroid to kill diseased cells.

3.3.3.2

radioimmunotherapy

RIT

molecular radiotherapy based on a personalized cancer treatment that combines radiation therapy with the precise targeting ability of immunotherapy

Note 1 to entry: In immunotherapy, scientists create monoclonal antibodies in a laboratory that mimic cellular activity in the body's immune system and are designed to recognize and bind to the antigen of a specific cancer cell.

Note 2 to entry: In RIT, the monoclonal antibody is paired with a radioactive material. When injected into the patient's bloodstream, the antibody travels to and binds to the cancer cells, allowing a high dose of radiation to be delivered to the tumour.

Note 3 to entry: The antibodies are designed to attach only very specific types of cells, consequently, radioimmunotherapy maximizes the radiation that can be delivered to the diseased tissue and minimizes the amount of radiation to which healthy tissue is exposed.

[SOURCE: Glossary of Molecular Imaging Terms, web SNMMI, 2017, modified.]

3.3.3.3

peptide receptor radionuclide therapy

molecular radiotherapy that is targeted towards peptide receptors

Note 1 to entry: The peptide receptor radionuclide therapy is used to overexpress peptide receptors in the treatment of neuroendocrine tumours.

3.3.4

selective internal radiotherapy

SIRT

radioembolization

cancer treatment that uses radioactive glass or resin beads, called microspheres, which are injected in the tumour blood supply

Note 1 to entry: The selective internal radiation therapy is mainly used for treatment of liver tumours.

3.4 Terms related to radiopharmacy

3.4.1

radiopharmacy

(See [3.1.2](#))

3.4.2

tracer

chemical compound used to trace the course of a biological process

3.4.2.1

radiotracer

tracer labelled by a radionuclide

3.4.3

radiopharmaceutical

radioactive drug used for diagnostic or therapeutic purposes

Note 1 to entry: The radiopharmaceutical has two components: a radioactive part (radionuclide) that defines the physical parameters such as physical half-life and type of radiation for the medical procedure, and non-radioactive part (tracer, chemical and/or biological part) that defines the biological parameters such as biological half-life and specificity.

3.4.4

radiochemical purity

percentage of activity of a radionuclide in the specified chemical form in relation to the total activity of the sample

3.4.5

radionuclide purity

quantity of desired radionuclide in relation to unwanted (impurity) radionuclides, typically expressed as a percentage purity or percentage impurity content

Note 1 to entry: Suppliers may state 'minimum' purity values rather than measured values.

3.4.6

compounding

formulation of radiopharmaceutical reagent kits from raw ingredients for the preparation of radiopharmaceuticals by the addition of radionuclides, adding reagents to commercial kits to modify or enhance the performance of radiopharmaceuticals, shelf life extension, fractionation, and/or synthesis from raw materials

3.4.7

radiopharmaceutical reagent kit

sterile and pyrogen-free reaction vial(s) containing non-radioactive starting material that is required to compound or produce a specific radiopharmaceutical

3.4.8

radionuclide generator

device that is based on the principle of the decay-growth relationship to produce a short-lived radionuclide product from its long-lived parent

Note 1 to entry: A long-lived parent nuclide is needed to decay to its short-lived daughter nuclide and the latter is then chemically separated.

Note 2 to entry: The most frequently used radionuclide ^{99m}Tc to form a radiopharmaceuticals produced in a Technetium 99m generator from parent nuclide ^{99}Mo .

3.5 Terms related to medical equipment

3.5.1

medical equipment

device that is used to aid in the diagnosis of patients

3.5.1.1

imaging device

device used to produce detailed images of the inside of the body for diagnostic or therapeutic purposes

Note 1 to entry: In nuclear medicine imaging, examples of these devices include the gamma camera and PET scanner.

[SOURCE: Glossary of Molecular Imaging Terms, web SNMMI, 2017, modified.]

3.5.1.1.1

gamma camera

imaging device used in diagnostic nuclear medicine, which is capable of detecting the gamma radiation from photon emitters

Note 1 to entry: The gamma camera creates two-dimensional pictures of the inside of the body from different angles. If it is a SPECT camera it can also produce 3D images.

