INTERNATIONAL HEALTH TERMINOLOGY
STANDARDS DEVELOPMENT ORGANISATION

SNOMED CT Style Guide: Body Structures – Anatomy

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Purpose of this document

This document describes editorial policies regarding the intended meanings of the anatomy content in SNOMED CT. It is intended to describe the editorial policies and previous decisions about meanings that are reflected in the current logic-based models. To the extent that there are inconsistencies between the stated policy in this document and the implemented logic-based definitions, these inconsistencies should be resolved through a consensus-based process. For short-term decision-making, the policies in this document should be adhered to. However, this is a working document, subject to change and revision. The intention is to support communication among those who are actively creating definitions, as well as those who are advising, consulting or providing feedback in a variety of capacities.

Status

The document is a working draft. Its contents have in part been derived from several historical sources, including the SNOMED RT Users Guide, Clinical Terms Version 3 documentation, minutes of the SNOMED CT Content Working Group, Concept Model Working Group, Kaiser CMT modelers meetings, and SNOMED Editorial Board / SNOMED International Standards Board meetings.

Table of Contents

1 Anatomical structures

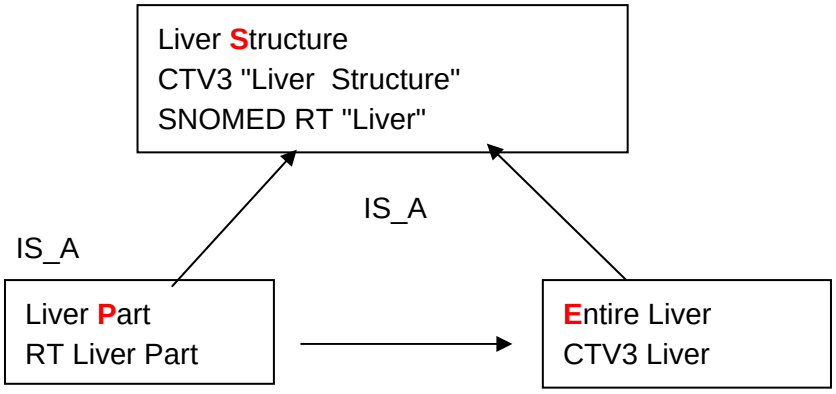
The top level of the anatomy hierarchy appears as those concepts under “physical anatomical entity” which is located under the “body structure” hierarchy as shown in the following list:

SNOMED CT Concept
- Body structure
  - Acquired body structure
  - Anatomical organizational pattern
  - Anatomical site notations for tumor staging (this needs to be moved elsewhere)
  - Morphologically altered structure
  - Physical anatomical entity
    - Group of anatomical entities
    - Anatomical spatial entity
    - Anatomical structure (the reified “S” part of the SEP triple)
      - Entire anatomical structure (the “E” part of the SEP triple)
      - <multiple other immediate subtypes of anatomical structure>

2 General Principles Underlying the SNOMED CT Model of Anatomical Structures

2.1 The Structure-Entire-Part (SEP) model

SNOMED CT uses a "structure-entire-part" triple, known as the SEP triple, to represent anatomical structures.
The following relationships provided a way for the anatomy in CTV3 to be mapped to RT:



The SNOMED CT anatomy hierarchy differentiates classes of "entire" anatomical entities from classes of "parts of" entire anatomical entities.
Entire concept: Denotes a class that is instantiated by entire anatomical entities of some kind: “entire heart” is instantiated by all individual hearts.
Entity **P**art concept: Denotes a class that is instantiated by all anatomical entities that are a proper part of some entity of a given kind: “heart part” is instantiated by all entities that are a proper part of some heart, e.g. my mitral valve, your right ventricle, Joe’s sinus node. “Heart part” is NOT instantiated by any heart.
Entity **S**tructure concept: Subsumes both the related “Entire” and “Part” concepts. Consequently, it denotes a class which is instantiated by anything that instantiates either the “Entire” or the “Part.” For instance, “Heart structure” is instantiated by my heart, my mitral valve, your heart, your right ventricle, Joe’s sinus node, Joe’s heart, etc.

The code named “Liver structure” in CTV3 is equivalent to “Liver structure” in the diagram above. Both the CTV3 code for “Liver structure” and the SNOMED RT code for “Liver” are interpreted to mean “Some or all of the liver”. *Site* attributes (procedure site, finding site) will usually take the value “liver structure” rather than "entire liver", since typically the site of a "liver disorder" or "procedure on the liver" is not necessarily the entire liver.

2.1.1 Purpose of the “Structure” concept

Adding the “Entity **S**tructure” codes is a convenience to assist with the logic-based aggregation of references to the entity or its parts. The implication of this view is that the “E” of the SEP triple is the code that should be regarded as the one that represents the real anatomical entity that is named. For example, the code for “entire liver” is the one that should correspond to the code for “liver” in the Foundational Model of Anatomy (FMA). The subtype hierarchy for “entire liver” fits much better with the FMA hierarchies, and indeed it might be possible to completely reconcile SNOMED’s “non-Structure” components with FMA anatomy.
A database has been developed that categorizes codes in the “physical anatomical entity” hierarchy according to their status as “S – structure”, “P – Part” or “E – Entire”, and provides the corresponding S and P code for each E code. This should provide some value to implementers. It can help with navigation, coordination with formal ontologies of anatomy, and selection of codes for post-coordination.

2.1.2 Naming conventions

"S" concepts are usually named "x structure (body structure)" or "structure of x (body structure)".
"E" concepts are usually named "entire x (body structure)" or "x entire (body structure)".
"P" concepts are usually named "x part (body structure)" or "part of x (body structure)".

2.1.2.1 Plurals

Outside the anatomy section of SNOMED, plurals were primarily used as headers, while the individual concept names were singular. In the anatomy section, we have taken plurals to represent meaningful differences from their singular counterparts.
For example, “cranial nerves” in the FSN would mean a group of cranial nerves, while “cranial nerve” would not imply more than one.

2.1.3 Conventions for merging concepts from SNOMED RT and Clinical Terms v.3

Where there were two concepts with the same name, the SNOMED RT code was to become the "S" code, and the CTV3 code was to become the "E" code. There are still instances of unrecognized pairing of the RT-CTV3 "S"-"E" pair, where neither code's FSN has been changed according to the naming conventions in this document. When these unmatched pairs are identified, it is our practice to change the FSNs accordingly, and to make the "E" code have a subtype (is-a) link to the "S" code.

2.1.4 "S" concepts without a corresponding "E" concept

Some "S" codes do not currently have a corresponding "E" code subtype, and there was no policy that required that such "E" codes be created during the merger of SNOMED RT and CTV3. However, it is likely that such a policy will be enforced in the future.

2.1.5 "S" Structure codes can subsume entities other than "E" or "P"

The SEP triple may give the impression that all "S" codes have exactly two children, one "E" and one "P", with all of the remaining descendants placed under "P". Again, in the past this degree of modeling consistency was not always followed. Some codes were purposely made subtypes of the "S" that are not strictly part of the corresponding "E". For example, perirenal tissue is a kidney structure but not a part of the kidney. It is used to define "perirenal abscess" so that it is subsumed by "renal abscess". While a perirenal abscess is not strictly within the substance of the kidney, it is still considered a kind of renal abscess, and the "S" anatomy hierarchy is used to support this inference.

This policy has introduced undesirable variation and arbitrariness into the terminology, and future revisions will seek to eliminate these variations. Where a code is needed for a site that is really meant to extend to entities that are not part of any kidney, this will be made clear in the name, e.g. "Structure of kidney and perirenal tissue".

