COMP2322:
Introduction to Health Informatics

Health Informatics:

Integrated Health

Time: **Tues+ Thur: 13:00-13:50**

Location: **Masri406**

Section: **1**

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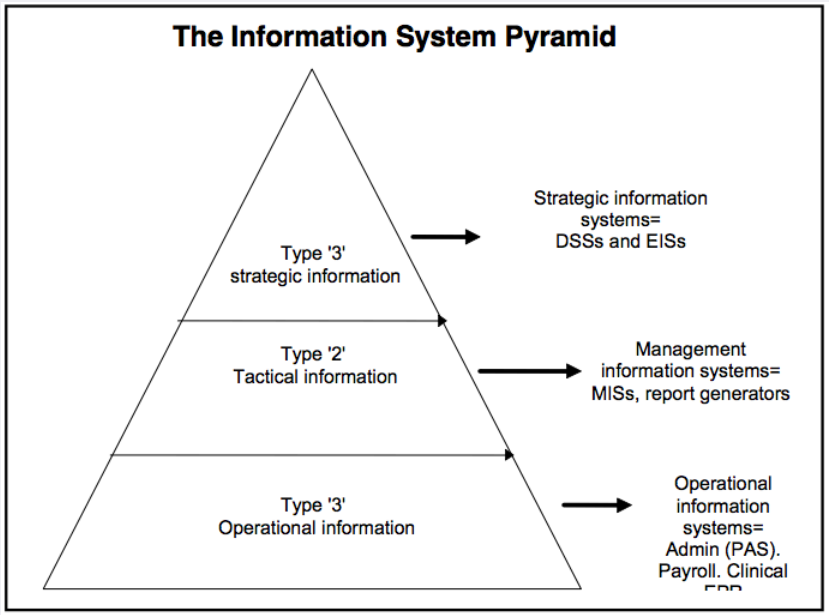
Dr Adel Taweel

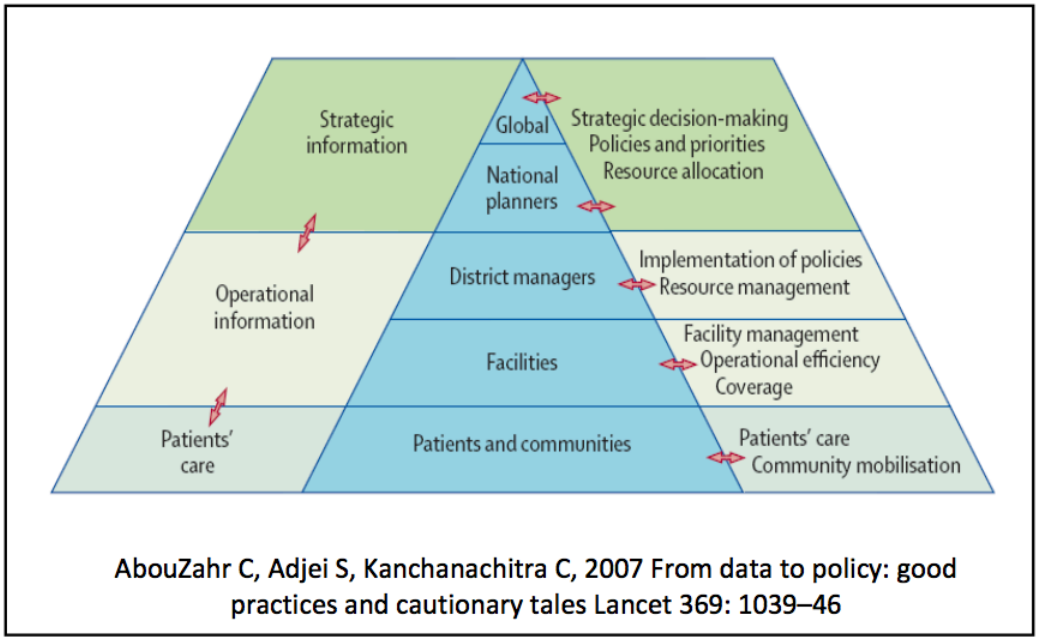
Birzeit University

Co-funded by the Erasmus+ Programme of the European Union

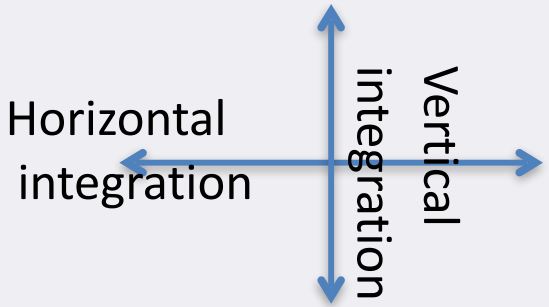
Recall: Health Information Systems

Operational <-> Tactical <-> Strategic Health Information Systems





AbouZahr C, Adjei S, Kanchanachitra C, 2007 From data to policy: good practices and cautionary tales Lancet 369: 1039–46



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Integrated Healthcare

What to integrate in healthcare?

