Understanding health care data and standards

Health care organizations exchange information according to a set of standards. Standards are agreed-upon methods for connecting systems together. Standards may pertain to security, data transport, data format or structure, or the meanings of codes or terms.

Standards are defined, updated, and maintained by standards development organizations (SDOs) through a collaborative process involving the audience that will be using the standards.

Health care organizations can reduce implementation costs, accelerate integration projects, and take advantage of common tooling by making an effort to use standards whenever possible.

Some standards to look out for in healthcare are as follows:

Standard	Description
Consolidated-Clinical Document Architecture (C-CDA)	C-CDA is a framework for creating clinical documents that contain both human-readable text and machine-readable XML
Direct	It is a standard for sending health information securely over the internet.
Fast Healthcare Interoperability Resource (FHIR)	FHIR is a specification for exchanging clinical and administrative health care data. The standard is based on REST and OAuth.
Validated Healthcare Directory Implementation Guide	An HL7 FHIR based implementation guide and architectural considerations for attesting to, validating, and exchanging validated data as well as a RESTful FHIR API for accessing data from that directory.
Integrating the Healthcare Enterprise (IHE)	IHE's work is organized into profiles that define how systems should cooperate.
Health Level 7 (HL7)	A commonly used data interchange standard. This standard includes messaging specifications for patient administration, orders, results, scheduling, claims management, document management, and many others.
Quality Reporting Document Architecture (QRDA)	A standard for communicating health care quality measures
Health Quality Measure Format (HQMF)	A standards-based representation of quality measures as electronic documents
OAuth 2.0	A simple authorization framework that enables a third-party application to obtain access to an HTTP service.
HEART (Health Relationship Trust)	A set of profiles that enables patients to control how, when, and with whom their clinical data is shared.
OpenID Connect	Simple identity layer designed to work with Oauth 2.0.

Health Level 7 (HL7):

Health Level 7 (HL7) refers to a set of international standards for exchange, integration, sharing, and retrieval of electronic health information for effective delivery of healthcare services. It also refers to the exchange of administrative data between software applications using a standard messaging protocol.

There are several different health information systems, such as labs, pharmacies, clinics, hospitals, and many others which share interrelated patient information between two or more clinical applications. HL7 provides a common framework for implementing interfaces that meet the needs of the customer and their systems. HL7 is widely used for the transfer of health data quickly, reliably, and securely.

Benefits of HL7- Healthcare information and management systems are getting more complex in the area of data sharing. The advancement of technology in the healthcare industry helps to make it easy to exchange health information between patient and healthcare providers.

Here are various benefits of HL7:

- HL7 helps to simplify the healthcare process by providing a standardized and cost-effective data exchange system.
- HL7 helps in creating an electronic health record which facilitates easy communication between systems and healthcare providers.
- Enables the exchange of information securely, using a standardized format.
- Allows easy communication between two or more systems.
- HL7 provides standardized healthcare information, with a clear understanding of data standards.

Logical Observation Identifier Names and Codes (LOINC):

LOINC (Logical Observation Identifier Names and Codes) is an international nomenclature for medical observations and measurements. Its objective is a language-, system- and institution-independent, universally unambiguous identification of medical analyses and descriptive content, which enables computer-aided automated data processing. Originally, LOINC was developed for the identification of laboratory parameters. Although the use of LOINC now extends far beyond this area, LOINC has its special strength in this domain.

The catalog of LOINC codes has been publicly available and in the public domain since 1995; it is compiled and maintained by the LOINC Committee at the Regenstrief Institute, a private non-

profit research organization at the Indiana University School of Medicine (IUSM) in Indianapolis, United States, supported by representatives from research, industry and the US government.

The origins of the development of LOINC date back to the year 1983: In this early phase of computer use in medicine, C. McDonald, later the "father of LOINC", and colleagues at the Regenstrief Institute of the Indiana University School of Medicine pointed out in an editorial to the American Medical Association (AMA) that – in addition to other identifications, for example for exchange formats and patient identifiers – there is a necessity for a set of unequivocal identifiers for clinical observations to make a future automated data exchange between medical computer systems possible.

McDonald drew a parallel back then to grocers, who introduced universal food product codes nationwide in the 1970s, paving the way for electronic cash register and merchandise management systems in food retailing. Similarly, in the midst of the era of the first, still purely mainframe-based patient record systems, McDonald saw the perspective for medicine – falling hardware and software costs would soon lead to the situation that every physician's practice would be able to afford such a system, and thus clinical data interchange (CDI) would become a necessity.

The fact that his editorial was rejected nine times between 1981 and 1983 before it was published shows that this view was hardly undisputed – the editors provided an elucidating note: "*Perhaps this article will provoke the discussions that will result in appropriate actions*". In fact, this impetus resulted in the first work on a corresponding standard, which was done in 1984 under the umbrella of the American Society for Testing and Materials (ASTM) in a Subcommittee E31.11, "Standards for the Exchange of Clinical Data", established for this purpose.

Early on, for pragmatic reasons, they focused on clinical laboratory results data: These are not only of high clinical relevance, but are also available in a precisely defined, structured form. In 1988, the standard developed by the ASTM was adopted and published as E1238-88 "Standard Specification for Transferring Clinical Laboratory Data Messages Between Independent Computer Systems"– as the first standard for clinical data which has undergone a public balloting and consensus process, in the way it complied with the ASTM policies at that time and thus with the criteria of the American National Standards Institute (ANSI), and in the way HL7 still practices it today in a similar form.

ASTM E1238 was incorporated as Chapter 7 in the standard HL7 V. 2.1, the further development of the first version of HL7 published in 1987. In the following years, further work on the standard for laboratory data communication shifted increasingly to HL7; the history of this merging is extensively presented elsewhere.

DICOM (Digital Imaging and Communications in Medicine):

DICOM-short for Digital Imaging and Communications in Medicine-has become indispensable to any modern clinical setting that deals with medical imaging. Considering

the ubiquitous need and utility of medical imaging in modern healthcare, the broad scope and application of DICOM is not hard to fathom. It allows the storage, viewing, and sharing of medical images and related data on devices within and across medical facilities.

DICOM is the standard communications protocol used for capturing, storing, and transmitting medical images and related data. Phrased simply, DICOM in medical imaging acts as a blueprint for the information structures and procedures controlling the input and output of data in medical imaging systems. The term refers to both the protocol itself and its corresponding file format. All data obtained in the process of medical imaging is stored in this format. Without it, sharing information between different imaging devices would be significantly more difficult.

DICOM was released in 1993 as the third version of the ACR-NEMA standard—a protocol conceived in the 1980s with the purpose of enabling interoperability of medical imaging devices from different manufacturers. Since then, DICOM has been crucial in the development of modern radiology, having improved the workflow and sustainability of medical imaging systems immensely by allowing equipment, digital archives, workstations, and servers from different vendors to share information effortlessly.

Medical imaging has a crucial role in healthcare at all major levels. Aside from providing key tools for clinical analysis and diagnosis, it is equally important for treatment itself. Without it, physicians would have to resort to invasive diagnostic methods far more often. Tracking progress during treatment would be far more difficult or impossible, and treatment of patients in follow-up care would not include as helpful databases for reference.

DICOM has become ubiquitous wherever there is medical imaging involved, from radiology, cardiology, oncology, nuclear medicine, radiotherapy, neurology, orthopedics, ophthalmology, dermatology, and dentistry, to veterinary medicine. Grasping its crucial role in creating interoperability between medical imaging devices and medical systems is vital for understanding what DICOM is in the first place and avoiding the confusion that arises when terms for medical information systems like PACS or RIS are introduced.
DICOM effectively satisfied the need for a standardized format for transferring medical images and data that emerged back in the 1980s when medical imaging and computing in clinical work were being introduced. This in turn provided many additional benefits, including:

- Eliminating the need for physical storage – DICOM allowed imaging information systems to securely store medical images and data digitally.

- Reduced costs and space requirements – Digital storage is significantly less expensive than the storage needed for hard-copy films. DICOM-compliant systems are far more cost-effective and provide a space advantage over the traditional film archives.

- Better diagnosis and patient care – Access to information and diagnosis too were facilitated with the implementation of DICOM. The interoperability of DICOM-compliant

devices ensures that medical data can be accessed by physicians worldwide. Telediagnosis, distance education, and accelerated peer review, consultation, and diagnosis are made possible. All of this provides a means for effective cooperation in the diagnostic process and better overall patient care.