2.1.6 Countable vs non-countable "E" entities

The "E" code needs to be interpreted with care when the "x" name refers to entities that do not have the property of "identity", meaning that they are not countable wholes, or could be interpreted as non-countable. In this circumstance, the interpretation of "E" means some portion of the thing being named. Examples include 'tissue' and types of tissue such as fascia, muscle, tendon, bone tissue, connective tissue, skin, mucosa/mucous membrane, nerve tissue, etc. "Muscle", "tendon", "bone" and "skin" can identify a type of tissue as well as an individual organ of that type. Bone tissue has no identity, but a particular bone does have identity.

To use skin as the archetypal example, the "E" code for "skin of finger" means a portion of the skin of a finger, so all of its subtypes must also be portions of skin. The "S" code for "skin of finger" then has a subtype "P" which would mean "proper part of a portion of skin of finger". This admits subtypes that are not kinds of skin, but may be parts of skin, including layers. For example, "epidermis of finger" (meaning a portion of epidermis of finger) could be a proper part of a portion of skin of finger.

2.1.6.1 Tissues, layers, membranes: portions

We regard the "E" code for "x tissue", "x layer" to have the meaning "portion of x tissue", and therefore regional subdivisions of tissue types are direct subtypes. For example, "transitional epithelium of urinary tract", as an "E" kind of code, should be a supertype of "transitional epithelium of urinary

bladder". The reason is that "(portion of) transitional epithelium of urinary bladder" is a kind of "(portion of) transitional epithelium of urinary tract".
We also deal with layers the same way. For example, we regard "serosal layer" and "serosa tissue" as meaning the same thing, since all serosal tissue is conifigured as a layer, and it can't be a serosa without being a layer; and their "E" codes mean "portion of serosal layer" or "portion of serosal tissue."
As another example, "layer of retina" would be a supertype of "nerve fiber layer of retina", and also a supertype of "retinal epithelium", where "retinal epithelium" represents a portion of the epithelium of the retina and is therefore a kind of (portion of) a layer.

2.1.7 Groups

The identity/countability issue extends to a problem differentiating groups of entities from one of the group. For example, consider x= "lymph node group", y="lymph node". In this case, the group should be linked to the member via an appropriate relationship (not yet in SNOMED), such as "has-member". In those cases where y is always necessarily a member of group x, it could be linked via a "member-of" relationship (also not yet in SNOMED).

2.1.8 What does "part-of" mean?

There are several possible ways of interpreting "part-of". In SNOMED, "A part-of B" means that in normal anatomy, the entire structure A is structurally included in B. Another way of saying it is that A is part-of B if there is no part of A that is not also part of B. For example, the humerus is not part-of the shoulder region, because the distal humerus is part of the humerus, and the distal humerus is not part of the shoulder region.
We do *not* use "part-of" for non-anatomical meanings, such as grouping tests together in batteries, nor do we use it to indicate relationships that are not strict anatomical inclusion.
Some recent work has begun to differentiate between "part-of" that is reflexive (that is, an entity is in some sense a "part-of" itself, much the same that a set can be viewed as a subset of itself), versus "proper-part-of", where an entity cannot be a "proper-part-of" itself. For now, we regard "part-of" relationships as implying strict partonomy.
There is sometimes confusion about parthood as opposed to location. For example, an embryo is not part of a mother's body, but a kidney is. The anatomy section is composed mainly of canonical parts; but a few abnormal parts are included to permit them to be used as the location of tumors or injuries. For example, a Meckel's diverticulum is a body structure that is part of the small intestine, and it is also a morphological abnormality. Likewise some stomas and other post-surgical structures are considered part of the body. A transplanted liver or kidney would be considered part of the body, as a post-surgical structure, even though the transplanted organ is not genetically identical. Likewise transplanted bone marrow is part of the body.
Non-living implants and devices, and foreign bodies, on the other hand, are considered to be located in the body but not part of the body.

2.1.9 Can the SNOMED CT relationships table be used to construct a "part-of" hierarchy?

The currently distributed part-of relationships need to be much more extensively modeled and quality assured. At present they are not "defining", that is, their CharacteristicType in the Relationships Table is "additional", and therefore they do not affect the classifier behavior. A substantial amount of effort

has gone into a draft of the updated part-of relationships; these will require review and approval before incorporation into the release. This will eventually result in the SEP triplet structures and part-of relations being strictly paralleled. It is a matter of time to implement and quality assure the changes.

2.1.10 Why are part-of relationships not "defining"?

The SEP structure, combined with the inference mechanism that is used with SNOMED CT, allows us to take advantage of anatomical relationships to infer subsumption (is-a) relationships between disorders, procedures, and other entities without reference to part-of relationships. The SEP structure also permits us to fully define anatomical structures without reference to part-of relationships (making them "necessarily true" but not among the "necessary and sufficient" conditions). For example, the *left hand structure* can be fully defined as a *hand structure* with *laterality=left.* This definition is sufficient. Converting the part-of relationships to have CharacteristicStatus = defining will require significant changes to the current model.

2.1.11 Entities with mass versus purely spatial “massless” entities

Points, lines, and surfaces can be considered to be massless. The FMA calls these “immaterial”. It is important to differentiate the codes/names for these entities from those that are intended to represent entities that have mass. At present, the concepts under “anatomical spatial entity” represent massless entities. Massless entities are not represented using the SEP model. It is conceivable that users may want to reference parts of a surface, and to enable this we would need to apply the SEP model to anatomical spatial entities, or else adopt defining part-of relationships.

2.2 Attributes used in anatomy

Defining Attribute	Permissible Values
LATERALITY	*Side 182353008* *Left* 7771000 *Right* 24028007 *Right and left* 51440002 *Unilateral* 66459002

2.2.1 Laterality

This attribute provides information on whether a body structure is left, right, bilateral or unilateral. It is applied only to bilaterally symmetrical body structures which exist on opposite sides of the body.

Permissible values include the following concepts:

- Side (qualifier value) 182353008
- Left (qualifier value) 7771000
- Right (qualifier value) 24028007
- Right and left(qualifier value) 51440002
- Unilateral (qualifier value) 66459002

Example:

Left kidney structure (body structure)
LATERALITY *Left (qualifier value)*

3 Specific policies related to anatomy

3.1 Body parts – Body regions

We have made some use of the FMA definition of "body part" and "body part subdivision". The various joint “regions” listed below are classified as “body part subdivisions”, since that is what is intended by the various diseases and procedures that use these codes in their definitions. They are not body parts because they are defined not by a set of bones but rather by a particular joint and its surrounding structures. However, our interpretation of the word “region” is according to common usage and is intended as a three-dimensional structure, *not* the FMA two-dimensional definition of “body region”. In other words, these regions are not simply “virtual” surface regions, but include the three dimensional structures as well. They include the overlying skin, the subcutaneous tissues, the bones, muscles, tendons, fascia, vessels and other included organs and tissues in the region.

3.1.1 Surface regions

Several codes contain the phrase “surface region”. These could be interpreted as massless (immaterial) mathematical surfaces, but a clinical terminology would have no direct use for such meanings in clinical records. They could be interpreted as having mass (not immaterial), but the depth then is a matter for fiat declaration. Should it be just skin deep, or should it include deeper layers of the surface? If only skin deep, the meaning of these codes would overlap with codes for skin regions. If deeper, the meaning would possibly be the same as the generic “structure” codes.
In the absence of a clear use case for these codes, it is also interesting to see what use has been made of them in the logic-based definitions. Many of those that are used (as of 20060131) also have corresponding codes that do not contain the “surface region” designation, and this creates inconsistency in modeling, with some using “x structure” and others using “x surface region”. “Buttock” and “shoulder” are the two most egregious examples.
Therefore, for the 20060731 release, all “surface region” codes will be retired as ambiguous, with MAYBE-A references to their corresponding codes that are clearly not immaterial, including “x structure”, “entire x”, and “skin of x”. Where the “x structure” codes do not currently exist, they will be created, without the “surface region” phrase, which is ambiguous.

