Interoperability in healthcare

eHealth Summer School | Session 8 | September 1st 2021 (11:00-11:40)

HL7®

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FH University of Applied Sciences TECHNIKUM WIEN

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Funded by City of Vienna Economic Affairs, Labour and Statistics

Agenda

- Problems around lack of interoperability
- Standards
- Interoperability definition
- Challenges and solutions in the healthcare interoperability area

Problems around lack of interoperability

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IT is revolutionizing Medicine

Types of Healthcare applications

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Critical installations and resources

Nursing

Coding

Oncology

Medication administration management

Emergency

Admission, discharge, transfer (ADT)

Laboratory (LIS)

Financial and accounting

Electronic Health Record (EHR)

Picture Archive and Communication System (PACS)

Supply Chain Management (SCM)

Device management

Master Patient Identification (MPI)

Computerized Physician Order Entry (CPOE)

Vendor Neutral Archive (VNA)

Knowledge management

Clinical Decision Support

Patient Relationship Management (PRM)

Intensive Care

Internal Medicine

Document management

Clinical Workflow Management System (CWMS)

Medical Documents and Reports mgmt

Human Resources mgmt

Radiology (RIS)

Vaccination

Anatomic Pathology

Drug interactions

Pharmacy (PHIS)

Anesthesiology

Dedicated Image Processing (CAD)

Automatic Voice Recognition system

Courtesy ENESIS 2020

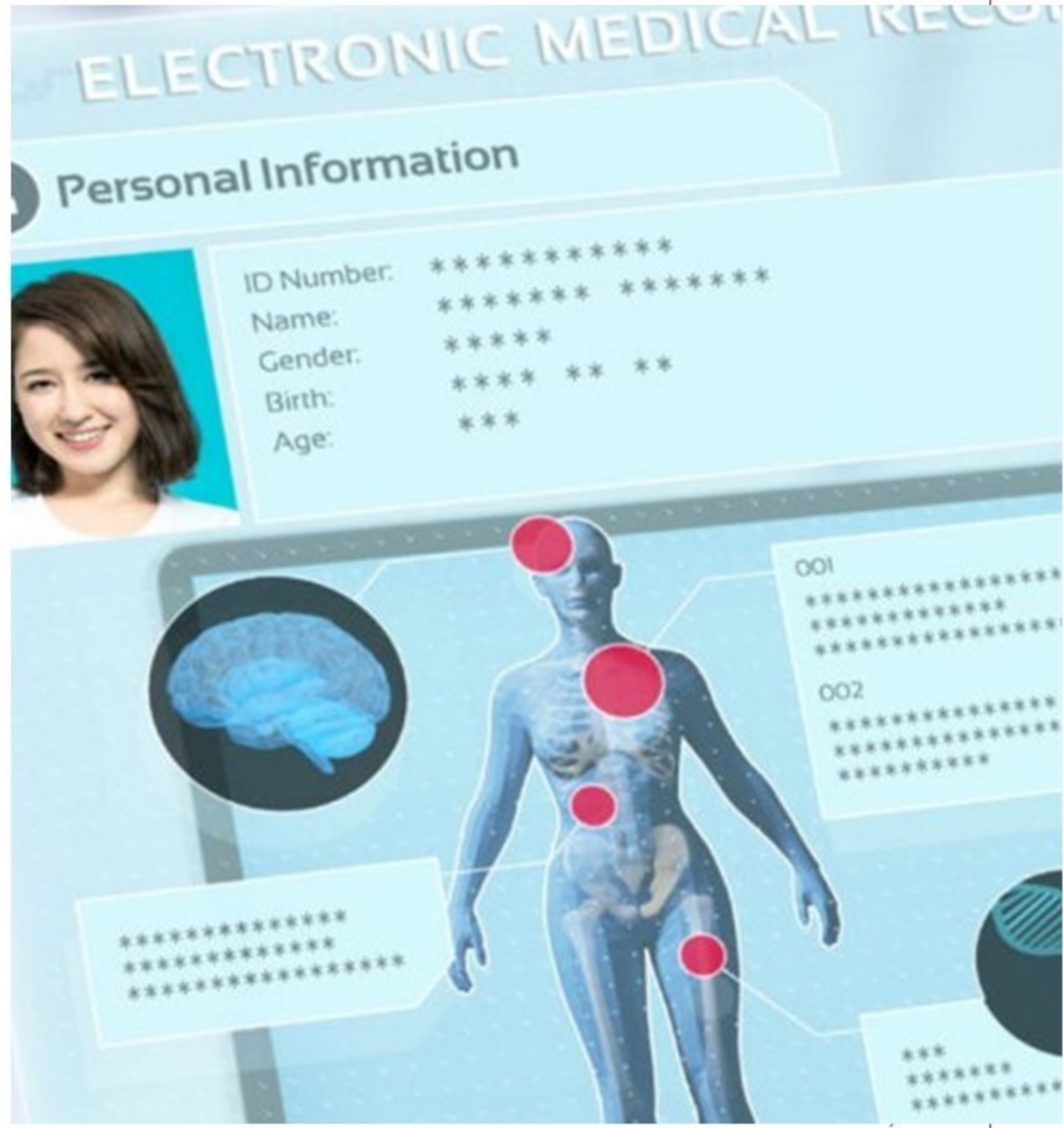
Operating Room (ORIS)