- Improved workflow – Manual filing, retrieval, and transport of folders are a thing of the past in medical imaging systems using DICOM. Faster image retrieval and the ability to access the images remotely allow physicians to work at a much quicker pace.
- Easier access to patient data – DICOM-compliant systems offer more organized and convenient management of medical information. All patient data can be reached through a single point of access as images are integrated into the hospitals' databases of DICOM images and related data.
- Additional imaging services – DICOM provides many additional imaging services, including managing imaging procedure worklists, printing images on film or digital media like DVDs, reporting procedure and archiving status, encrypting datasets, organizing layouts of images, encoding ECGs, CAD results, and structured measurement data, to list a few. DICOM-compliant imaging devices with diagnostic monitors enable clearer visualization of images in comparison to the traditional viewing of images on light boxes.

Public and private hospitals, diagnostic centers, analysis laboratories, and an increasing number of smaller practices all use DICOM-compliant medical imaging technology. NEMA states that all major vendors of medical imaging technology use DICOM, and that every medical profession using medical imaging will soon be using DICOM.

Electronic Health Records (EHR) Standards for India

In September 2013 the Ministry of Health & Family Welfare (MoHFW) notified the Electronic Health Record (EHR) Standards for India. The set of standards given therein were chosen from the best available and used standards applicable to Electronic Health Records from around the world keeping in view their suitability to and applicability in India. The Committee constituted to recommend the standards drew from experts, practitioners, government officials, technologists, and industry.

The notified standards were not only supported by professional bodies, regulatory bodies, stakeholders, but various technical and social commentators as well, as being a step in the right direction. MoHFW moved ahead with facilitating the adoption, as next steps, and in last two years the Ministry has made available standards like SNOMED CT free-for-use in the country as well as appoint interim National Release Center (NRC) to handle this clinical terminology standard that is fast gaining widespread acceptance amongst the various healthcare IT stakeholder communities worldwide.

At the time of notifying the standards in September 2013, it was understood that the standards themselves will continue to evolve over time. Consequently, it was accepted that this notification will require revision from time to time. This becomes all the more necessary as understanding of

those standards, their implementation and the expectations from the healthcare systems improve. Hence, MoHFW constituted an expert group to review the earlier notified set of standards based on the experience and with eyes firmly on the future. The set of standards provided herein represents the recommendations of the Expert Committee arrived at after deliberating on the various aspects of standardizations in healthcare record systems. The Committee also carefully examined the provisions of open standards and the guidelines as per the norms suggested by MeitY, Government of India and recommended the standards given later in the document.

For a health record of an individual to be clinically meaningful it needs to be from conception or birth, at the very least. As one progresses through one's life, every record of every clinical encounter represents a health related event in one's life. Each of these records may be insignificant or significant depending on the current problems that the person is suffering from. Thus, it becomes imperative that these records be available, longitudinally arranged as a time series, and be clinically relevant to provide a summary of the various healthcare events in the life of a person.

An Electronic Health Record (EHR) is a collection of various medical records that get generated during any clinical encounter or events. With rise of self-care and homecare devices and systems, nowadays meaningful healthcare data get generated 24x7 and also have long-term clinical relevance. The purpose of collecting medical records, as much as possible, are manifold - better and evidence based care, increasingly accurate and faster diagnosis that translates into better treatment at lower costs of care, avoid repeating unnecessary investigations, robust analytics including predictive analytics to support personalized care, improved health policy decisions based on better understanding of the underlying issues, etc., all translating into improved personal and public health.

Without standards, a lifelong medical record is simply not possible, as different records from different sources spread across ~80+ years, potentially, needs to be brought meaningfully together. To achieve this, a set of pre-defined standards for information capture, storage, retrieval, exchange, and analytics that includes images, clinical codes and data is imperative.

References:

1. https://www.nrces.in/standards/ehr-standards-for-india#interoperability_standards
2. https://www.degruyter.com/document/doi/10.1515/labmed-2019-0193/html#d25609466e439
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4. https://loinc.org/slideshows/loinc-for-beginners-december-2017/
5. https://www.postdicom.com/en/blog/dicom-a-look-into-its-scope-and-utility
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Certificate Course in Healthcare Technology (CCHT)

Understanding Health Care Data and Standards

CERTIFICATE COURSE IN HEALTHCARE TECHNOLOGY

Who am I ?

Kumar is a Senior Technology and Security leader with 20+ years of proven expertise in Digital Strategy, Digital Innovation, Systems Design and Development, Planning, Budgeting, Enterprise Architecture, Information Security and Privacy. He brings in a perfect blend of technology and security vision, resulting in consistent development of innovative digital strategies. He has realised these strategies by implementing high performance, scalable and secure digital solutions resulting in improved efficiency, improved compliance, and reduction in cost.

He has completed his Executive Education in General Management from Indian Institute of Management, Bangalore, and Post-Graduation (M.Phil.) in Hospital and Health Systems Management from Birla Institute of Technology and Science, Pilani (BITS). In addition to this, he is a Certified Healthcare CIO, ISO 27001:2013 Lead Information Security auditor, DSCI Certified Data Privacy Lead Assessor and a TOGAF certified practitioner.

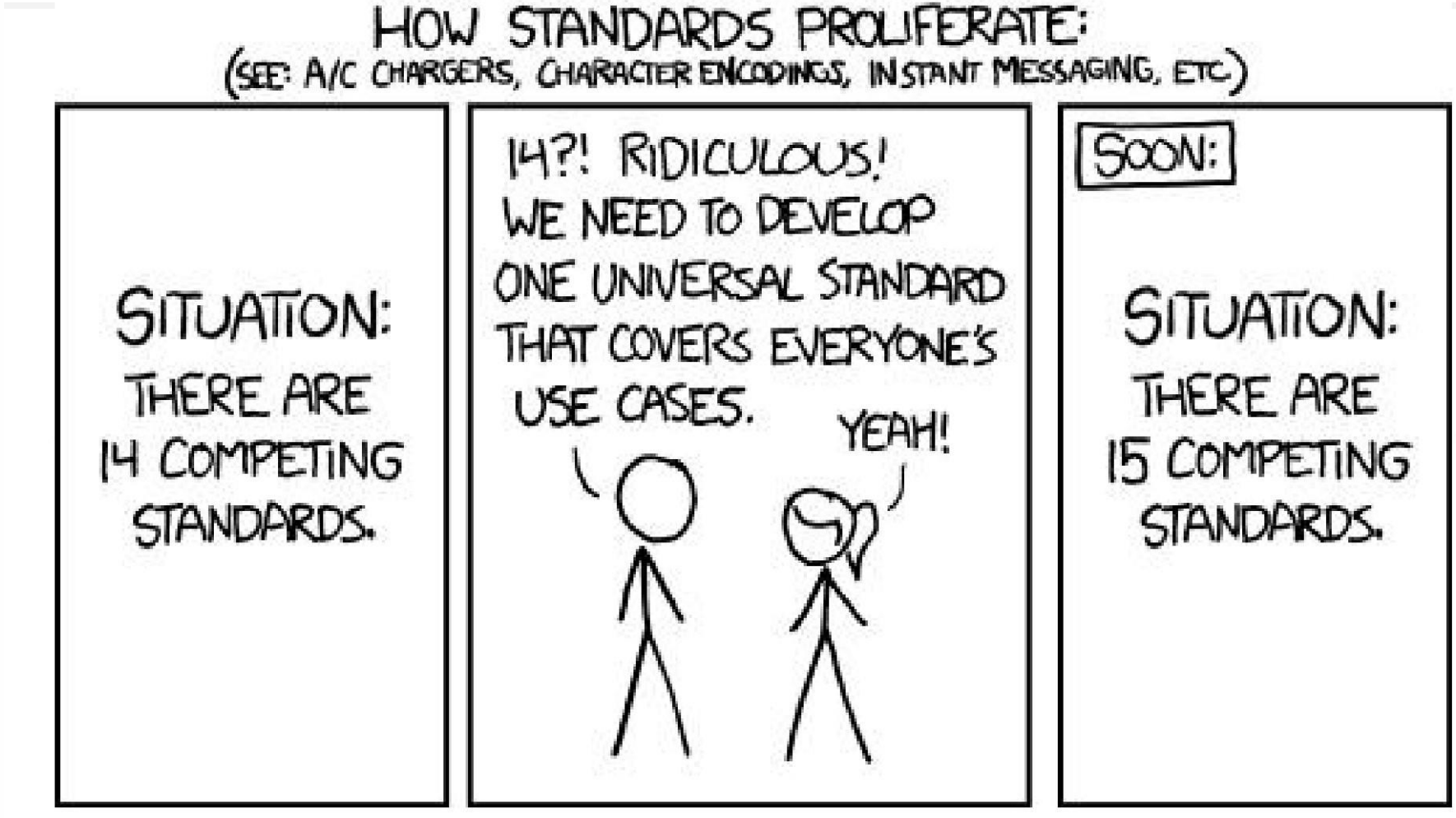
Learning Objectives

- Setting the context for the need for standards
- Focus on key Digital Healthcare Standards with examples

