Telemedicine Standards
Telemedicina e e-Saúde
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References

- Sources are indicated by [RefSource] where the complete citation will be at the end
- Insite citations will be From: CitationSource
Standards

Objectives

- Facilitate imaging medical devices interoperability by specifying:
  - A set of protocols for network communication
  - The syntax and semantics of Commands and the protocol information
  - Data storage services that should be implemented by devices that implement the standard
    - Includes file formats and directories structure
- Reuse international standards as possible
- Define the requirements to be conformant with the standard

DICOM – Does not specify

- Implementation details;
- Set of capabilities and functionalities that a system with compliant devices should provide;
- The test procedure or validation to be compliant with the standard
  - Only the requirements
  - Some other consortiums (e.g.: Wi-Fi-Alliance) do
DICOM – Standard parts
### Protocol Architecture

- **[Dicom-NET]**
  - Medical imaging application
  - DICOM Application Message exchange
  - DICOM Upper Layer Protocol for TCP/IP
  - TCP/IP
  - Network

### Association Request Example

- **[Dicom-NET]**
  - **Requestor**
    - A-ASSOCIATE request
    - A-ASSOCIATE confirmation
  - **Dicom UL Service Provider**
  - **Acceptor**
    - A-ASSOCIATE indication
    - A-ASSOCIATE response

SAP – Service Access Point
UL – Upper Layer
PACS

- Picture Archiving and Communication Systems

- Composed of:
  - Acquisition device(s);
  - Communication network (secure);
  - Archive system(s);
  - Visualization stations;

- DICOM is the standard that defines the communication and storage.

UMLS

Unified Medical Language System

Standards

Based on [UMLS Basics (tutorial)](UMLS-TUTORIAL)
Telemedicina e eSaúde

UMLS

- Enable the development of applications that understand biomedical language;

The Knowledge Sources
(delivered as machine readable files)

UMLS Sources of data

- The Meta-Thesaurus has more than 100 vocabularies;
  - ~76% in English, with 17 other languages (including PT, 1.38%)

  Example:

<table>
<thead>
<tr>
<th>Term</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atrial fibrillation</td>
<td>ICD-9-CM</td>
</tr>
<tr>
<td>AF</td>
<td>NCI Thesaurus</td>
</tr>
<tr>
<td>AFib</td>
<td>MedDRA</td>
</tr>
<tr>
<td>Atrial fibrillation (disorder)</td>
<td>SNOMED Clinical Terms</td>
</tr>
<tr>
<td>atrium; fibrillation</td>
<td>ICPC2-ICD10 Thesaurus</td>
</tr>
</tbody>
</table>
Categories

• Most important categories of the used dictionaries;

Entry example

• **Concept Unique Identifiers (CUI):** a meaning of something. Associated with the several names of the concept. Identifier starts with C + 7 digits. **C0018681** in the figure.

• **Lexical (term) Unique Identifiers (LUI):** lexical variants. Identifier L+7 digits, example has 3 LUIs.

• **String Unique Identifiers (SUI):** each "name" for the unique concept or string has a unique permanent identifier with S+7 digits.

• **Atom Unique Identifiers (AUI):** sources of the strings/concepts from where the MetaThesaurus is built. Identifier A + 7 digits.
Semantic

- Semantic types
  - High level categories
  - Ex.: Physiologic Function

- Semantic relations
  - Relation between types
  - Ex.: disrupts

Specialist Lexicon and tools

- English lexicon that includes biomedical terms and current words. With the information on:
  - Syntax
  - Morphology
  - Spelling

- Tools:
  - Lexical variants generator
  - String normalizer
  - Word indexer
SNOMED CT
Systematized Nomenclature of Medicine Clinical Terms

Standards

Based on SNOMED Clinical Terms® User Guide July 2009
International Release, The International Health Terminology Standards Development Organisation [SNOMED-UG]

SNOMED CT

- Aggregation of
  - SNOMED Reference Terminology (SNOMED RT) by the College of American Pathologists (CAP)
  - Clinical Terms Version 3 (CTV3) from the UK NHS