What Healthcare professionals need

- Information quality (not “data”)
- Consolidated information
  - In a single application
    - One login, one password
- Correlated information
- Pre-processed information

Electronic Health Records

- EPR or EHR
- Sometimes do not “consume” and consolidate information
- Usually, they just call other applications that knows better
  - No real interoperability
  - No data sharing
  - Decreased security



Typical issues

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- The application that collects/produce information:
  - Many times, is not the one that needs to process or present that information
  - Does not transmit or does not know how to send information in a non-ambiguous and secure way
- The application that really needs the information:
  - Does not have it or does not know how to receive it in a non-ambiguous and secure way
  - If it had it:
    - It would be able to format it in the best way for its purpose
    - Would be able to post-process it
    - Would be able to correlate with other information from several sources and produce knew knowledge not known before

Data sharing vs data access

- Data sharing is not data access

- On the right, App 1 knows nothing about “Data”, just calls App 2 to show it to the human user


Photo by Jen Theodore on Unsplash

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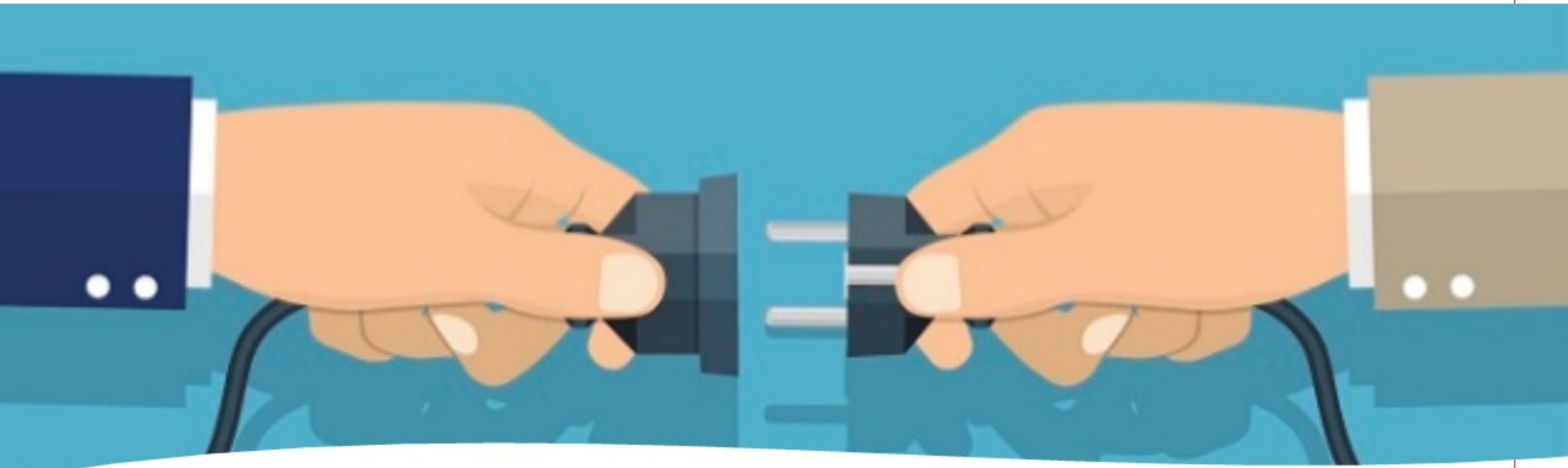
Interoperability ?

- One of the keys to the improvement of healthcare
- Reduces costs
- Improves clinical decision making
- Key enabler of individual and public health
- Promotes the transition to a “digital world”
- That’s why governments issues Laws to make interoperability happen faster (Meaningful use)

Standards



Why adopt standards?

Standards provide people and organizations with a basis for mutual understanding, and are used as tools to facilitate communication, measurement, commerce and manufacturing. **Standards** are everywhere and play an **important** role in the economy, by facilitating business interaction

The Importance of Standards - CEN-CENELEC

Where do we connect electrical devices?