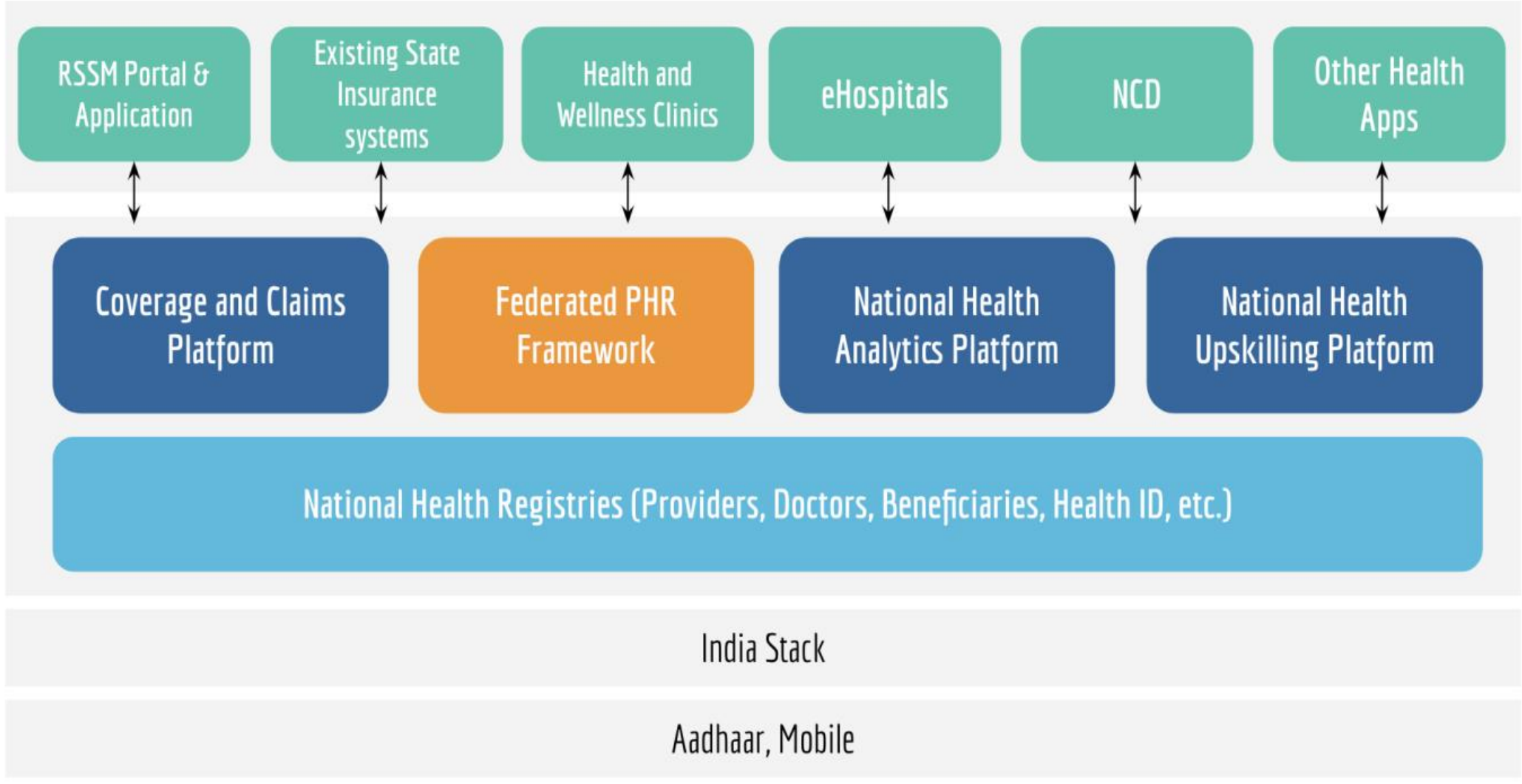
Overview of the Session

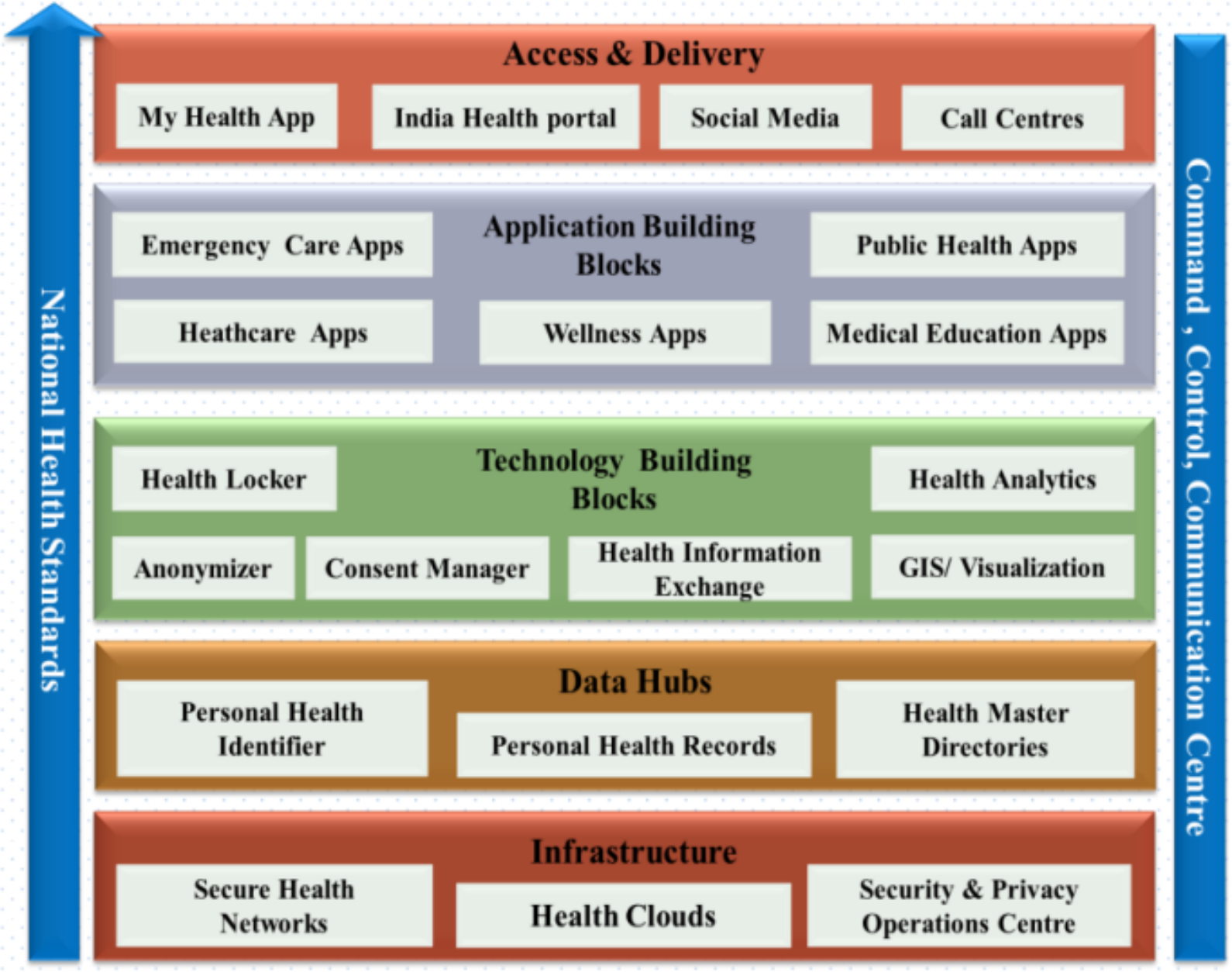
- Need for Standards
- Types of Standards
- Quick Primer on key Digital Health Standards with relevant examples

Context


HOW STANDARDS PROLIFERATE:
(SEE: A/C CHARGERS, CHARACTER ENCODINGS, INSTANT MESSAGING, ETC)
SITUATION: THERE ARE 14 COMPETING STANDARDS.
14?! RIDICULOUS! WE NEED TO DEVELOP ONE UNIVERSAL STANDARD THAT COVERS EVERYONE'S USE CASES.
YEAH!
SOON:
SITUATION: THERE ARE 15 COMPETING STANDARDS.