Health Informatics in Healthcare

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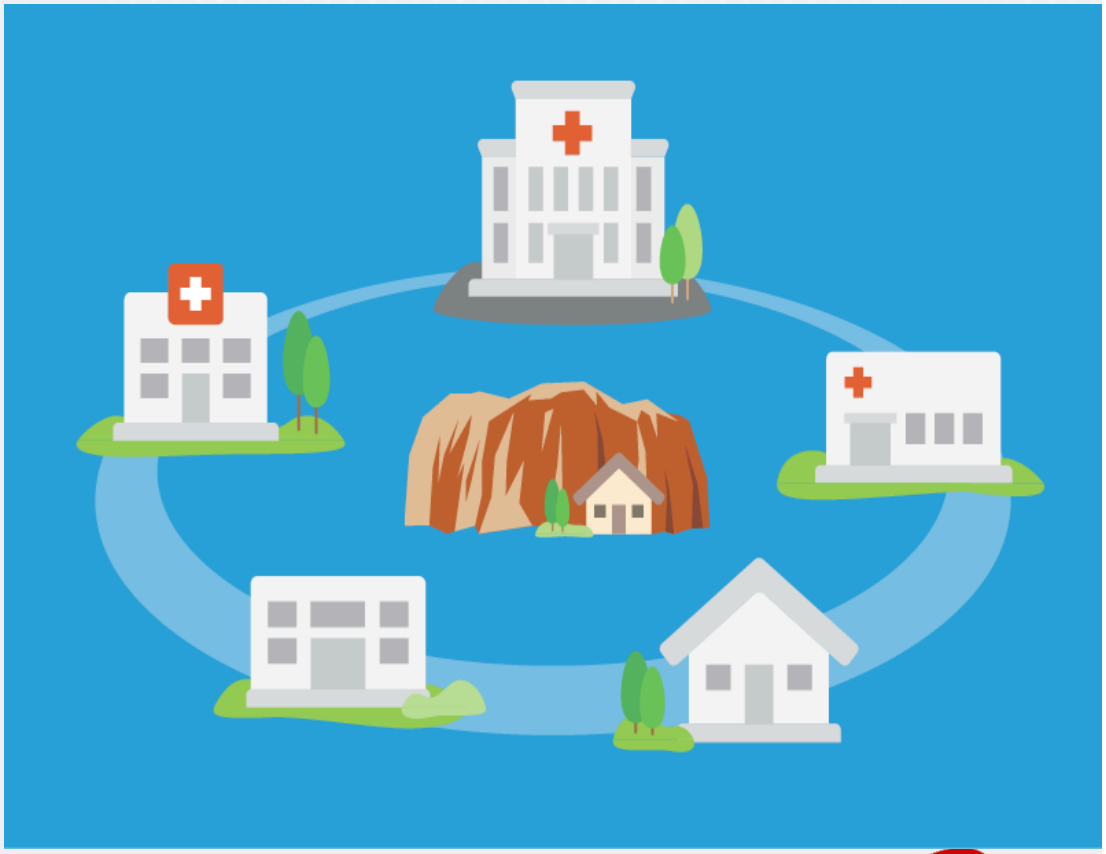
Health Information Systems' Collaboration

- The implementation of HIS within healthcare must meet both national and local performance goals.

- Improved outcomes comes from Knowledge exchange,
  - which comes from collaboration when **sharing a common understanding**
  - learning from past experiences to make better decisions in the future.



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Health Information Systems' Collaboration: within an organisation

- Effective collaboration requires **sharing** of knowledge and **exchange** of information.

- To succeed, it requires a multidisciplinary approach, with systems that can work in:
  - a complex healthcare organizations environment
  - diverse and complex patient populations.

http://hitinfrastructure.com/news/clinical-communication-collaboration-key-for-hit-systems