- Composed by:
  - Concepts, terms and relationships
Hierarchies (examples)

- Clinical finding
- Physical force
- Procedure
- Event
- Observable entity
- Environment or geographical location
- Body structure
- Social context
- Organism
- Situation with explicit context
- Substance
- Staging and scales
- Pharmaceutical/biologic product
- Linkage concept
- Specimen
- Qualifier value
- Special concept
- Record artefact
- Physical object

Granularity
Identifiers

- Concepts
  - Numerical Identifier

- Descriptions
  - Numerical Identifier

ConceptID 22298006:

- **Fully Specified Name:** Myocardial infarction (disorder)
- **DescriptionID:** 751689013
- **Preferred term:** Myocardial infarction
- **DescriptionID:** 37436014
- **Synonym:** Cardiac infarction
- **DescriptionID:** 37442013

Uniquely identifies a concept

Semantic tag ➔ semantic category

Relationships

- Navigation
- Aggregation
- Definition
- Qualification
- Kind-of-value
- Additional

Fracture of tarsal bone (disorder)

- IS_A Fracture of foot (disorder)
- FINDING SITE Bone structure of tarsus (body structure)
- ASSOCIATED MORPHOLOGY Fracture (morphologic abnormality)

See Editorial Guide 4.5.6
Attributes define (examples):

- Clinical results (Clinical Findings)
- Procedures
- Evaluation Procedures
- Specimen
- Pharmaceutical / biologic product
- Explicit context
- Events
- Physical objects
ICD

- International Classification of Diseases
- Defined by WHO
- For clinical and management use;

ICPC-2

- International Classification Primary Care, 2nd Edition
- One of the adaptations of ICD by WHO
- It allows to classify:
  - Reasons for “meeting” (doctor visit)
  - Diagnostic
  - Procedure used
WHO others

- **ICF** – International Classification of Functioning, Disability and Health
- **ICHI** – International Classification of Health Interventions

LOINC

- **Logical Observation Identifiers Names and Codes**
- Maintained by the Regenstrief institute
- Defines codes to identify test **results** and clinical **observations** and **measures**.
  - On the context of HL7 and CEN TC251 messages
- Allows the suggestion of new terms
- Freely available.
LOINC (cont.)

- Used by/compatible with other standards
  - HL7 (used by)
  - UMLS (maps to)
  - SNOMED (used with)

MeSH

- Medical Subject Headings
- Maintained by the national library of medicine from the USA
- Defines an hierarchical structure of medical terms
- Used to indexed medical articles;
  - Books, documents, audio-visuals
**HL7**

- **Health Level International 7**
- Defines standards for the exchange, integration and search of health information on an electronic format.
- Supports the clinical practice and management
- + 2300 members
- The 7 refers to the OSI layer

**HL7**

- Promotes the interoperability between systems:
  - Functional Int.: information exchange
  - Semantic Int.: information usage
- Divided in several working groups;
- **Technical committee** for EHR
- Standards freely available
  - HL7 Standards
  - Some restrictions
Model

- **RIM – Reference Information Model:**
  - Object Model that identifies the life-cycle of the events carried by the messages;
  - Model shared by all domains, i.e., from all create their messages;
  - Based on the UML (Unified Modelling Language) methodology

- **HDF – HL7 Development Framework**
  - Supports the extension of the semantic interoperability semantic to “all” medical information.

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American Telemedicine association (ATA)

Standards
Guidelines

• Defined for/by several working groups

• **Core Standards for Telemedicine Operations**
  • Contains the basic definitions for all other documents;
  • Define the nomenclature, what are the technical, administrative and clinical standards;

Home Telehealth Clinical Guidelines

• Defines terminology,
• Criteria for patients, medical institutions, technologies
• Interactive services, monitoring
• From 2003
Home Telehealth Clinical Guidelines Example

- Use of Sensor Technology
  - If a detached remote sensor is employed for a home communications unit the following is required:
    - Indication of out of range for wireless operation
    - Indication for low battery status
    - Indication that the sensor is working properly
  - The sensors should not damage or irritate the patient’s skin, and should not irritate the patient during sleep.
  - The sensors should not contain elements that pose a danger if chewed, licked or otherwise manipulated by the patient.

