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Health informatics — Categorial structure for representation of 3D human body position system —

Part 1: Bones

Informatique de santé — Structure catégorielle pour la représentation du système de positionnement du corps humain en 3D —

Partie 1: Os

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Foreword

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This document was prepared by Technical Committee ISO/TC 215, *Health informatics*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Anatomical descriptions can be very abstract, requiring long narrative descriptions. These descriptions can lead to ambiguity and coding inconsistency. Text-based expressions lack expressiveness and accuracy, medical information is not captured and re-used sufficiently and there are also issues in interoperability. There is currently no unified way of expressing anatomical concepts.

However, recent advancements in imaging technology are dramatically revolutionizing the field. For instance, the spatial resolution in a CT scan is less than 1 mm. Regarding accuracy and expressiveness, it is believed that the gap between medical imaging and clinical terminology is increasing over time. Patients are also having problems understanding their disease because visualization is not given by standard terminology.

Healthcare workers are seeking to achieve additional expressiveness by adopting 3D data in the medical field. Radiation therapies are designed by 3D systems to generate optimal intensities while protecting adjacent tissue. In operating theatres, operations are often guided by 3D navigation systems. For example, arthroplasties are designed and simulated before surgery using 3D technology. Researchers are also studying ways to simulate operation tactics using 3D data by 3D printing, such as AR (augmented reality) and VR (virtual reality). Since 3D systems can deliver accurate spatial information in the human body, it is evident that a standard terminology infrastructure will provide additional expressiveness, accuracy and comparability when 3D data is adopted in medical informatics. Since anatomy is a key piece of information in many clinical descriptions, 3D data can increase the accuracy and expressiveness of clinical terminology. 3D data are numbers that can be processed by mathematical functions providing more computability in research, software production and artificial intelligence.

3D systems provide a consistent way of expressing anatomical concepts in a precise manner. Accurate data can improve data exchange between electronic health records, epidemiological analysis and quality. Increased accuracy also means better clinical decision support systems for patient safety, reducing medical errors and improving efficiency. It also provides visual information for patients and caregivers when conventional standard terminology system does not. HBPS (Human body position system) is intended to be used in electronic health records, personal health record and various medical research purposes.

HBPS is a way of expressing clinical concepts by combining 3D data and text-based terminology. Although the main purpose of 3D is graphical expression, it can play a terminological role in many ways as it has accurate anatomical concept. It can have attributes that are similar to codes in semantic terminological system. It can be pre- or post-coordinated, just as conventional terminological concepts. Since the data inside a 3D system is purely numeric, it can be captured and retrieved better than semantic medical information.

Health informatics — Categorial structure for representation of 3D human body position system —

Part 1: Bones

1 Scope

This document describes the high-level concepts required for representation of 3D data in health information systems from a terminological perspective. It is intended to be used in analysing, developing and managing terminologies in HBPS. The use cases include clinical findings, disorders, problem lists and procedures.

Topics considered in the scope of this document:

— description of terminological concepts for representation of 3D data for human body;

— establishing of the relationships needed for 3D data in terminological systems;

— use cases.

Topics considered outside the scope of this document:

— 3D data structure, implementation and software functionality.

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 General

3.1.1
3 dimensional
3D
computer graphics that define an object by its width, length and depth

Note 1 to entry: See Figure 1.

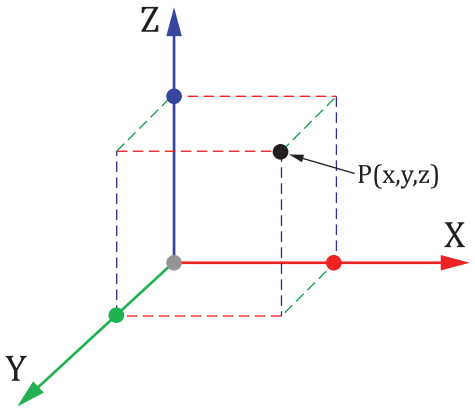

Figure 1 — Three-dimensional space and coordinate of a point

3.1.2
3D data element
unit of 3D data for which the definition, identification, representation, and permissible values are specified by means of a set of attributes

Note 1 to entry: A 3D data element include vertex (a single point that has three-dimensional position and corner of a 3D model), edge (where two faces meet), face (surface of 3D model defined by vertices and edges) and polygon (straight-sided shapes, defined by vertices and edges).

Note 2 to entry: See Figure 2.