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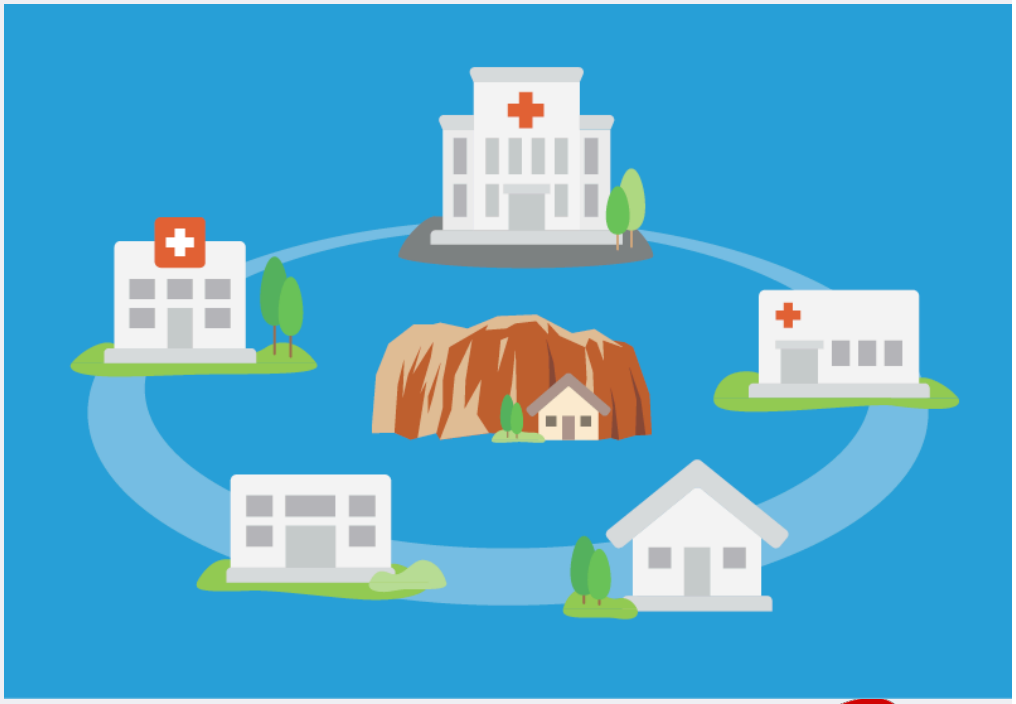
Health Information Systems

- HISs refer to any system that helps to
  - ➢ Capturing, storing, managing, analyzing or transmitting information related to the health of individuals
  - ➢ Administering and managing the activities of organizations that work within the health sector (financial, personnel, payroll, bed census etc.)
  - ➢ Evaluating Hospital Performance and Cost , and projection of the long-term forecast



EMR vs EHR vs PHR!

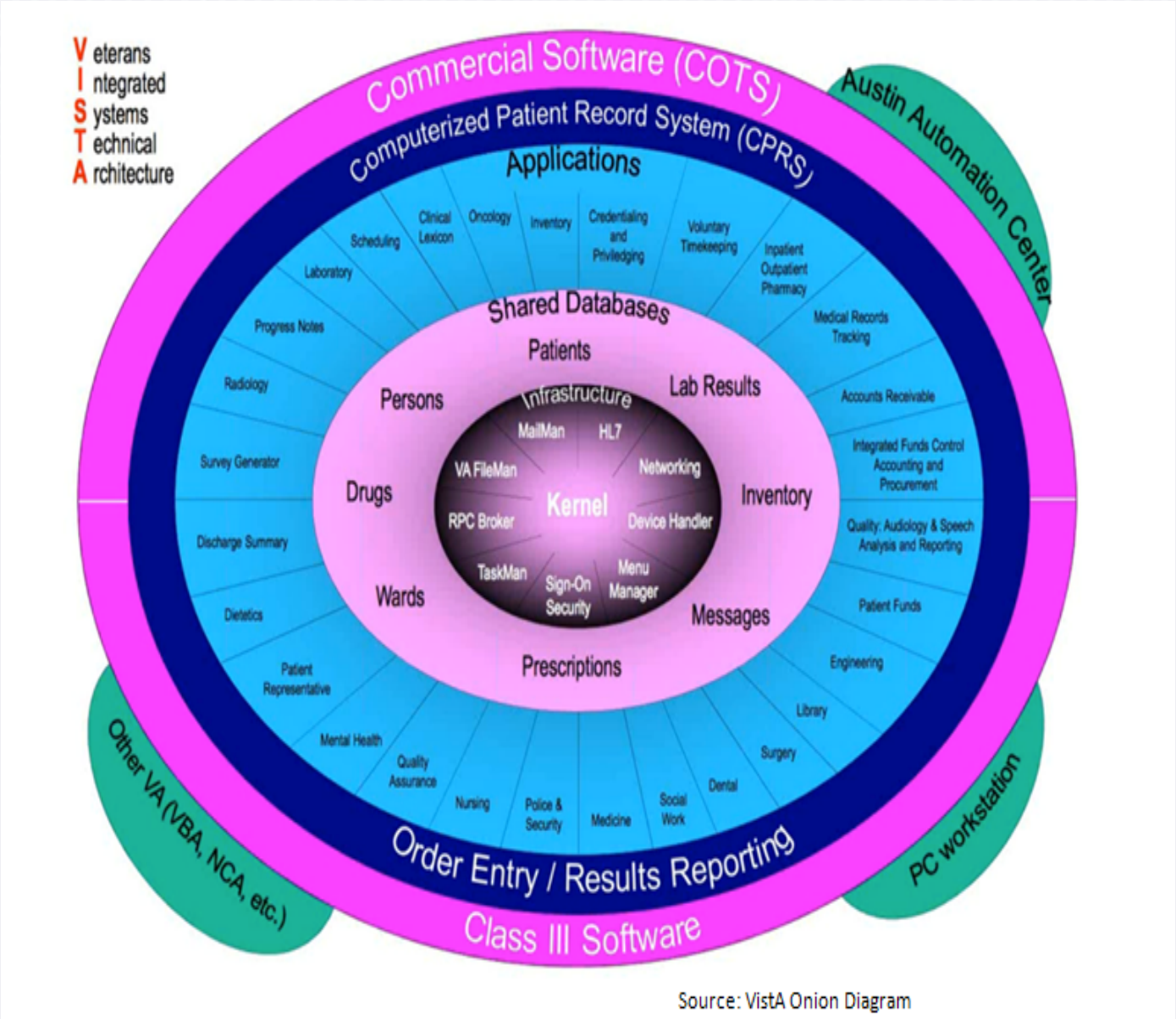
- **Electronic Medical Record**:
  - An electronic record of health-related information on an **individual**
  - created, gathered, managed, and consulted by authorised clinicians and staff
  - serves **one** healthcare organisation.
- **Electronic Health Record**:
  - An electronic record of health-related information on an **individual**
  - conforms to nationally recognised **interoperability standards**
  - Supports the functions of other Health information systems
  - created, managed, and consulted by authorised clinicians and staff
  - Serves/across **more than one** healthcare organisation.
- **Personal Health Record**:
  - An electronic record of health-related information on an **individual**
  - can be drawn from **multiple sources** while being managed, shared, and controlled by the individual.
  - conforms to nationally recognised **interoperability standards**