India's National Health Stack





National Digital Health Blue Print

Without standards, there can be no improvement

Taiichi Ohno – Founder of Toyota Production Systems

Globally Recognized Standards: Critical to Improvements in Healthcare Delivery

Standards:

- Establish a common terminology
- Facilitate interoperability and integration
- Create structured information models for data structure and interchange
- Enhance security and privacy

What is a Standard?

- A standard specifies a well-defined approach that supports a business process and . . . has been agreed upon by a group of experts
  - ✓ has been publicly vetted
  - ✓ provides rules, guidelines, or characteristics
  - ✓ helps to ensure that materials, products, processes and services are fit for their intended purpose
  - ✓ is available in an accessible format
  - ✓ is subject to ongoing review and revision process
- Harmonization is required when a proliferation of standards prevents progress rather than enables it.

Source: HITSP Definition

What is Interoperability

The ability of two or more systems or components to exchange information and to use the information that has been exchanged.

Functional Interoperability

Semantic Interoperability

Impact on Healthcare IT

- Technology trends can no longer develop in a void
- Systems must connect with each other
  - ✓ Organizational
  - ✓ Local
  - ✓ National
  - ✓ Global
- Public/Private partnerships needed

Health Technology Standards

Vocabulary Standards	Content	Transport	Security
• CPT • ICD 10/11 • LOINC • National Drug Code (NDC) • RadLex • RxNorm • SNOMED CT • CDC • Unified Code Units of Measure	• Consolidated CDA • HL7 • FHIR	• DICOM	• ISO 27001 Standards • Personal Data Protection

Health Level 7 (HL7)

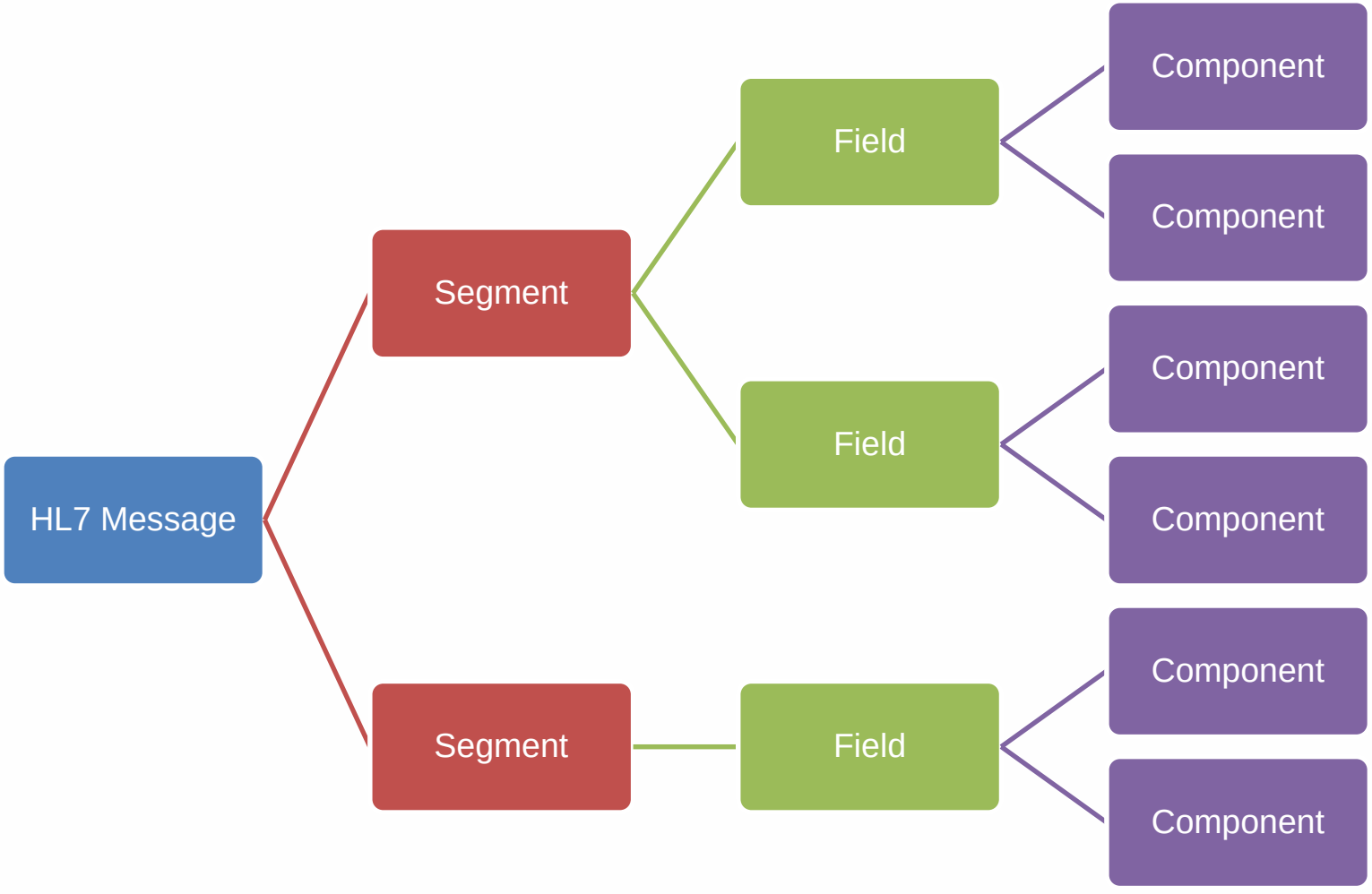
Introduction

- Founded as an international standards development organization in 1987 to promote communication between hospital data systems
- Stated a goal of creating a platform independent method of moving data between different systems
- Developed grammar for messaging and standardized vocabulary
  - ANSI Standard for clinical interoperability
  - HL7 standards are widely adopted and continue to evolve
  - Meaningful Use has identified a number of HL7 standards to support sharing data between systems
  - HL7 website: http://www.hl7.org/

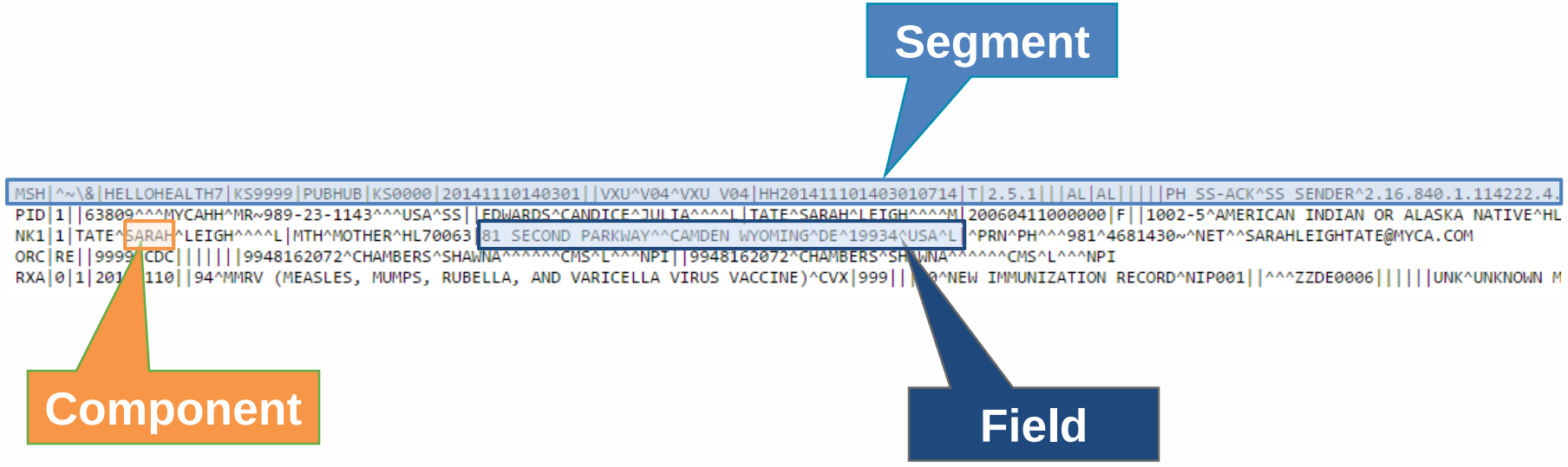
HL7 Versions

- HL7 version 2.x messaging
- HL7 version 3 messaging
- HL7 Clinical Document Architecture (CDA)
- HL7 Fast Healthcare Interoperability Resources (FHIR)