3.1.3
human anatomy
study of structures in the human body and how the body parts are organized, physical substance of the human organism

Note 1 to entry: Human anatomy is composed of living cells and extracellular materials and organized into tissues, organs and systems.

3.1.4
anatomical site
formal representation of a sanctioned characteristic composed of the semantic link {HasAnatomicalSite} with an associative relation to the characterizing category including but not limited to <Anatomical structure>

[SOURCE: ISO/TS 22789:2010, 3.2.1]

3.1.5
terminology
structured, human and machine-readable representation of concepts

3.1.6
concept
unit of knowledge created by a unique combination of characteristics

[SOURCE: ISO 1087:2019, 3.2.7, modified — Notes to entry removed.]

3.1.7
clinical terminology
terminology describing health conditions and healthcare activities

3.2 Characterizing categories

3.2.1
3D model
three-dimensional model in virtual space composed of *3D data elements* (3.1.2)

Note 1 to entry: The 3D model covers the human body model and the 3D site model representing these concepts virtually.

3.2.2
3D human body model
3D model (3.2.1) that represents a normal anatomical structure

Note 1 to entry: See Figure 2.

Note 2 to entry: A human body model, which defines systems, organs and body regions, is composed of multiple 3D models.

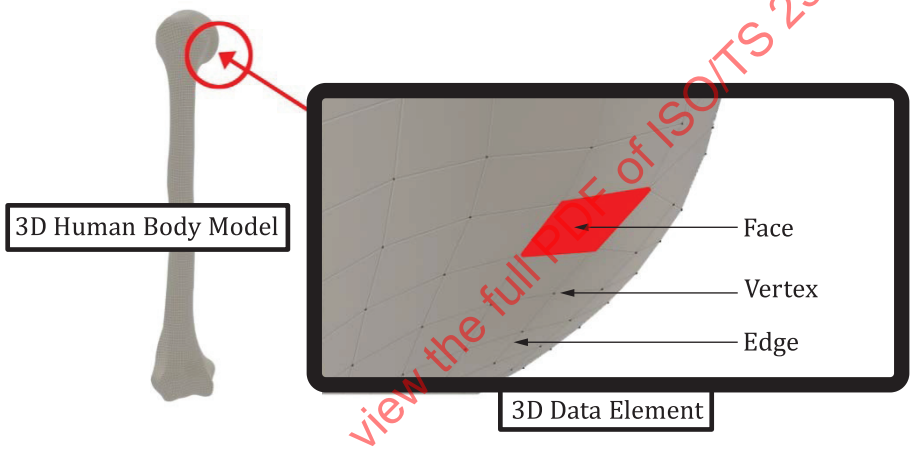

Figure 2 — 3D human body model and 3D data element

3.2.3
3D site model
3D model (3.2.1) that represents *anatomical sites* (3.1.4)

Note 1 to entry: It is used to annotate clinical concepts, such as disorder, symptom and finding. It describes the location, size, shape and volume of anatomical areas in which health professionals are interested.

3.2.4
virtual medical entity
entity that represents a medical concept in virtual space

Note 1 to entry: A virtual medical entity is composed of a 3D model and a descriptive entity. The medical *concept* (3.1.6) can be pre-coordinated, i.e. predefined within a formal (concept representation) system, with an equivalent single unique concept identifier, or post-coordinated, i.e. represented using more than one concept from one or many compositional systems, combined using mechanisms within or outside the compositional systems, with a corresponding 3D model.

3.2.5
virtual body part
medical entity (3.2.4) that constitutes part of a human body in virtual space

Note 1 to entry: It represents body structure or normal anatomy part in virtual space

EXAMPLE Virtual Body Part "L3 Vertebra" (see Figure 4).

3.2.6
virtual clinical finding
virtual medical entity (3.2.4) that constitutes a clinical finding

Note 1 to entry: It includes diagnosis, symptom, nursing diagnosis.

EXAMPLE Virtual Finding "L4 body osteomyelitis" (see Figure 5).

3.2.7
virtual clinical intervention
virtual medical entity (3.2.4) that constitutes clinical interventions or clinical activities that help treat or cure a condition

EXAMPLE Virtual Intervention "L4 laminectomy, right" (see Figure 6).

3.2.8
virtual observation
virtual medical entity (3.2.4) that constitutes an observation or assessment of patient condition

EXAMPLE Virtual Observation "Blood pressure measured at right upper arm" (see Figure 7).

3.2.9
virtual object
virtual medical entity (3.2.4) that constitutes an object in the human body that originates outside the body

Note 1 to entry: Virtual objects can be found in human body by intervention, accident or operative procedure.