EXAMPLE Mapping the 2D or 3D distribution of the radiopharmaceutical administered to the patient.

3.5.1.1.1.1

single photon emission computed tomography scanner

SPECT scanner

specialized gamma camera used in diagnostic nuclear medicine, which is capable of mapping the 3D distribution of the radiopharmaceutical administered to the patient

3.5.1.1.1.1

SPECT-CT scanner

hybrid imaging device combining single photon emission computed tomography (SPECT) and X-ray computed tomography (CT)

3.5.1.1.2

positron emission tomography scanner

PET scanner

imaging device used in diagnostic nuclear medicine, which is capable of mapping the 3D distribution of radiopharmaceuticals labelled by a positron emitter

Note 1 to entry: PET scanners make use of coincidence timing windows, thus discarding the need for collimators.

3.5.1.1.2.2

PET-CT scanner

hybrid imaging device combining positron emission tomography (PET) and X-ray computed tomography (CT)

3.5.1.1.2.3

PET-MRI scanner

hybrid imaging device combining positron emission tomography (PET) and magnetic resonance imaging (MRI)

3.5.1.2

intraoperative gamma probe

hand-held device containing a radiation detector for intraoperative use following injection of a radiopharmaceutical to locate radioactivity

3.5.1.3

radionuclide calibrator

activimeter

dose calibrator

device used in nuclear medicine for the measurement of activity of radiopharmaceuticals that will be administered to a patient

[SOURCE: Glossary of Molecular Imaging Terms, web SNMMI, 2017, modified.]

3.6 Terms related to medical studies

3.6.1

medical study

outcome of the appliance of a medical procedure that could include the usage of a specific technique

EXAMPLE A myocardial perfusion study can be carried out with PET-CT or SPECT-CT techniques.

3.6.1.1

nuclear medicine imaging study

medical imaging study based on the administration of a radiopharmaceutical

3.6.2

planar imaging

projection imaging

imaging corresponding to the acquisition of two-dimensional (2D) images

3.6.3

scintigraphy

nuclear medicine imaging using a gamma camera

Note 1 to entry: Scintigraphy can produce planar and tomographic images.

3.6.4

computed tomography

three-dimensional (3D) imaging created from projection data using a specific tomographic algorithm reconstruction

Note 1 to entry: In nuclear medicine, image obtained using SPECT or PET scanners.

Note 2 to entry: Without any precision, this term also refers to a CT scanner (computed tomography scanner), which is a medical imaging device using X-ray.

3.6.4.1

positron emission tomography

PET

nuclear medicine tomography obtained using a PET device

EXAMPLE A frequently used PET radiotracer is ^{18}F -fluorodeoxyglucose (FDG), composed of a simple sugar labelled by radioactive fluorine. Once the FDG radiotracer accumulates in the body's tissues and organs based on the rate of sugar use, the PET scanner creates three-dimensional images that show how the FDG is distributed in the area of the body that provides important information on the cellular activity.

3.6.4.2

single photon emission computed tomography

SPECT

nuclear medicine tomography obtained using a SPECT device

3.6.5

hybrid imaging

combination of two imaging techniques that provides information from two different studies to be displayed in a single set of images

[SOURCE: Glossary of Molecular Imaging Terms, web SNMMI, 2017, modified.]

3.6.5.1

single photon emission tomography with X-ray computed tomography

SPECT-CT

nuclear medicine hybrid imaging technique combining single photon emission computed tomography (SPECT) and X-ray computed tomography (CT) that provides details on the function and anatomy of organs and tissues respectively

3.6.5.2

positron emission tomography with X-ray computed tomography

PET-CT

nuclear medicine hybrid imaging technique combining positron emission tomography (PET) and X-ray computed tomography (CT) that provides details on the function and anatomy of organs and tissues respectively

Note 1 to entry: CT is also used for photon attenuation correction of PET images.

3.6.5.3

positron emission tomography with magnetic resonance imaging

PET-MRI

nuclear medicine hybrid imaging technique combining positron emission tomography (PET) and magnetic resonance imaging (MRI) that provides details on both the anatomy and function of organs and tissues

Annex A (informative)

Methodology used in the development of the vocabulary

A.1 General

The steady growth and evolution of the nuclear medicine concepts contained in this standard requires the use of

- clear technical descriptions, and
- a coherent and harmonized vocabulary that is easily understandable by all potential users.