3.1.2 Joints – Joint regions

In many diseases and procedures, reference is made to areas of the body that may ambiguously imply either a joint or a region surrounding the joint. The main words that may ambiguously refer to either a joint or a region are:

Ankle = Ankle joint structure [70258002] Ankle region structure [344001]

Knee	=	Knee joint structure [49076000]	Knee region structure [72696002]
Hip	=	Hip joint structure [24136001]	Hip region structure [29836001]
Wrist	=	Wrist joint structure [74670003]	Wrist region structure [8205005]
Elbow	=	Elbow joint structure [16953009]	Elbow region structure [127949000]
Shoulder	=	Shoulder joint structure [85537004]	Shoulder region structure [16982005]

Bone structure of shoulder girdle [272691005]: This code is used to define procedures and diseases affecting some bone tissue of the shoulder region. It is therefore **not** a kind of bone (organ), but it is a kind of bone structure, and is part of the shoulder region. Any part of the proximal humerus, scapula or clavicle is included.
Intertarsal joint structure (synonym: "tarsal joint") [27949001]: This is a structure that is part of a group of joints forming articulations between the seven bones of the tarsus. The talocalcaneonavicular joint [27162001] is the articulation between the talus and the other bones of the tarsus, and is thus assumed to be what is meant by the rarely-used term "talotarsal joint". The subtalar joint [127863007] is the same as the talocalcaneal joint. Dislocations of the subtalar joint will ordinarily also involve the talonavicular joint [127864001]. The subtalar and talonavicular joints taken together constitute the talocalcaneonavicular joint.

3.1.3 Orbital region

Orbital region structure is a synonym for *eye region structure* which subsumes bony orbit, eye and ocular adnexa.

3.1.4 Shoulder region – Upper limb; Hip region – Lower limb

The shoulder region is part of the upper extremity, and the hip region is part of the lower limb. This follows the general pattern used in the International Classification of Diseases 9th Edition (ICD-9) where one finds “upper limb including shoulder” and “lower limb including hip”. It also follows the rigorous ontological views of the FMA, in which the upper limb consists of the free upper limb and the pectoral girdle (of which the shoulder region is part), and the lower limb consists of the free lower limb and pelvic girdle (of which the hip region is part). It would be possible to add codes for upper limb not including pectoral girdle (also known as free upper limb) and lower limb not including pelvic girdle (also known as free lower limb). So far these “free limb” concepts have not been added.

3.1.5 Axilla – Upper limb – Trunk

The axilla is bounded by the upper limb laterally and the thorax medially; therefore from one perspective it is not strictly part of either the upper limb or the trunk. The alternative view is that it is both. Axilla structure is currently defined in SNOMED as being both an upper limb structure and a thoracic structure.

3.1.6 Lower limb – Lower Leg – Leg – Foot

The lower limb (syn: lower extremity) includes the foot, but the lower leg (syn: leg) does not. Stedmans definition of lower leg is "The segment of the inferior limb between the knee and the ankle". "Leg" is used in ICD classifications to mean "lower leg". Common usage in English makes "leg" a synonym of "lower extremity". In order to avoid confusion, FSN's should always specify "lower leg" or "lower extremity". When an FSN (for a procedure or clinical finding code) has only the word "leg" with no

other wording in the FSN that would allow determination of which meaning is intended, the code is ambiguous and should be retired.

3.1.7 Mouth region [123851003] – Oral region of face [836005]– Teeth – Tongue – Larynx

3.1.7.1 Meaning of the word "mouth"

There are several different meanings of the word "mouth". These include "mouth region", "oral region of face", and "rima oris".

Mouth region

The mouth region includes structures surrounding the oral cavity as well as structures of the oral region of the face. Most disorders that have a *finding-site* of "mouth" should use "mouth region".

Oral region of face (labial part of mouth)

The oral region of the face includes the skin and subcutaneous tissues of the lips and perioral region, plus the orbicularis oris muscle, and any vessels and nerves in these structures.

Rima oris

The rim of the opening bounded by the lips is called the rima oris.

3.1.7.2 Teeth – Maxilla – Mandible

Even though teeth are supported by the maxillary or mandibular bone, they are *not* "part-of" the maxilla [70925003] or mandible [91609006]. Teeth *are* part of upper jaw [4335006] and lower jaw [48077000].

3.1.7.3 Root of tongue [47957008]

Prior versions had different codes for the base and root of the tongue. We found no reproducible distinction, and have retired "base of tongue" [7283002] as a duplicate of "root of tongue". The four regional parts of the tongue are the ventrum, dorsum, root and body. The root of the tongue is the posterior third, the dorsal surface of which forms the anterior wall of the oropharynx. The root of the tongue rests on the floor of the mouth. The nerves and vessels that supply the intrinsic muscles of the tongue traverse the root of the tongue.

3.1.7.4 Inferior surface of tongue [422005]

Even though SNOMED 2 and SNOMED 3 had separate codes for "inferior surface of tongue" and "ventral surface of tongue", we regard them as synonyms. There is no ventral surface of the posterior third of the tongue, so the ventral surface of the anterior two thirds is the same as the ventral surface, which is the inferior surface.

3.1.7.5 Larynx [4596009] – Inlet of larynx [917004] – Interarytenoid fold [105585004] – Hypopharyngeal aspect of interarytenoid fold [102295003]

The interarytenoid fold forms part of the inlet of the larynx. The fold has two surfaces, one forming part of the wall of the supraglottic larynx, the other forming part of the wall of the hypopharynx (the "food tube" behind the larynx, leading to the esophagus). Is the "hypopharyngeal aspect of the interarytenoid fold [102295003]" a part of the the hypopharynx, the larynx, or both? A tumor of this site should be categorized as a tumor of the hypopharynx, and not as a tumor of the larynx, but the interarytenoid fold [105585004] is considered part of the larynx. Given these two facts, we do ***not*** give a part-of relationship between the hypopharyngeal aspect of the interarytenoid fold and the

interarytenoid fold. This emphasizes the fact that we determine how to model anatomical entities based on the way that model causes disorders and procedures to be organized, ***not*** based on a simple reading of the term names.

3.1.8 Abdominal regions

The named regions of the abdomen are by tradition divided horizontally by the transpyloric plane and the interspinous plane, and vertically by the midclavicular plane. The lateral regions are therefore bounded above by a plane that is inferior to the ribs. In contrast, the flank is the lateral region of the abdomen bounded above by the ribs. Thus some parts of the hypochondriac regions, which are superior to the transpyloric plane but inferior to the ribs, would be considered also part of the flank. The hypogastric region is also sometimes called the pubic region.

3.2 Skin regions – Skin of <named body part>

Since the phrase "skin of finger" can mean "some or all of the skin of finger" (if interpreted as a “structure” rather than an “entire” in the SEP model), we could use "is-a" to represent the relationship between "skin of finger" and "skin of hand". Thus "skin of finger" is-a "skin of hand", is-a "skin of upper extremity", is-a "skin region". We have refrained from adding the word "region" to all of these names, since it could be confusing without a clear distinction between “the entire region” and “some subregion”.

3.2.1 Scalp

Formal definitions of “scalp” include layers beneath the skin. Therefore we make a distinction between the scalp and the skin of the scalp.

3.3 Organs – Organ system subdivisions

The FMA notion of body organ is also used. Organs include individual bones, joints, muscles, arteries, veins, lymph vessels, nerves, etc. Codes with a meaning that includes groups of such organs are frequently listed in SNOMED. In most cases, these have been interpreted to be entities in the subsumption hierarchy (is-a hierarchy) of the particular organ type, that is, they are kinds of organ. When we also need a concept that means the collection of organs (rather than an organ in the collection), we have created another entity (code) that is a kind of organ system subdivision. But many such collections don’t yet have such a corresponding organ system subdivision code. The default has been to interpret codes as denoting organs rather than organ system subdivisions.