EXAMPLE Virtual Object "hip implant device, right" (see Figure 8)

3.2.10
descriptive entity
text-based description of a *virtual medical entity* (3.2.4)

Note 1 to entry: It provides description to a 3D model to form a *virtual medical entity* (3.2.4). It can be used as a pre-coordinated concept representation, i.e. predefined within a formal (concept representation) system, with an equivalent single unique concept identifier or post-coordinated, or as a post-coordinated concept representation, i.e. using more than one concept from one or many compositional systems, combined using mechanisms within or outside the compositional systems, with a *3D model* (3.2.1).

3.2.11
text body part
descriptive entity (3.2.10) that constitutes a part of the human body

Note 1 to entry: It represents concepts of body structure or normal anatomy.

— Bone structure of right tibia (SCTID: 719491009)

— Structure of mid-palmar space (SCTID: 58841000)

— Structure of epiphyseal line (SCTID: 84157002)

— Knee joint cavity (SCTID: 305003004)

— Entire tuberosity of phalanx (SCTID: 727352007)

3.2.12
text finding
text-based entity that represents a judgment on clinical status

Note 1 to entry: It contains diagnosis, symptom, nursing diagnosis.

— Fracture of Bone (SCTID: 125605004)

— Pain in left leg (SCTID: 287047008)

— Hyperostosis of skull (SCTID: 788954009)

— Leg swelling symptom (SCTID: 248480008)

— Malignant neoplasm of bone and cartilage (ICD 10: C41.9)

— Pressure ulcer of heel (SCTID: 225561003)

3.2.13
text intervention
descriptive entity (3.2.10) that constitutes clinical activity that intervenes with disease process

Note 1 to entry: It includes conventional terminological categories that cover surgery, radiologic examination, procedures.

— Open reduction (SCTID: 133860004)

— Application of cast (SCTID: 118480003)

— Fibula X-ray (SCTID: 241076001)

— Examination of lower leg (SCTID: 284382009)

— Pressure ulcer assessment (SCTID: 225393005)

3.2.14
text observation
descriptive entity (3.2.10) that constitutes observation or assessment of patient condition

— Non-Invasive arterial pressure (SCTID: 251076008)

— Arm Length (SCTID: 249748003)

— Cobb angle (SCTID: 285285000)

3.2.15
text object
text-based entity that constitutes object originating outside human body

Note 1 to entry: It can be found in human body by intervention, accidents or operative procedure.

— Foley 5 ml balloon 2-way all silicone male length urethral catheter (SCTID: 411524000)

— Hip Joint implant (SCTID: 303533002)

— Synthetic bone graft (SCTID: 714549006)

— Metal stent (SCTID: 257363003)

4 Categorial structure of 3D human body position system

4.1 Overview

A 3D human body position system uses 3D models in combination with text-based entity. The document describes categories and relations that are required to express clinical concepts with 3D human body models (see Figure 9). It is designed to be used in the development of medical terminologies in various medical domains. Though this categorial structure relates to terminologies and classifications, it is

not directly applicable to the content of existing terminologies, such as SNOMED CT®[1]. SNOMED CT® concepts or concepts from other terminologies may be used in the implementation of this structure.

4.2 Representational relations

4.2.1 shareElement

The representational relation between a 3D human body model (see 3.2.2) and a 3D site model (see 3.2.3). Sometimes, a 3D site model can be created with parts of a 3D anatomical model. They share 3D data elements (see 3.1.2) which are points, surfaces and volume.

EXAMPLE Surgical neck of humerus (3D site model) sharesElement 3D human body model "Humerus" (Figure 3).

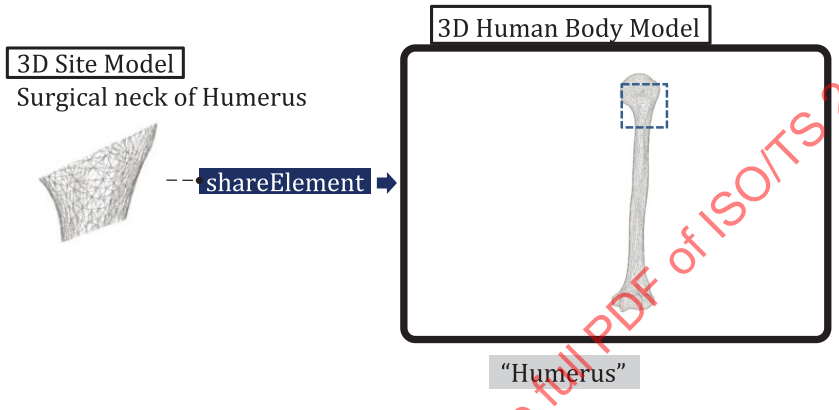

Figure 3 — Structural relation of shareElement

4.2.2 isBodyPart

The representational relation that relates a 3D human body model (see 3.2.2) to text body parts (see 3.2.11) that represent human anatomy (see 3.1.3)