Electronic Health Records Concept

Electronic Health Records (EHR) systems:

- at the **centre** of health information systems.
- Key to implement management and operational systems.
- Aims to improve **quality** of clinical **data**, which strongly depends on the level of **integration** and **normalisation** of an EHR:
  - **Integration**: refers to the level of system and data integration between HISs **in an organisation** for their ability to **communicate** or **exchange data**, to form a common EHR.
  - **Normalisation**: refers to using or defining **common standards**, in HISs, to communicate on both **structure** and **meaning,** possibly, across organisations.

Open Source EHR System Example: VistA



Source: VistA Onion Diagram

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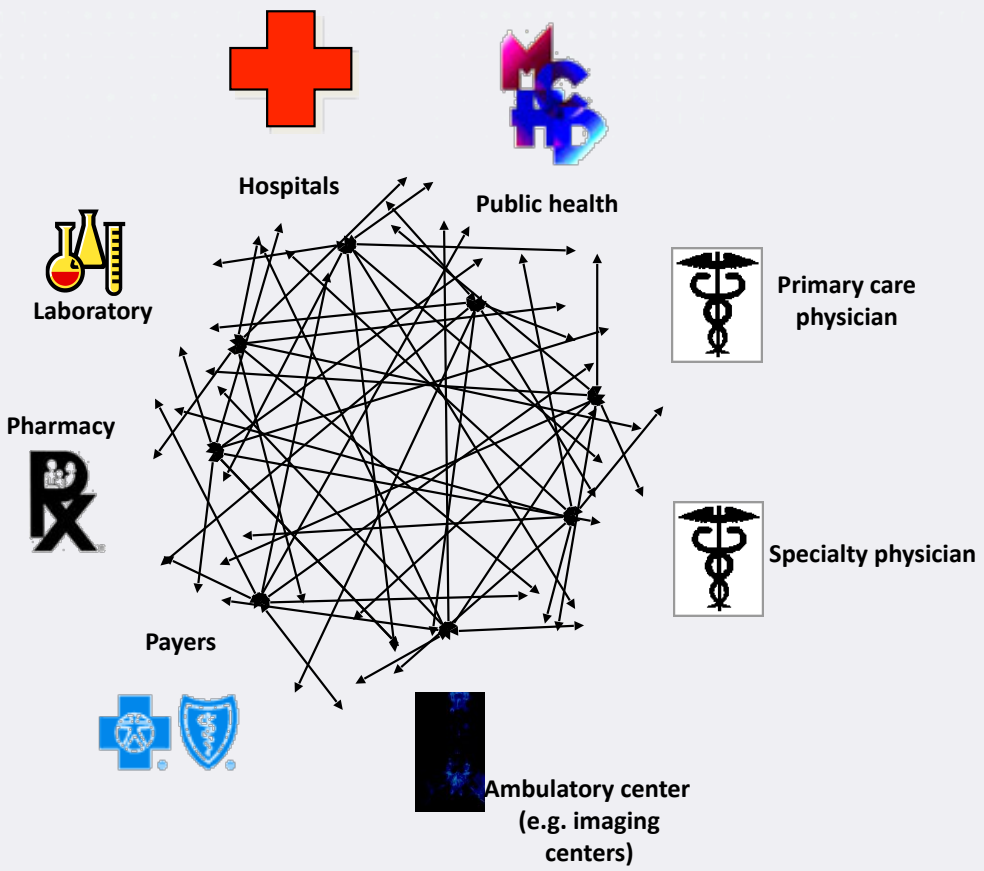
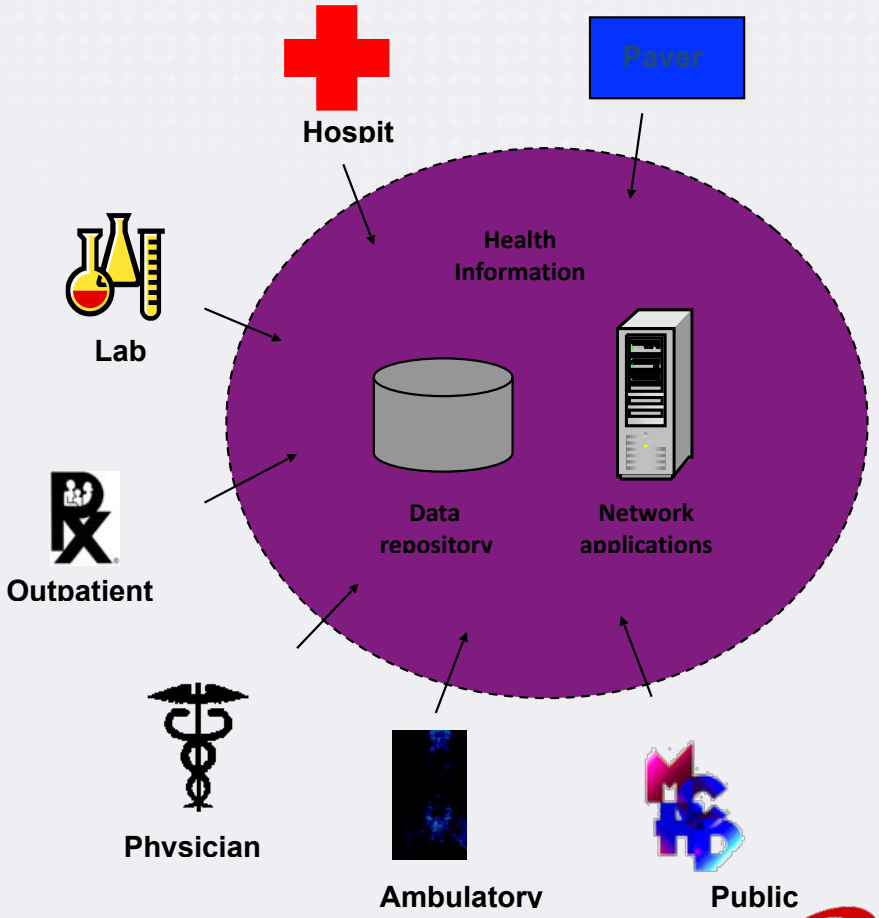
Integrated Healthcare: Disconnected data!

Current system fragments patient information and creates **redundant**, **inefficient** efforts



Future system will consolidate information and provide a foundation for **unifying** efforts