Concepts are not independent of one another, and an analysis of the relationships between concepts within the fields of energy efficiency and renewable energy sources and the arrangement of them into concept systems is a prerequisite of a coherent vocabulary. Such an analysis was used in the development of the vocabulary specified in this International Standard. Since the concept diagrams employed during the development process may be helpful in an informative sense, they are reproduced in [A.3](#).

A.2 Concept relationships and their graphical representation

A.2.1 General

In terminology work, the relationships between concepts are based on the three primary forms of concept relationships indicated in this annex: the hierarchical generic ([A.2.2](#)), and partitive ([A.2.3](#)) and the non-hierarchical associative ([A.2.4](#)).

A.2.2 Generic relation

Subordinate concepts within the hierarchy inherit all the characteristics of the superordinate concept and contain descriptions of these characteristics which distinguish them from the superordinate (parent) and coordinate (sibling) concepts, e.g. the relation of mechanical mouse, optomechanical mouse and optical mouse to computer mouse.

Generic relations are depicted by a fan or tree diagram without arrows in [Figure A.1](#) (ISO 704:2009, 5.5.2.2.1, Example 1, modified).

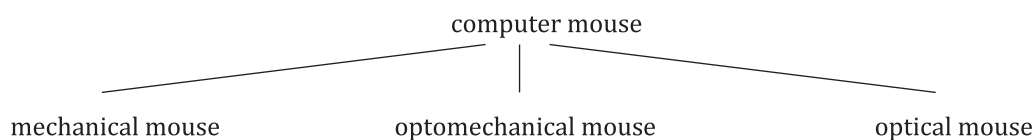


Figure A.1 — Graphical representation of a generic relation

A.2.3 Partitive relation

Subordinate concepts within the hierarchy form constituent parts of the superordinate concept, e.g. mouse button, mouse cord, infrared emitter and mouse wheel may be defined as parts of the concept optomechanical mouse. In comparison, it is inappropriate to define red cord (one possible characteristic of mouse cord) as part of an optomechanical mouse.

Partitive relations are depicted by a rake without arrows in [Figure A.2](#) (ISO 704:2009, 5.5.2.3.1, Example 1, modified). Singular parts are depicted by one line, multiple parts by double lines.

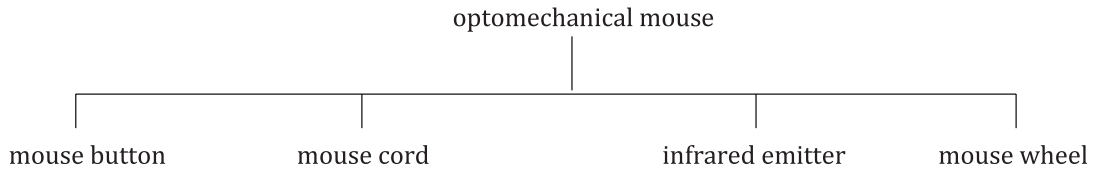


Figure A.2 — Graphical representation of a partitive relation

A.2.4 Associative relation

Associative relations cannot provide the economies in description that are present in generic and partitive relations but are helpful in identifying the nature of the relationship between one concept and another within a concept system, e.g. cause and effect, activity and location, activity and result, tool and function, material and product. Besides, associative relations are the most commonly encountered in terminology practical work, as they correspond to the concepts relations established in the real world.

Associative relations are depicted by a line with arrowheads at each end in [Figure A.3](#) (ISO 704:2009, 5.6.2, Example 1, modified).

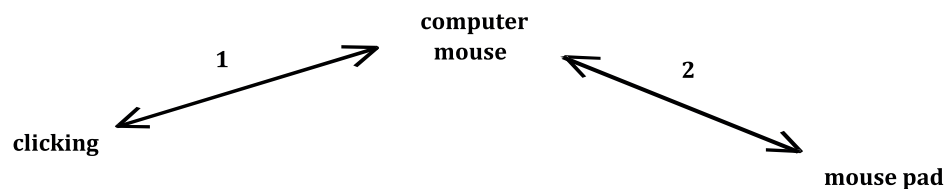


Figure A.3 — Graphical representation of an associative relation

A.3 Concept diagrams

[Figures A.4](#) to [A.9](#) show the concept diagrams on which the thematic groups of the nuclear medicine vocabulary are based. Notations in following diagrams show the position of each concept according to generic, partitive and associative relationships.