Examples:

Organ	Organ system subdivision
Vertebra (bone of vertebral column)	Spine (subdivision of skeletal system)
Cervical vertebra	Cervical spine (subdivision of spine)
Third cervical vertebra	——
Bone of skull	Skull (subdivision of skeletal system)
Bone of thoracic cage	Thoracic cage (subdivision of skeletal system)
Rib	——

Third rib ——
Right third rib ——
Quadriceps femoris muscle ——
Quadriceps femoris muscle, left ——
Vastus medialis muscle ——

3.4 Cell, Tissue, Organ

In general, organs are made up of tissue, and tissue is made up of cells. However, a cell is not necessarily part of tissue, and tissue is not necessarily part of a named organ.

3.5 Body systems and tracts

Many terms are used imprecisely in clinical practice and in medical publications to refer to body systems or tracts, and ambiguities frequently arise with many of these terms. In particular, the terms for the gastrointestinal, alimentary, genitourinary, genital, urinary, respiratory, biliary, lymphatic, lymphoid, immune, reticuloendothelial, and hematopoietic systems of the body may have multiple interpretations. We have (arbitrarily) made the following definitions and distinctions in order to achieve internal consistency of the terminology. We recognize that it may not be possible to get universal consensus regarding the names that should be used for each of these codes. The goal is to be consistent and clear in defining the meaning of each code, and to allow users and system designers to present the terms that best reflect these meanings in their own implementation contexts.

3.5.1 Urinary system – Urinary tract – Genitourinary system – Genitourinary tract

3.5.1.1 Urinary system:

The urinary system includes the organs involved in the formation and secretion of urine, including the kidney, ureters, bladder, and urethra. *Urinary system* includes the prostatic urethra (since it is a male urinary outflow structure) but excludes other parts of the prostate (and the prostate as a whole) and also excludes the seminal vesicles (see *lower urinary tract*). Unless clearly specified otherwise, *urinary tract* and *urinary system* are considered synonyms, and terms that include the phrases are interchangeable. For example, *computed tomography of urinary tract* is the same as *computed tomography of urinary system*. Broad categories that are intended to exclude the kidney should specifically use the term *urinary tract proper* (see next). Examples include “operation on urinary tract proper” and “disease of urinary tract proper”.

3.5.1.2 Urinary tract proper:

The urinary tract proper includes the organs involved in the secretion of urine but excludes the kidney itself; it includes the renal pelvis, ureters, bladder, and urethra. It is a fairly subtle distinction from urinary system, but may be useful for categorizing disorders affecting the flow of urine (as opposed to its formation), such as “urinary tract obstruction”, and as the site of tubular structures lined with urothelium. Because *urinary tract* is ordinarily used as a synonym of *urinary system*, we have added the word “proper” to distinguish this more specific meaning (which excludes the non-collecting parts of the kidney) from the broader meaning.

3.5.1.3 Upper urinary tract:

The *upper urinary tract* is the *urinary system* above the junction of *ureter* with the *bladder*, and consists of the kidneys and ureters. Since upper urinary tract infections include kidney infection, the *upper urinary tract* must include the *kidney*. The FSN of this concept is "*kidney and/or ureter structure (body structure)*", and it has a synonym of *upper urinary system*.

3.5.1.4 Upper urinary tract proper:

The *upper urinary tract proper* is the part of the *urinary tract proper* above the junction of the ureter with the bladder. It consists of the *renal collecting system* and the *ureter*.

3.5.1.5 Lower urinary tract:

The *lower urinary tract* is the *urinary system* below the junction of the *ureter* with the *bladder*. It consists of the *bladder* and *urethra*. *Lower urinary tract* and *lower urinary system* are the same. The male and female specific components are located under *male urinary outflow structure* and *female urinary outflow structure*, respectively.

3.5.1.6 Genitourinary system:

The genitourinary system includes the entire urinary system as well as the genital system. We consider *genitourinary tract* to be synonymous with *genitourinary system*.

3.5.1.7 Genital system:

The genital system is comprised of both internal genital organs and external genitalia. *Genital tract* is defined only for the female: The *female genital tract* is comprised of ovaries, fallopian tubes, uterus, vagina and vulva.

3.5.2 Digestive system – Digestive tract – Alimentary tract – Gastrointestinal tract (upper & lower)

Digestive tract is the same as the *alimentary tract*, and includes the entire passage for food through the body, including mouth, oral cavity (both vestibule of mouth and cavitas oris propria), oropharynx, esophagus, stomach, duodenum, jejunum, ileum, colon, rectum, and anal canal.

Digestive system: includes the digestive tract as well as the associated organs of digestion, including tongue, teeth, salivary glands, liver, exocrine pancreas, gallbladder and biliary tract.

Gastrointestinal tract: There are two meanings in common usage of this term. The first would more properly be named the "esophago-gastrointestinal tract", since the esophagus is ordinarily included. Endoscopists frequently adopt this meaning, even though it is contrary to some dictionary definitions, which exclude the esophagus. Including the esophagus also does not follow a strict lexical interpretation.

Upper gastrointestinal tract: By convention in describing upper GI bleeding and upper GI radiographic and endoscopic procedures, this includes the esophagus, stomach and duodenum. It is part of the gastrointestinal tract that includes the esophagus, but obviously not part of the more restricted stomach-intestine entity.

Lower gastrointestinal tract: By common convention in describing lower GI bleeding, lower GI radiographic and endoscopic procedures, and lower GI output from ileostomies and colostomies, this includes the jejunum, ileum, cecum, colon, rectum and anal canal. The ligament of Treitz may be used

as the dividing line between upper and lower GI tract (and the dividing line between duodenum and jejunum). See J Vasc Interv Radiol 9:747 for an example that shows inclusion of the jejunum and below as part of the lower GI tract. Also, since the upper GI tract is said to end at the duodenum-jejunum boundary, and there is no code meaning “middle GI tract”, the jejunum can be inferred to be in the lower GI tract.

3.5.3 Biliary tract – Liver

Biliary tract: includes the gallbladder and the intrahepatic and extrahepatic bile ducts, and the common bile duct. It does not include the liver itself. We use "biliary system" as a synonym for biliary tract. (Another code might be created to mean an entity that includes the entire liver with the biliary tract, but we do not at present perceive a need for it).

3.5.4 Respiratory tract – Respiratory system – Upper aerodigestive tract

We have chosen to have "respiratory tract" mean the same as the Nomina Anatomica term "apparatus respiratorius", which includes the structures through which air passes from the nares to the alveoli. The oral cavity, however, is not included (even though functionally one might expect it to be). The phrase “respiratory system” is sometimes regarded as a synonym of "respiratory tract", but we have given them separate meanings. Respiratory system does not, however, mean the global respiratory system that might include the CNS components of breathing. Pleura are part of the lower respiratory system, but not a part of the lower respiratory tract (see below).

Upper aerodigestive tract is a phrase that may have several meanings. The SNOMED code for "upper aerodigestive tract" has adopted the meaning defined by Muir and Weiland in "Upper aerodigestive tract cancers", Cancer 1995 Jan 1;75(1 Suppl):147-53, which states: "Cancers of the upper aerodigestive tract constitute approximately 4% of all malignancies. These include cancer of the lip, tongue, major salivary glands, gums and adjacent oral cavity tissues, floor of the mouth, tonsils, oropharynx, nasopharynx, hypopharynx and other oral regions, nasal cavity, accessory sinuses, middle ear, and larynx." This definition matches the tumors included in the CAP Cancer Checklist for upper aerodigestive tumors. Some publications include the esophagus, or at least the cervical esophagus, when referring to the upper aerodigestive tract, but we have decided to exclude esophagus.

Aerodigestive tract is a phrase with more variation in meaning than "upper aerodigestive tract." There is currently no code for this term, because of the variable meanings, and limited reference to "aerodigestive tract" in the literature. It certainly would include the upper aerodigestive tract plus the tracheobronchial tree, lungs, and esophagus, but the few literature citations using the term do not appear to intend it to include any of the digestive tract except the esophagus, in spite of the strict lexical interpretation that might lead one to expect inclusion of the entire digestive tract. The lower aerodigestive tract would be the combination of the esophagus and the lower respiratory tract. There is currently no code for this term.