Telehealth Practice Recommendations for Diabetic Retinopathy

- Defines:
  - Professional qualifications
  - Equipment specifications
  - Legal requirements
  - Validation
  - Quality control

- From 2011
Telehealth Practice Recommendations for Diabetic Retinopathy

Flow diagram for an ocular telehealth system [ATA-RECDIA]

Other guidelines

- Practice Guidelines for Video-Based Online Mental Health Services, May 2013
- Quick Guide to Store-Forward and Live-Interactive Teledermatology for Referring Providers, April 2012
- Evidence-Based Practice for Telemental Health July 2009
- ...
Guidelines for the Surgical Practice of Telemedicine

- By the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES)
- With definitions, appropriate use, comments
- Revised October 2010

Example: Telesurgery (Remote Surgery)

- Definition:
  - Surgery, procedure or intervention performed on an inanimate trainer, animate model, or patient, in which the surgeon or operator is not at the immediate site of the model or patient being operated upon. Visualization and manipulation of the tissues and equipment is performed using tele electronic devices.

- Appropriate Use:
  - Demonstration and/or teaching technique or procedures using inanimate trainers as the objects of the procedure.
  - Demonstration and/or teaching techniques or procedures using animate model for purposes of testing technology.
  - Demonstration and teaching techniques or procedures on patients under strict guidance of an IRB and only when a qualified surgeon is present to intervene in a timely fashion if technical difficulties arise.

- Comments:
  - Remote surgery remains investigational and should be performed with IRB approval and only by surgeons familiar with the technology. The introduction of telerobotic surgery, coupled with improvements in bandwidth and reduction in time has allowed for the remote safe completion of common surgical procedures (19-23).
  - ....

Fonte: [SAGES]
HON Code (Health on the net)

What is

- "HONcode is the oldest and the most used ethical and trustworthy code for medical and health related information available on Internet."
- Improve the information quality for health professionals and patients

Source: http://www.hon.ch/
HONCODE Principles

Source: http://www.hon.ch/

- Principle 1: Authority
  - Give qualifications of authors

- Principle 2: Complementarity
  - Information to support, not replace

- Principle 3: Confidentiality
  - Respect the privacy of site users

- Principle 4: Attribution
  - Cite the sources and dates of medical information

- Principle 5: Justifiability
  - Ability to back claims

- Principle 6: Transparency
  - Accessibility, provide valid contact details

- Principle 7: Financial disclosure
  - Provide details of funding

- Principle 8: Advertising
  - Clearly distinguish advertising from editorial content

The end
Telemedicine Standards
References – Standards

- [UMLS-TUTORIAL] UMLS Basics [tutorial](http://www.nlm.nih.gov/research/umls/)
- [SAGES] Guidelines for the Surgical Practice of Telemedicine

References – Standards – Sites

- American Telemedicine Association, Standards and Guidelines
- I do Imaging, Free Medical Imaging Software
- OpenEHR
Acronyms

- EHR – Electronic Health Record
- HON – Health On the Net
- ICD – International Classification of Diseases
- ICF – International Classification of Functioning, Disability and Health
- ICHI – International Classification of Health Interventions
- ICPC – International Classification of Primary Care
- IHE – Integrating the Healthcare Enterprise
- LOINC – Logical Observation Identifiers Names and Codes
- MeSH – Medical Subject Headings

Acronyms

- PACS – Picture Archiving and Communication System
- RCT – Randomized Controlled Trial
- RIM – Reference Information Model
- RIS – Radiology Information System
- SAP – Service Access Point
- SNOMED CT – Systematized Nomenclature of Medicine Clinical Terms
- UL – Upper Layer
- UMLS – Uniform Medical Language System
- WHO – World Health Organization