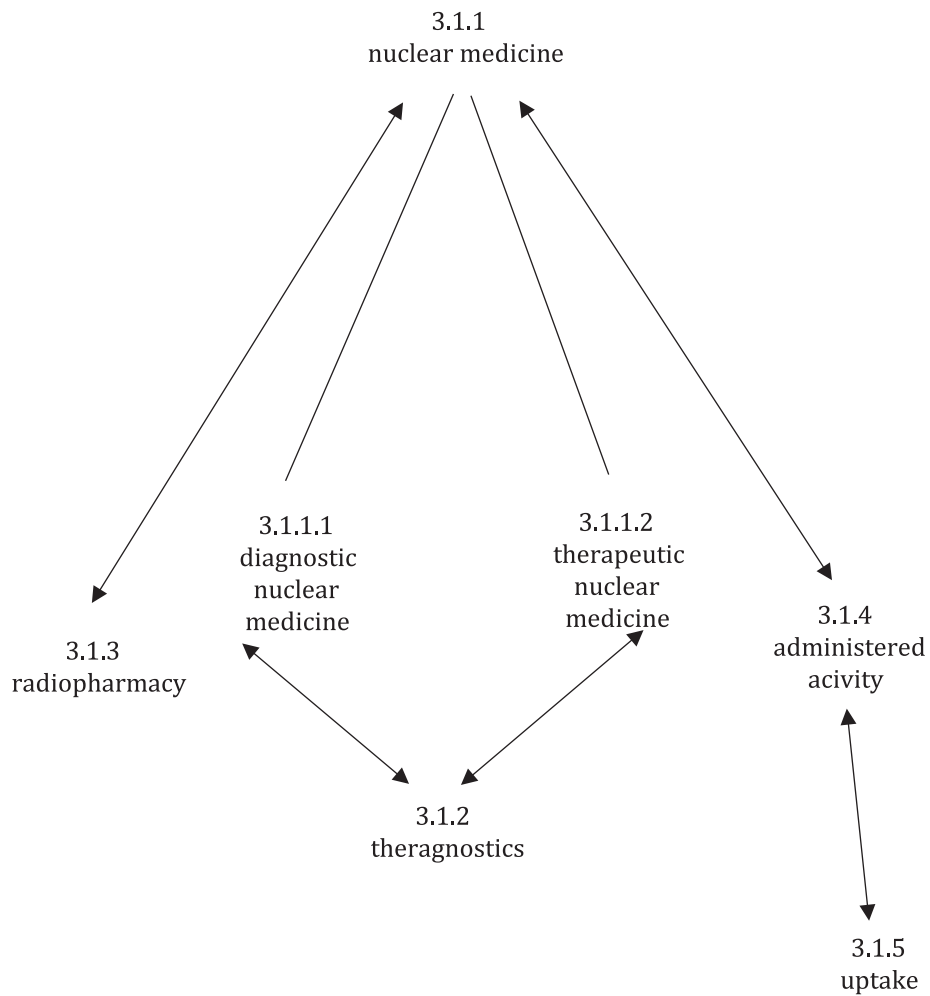


Figure A.4 — [3.1](#) Basic terms related to nuclear medicine

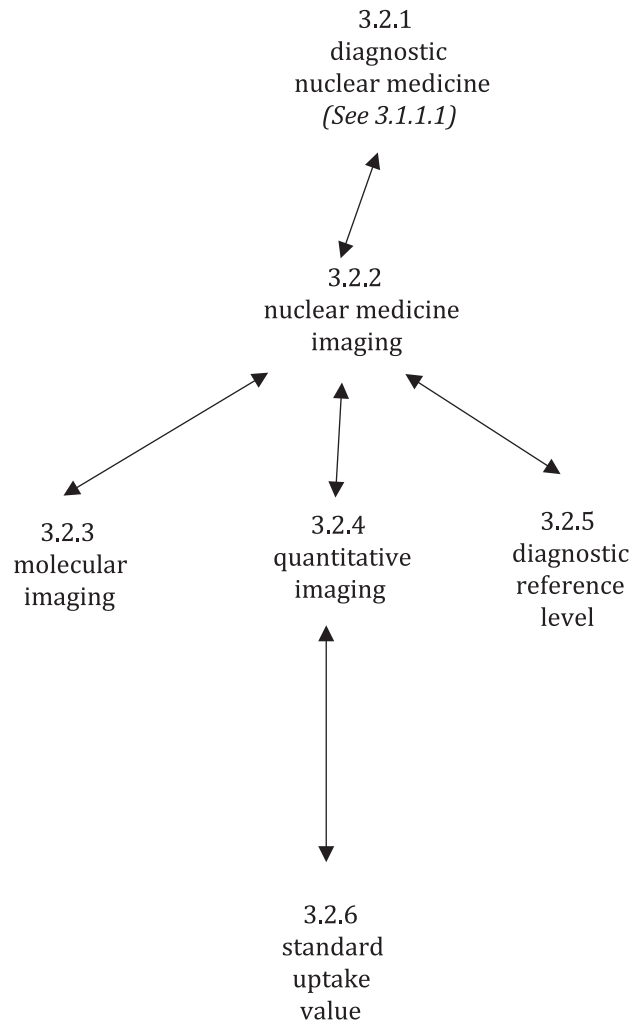