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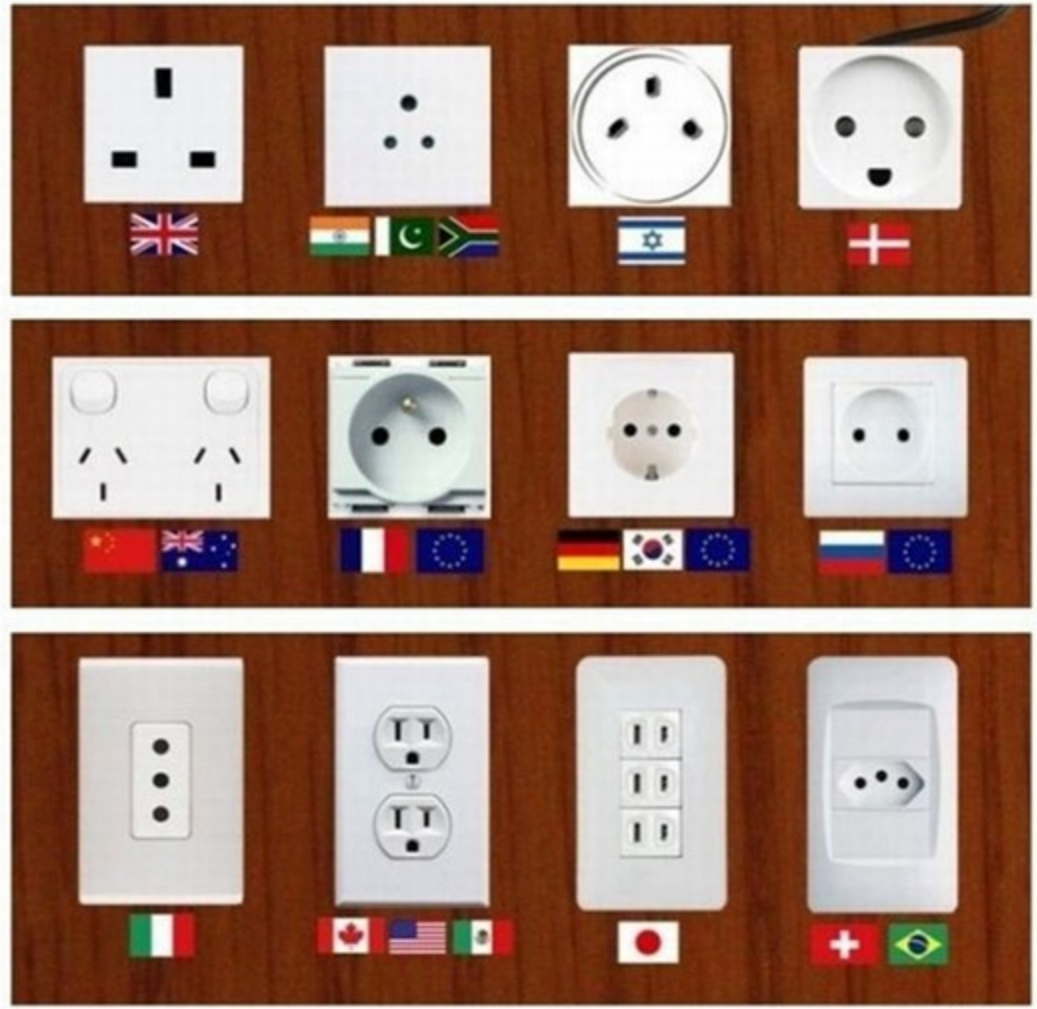

The size of the cards in your wallet

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Developing custom solutions

- Usually does not involve many experts
- Simple
- Cheap (one can imagine)
- Very specific use
- Hardly scalable (because they are too specific)
- Little or no documentation
- Hard to support by third-parties

Adopting standards (instead of inventing them)

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- More complex implementation
- More expensive at the beginning (but with lower TCO)
- Designed throughout many years by experts in the field
- Officially published as “standards” by SDOs (ISO, CEN, ANSI, IEEE, HL7…)
- Thought to be adopted in a wide range of scenarios
- May be adapted and scaled in different use cases
- Standards evolve and are reviewed for new use cases
- A lot of documentation
- Supported by companies and wide range of communities
- Conformity certification may be obtained for a product or person