EXAMPLE In Virtual Body Part "L3 Vertebra" (Figure 4), 3D site model isBodyPart "Entire L3 vertebra" (SCTID: 181843001)

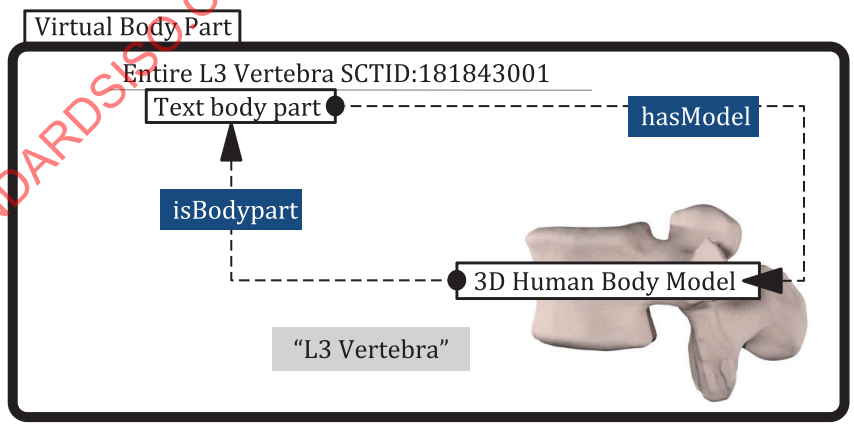

Figure 4 — Conceptual relation of isBodyPart

1) SNOMED CT is the registered trademark of International Health Terminology Standards Development Organisation. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of the product named.

4.2.3 hasFinding

The representational relation between a 3D site model (see 3.2.3) and a text finding (see 3.2.12)

EXAMPLE In the Virtual clinical Finding "L4 body osteomyelitis" (Figure 3), L4 body model (3D site model) hasFinding "acute osteomyelitis of lumbar spine (SCTID: 203159006)

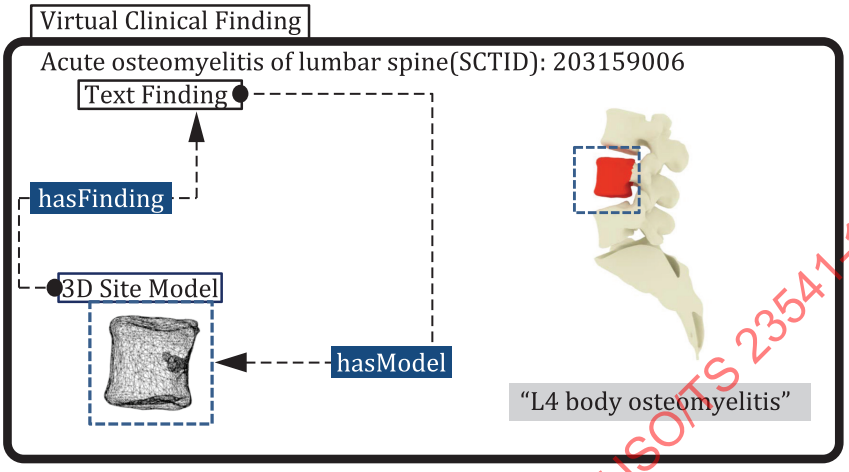

Figure 5 — Conceptual relation of hasFinding

4.2.4 hasIntervention

The representational relation between a 3D site model (see 3.2.3) and a virtual clinical intervention (see 3.2.7).