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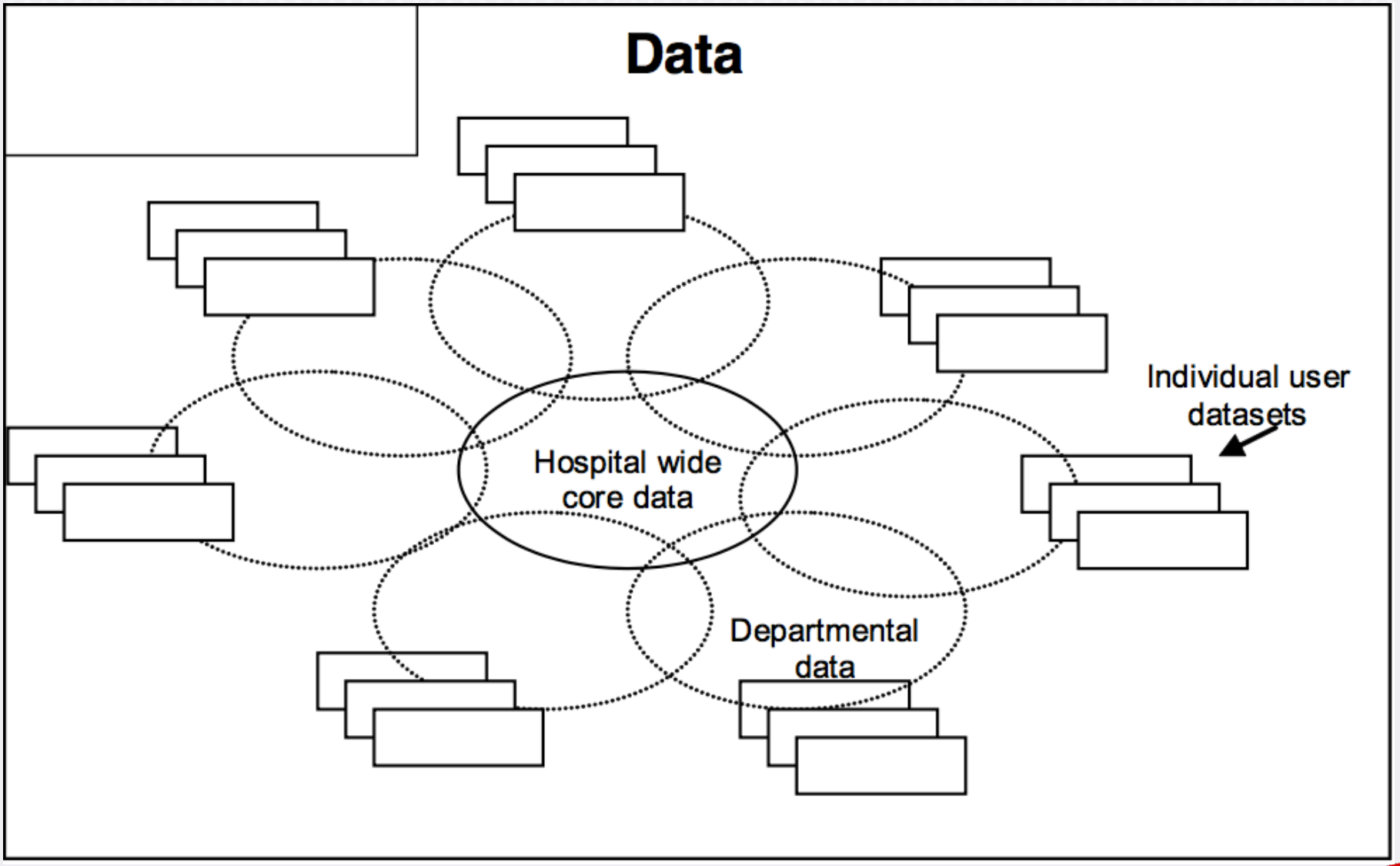