Health Level 7 Message Format



Health Level 7 Message Format contd…



Benefits

- HL7 helps to simplify the healthcare process by providing a standardized and cost-effective data exchange system.
- HL7 helps in creating a electronic health record which facilitates easy communication between systems and healthcare providers.
- Enables the exchange of information securely, using a standardized format.
- Allows easy communication between two or more systems.
- HL7 provides standardized healthcare information, with a clear understanding of data standards.

HL7 Additional Resources

- HL7 (hl7.org) has a variety of materials including tutorials where you can get the specifics for each of its standards.
- HL7's website is at: http://www.hl7.org/
- CDC's Vocabulary Access and Distribution Systems (PHIN VADS) can be found at https://phinvads.cdc.gov/

SNOMED CT

Introduction

SNOMED CT is the **most comprehensive**, multilingual clinical healthcare terminology in the world

- Is a resource with comprehensive, scientifically **validated clinical content**
- Enables **consistent representation** of clinical content in electronic health records
- Is **mapped** to other international standards
- Is in use in **more than eighty countries**

The SNOMED CT clinical terminology has unmatched depth, enabling clinicians to record data with enhanced accuracy and consistency. SNOMED CT remains a growing and evolving product made better by the Community of Practice.

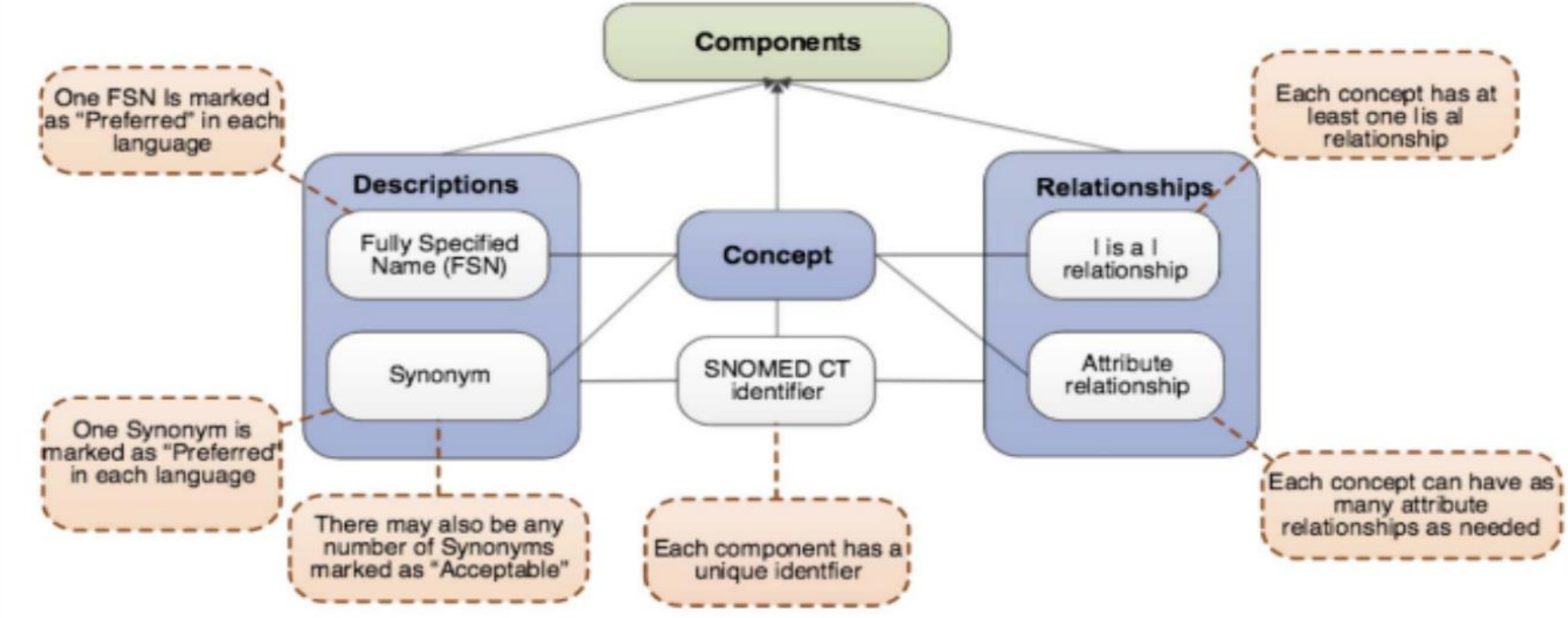
How it Works

- The SNOMED CT logical model defines the way in which each type of SNOMED CT component and derivative is related and represented.

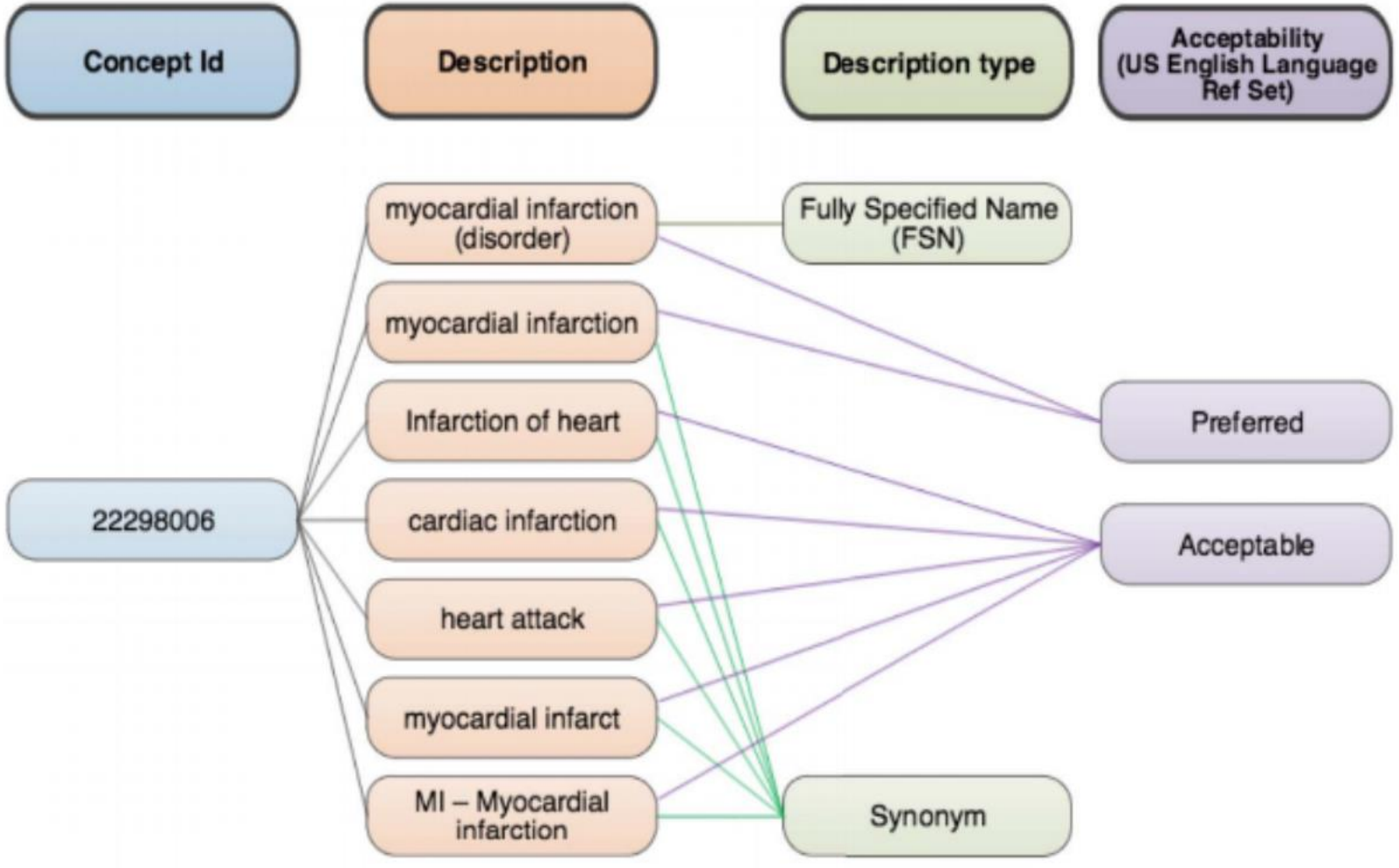
- The core component types in SNOMED CT are concepts, descriptions and relationships. Our model specifies how the components can be managed in an implementation setting to meet a variety of primary and secondary uses.