Interoperability definition

What is interoperability

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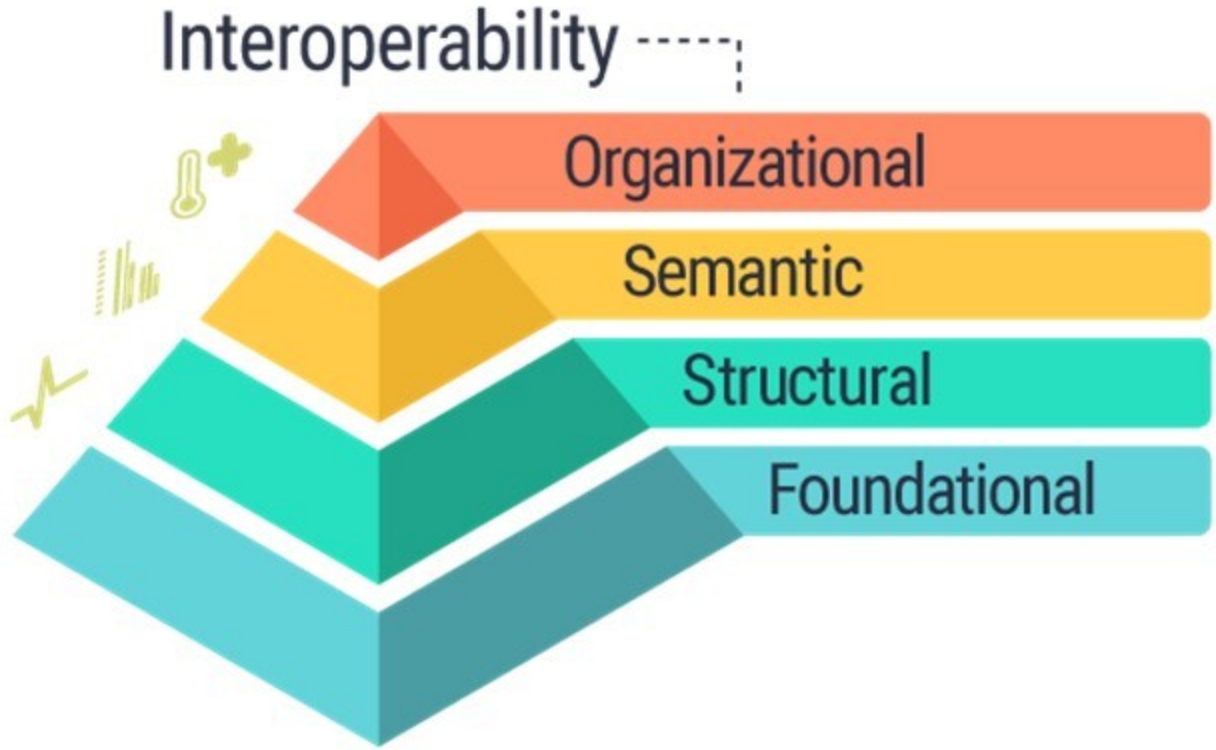
The ability of different information systems, devices and applications (systems) to access, exchange, integrate and cooperatively use data in a coordinated manner, within and across organizational, regional and national boundaries, to provide timely and seamless portability of information and optimize the health of individuals and populations globally.