Upper respiratory tract is that part of the respiratory tract from the larynx up, and includes the nasal cavity, paranasal sinuses, nasopharynx, oropharynx and larynx.

Lower respiratory tract begins below the larynx, and includes the tracheobronchial tree (from the trachea through the terminal bronchioles) as well as the lungs, including the alveolar respiratory tract or pulmonary region (which extends from the respiratory bronchioles to the alveoli).

Lower respiratory *system* includes the lower respiratory *tract* and the pleura.

3.5.5 Lymphoid system – Lymphatic system – Immune system– Mononuclear phagocytic system – hematologic system – hematopoietic system – dendritic cell system

Lymphatic system (Lymphatic system structure [89890002]): is conceptually the set of structures through which lymph flows. It includes the lymph nodes (lymph node structure 59441001) and lymphatics (structure of lymphatic vessel 83555006). It supports the categorization of findings, disorders and procedures that relate to the flow of lymph.

Lymphoid system (Lymphoid system structure [122490001]): is conceptually the set of structures made up of aggregates of lymphoid cells. It includes lymphoid aggregates of the intestine, marrow, liver, and other locations, and the lymph nodes, spleen, and thymus, and tonsils & adeonoids. It excludes the lymph vessels. It supports categorization of lymphomas.

Immune system (Immune system structure [116003000]): includes all of the lymphoid system, as well as the mononuclear phagocytic system. There are also essential components of the immune system that are cellular and sub-cellular and are involved in cellular and humoral immunity.

Mononuclear phagocytic system (Mononuclear phagocyte system structure [127908000]): a collection of true macrophages, distributed widely in the body (splenic sinusoids, liver Kuppfer cells, pulmonary alveolar macrophages, osteoclasts, macrophages in serous membranes, and microgliocytes). It is part of the immune system.

Dendritic cell system (Dendritic cell system structure [127909008]): a collection of antigen-presenting cells, including epidermal Langerhans cells, dendritic reticulum cells, and interdigitating cells. Class I histiocytoses (Langerhans cell histiocytosis) are disorders of the dendritic cell system.

Reticuloendothelial system (Reticuloendothelial system structure [6013009]): an outdated term, includes the true macrophages (the mononuclear phagocytic system) and also additional endothelial cells that line lymphoid sinusoids and hematopoietic tissues.

Hematologic system (hematological system structure [414387006]) : includes the bone marrow, the lymphoid system, the hematopoietic system, and the terminal cells of all lineages of the hematopoietic system (red cells, white cells, platelets, histiocytes, plasma cells, etc). This means that disorders of the hematologic system do *not* necessarily include disorders of the hemostatic system, even though bleeding and thrombosis are usually categorized as hematologic.

Hematopoietic system (hematopoietic system structure [57171008]): includes the structures and cells responsible for erythropoiesis, granulocytopoiesis, monocytopoiesis, thrombocytopoiesis, and lymphopoiesis. Hematopoietic should be differentiated from hematologic, since the terminal cells of each lineage (the erythrocyte, segmented neutrophil, monocyte, histiocyte, platelet, mature T- and B-cells, plasma cells, etc.). are no longer strictly hematopoietic.

3.5.6 Skeletal system [113192009] – Bony skeleton/bone structure [272673000] – Vertebral column [421060004]

The skeletal system (systema skeletal in Nomina Anatomica) includes both bones and cartilages of the body. The bony skeleton includes just the bones. The vertebral column is part of the skeletal system, and includes the intervertebral discs (fibrocartilage). Individual vertebrae are part of the bony skeleton. The spinal region (also sometimes called the spine) includes the spine proper (same as

vertebral column = vertebra and intervertebral discs) as well as the contents of the spinal canal, and also paraspinal ligaments, muscles, soft tissues, and skin.

3.5.7 Soft tissue

There are at least three different use cases (and therefore at least three different meanings) for the phrase “soft tissue”:

1) A category for tumors. So-called soft tissues give rise to similar types of neoplasms that appear to be of mesenchymal stem cell origin, generally termed the soft tissue neoplasms, and this appears to account for the inclusions and exclusions of the category. Non-neoplastic masses arising in the same tissues are included in the most recent WHO classification of “soft tissue tumors.” For tumors, soft tissue is defined as “non-epithelial extraskeletal tissue of the body exclusive of the reticuloendothelial system, glia and supporting tissue of various mesenchymal organs.”.[1] Other explicit inclusions are: fibrous tissue, fascia, ligaments, tendons, tendon sheaths, synovia, bursas, skeletal muscle, smooth muscle, fatty tissue, adipose tissue, blood vessels, lymph vessels, peripheral nerves, sympathetic and parasympathetic nerves and ganglia. Subcutaneous tissue is included. Skin is excluded. Skeletal cartilage is excluded, along with pleura, pericardium and peritoneum, the central nervous system, endocrine glands, and viscera.
   FSN: Extraskeletal non-epithelial non-reticuloendothelial non-glial soft tissue (body structure)
2) A category for sites of non-bone disorders and injuries of the limbs, head, neck, and body wall. In this case, skeletal cartilage is included as a soft tissue. Skin and lymph nodes are not included, but otherwise all non-bone structures of the limbs are included. Subcutaneous tissue and fat are included. For the head, neck and torso, this category excludes reticuloendothelial system, central nervous system, endocrine glands, viscera and supporting tissues.
   FSN: Musculoskeletal and/or neurovascular soft tissue excluding central nervous system and visceral soft tissues (body structure)
3) A category for structures identified in images. In this case, soft tissues include everything except for mineralized bone tissue and teeth.

NOTE: As of the 20080131 release, these three meanings have not been incorporated into the terminology, and therefore concepts using the phrase “soft tissue” require significant changes.

3.5.8 Hematopoietic system – Blood – Spleen – Lymph nodes – Thymus

Hematopoietic is used to mean the not-as-yet-mature cellular elements that eventually form the cellular components of blood. The blood itself cannot be strictly part of the hematopoietic system, since this would cause all components of blood to be part of the hematopoietic system (including components like albumin, clearly not 'hematopoietic'). Leukocytes, red cells and platelets are the *result* of hematopoiesis, but they are not blood-forming themselves, in the strict sense we are using (otherwise leukocytosis would become a disorder of hematopoiesis, whereas it can arise simply from a demargination of white cells following stress). We have created a code named "cellular components of blood"; note that platelets are not actually cells, but are 'cellular components'. Likewise, for spleen,

[1] Enzinger FM, Weiss SW: Soft-Tissue Tumors. St. Louis: Mosby, 1995.

lymph nodes and thymus, we have created "hematopoietic cells of spleen" etc. to indicate that they are part of the hematopoietic system. This enables differentiation of disorders of the hematopoietic system from infectious, traumatic and other disorders, and prevents incorrect autoclassification.

3.5.9 Blood – Cardiovascular system – Hematopoietic system

The blood is not necessarily part of the cardiovascular system, nor is it necessarily part of the hematopoietic system. If it were, then leukemia would be a cardiovascular disorder, and septicemia would be a hematopoietic disorder. Since these inferences violate our clinical expectations, we make the underlying model of anatomical relationships support the kind of relationships that are correct and expected. Thus blood is a body fluid, not strictly part of either the hematopoietic or cardiovascular systems.

3.5.10 Circulatory system – systemic, central, peripheral, cerebrovascular, intracranial, extracranial

3.5.10.1 Systemic vs pulmonary circulation

The systemic circulatory system is the combined arterial and venous circulation that begins where blood leaves the left ventricle and ends where blood enters the right atrium. It excludes the coronary circulation.

The pulmonary circulation is the combined arterial and venous circulation that begins where blood leaves the right ventricle and ends where blood enters the left atrium.