Figure A.5 — **3.2** Terms related to diagnostic nuclear medicine

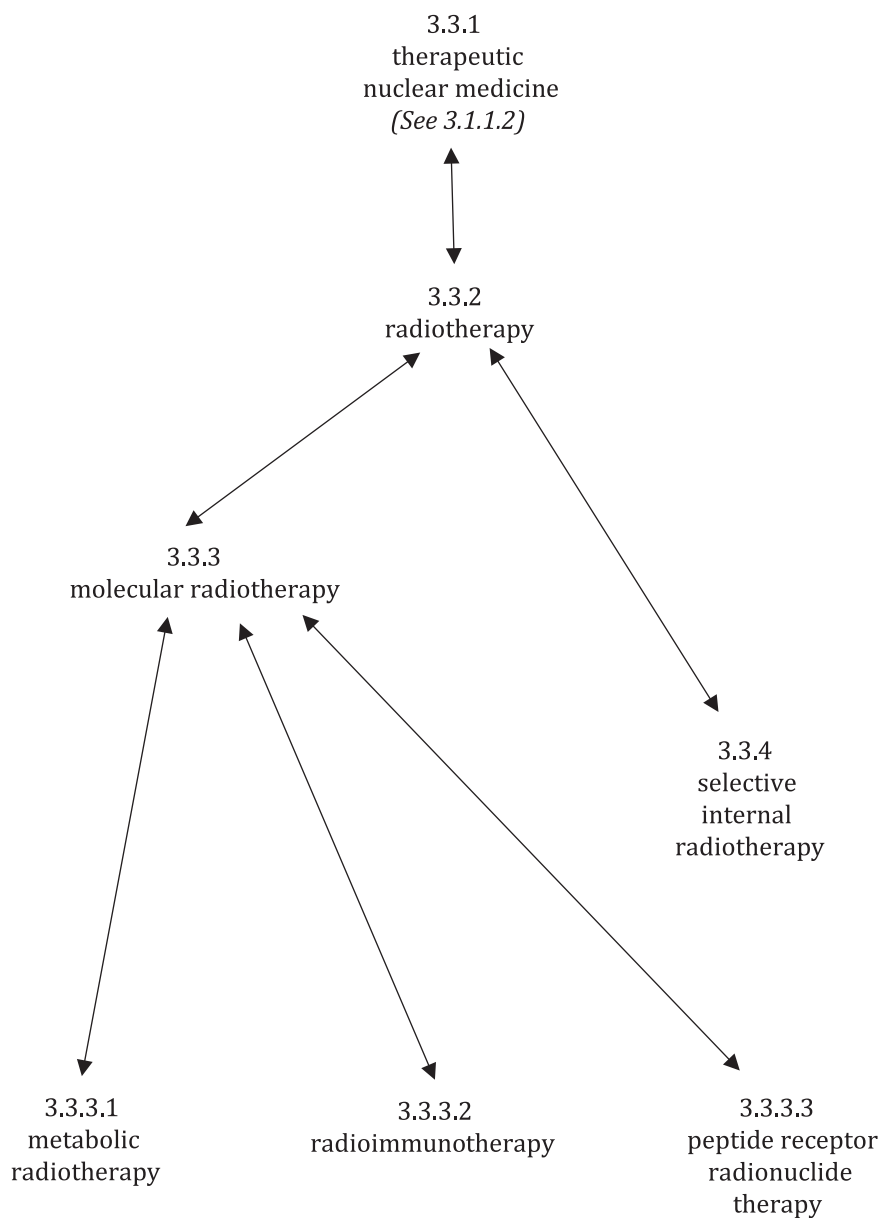