https://www.himss.org/resources/interoperability-healthcare

Interoperability levels

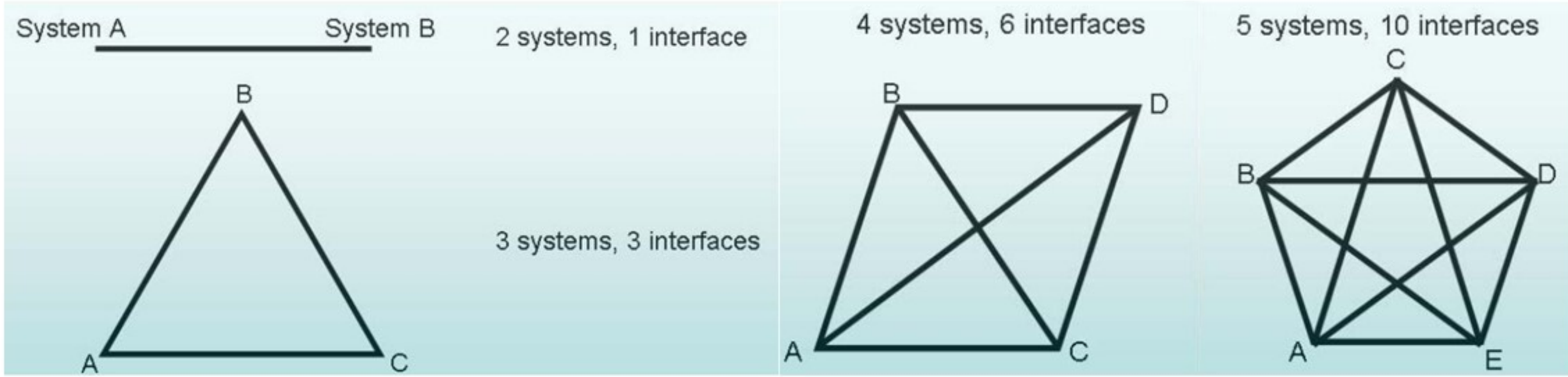


- **Foundational (level 1):** Establishes the inter-connectivity requirements needed for one system or application to securely communicate data to and receive data from another
- **Structural (level 2):** Defines the format, syntax and organization of data exchange
- **Semantic (level 3):** Provides for common underlying models and codification of the data
- **Organizational (level 4):** Includes governance, policy, social, legal and organizational considerations to facilitate the communication and use

Challenges and solutions in the healthcare interoperability area

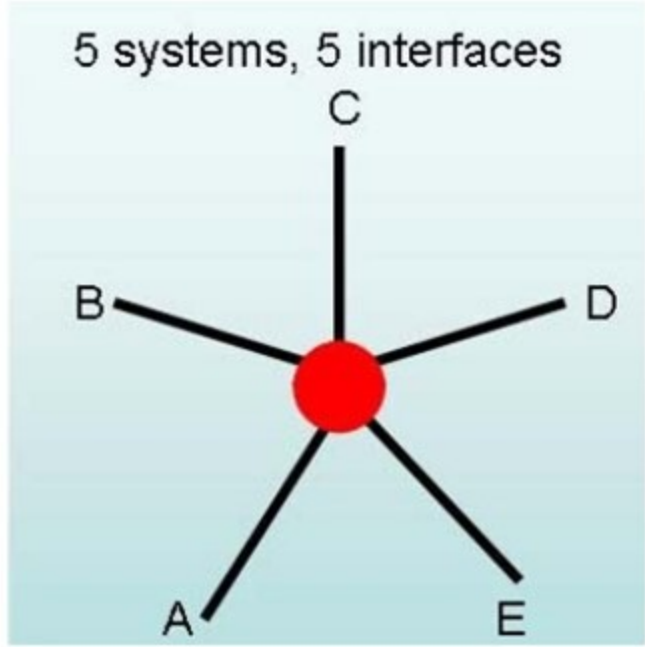
Connections between systems

- In order to enable information sharing between different systems, they must be able to communicate
- The number of connection grows around ½ the square of systems to interconnect
- For 30 systems, 435 different connections would be required



Normalized connections

- Communications should be done using a closed set of communication protocols
- Using a central node (integration engine)

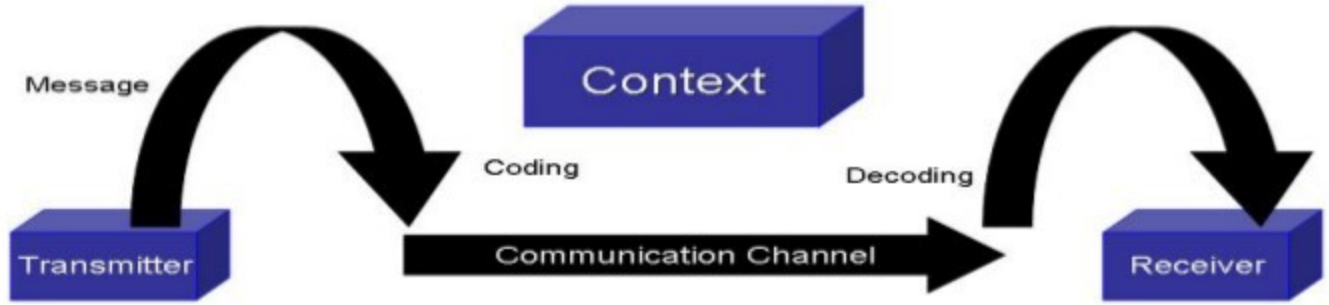


Ambiguity in natural language

People communicate and understand each other not only because they use the same language and words

When the communication channel cannot rely solely on external context, the sender must be specific enough about the information and context

Ambiguity occurs when a language or vocabulary allows more than one meaning to a word or expression of a concept



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Terminologies

- One of the biggest challenges in medical information is the representation of medical knowledge in a way that it can be safely manipulated by information systems
- Decision support modules are components in many healthcare systems. These require controlled vocabularies. The ambiguity of natural language could generate false positives or generate patient safety issues