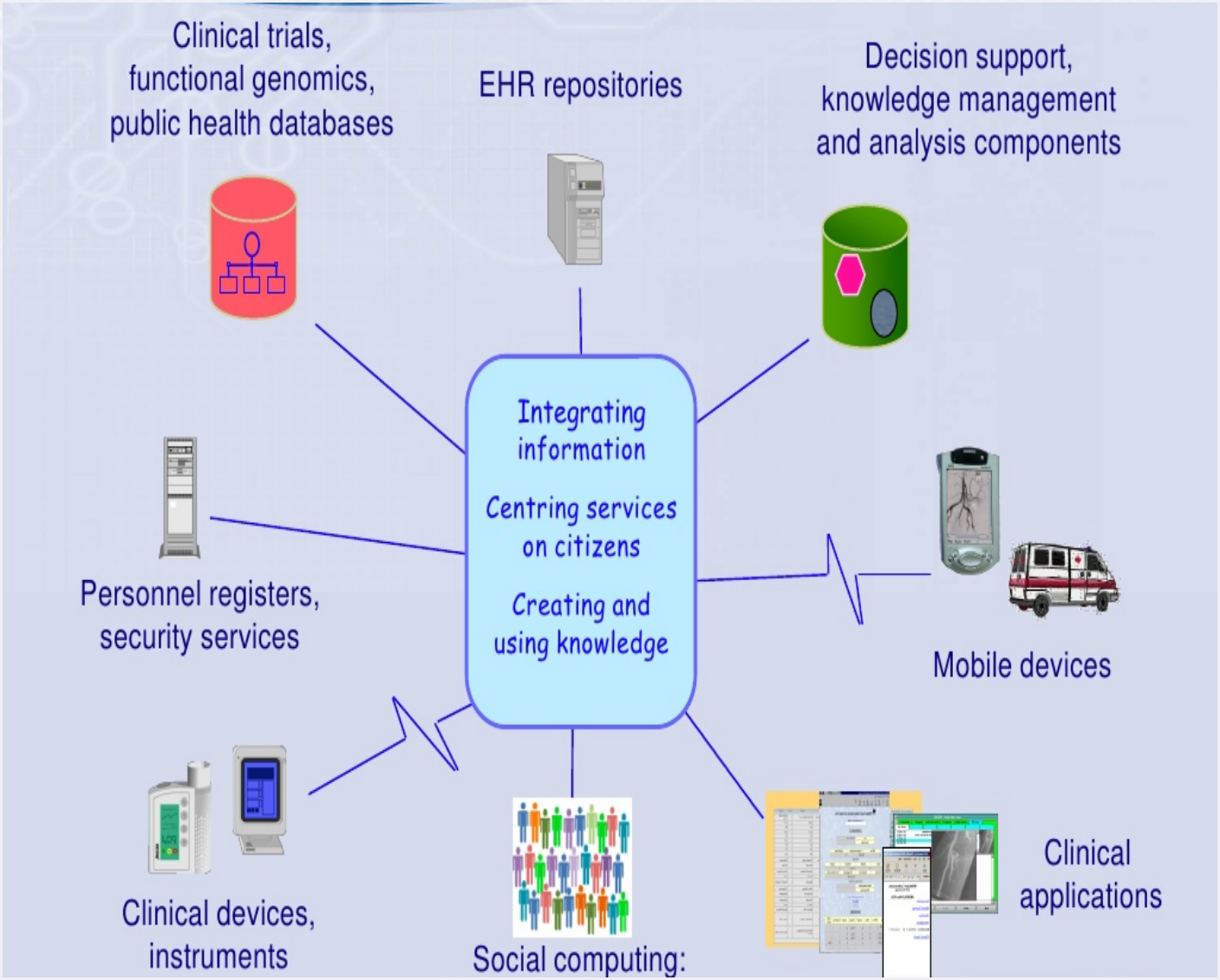
HIS in a Hospital: Data