Figure A.6 — **3.3** Terms related to therapeutic nuclear medicine

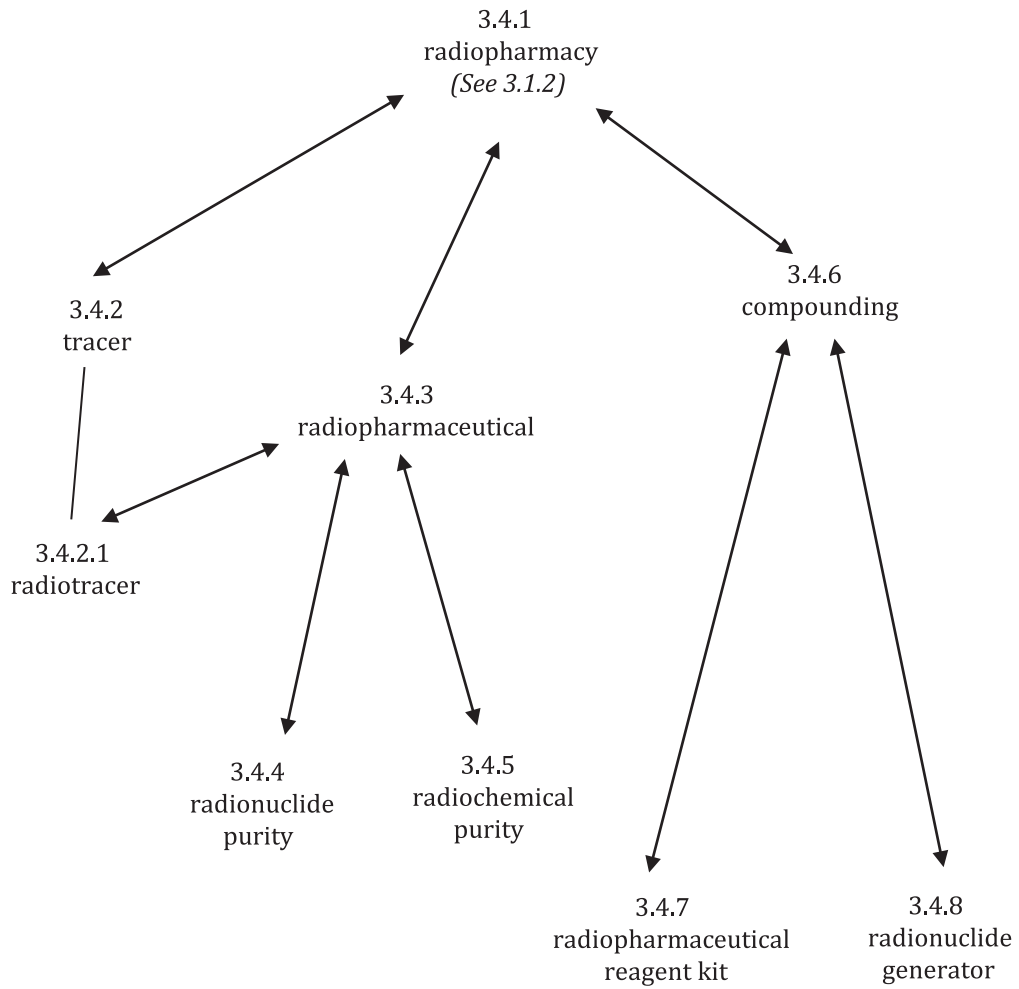


Figure A.7 — 3.4 Terms related