Concepts

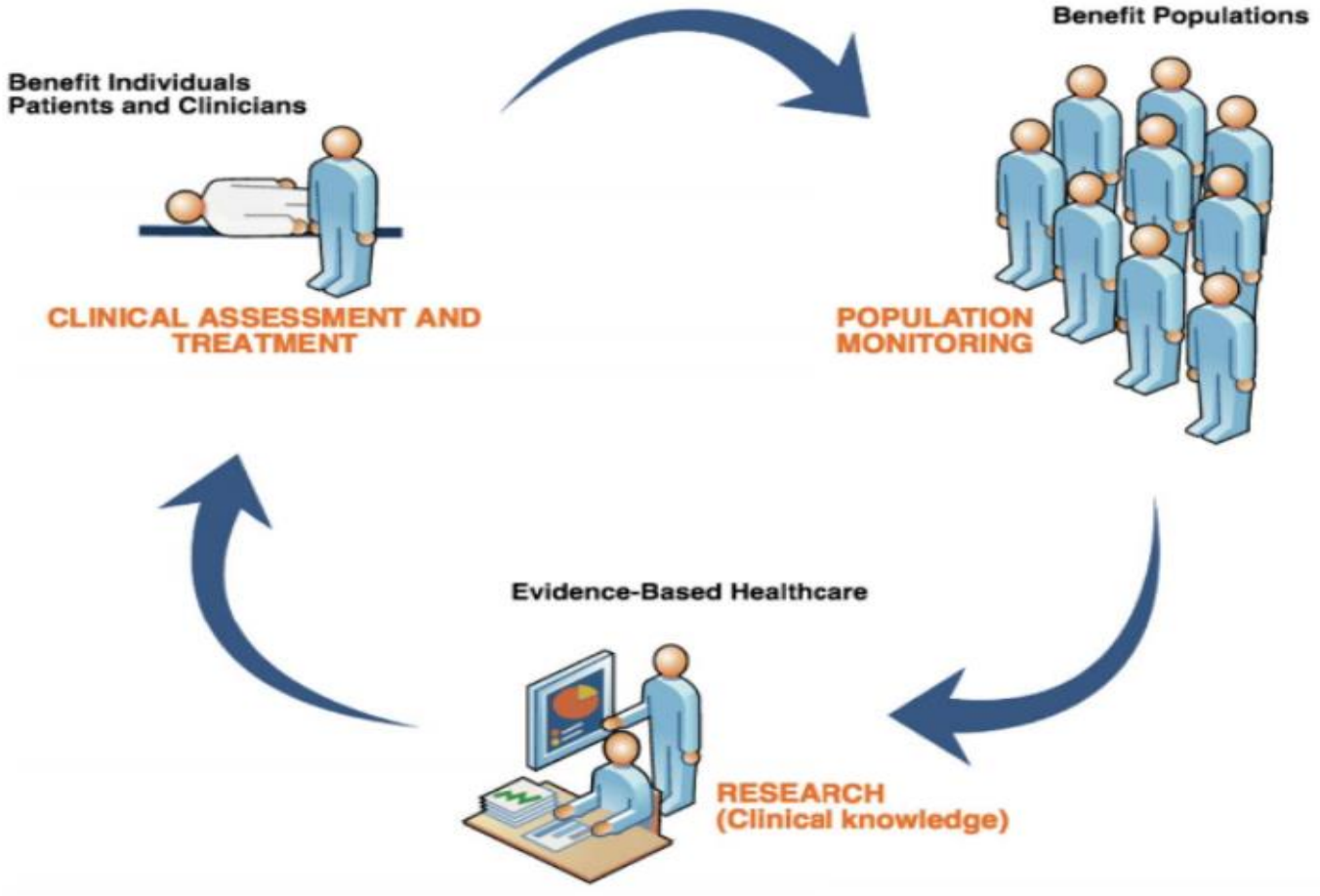
Every concept represents a unique clinical meaning, which is referenced using a unique, numeric and machine readable SNOMED CT identifier. The identifier provides an unambiguous unique reference to each concept and does not have any ascribed human interpretable meaning.



Description



How is it Used



Benefits

Individuals

- Enabling clinical information to be recorded consistently
- Enabling support systems to check the record and provide real-time advice
- Supporting the sharing of appropriate information with others involved in delivering care, allowing the understanding of the information in a common way by all providers
- Allowing accurate and comprehensive analysis that identifies patients who require follow-up or changes of treatment
- Removing language barriers – SNOMED CT enables multilingual use

Population

- Facilitating early identification of emerging health issues, monitoring of population health and responses to changing clinical practices.
- Enabling accurate and targeted access to relevant information, reducing costly duplications and errors.
- Enabling the delivery of relevant data to support clinical research and contribute evidence for future improvements in treatment.
- Enhancing audits of care delivery with options for detailed analysis of clinical records to investigate outliers and exceptions.

Evidence Based Healthcare

- Enabling links between clinical records and enhanced clinical guidelines and protocols.
- Enhancing the quality of care experienced by individuals.
- Reducing costs of inappropriate and duplicative testing and treatment, limiting the frequency and impact of adverse healthcare events.
- Raising the cost-effectiveness and quality of care delivered to populations.

Fast Health Interoperable Resources (FHIR)

Introduction

- The latest HL7 standard for exchanging electronic healthcare information
- Acronym
  - F – Fast (to design and to implement)
    - ✓ Relative – No technology can make implementation as fast we like
  - H – Healthcare
    - ✓ That's why we're here
  - I – Interoperable
    - ✓ Ditto
  - R – Resources
    - ✓ Building blocks (our next focus)

Introduction Contd…

- A set of modular components called “Resources” which is the basic building block of all exchangeable content
- Defines a simplified approach to implementation w/o sacrificing information integrity
- Resources refer to each other using URLs
  - ✓ Build a web to support healthcare process
- Exchange resources between systems
  - ✓ Using a RESTful API (e.g. web approach)
  - ✓ As a bundle of resources (messages, documents)

Manifesto

- Focus on **Implementers**
- Target support for **common scenarios**
- Leverage cross-industry **web technologies**
- Require **human readability** as base level of interoperability
- Make content **freely available**
- Support multiple **paradigms** & architectures
- Demonstrate best practice **governance**

Modules

- Foundation: It is the basic infrastructure upon which the rest of the specification is built
- Implementer Support: This includes services that intend to help implementers to efficiently use the specification
- Security & Privacy: These cover the documentation and services to create as well as maintain security, integrity and privacy of the resources
- Conformance: This deals with the way conformance is validated to the specification, and clarifies implementation guides
- Terminology: This manages the use and support of various terminologies and related artifacts under one umbrella
- Linked Data: Manages the different way in which resources are exchanged