Functions of terminologies

- Unique identifier – Code
  - Numeric, no meaning
  - May include a “check-digit”
  - In the direction of the use of ISO identifiers (called OIDs)
  - An “assigning authority” that creates those identifiers is associated (HL7 is may be one of them)
  - Description in natural language (e.g.: “female”)
    - Allows translations (e.g.: “female”)
    - Allows synonyms (e.g.: “girl” or “woman”)

The added value lies in the removal of ambiguity

An example of a code

- Element: gender
- Class: demographic
- Controlled terminology (value set)
  - Male
  - Female
  - Unknown (does not know/asked)
  - Ambiguous
- Representation: example values: “MFUA”

- According with HL7 FHIR
- http://hl7.org/fhir/R4/codesystem-administrative-gender.html

Code	Display	Definition	Comments
male	Male	Male.	Male
female	Female	Female.	Female
other	Other	Other.	The administrative gender is a value other than male/female/unknown. Where this value is selected, systems may often choose to include an extension with the localized more specific value.
unknown	Unknown	Unknown.	A proper value is applicable, but not known. Usage Notes: This means the actual value is not known. If the only thing that is unknown is how to properly express the value in the necessary constraints (value set, datatype, etc.), then the OTH or UNC flavor should be used. No properties should be included for a datatype with this property unless: Those properties themselves directly translate to a semantic of "unknown". (E.g. a local code sent as a translation that conveys 'unknown') Those properties further qualify the nature of what is unknown. (E.g. specifying a use code of "H" and a URL prefix of "tel:" to convey that it is the home phone number that is unknown.)

4.3.14.85 Code System http://hl7.org/fhir/administrative-gender

Patient Administration Work Group	Maturity Level: N	Normative (from v4.0.0)	Use Context: Any

This page has been approved as part of an ANSI standard. See the Patient Package for further details.

This is a code system defined by the FHIR project.

Summary

Defining URL:	http://hl7.org/fhir/administrative-gender
Version:	4.0.1
Name:	AdministrativeGender
Title:	AdministrativeGender
Definition:	The gender of a person used for administrative purposes.
Committee:	Patient Administration Work Group
OID:	2.16.840.1.113883.4.642.4.2 (for OID based terminology systems)
Source Resource	XML / JSON

This Code system is used in the following value sets:

- ValueSet: AdministrativeGender (The gender of a person used for administrative purposes.)
- ValueSet: AdministrativeGender (The gender of a person used for administrative purposes.)

4.3.14.85.1 Content

4.3.14.85.2 AdministrativeGender

The gender of a person used for administrative purposes.

A concept in SNOMED CT

- Some of the descriptions associated with ConceptID 22298006:
- Fully Specified Name: Myocardial infarction (disorder)