The heart chambers are also considered part of the circulatory system.

3.5.10.2 Central vs peripheral vs cerebrovascular system

The term “central vascular” is not in common use. In fact, the term does not appear in SNOMED at all. However, the term “peripheral vascular” is very common, and therefore it requires a definition that (by default) sets the boundary between central and peripheral vascular systems.

The simplest definition of peripheral vascular system is that it is the vascular system that is not central; and then the central vascular system includes the pulmonary circulation, coronary circulation, cerebrovascular system, thoracic aorta, superior vena cava, inferior vena cava, and mediastinal blood vessels.

Peripheral vascular disease is often distinguished from cerebrovascular disease and coronary artery disease. These are the three major categories of diseases caused by problems in vascular circulation in general, and atherosclerosis in particular. As a result of this clinical distinction, the cerebrovascular system is excluded from the peripheral vascular system.

“Cerebrovascular” is commonly defined in two ways: as either the blood vessels *in* the brain, or the blood vessels that *supply* the brain (including those within the brain). Because cerebrovascular disease includes extra-cranial occlusions of the vertebral and carotid arteries, we define the cerebrovascular system as those vessels involved in the supply and drainage of blood to the brain. Convention does, however, tend to exclude the innominate artery - which gives rise to the left common carotid – and the arch of the aorta – which gives rise to the right common carotid. Convention also excludes the subclavian arteries which give rise to the vertebral arteries.

3.5.10.3 Intracranial vs extracranial vascular system

Some vascular trees are located wholly within the cranial cavity, but some (internal carotid; vertebral) cross the boundary between extra- and intra-cranial. Intracranial segments of such vascular trees must be individually identified as such, and the entire vascular tree must not be categorized as either extra- or intra-cranial. See “tree-structured organs” below. These are regional parts of venous or arterial tree organs.

3.5.11 Endocrine system

The endocrine system structurally is composed of the endocrine pancreas, pineal body, paraganglia, paraaortic bodies, parathyroid glands, endocrine ovary, endocrine testis, adrenal glands, pituitary gland, thyroid gland, the juxtaglomerular apparatus, and some diffuse neuroendocrine structures. Certain parts of the thymus have been shown to be capable of producing endocrine hormones, but the thymus itself is not categorized as part of the endocrine system.

3.5.12 Nervous system

The nervous system is divided into central and peripheral subdivisions. The central nervous system, sometimes also called the “neuraxis”, consists of the brain and spinal cord. The pyramidal system is a subdivision of the central nervous system; the extrapyramidal system is part of the brain. The peripheral nervous system includes all neural structures outside the central nervous system. The nervous system is also subdivided into autonomic, somatic and enteric subdivisions. The autonomic system is further divided into sympathetic and parasympathetic subdivisions. The autonomic system is not entirely a part of the peripheral nervous system; but all autonomic nerves are peripheral (see the section on tree-structured organs and the meaning of “nerve”.)

3.6 Tendons – Muscles

Is a muscle an entire functional unit, including attachments to the skeletal system, or merely the contractile part of this unit? Either choice could be made; clinically we think of the muscle as the contractile part only. The FMA definition of *organ* implies that tendons should be considered part of their corresponding muscles, rather than organs in their own right.

We have decided to model tendon structures as subtypes of their muscle structures. Thus the *Achilles tendon structure* is a triceps surae (gastrocnemius and soleus) muscle structure. This causes the classifier to make a rupture of the Achilles tendon a kind of disorder of the triceps surae (gastrocnemius and soleus) muscle. Functionally this makes sense, even though to some users it may violate the natural sense of "muscle" as contractile tissue only.

3.6.1 Muscle functions

When modeling muscle categories according to their functions, assume they mean the function of the *entire muscle* unless otherwise stated. This follows the general heuristic that CTV3 codes meant *entire entity* unless otherwise stated, while SNOMED codes meant *entity structure* unless otherwise stated. Most of the muscle functional groupings came from CTV3.

3.7 Bones – Bone Tissue

3.7.1 The word “bone”:

In ordinary usage, the word “bone” conflates the meanings “bone organ” and “bone tissue” onto the single word.

3.7.2 Definitions:

3.7.2.1 Bone (tissue) structure:

a quantity of regular connective tissue which consists of osteocytes and related cells, the intercellular matrix of which is ossified. (or any part thereof)

3.7.2.2 Bone structure:

a bone organ or any part thereof.

3.7.2.3 Bone organ:

an organ with cavitated organ parts, which primarily consists of compact (cortical) and cancellous bone, which surround bone marrow cavities; other parts include periosteum, endosteum, (and, according to FMA, articular cartilage.)

3.7.2.4 Non-ossified parts of bone

Bone organs are composed primarily of bone tissue, but there are some non-ossified parts. In particular, periosteum is clearly a part of a bone organ, but is not ossified tissue.(Articular cartilage is in dispute: SNOMED doesn’t currently model articular cartilage as a part of bone, although FMA does).

3.7.2.5 Bone marrow and marrow cavity:

Because bone marrow is contained within a marrow cavity, it is in one sense included within a whole bone. If you have a whole femur, you also have its bone marrow - at least in living subjects. But in another sense the marrow is not strictly part of the bone organ itself. In skeletons, the whole femur has a cavity where the marrow was, but there is no marrow. Clinical reasoning generally does not include marrow disorders under bone disorders, nor marrow procedures under bone procedures.

Examples:

Bone marrow disorders are not musculoskeletal disorders, but bone disorders are.

Bone marrow transplants are not considered types of bone transplant.

Osteomyelitis is not the same as osteitis.

The (empty) marrow cavity is part of the bone organ, and the marrow is contained in the marrow cavity but is not part of the bone organ. Therefore *Bone marrow structure (body structure)* is not a subtype of *Bone structure (body structure).*

All bone marrow was intended to be the E “entire” counterpart to the S of *bone marrow structure*, and so it also is **not** a subtype of *Bone structure (body structure).*

3.7.2.6 Structure of (named bone) versus Bone structure of (named bone)

To differentiate marrow, vessels, nerves and periosteum from the actual hard tissue of bones, we differentiate “structure of tibia” from “bone structure of tibia”. The bone marrow and other soft tissues

of the tibia can then be categorized separately from the hard tissues. Bone marrow diseases are not considered musculoskeletal diseases, so bone marrow structures should not be placed in the bone (tissue) structure hierarchy.

3.7.3 Long bone [113193004] – Short bone: [21478002]

ICD-9 makes a distinction between the long bones of the limbs (humerus, radius, ulna; femur, tibia, fibula) and all the others, which it terms short bones. Dictionary definitions of long bone sometimes cite the proportional relationship between length and width (length >> width), and one could infer from this description that metacarpals, metatarsals, and phalanges might fit the definition of long bone. However, we have not defined these as long bones, but have followed the ICD-9 distinction (see 170.5 and 170.8, for example). We have thus far left non-limb bones unclassified with respect to long vs short.

3.7.4 Sternum – Manubrium, Body, Xiphoid

The sternum is considered a bone organ. The manubrium, body and xiphoid are parts of the sternum classed as zones in FMA.

3.7.5 Nasal turbinates – Nasal conchae

We have differentiated between the bone underlying the nasal turbinates (118648008, 122491002, 122492009, and 122493004) and the turbinates themselves. The turbinates themselves (6553002, 60962000, 65289004 and 33415007) include both bone and overlying mucous membranes and other tissues. The inferior nasal turbinate bone is a facial bone (and skull bone) in its own right. However, parts of the ethmoid bone form the middle, superior and supreme nasal conchae. This means that the bones of the middle, superior and supreme turbinates are not bone organs.