- Administration: Here the basic resources are managed in order to efficiently track patients, practitioners, organizations, devices, substances, etc.
- Clinical: This supports core clinical content such as problems, allergies, and the care process involved (care plans, referrals)
- Medications: This develops and tracks medication management and immunization tracking
- Diagnostics: Records observations, diagnostic reports and requests along with other related content
- Workflow: A very crucial aspect is seamlessly managing the process of care, and technical artifacts to do with obligation management
- Financial: This is much technical in nature and includes billing and claiming support
- Clinical Reasoning: This includes clinical decision support and quality measures

Fast Health Interoperable Resources (FHIR)

```
<Patient xmlns="http://hl7.org/fhir">
  <id value="glossy"/>
  <meta>
    <lastUpdated value="2014-11-13T11:41:00+11:00"/>
  </meta>
  <text>
    <status value="generated"/>
    <div xmlns="http://www.w3.org/1999/xhtml">
      <p>Henry Levin the 7th</p>
      <p>MRN: 123456. Male, 24-Sept 1932</p>
    </div>
  </text>
  <extension url="http://example.org/StructureDefinition/trials">
    <valueCode value="renal"/>
  </extension>
  <identifier>
    <use value="usual"/>
    <type>
      <coding>
        <system value="http://hl7.org/fhir/v2/0203"/>
        <code value="MR"/>
      </coding>
    </type>
    <system value="http://www.goodhealth.org/identifiers/mrn"/>
    <value value="123456"/>
  </identifier>
  <active value="true"/>
  <name>
    <family value="Levin"/>
    <given value="Henry"/>
    <suffix value="The 7th"/>
  </name>
  <gender value="male"/>
  <birthDate value="1932-09-24"/>
  <careProvider>
    <reference value="Organization/2"/>
    <display value="Good Health Clinic"/>
  </careProvider>
</Patient>
```

Resource Identity & Metadata

Human Readable Summary

Extension with URL to definition

Standard Data:
- MRN
- Name
- Gender
- Birth Date
- Provider

FHIR and Cost of Integration

- These factors will drive down the cost of integration and interoperability
  - Easier to Develop
  - Easier to Troubleshoot
  - Easier to Leverage in production
  - More people to do the work (less expensive consultants)
- Competing approaches will have to match the cost, or disappear – effect is already being felt

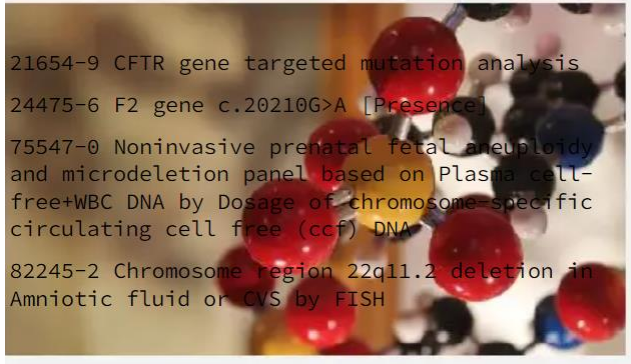
Logical Observation Identifiers Names and Codes (LOINC)

Introduction

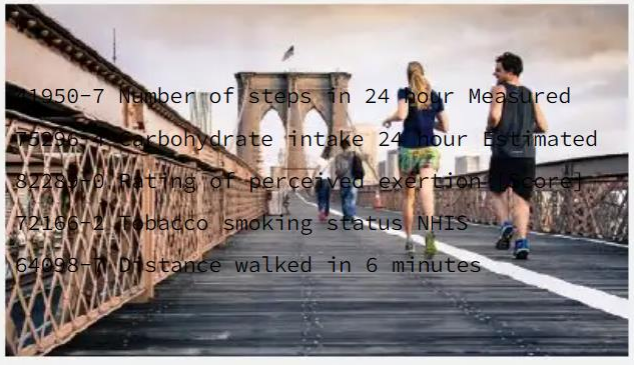
- Its objective is a language-, system- and institution-independent, universally unambiguous identification of medical analyses and descriptive content, which enables computer-aided automated data processing
- Established in 1994 by Regenstrief Institute
- Vocabulary standard for observation identifiers
- LOINC is like a bar code for measurements and reports
- LOINC uses RELMA (Regenstrief LOINC Mapping Assistant), which is a software program that helps users map their local terms or lab tests to LOINC codes that are universal in nature.

84000+ Standardized Variables

Genetics

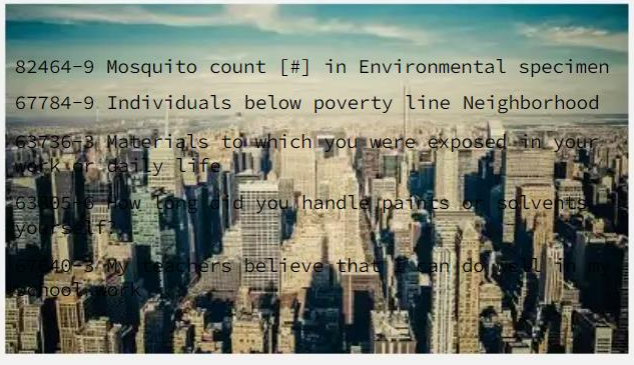


Lifestyle

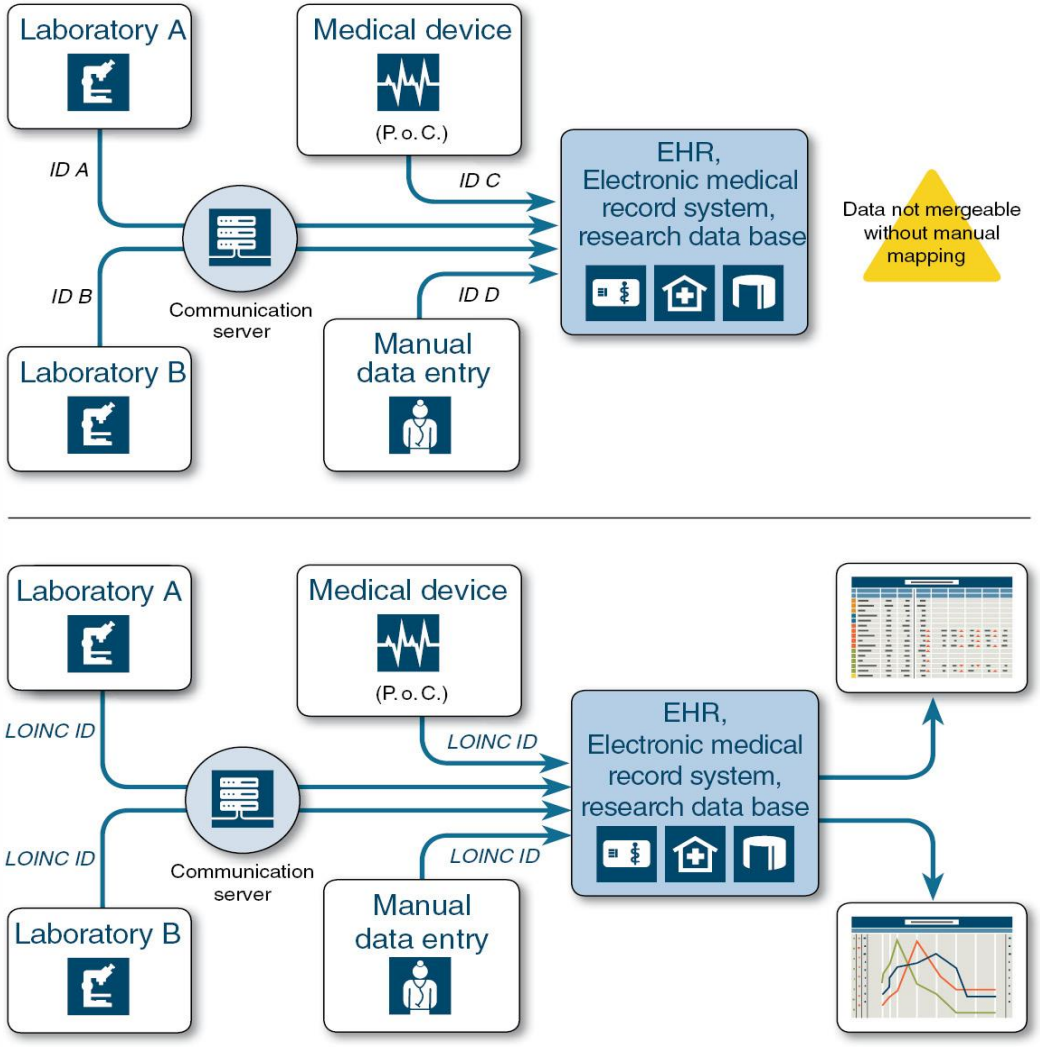


Lab and clinical

Environmental



Data Integration Example



Examples

Codes for individual observations

- 6690-2Leukocytes [#/volume] in Blood by Automated count
- 2339-0Glucose [Mass/volume] in Blood
- 29463-7Body weight5
- 5423-8 Number of steps in unspecified time Pedometer