to radiopharmacy

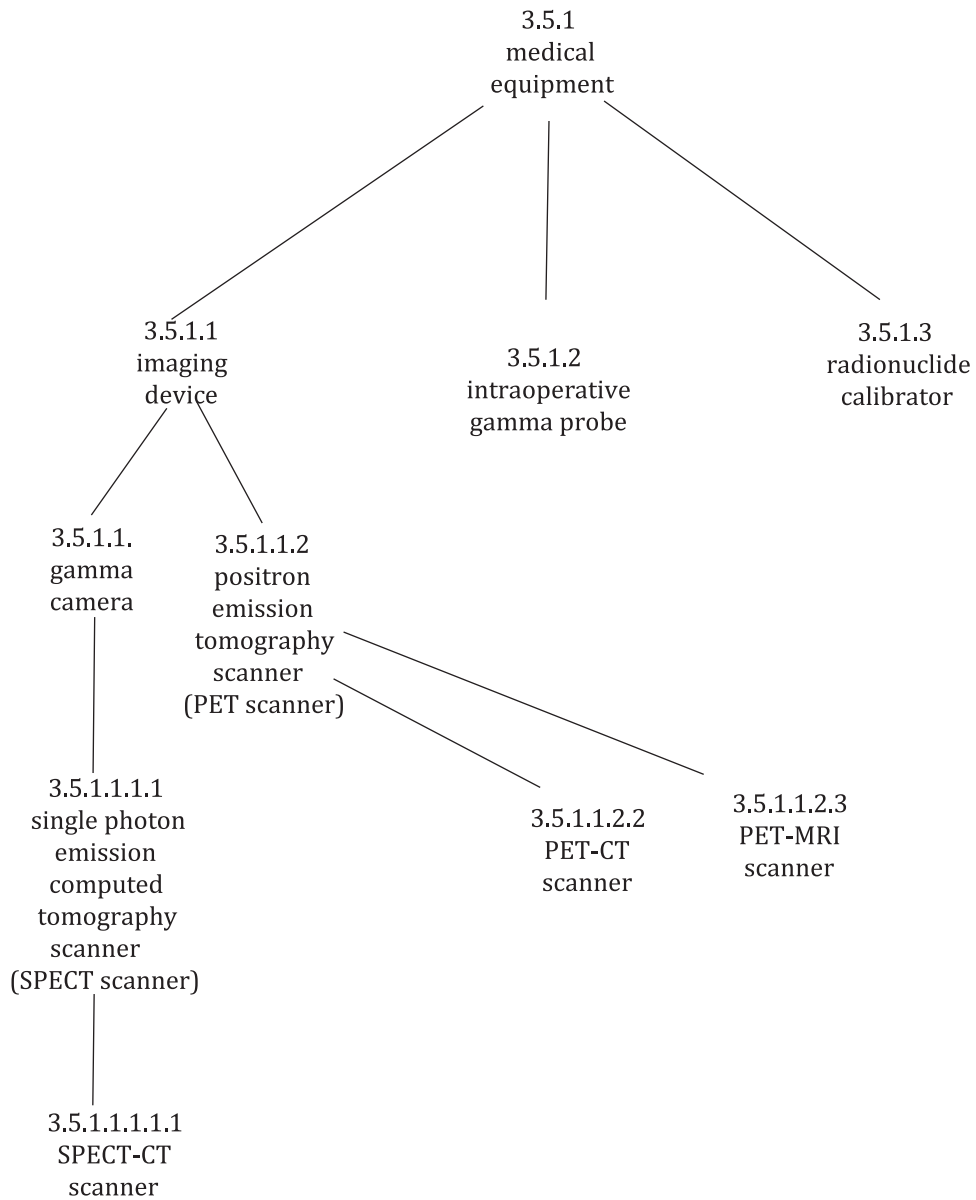


Figure A.8 — 3.5 Terms related to medical equipment