Electronic Health Records Land escape



Source: Eurorec

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EHR System objectives

The EHR should enable the consistent capture, processing, retention, protection and communication of health information such that interoperability is achieved in support of shared care, improved quality of care, effective resource management, providing evidence of actions taken in health(care), and in support of the uses of anonymized information for health system management.

[ISO 18308]

EHR System objectives...

"The EHR should enable authorized users to access health information that is relevant, intact, appropriate to their permissions and within a timeframe that is appropriate to the context".

[ISO 18308]

EHR System objectives...

The EHR should enable the communication (or exchange) of all health information between care settings, subject to appropriate consent and access rights, to a sufficient quality to support safe shared clinical care.

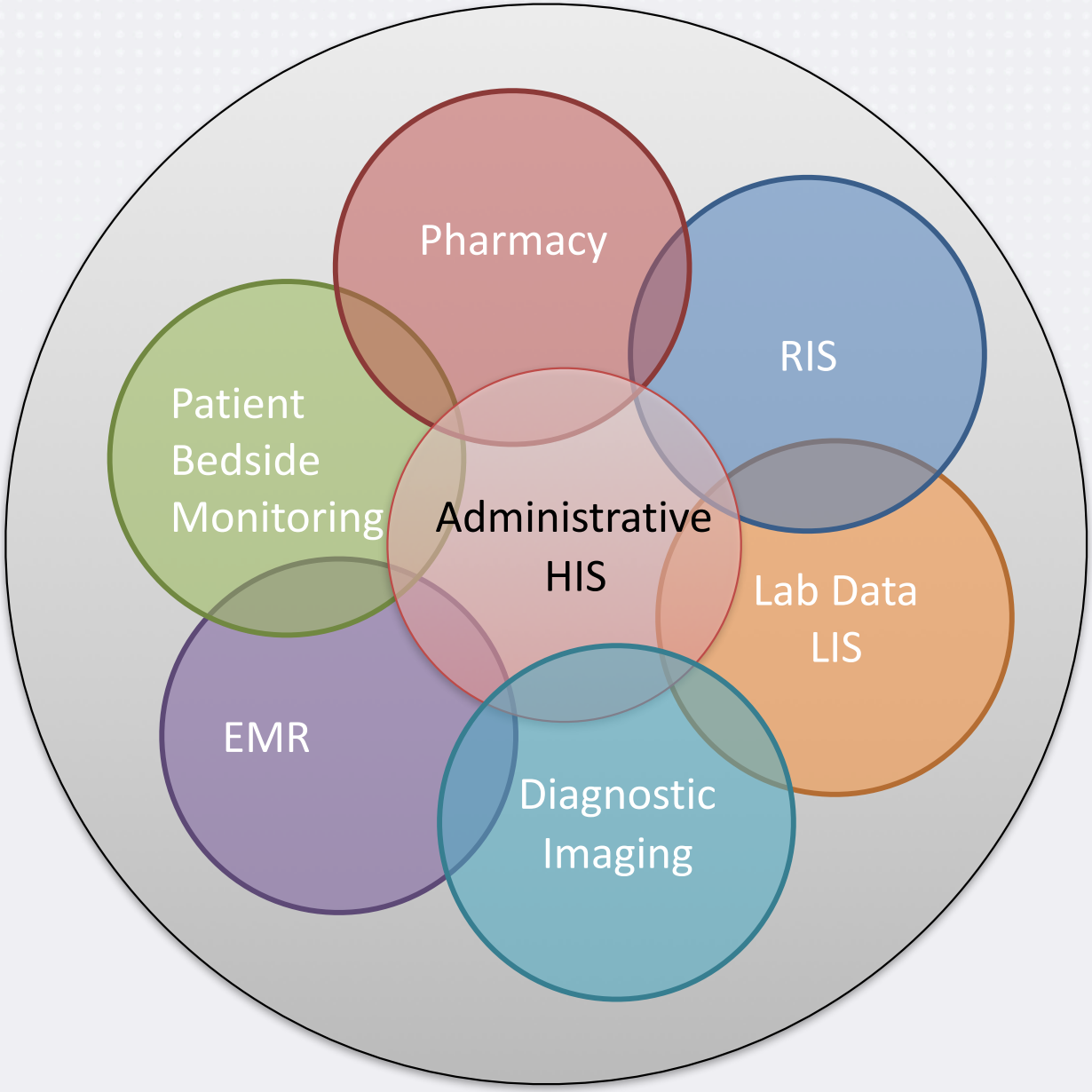
[ISO 18308]

Why share Medical Data?