DescriptionID 751689013

- Preferred term: Myocardial infarction

DescriptionID 37436014

- Synonym: Cardiac infarction

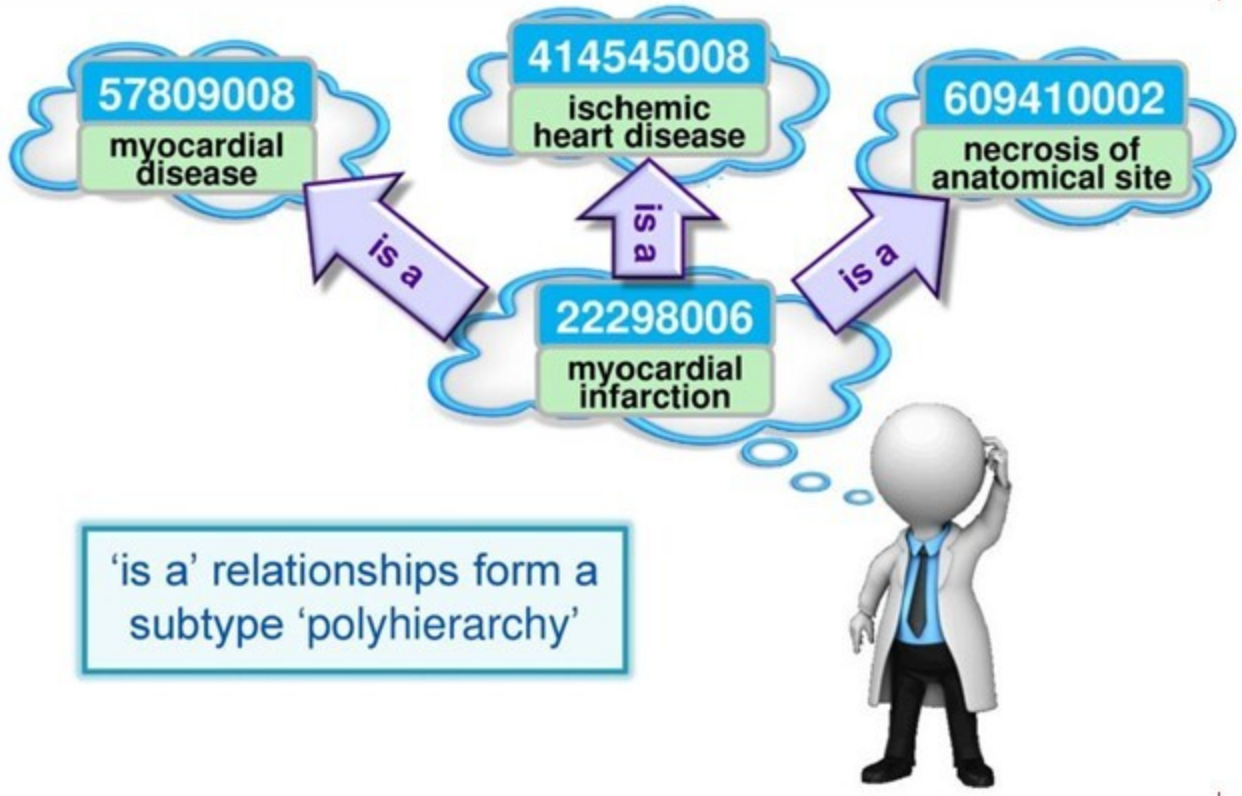
DescriptionID 37442013

- Synonym: Hear attack

DescriptionID 37443015

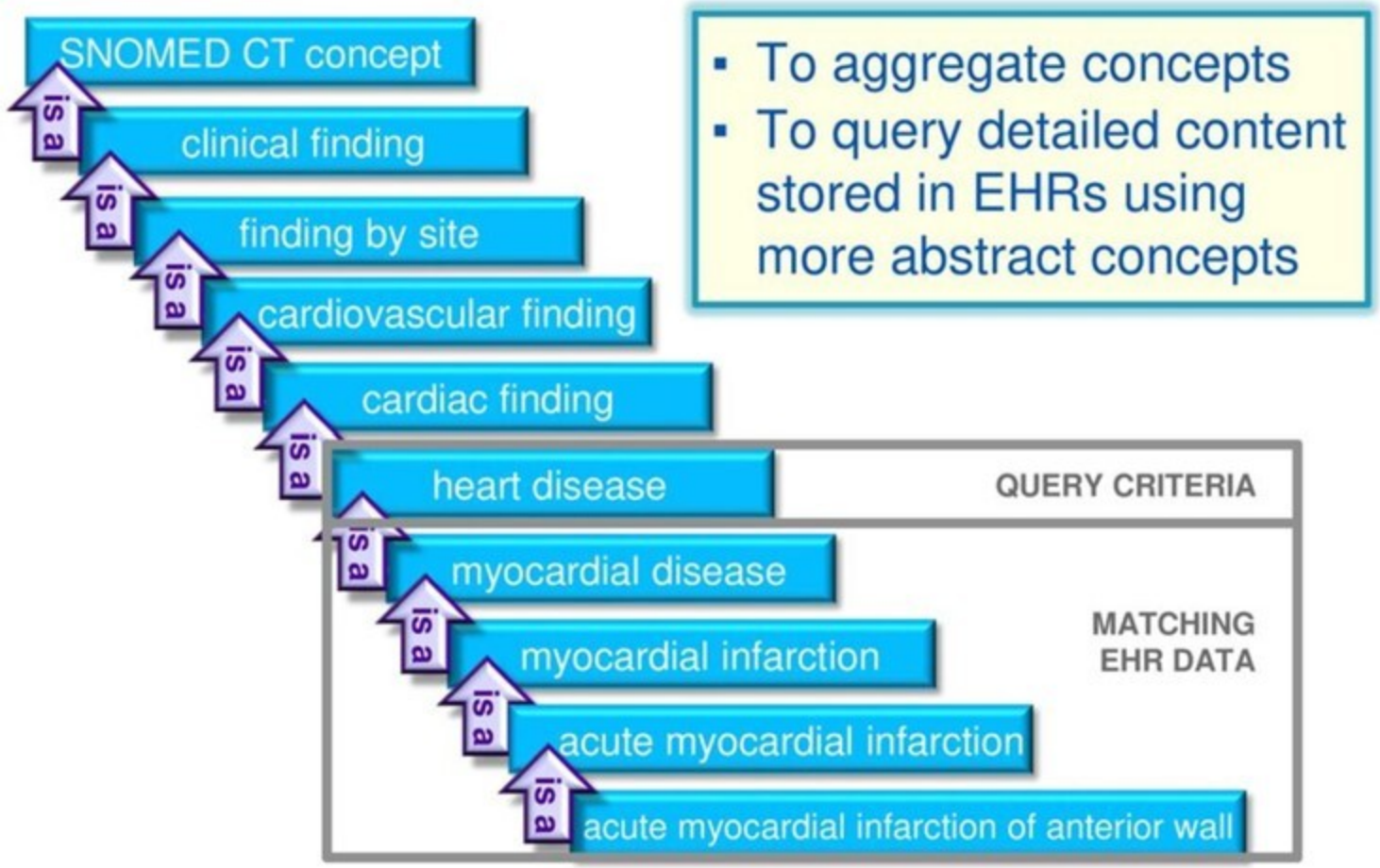
- Synonym: Infarction of heart

DescriptionID 37441018



Adapted from "Solving the Health IT Interoperability Puzzle with SNOMED CT" – Dr. Michael Bainbridge IHTSDO

A concept in SNOMED CT Relationships



- To aggregate concepts
- To query detailed content stored in EHRs using more abstract concepts

Adapted from "Solving the Health IT Interoperability Puzzle with SNOMED CT" – Dr. Michael Bainbridge IHTSDO

Standard terminologies

- ICD-9-CM, ICD-10 – International classification of Diseases
- DRG's – Diagnosis Related Groups
- SNOMED-CT – Clinical Terms
- NDC – National Drug Codes
- LOINC – Logical Observation Identifiers, Names and Codes
- CPT-4 – Current Procedural Terminology
- ICPC-2 – International Classification of Primary Care
- NANDA – North American Nursing Diagnosis Association
- ICP - International Classification of Nursing Practice
- MeSH, ULMS – Unified Medical Language System

Adapted from "HL7 vocabularies: Bridging information models and vocabulary in HL7" woody Beeler

Some standards in healthcare IT

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- Content
  - HL7 v2.x, HL7 v3.x, HL7 FHIR
  - HL7 CDA
- Terminologies
  - LOINC
  - UCUM
  - SNOMED CT
  - RxNorm
  - RadLex
  - MEDCIN
  - ICD-10
  - CPT
  - HCPCS
  - CDC CVX e MVX
  - NDC

HL7 International

LOINC from Regenstrief

SNOMED International Leading healthcare terminology worldwide

NIH U.S. National Library of Medicine

RSNA Informatics RadLex

CMS.gov Centers for Medicare & Medicaid Services

- Transport
  - HL7 FHIR
  - Direct Standard
  - IHE
  - DICOM
  - HL7 MLLP
- Privacy and security
  - HIPAA
  - IHE ATNA

FHIR

IHE International Integrating the Healthcare Enterprise

DICOM Digital Imaging and Communications in Medicine

HIPAA Health Insurance Portability and Accountability Act

https://www.himss.org/library/interoperability-standards/types-standards