Codes for collections (panels and documents)

- 57021-8CBC W Auto Differential panel – Blood
- 34565-2Vital signs, weight and height panel
- 44249-1PHQ-9 quick depression assessment panel
- 36813-4CT Abdomen and Pelvis W contrast IV18842-5Discharge summary

Use Cases for Laboratory

- Electronic transmission of laboratory results data (observation reporting), Ex:HIS-LIS
- Laboratory requests as part of a fully electronic order entry process (where the request often requires a lower level of granularity of the coded information than the transmission of findings
- Data pooling in inter-laboratory comparison tests within the framework of quality assurance in laboratory medicine;
- Accounting and billing of diagnostic services – which requires appropriate mapping to accounting systems and billing code systems;
- Export of data for medical research purposes (clinical research, health services research);
- As well as the prospective export of data to the patient or the citizen himself – to support automated transfer into layman-friendly texts via a LOINC standardization.

Digital Imaging and Communications in Medicine (DICOM)

Introduction

Digital Imaging and Communication in Medicine (DICOM) has become one of the most popular standards in medicine. In the beginning, DICOM was used for communication of image data between different systems. Actual developments of the standardisation enables increasingly more DICOM-based services for the integration of modalities and information systems (e.g. RIS, PACS). DICOM interfaces are available for connection of any combination of the following categories of digital imaging devices:

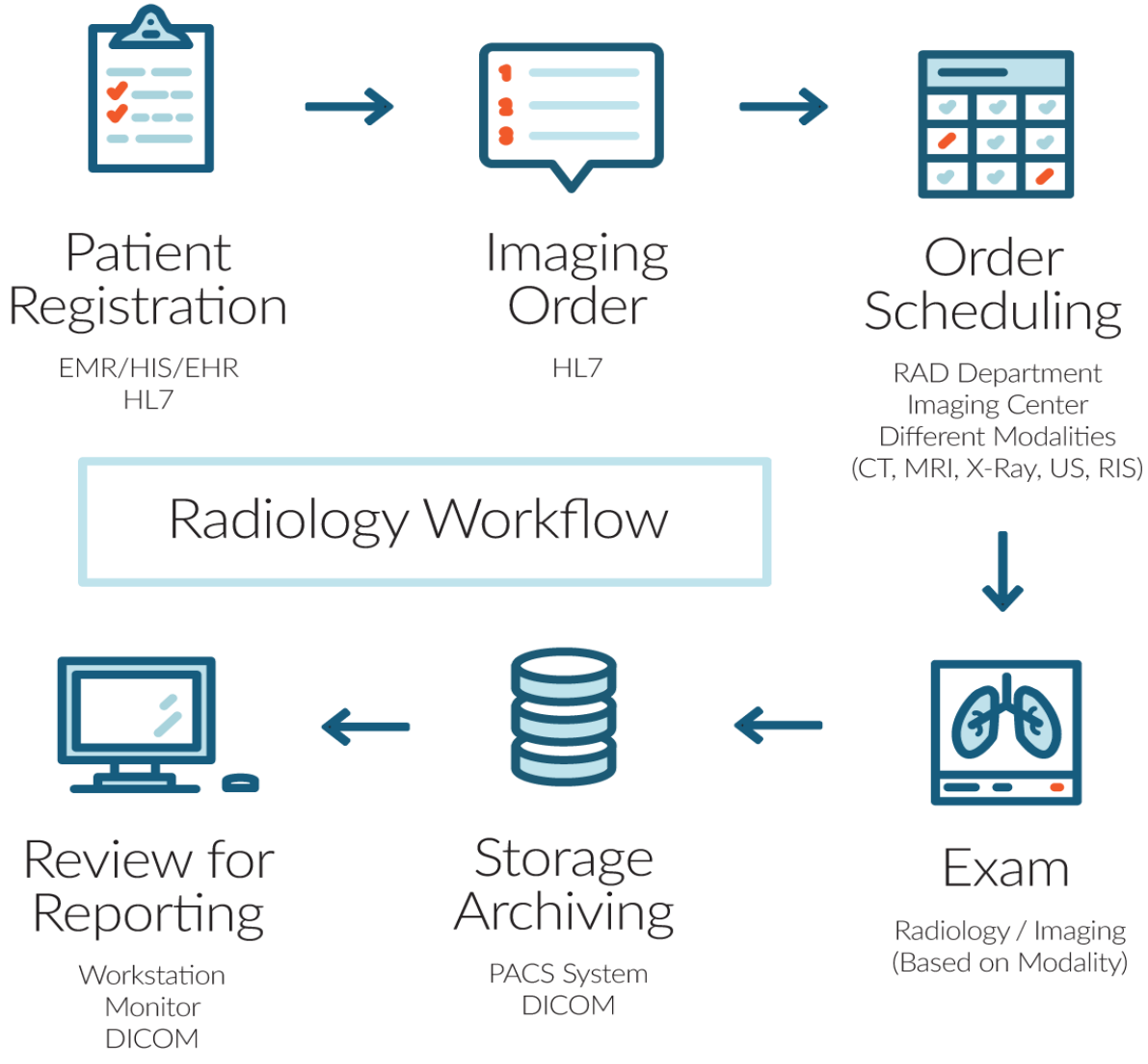
- image acquisition equipment (e.g., computed tomography, magnetic resonance imaging, computed radiography, ultrasonography, and nuclear medicine scanners);
- image archives;
- image processing devices and image display workstations;
- hard-copy output devices (e.g., photographic transparency film and paper printers).

Key Elements

- DICOM File Format
  - ✓ All Medical Images are saved in DICOM format. Medical Imaging Equipment creates DICOM files.
  - ✓ Doctors use DICOM Viewers, computer software applications that can display DICOM images, to diagnose the findings in the images. DICOM files contain more than just images.
  - ✓ Every DICOM file holds patient information (name, ID, sex and birth date), important acquisition data (e.g., type of equipment used and its settings), and context of the imaging study that is used to link the image to the medical treatment it was part of.

- DICOM Network Protocol
  - ✓ All medical imaging applications that are connected to the hospital network use the DICOM protocol to exchange information, mainly DICOM images but also patient and procedure information.
  - ✓ The DICOM network protocol is used to search for imaging studies in the archive and restore imaging studies to the workstation in order to display it. There are also more advanced network commands that are used to control and follow the treatment, schedule procedures, report statuses and share the workload between doctors and imaging devices.

DICOM Workflow



Benefits

- Eliminating the need for physical storage
- Reduced costs and space requirements
- Better diagnosis and patient care
- Improved workflow.
- Easier access to patient data
- Additional imaging

Recap

- Learnt the need for standards
- Architecture of National Digital Health Blueprint
- Interoperability
- Impact of Health IT Standards
- Quick overview of key Digital Health Standards

Activity

A Healthcare provider organization is exploring to replace its Hospital Information Management System. The management wants to understand the key standards the software provider must adhere. Based on what we learnt in this module can you draft a 20-slide presentation for this transformative program?

References

- What Does an HL7 Interface Do and What are its Benefits? | by Denise Roybal | Medium
- Introduction to FHIR, Grahame Grieve
- SNOMED - 5-Step Briefing
- LOINC: Origin, development of and perspectives for medical research and biobanking – 20 years on the way to implementation in Germany in: Journal of Laboratory Medicine Volume 43 Issue 6 (2019) (degruyter.com)
- LOINC for Beginners (December 2017) – LOINC
- An Introduction to DICOM (Digital Imaging and Communications in Medicine) | ExtraHop
- DICOM: A Look into its Scope and Utility | PostDICOM
- Understanding and Using DICOM, the Data Interchange Standard for Biomedical Imaging (nih.gov)

Thank you