3.8 Tree structured organs

Arteries, veins, nerves, and the bronchi form tree-like structures that distribute across multiple regions. Because of their extent and their interdigitation with other structures, they require some slightly different thinking and modeling. FMA deals in a very consistent way with organs that are structured as trees, which can either have a cavity or be solid. In the first category (“organ with organ cavity”) it has a subtype “hollow tree organ”. The hollow tree organs are:
tracheobronchial tree
biliary tree
vascular trees,
arterial trees
the systemic arterial tree
the pulmonary arterial tree
venous trees
the systemic venous trees (superior, inferior, and 4 cardiac trees)
the pulmonary venous trees (there are 4: sup L, inf L, sup R, inf R)
the portal venous tree
lymphatic trees (there are two: the right lymphatic duct tree, and the thoracic duct tree)

Among the solid organs, there is one category that is tree-structured. The tree-structured solid organs include:
neural tree organs
cranial nerve trees
spinal nerve trees
spinal accessory nerve tree (strictly neither a cranial nerve nor a spinal nerve per se)
peripheral nerve trees
autonomic nerve trees
cranial nerve-tract complex trees

Having accepted the idea of tree-structured organs, the next task is to decide what words to use in a systematic way to refer to them and their various parts.

3.8.1 The words “artery” and “vein”

FMA defines “artery” as a subdivision of an arterial tree (organ) which consists of branching sets of tubes (arterial trunks) that form a tree; together with other arterial trees (organ part), it constitutes an arterial tree (organ).
Similarly, it defines “vein” as a subdivision of a venous tree (organ) which consists of branching sets of tubes (venous trunks) that form a tree; together with other venous trees (organ part), it constitutes a venous tree (organ)
To restate these definitions, it would be correct to say that FMA regards “artery” as an “arterial tree – organ part” and “vein” as a “venous tree – organ part”. There are thus three potential meanings for “artery”, and three for “vein”:

1) an arterial (or venous) trunk
2) an arterial (or venous) tree organ, and
3) an arterial (or venous) trunk plus all its branches.

In modeling SNOMED meanings that refer to arteries or veins, it is necessary to decide which of these meanings is intended. It is easy to dispense with (2) because there are only two arterial tree organs and only eleven venous tree organs, and these are readily named as such. The remaining difficulties arise in differentiating when a trunk is intended, and when an entire tree (trunk plus branches) is intended.

3.8.2 Artery : trunk of artery vs arterial tree

3.8.2.1 Pulmonary artery – Artery of lung – Trunk of pulmonary artery

Trunk of pulmonary artery [45341000]: This is the main pulmonary artery, the "great vessel" coming off the right ventricle and splitting into right and left main pulmonary arteries. Some dictionaries make this synonymous with "pulmonary artery".
Pulmonary artery within lung [128260003]: Any artery of the pulmonary circulation that is regionally within the lung, the boundary being defined by the hilum.
Pulmonary artery [81040000]: Any artery of the pulmonary circulation, i.e. artery(ies) conveying unoxygenated blood from the heart into the lungs, including the trunk, right and left branches of the pulmonary artery, which are within the mediastinum, and all their branches, which tend to occur at or past the hilum and are therefore regionally within the lung.

3.8.2.2 Common carotid artery – Artery of neck

The right common carotid artery usually arises from the brachiocephalic trunk behind the right sternoclavicular joint, and thus has no real thoracic portion. However, the left common carotid arises from the arch of the aorta and does have a short thoracic portion. Should the common carotid artery (not specifiying laterality) be an artery of neck, i.e. an artery that is part of the neck? Strictly speaking, it is not, because of the thoracic portion of the left common carotid. At present, however, the model of anatomy includes common carotid artery as an artery of the neck. This needs to be changed.

3.8.3 Vein : trunk of vein vs vein as a tree structure

In general “tributary of vein x” is-a vein and part-of X. (but some veins that are part of the x venous tree are not direct tributaries of x. I think we mean “direct tributary” when we say something is a tributary). The trouble is that “trunk of vein x” is really what has been classified under the vein hierarchy. So, for example, internal jugular vein is listed as a vein of the neck, but of course its entire venous tree extends into the head, so “internal jugular vein – venous tree” is not strictly part of the neck, while “internal jugular vein – venous trunk” is strictly part of the neck. This all needs to be made much clearer, for veins, arteries and nerves.

3.8.3.1 Vein and its tributaries:

We have retired all the “vein x and its tributaries”, with MAYBE-A links to “structure of vein x” and “entire vein x”. This follows the FMA definition of “vein” to mean that it is a tree-like organ part with multiple branches (tributaries). To specify the root or trunk of a vein requires a separate term.

3.8.3.2 Pulmonary vein vs vein of lung

Pulmonary vein great vessel: There are four pulmonary veins that enter the left atrium, two on each side; these are what is intended by the name "pulmonary vein." The pulmonary veins are "great vessels" (vessels that enter the heart). Common usage sometimes might result in people referring to any vein that is part of the lung as a "pulmonary vein," but we have a separate code (see “pulmonary venous structure”) for this meaning. As with other veins, we adopt the meaning that includes the tree structure feeding into the trunk of the vein. Pulmonary vein means “one of the four pulmonary veins along with its tree-structured tributaries”.

Pulmonary venous structure [122972007]: This means any vein that drains the lung, and a synonym is “vein of lung”. Pulmonary veins are kinds of "vein of lung." But "Pulmonary vein" and "vein of lung" are not synonyms.

So far, there is no code for “pulmonary vein within lung”.

3.8.3.3 Retinal vein

There is no vein named “retinal vein” therefore “vein of retina” and “retinal vein” are the same.

3.9 The word “nerve”

FMA needs further refinement of its definitions and comments related to the word “nerve”. The comment under “neural tree organ” says:

The term nerve is conventionally used as a homonym for two concepts: 1. an anatomically distinct nerve trunk (without branches) that is identified in a dissection (e.g. the structure that student identifies when a pin is placed in the trunk of the vagus nerve, for instance located on the arch of the aorta); 2. a larger anatomical entity which supports a related set of functions (e.g. all anatomical components of the vagus nerve that are necessary for it to execute its functions; for instance when a student is asked which nerve is responsible for slowing the heart his answer, the vagus nerve, includes the vagal nucleus, as well as the trunk and branches of the vagus). Neural tree designates the second concept in order to distingiush it from the first which is only a part (subdivision of) the vagal neural tree.
Yet the definition of the FMA class labelled "nerve" is:
Segment of neural tree organ which has as its parts a nerve trunk and its branches; together with other nerves of the same tree it constitutes a neural tree. Examples: chorda tympani, digastric branch of facial nerve, greater petrosal nerve, posterior cutaneous branch of posterior ramus of cervical nerve, superior lateral cutaneous nerve of arm.
It seems obvious that FMA has acknowledged three meanings for "nerve":

1) a nerve trunk
2) the entire neural organ including nuclei, ganglia, roots, etc.
3) a nerve trunk plus all its branches (excluding nuclei, ganglia, and roots)

It does create some confusion when FMA recognizes that "nerve" is commonly used as a homonym for the first two meanings, and then seems to gloss over this fact and assigns the third meaning as the one that they will adopt for the class labelled "nerve".
The trouble in resolving this problem is that when we call the first one "nerve trunk" and the second one "neural tree", there is no common word (other than nerve) for the third meaning.

One solution is to use the phrase "neural organ" for the second meaning, since it is not really just a tree structure (at least an "above-ground" tree: the ganglia aren't in the trunk or the branches); then the phrase "nerve tree" can be used for the third meaning. This would give us the trio of "nerve trunk", "neural organ", and "nerve tree". I think these phrases have better transparency than the trio of "nerve trunk", "nerve tree organ" and "nerve".