HL7 standards (most important ones)

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- HL7 v2
  - Standard for exchange of messages from events between clinical systems
  - Text (ER7) or XML messages
- HL7 v3
  - Complete set of messages, data types and terminologies
  - Around the rather complex “reference information model” (RIM)
  - Primarily focused on semantic interoperability
  - XML messages
- HL7 CDA
  - Part of HL7v3
  - Defines a Clinical Document Architecture
  - For exchange between systems
  - May contain any type of clinical content
  - Transmitted in XML format

- HL7 FHIR
  - The HL7 Fast Healthcare Interoperability Resources (FHIR) uses RESTful APIs as data access model
  - HL7 FHIR combines the best features of HL7 v2.x, v3 and CDA, while promoting the best practices in web standards
  - Version 4 is the first normative (ANSI standard)
  - Supports REST and Service Oriented Architecture (SOA)
  - Messages in XML, JSON, HTTP, Atom, OAuth and others

https://www.hl7.org/implement/standards/

DICOM 3.0 standard

- Defines
  - Medical image format and related information
  - Data transfer, storage and display protocol
- Original mission
  - To enable users to retrieve images and associated information from digital imaging equipment in a standard format using point-to-point connection
  - To hide differences same across multiple image equipment manufacturers

DICOM
Digital Imaging and Communications in Medicine

Integrating the Healthcare Enterprise

- Made by Regional, National and International organizations that involves users and manufacturers
- To promotes interoperability in eHealth by:
  - Collecting the User needs –> Use cases
  - Selecting standards -> Specify Profiles to support use cases
  - Testing profiles implementation in solutions -> Proof of concept
- Aggregates established standards, like HL7, DICOM and others
- Supplies technical framework that describes in detail the processes workflows
- IHE is not a standard, it is a constraint profile (a.k.a. Conformance profile)

Thank you!

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