EXAMPLE In Virtual clinical Intervention "L4 laminectomy" (Figure 6), Part of 4th lumbar vertebra model (3D site model) hasIntervention "Excision of lamina of vertebra" (SCTID: 387731002)

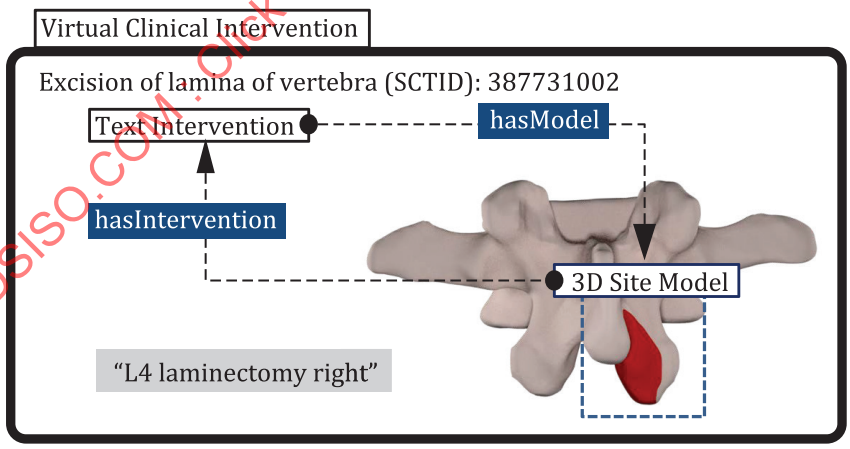

Figure 6 — Conceptual relation of hasIntervention

4.2.5 hasObservation

The representational relation between a 3D site model (see 3.2.3) and a text observation (see 3.2.14).

EXAMPLE In Virtual Observation of "blood pressure measure at right upper arm", right upper arm model (3D site model) hasObservation "Non-invasive arterial pressure" (SCTID: 251076008).

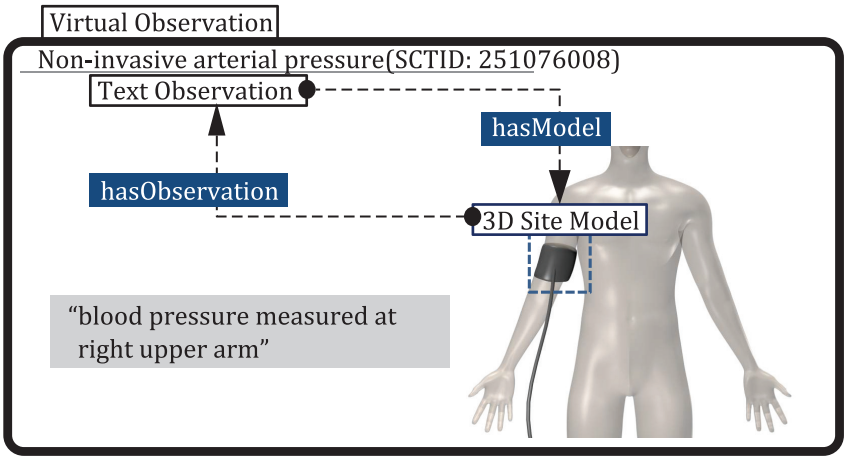

Figure 7 — Conceptual relation of hasObservation

4.2.6 hasObject

The representational relation between a 3D site model (see 3.2.3) and a text object (see 3.2.15).

EXAMPLE In Virtual Observation of "hip implant device, right", right hip implant model (3D site model) isObject "hip prosthesis, device" (SCTID: 67270000).

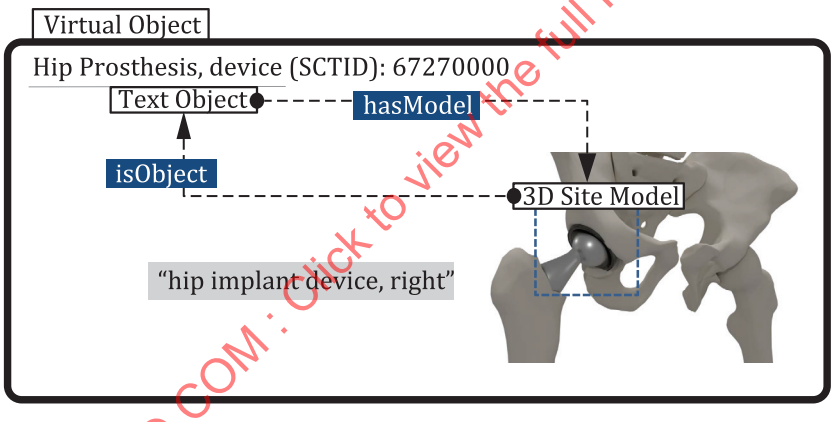

Figure 8 — Conceptual relation of isObject and hasModel

4.2.7 hasModel

The representational relation between a descriptive entity (see 3.2.10) and a 3D model (see 3.2.1).

EXAMPLE In Virtual Observation of "hip implant device, right", Virtual Object hasModel right hip implant model (Figure 8).