3.9.1 Nerves – Entire nerve – Nerve and branches – Nerve tissue

There are several codes with the phrase "x nerve and its branches" which came from CTV3, and they are interpreted as meaning the entire nerve and its branches. Therefore, "x nerve and its branches" would be a duplicate of "entire x nerve", when we interpret "entire x nerve" as being a neural tree organ.[2] For example, "entire facial nerve" is a neural tree organ, and so there is no need for an additional concept called "facial nerve and its branches", which would mean the same thing. An "entire cranial nerve" is a neural tree organ, and "structure of cranial nerve" is that organ or any part

[2] A "neural tree organ" is defined in FMA as "a nonparenchymatous organ which has as its parts an aggregate of neurons (nuclei or ganglia) and their axons which are grouped into fasciculi by connective tissue to form elongated, cable-like structures that are arranged into a tree". The cranial nerves and spinal nerves are considered to be neural tree organs.

(or branch) thereof. Branches of the cranial and spinal nerves are segments of the neural tree organs that they branch from.[3]

3.9.2 Nerve and its branches:

We have retired all the “nerve x and its branches”, with MAYBE-A links to “structure of nerve x”, and “entire nerve x”. This follows the FMA interpretation of “nerve x” to mean that it is a tree-like organ part with branches. To specify the trunk of a nerve requires a specific term.

3.10 Cerebrum – Telencephalon – Supratentorial brain

“Cerebrum” may refer to the supratentorial brain, which is everything except the midbrain, medulla, pons, and cerebellum. In this interpretation, the telencephalon and diencephalon are in the cerebrum. On the other hand, “cerebrum” may refer only to the parts derived embryologically from the telencephalon, which are the cerebral hemispheres and the intercerebral commissure (corpus callosum and anterior commissure).

“Supratentorial brain” is a phrase sometimes used for categorizing tumors (ICD-9 codes 191.0-5 or 191.8-9), and for designating the location of swelling that can result in herniation. The telencephalon and diencephalon (including thalamus, geniculate bodies, pineal body, habenulae, and hypothalamus) are definitely supratentorial. Strictly speaking, the *upper* part of the midbrain (mesencephalon) also is supratentorial. However, the broad categories of ICD codes listed above would exclude any midbrain tumors from the list of supratentorial tumors, so we follow that pattern and exclude all midbrain structures from the supratentorial brain.

3.11 Regional lymph nodes of the lung

We have retained codes representing the nodes in traditional anatomy (lymph nodes categorized as: pulmonary, bronchopulmonary, tracheobronchial, tracheal, and esophageal) along with codes representing node groups used for clinical staging of lung cancer (lymph nodes categorized into 14 stations). Professional societies concerned with the clinical staging of lung cancer have developed at least three different nomenclatures for "stations" of lung-related lymph nodes. The ATS (Americal Thoracic Society) map, published in 1983, is given in *Am Rev Respir Dis* 1983; 127:659-669. A revised system adopted by the American Joint Committee on Cancer (AJCC) and the International Union against Cancer (UICC) in 1997 is given in *Chest* 1997; 111:1718-1723. Even though the numbering of the stations is very similar, the inter-relationships between the various node groups are complex, particularly in stations 4 and 10, near the carina and hilar regions. For example, we believe that AJCC Station 10, named "hilar lymph node", is a synonym for "bronchial lymph node" and "bronchopulmonary lymph node"; however, ATS Station 10R, named "right tracheobronchial lymph node" is not a subtype of "tracheobronchial lymph node" because its definition includes nodes covered by both "lower paratracheal lymph node" (AJCC Station 4) and by "hilar lymph node" (AJCC Station 10). We use "tracheobronchial lymph node" as a supertype of both inferior tracheobronchial (subcarinal) and superior tracheobronchial (a subset of lower paratracheal).

[3] A “nerve” according to FMA is defined as “ a segment of a neural tree organ which has as its parts a nerve trunk and its branches; together with other nerves of the same tree it constitutes a neural tree.”

3.12 Prostate lobes

The "posterior lobe" of the prostate is described in newborns but does not persist into the adult. The three prostate lobes [113295002] are the left and right lateral lobes and the variable middle lobe.

3.13 Abdominal cavity – Pelvic cavity

The term "abdominal cavity" has two meanings, one including the pelvic cavity, the other excluding it. “Abdominal cavity structure” is used as inclusive of both. “Abdominal cavity proper” is used as exclusive of the pelvic cavity.

3.14 Ear – external ear – pinna/auricle

The ear includes external, middle and inner ear. The external ear has two main parts, the auricle (also called the pinna) and the external auditory canal. The external auditory canal is sometimes also called the external auditory meatus. External auditory meatus is not just the external opening of the canal, but rather is a synonym for the canal extending to the ear drum (tympanic membrane). The internal auditory canal is not part of the ear. It is an opening in the temporal bone, and is primarily a nerve conduit that runs roughly parallel to the external auditory canal.

4 Known issues and problems

4.1 Policy for naming regions and surfaces

There is frequently a risk of ambiguity when we name regions and surfaces. For example, consider “thoracic region” and “region of thorax”. Do these mean “the (whole) thorax, a region of the body”, or do they mean “a region of the body that is part of the thorax”? Likewise consider “tooth surface” and “surface of tooth”. Do these mean “the (whole) surface of a tooth”, or do they mean “one of the sub-parts of the tooth surface”?
An FSN naming policy needs to be developed for these situations.
In addition, care must be taken when applying laterality qualifiers. It is never correct to apply laterality to “the (whole) thorax, a region of the body” (we cannot have two of them – there is only one), but it can be correct to apply laterality to “a region of the body that is part of the thorax”, since such a region might be on the right or left side of the body.

4.2 Representation of subcellular structures

Representation of cells and subcellular components of systems: should they be included in the body structure hierarchy?

4.3 The problem with pre-coordinated "combined sites"

It may be helpful to users to have a convenient way of indicating that a disease or procedure or specimen involves a group of body structures. To do this in SNOMED 3, a set of special "combined

site" codes were created in the Topography (T) section. These codes require special handling with respect to their relationships.

Take for example the code for a combined site "liver and spleen". Assume that the use of this code in post-coordinated expressions means that **both** the liver and the spleen are affected. We would expect a query for diseases of the spleen to retrieve diseases involving this combined site. In order for this to happen, there may be several choices of how to structure the anatomy section. The most obvious would be to make "liver and spleen" a subtype of liver structure and a suptype of spleen structure. But this means that when you examine the hierarchy, you see:

Physical anatomical entity
- Organ structure
  - Liver structure
    - Liver-and-spleen
  - Spleen structure
    - Liver-and-spleen

There are two main problems with this approach. First, it is overloading the is-a relationship. Liver-and-spleen is a spleen structure only in the sense that “side-salad-and-spleen” is a spleen structure. Second, it creates the expectation that arbitrary site combinations could be pre-coordinated into the anatomy hierarchy, increasing the maintenance burden and interfering with quality control.

Another possibility might be to use the “part-of” relationship to link liver to "liver and spleen", and also link spleen to "liver and spleen". But similar problems of maintenance and correctness arise as with the is-a approach. What if we add "liver and gallbladder", "liver and diaphragm", "liver and adrenal", "liver and ipsilateral adrenal", "liver and contralateral adrenal", and so forth? If we need to add a part-of relationship for every combined site, we will end up with (seemingly) arbitrarily many part-of relationships in the definition of each site that is involved in a combined site. .

The appproach that has been chosen is to place combined sites in a separate hierarchy under “group of anatomical entities”. They will eventually need a new relationship type, such as “has-member”, to link them to the anatomical sites of which they are composed. For example, “liver and spleen” is-a “group of anatomical entities” which “has-member = liver” and “has-member = spleen”. The “has-member” relationships can then be used to construct routines for retrieval of data that uses these codes to post-coordinate sites.

At the present time, combined sites should not be used in routine modeling of finding-site or procedure-site in the logic-based definitions of codes in the international distribution.

“Hepatosplenomegaly” should have two finding-site relationships, one for spleen and one for liver, rather than one finding site that points to the combined site “liver and spleen”.

Advice on proper modeling of disorders with multiple sites can be found in the Style Guide for Clinical Findings.