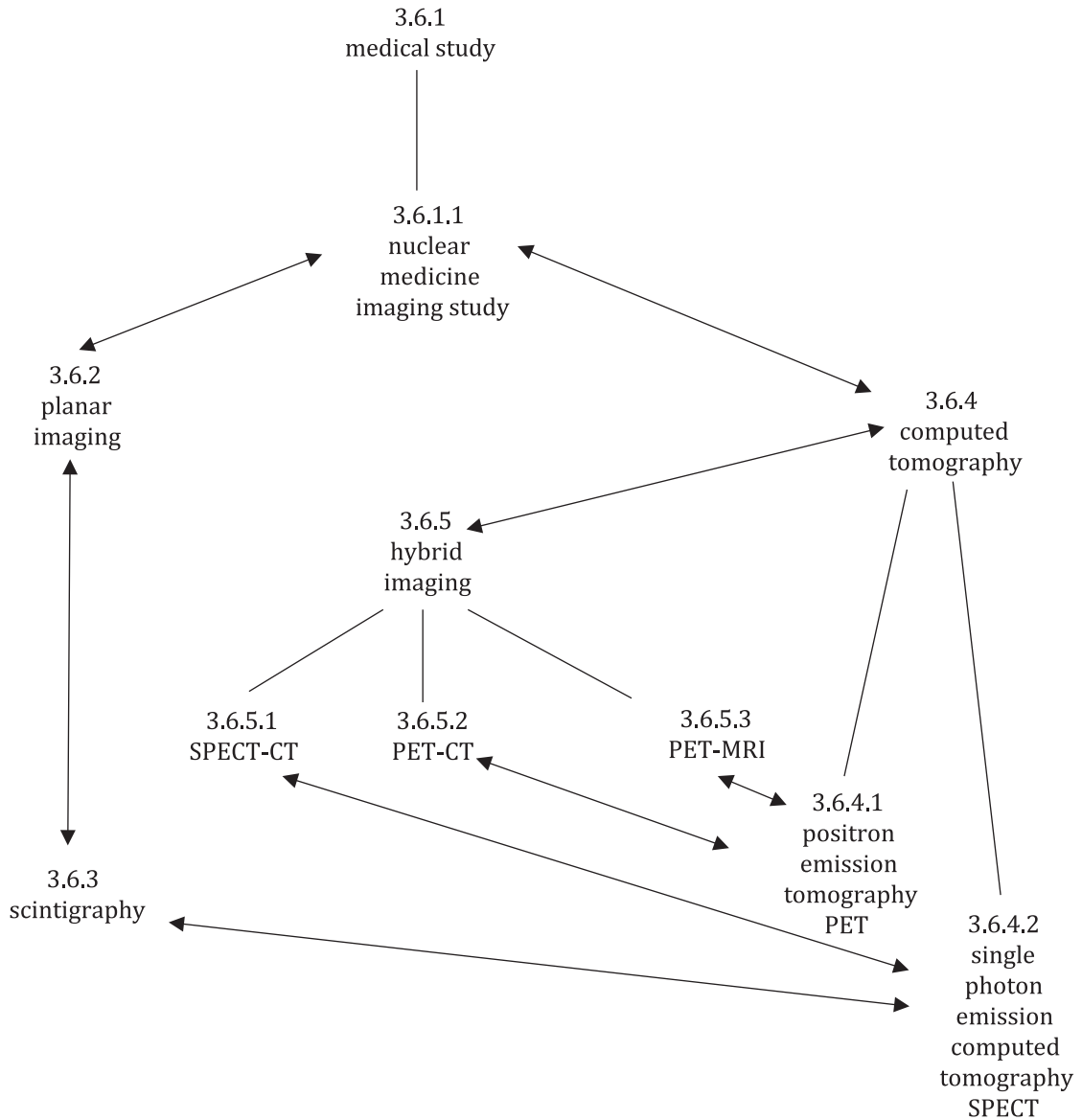


Figure A.9 — 3.6 Terms related to medical studies

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