- Increases patient safety
- Lowers Healthcare costs
- Allows for coordination of care
- Increases communication between providers

=> Similar to a Banking analogy of providing banking services in multiple branches

HIS: Integrated health



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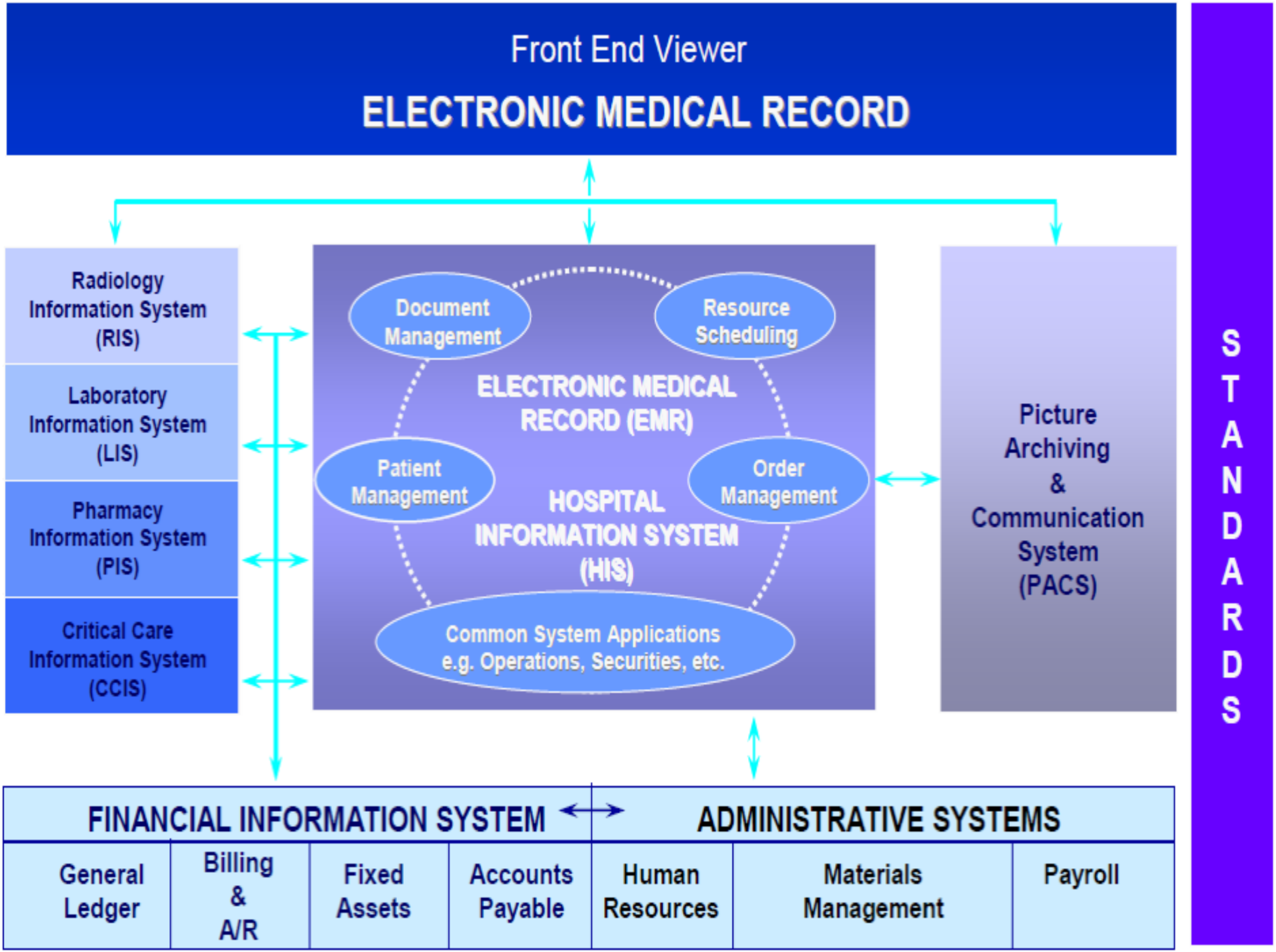
Front End Viewer
ELECTRONIC MEDICAL RECORD
Radiology Information System (RIS)
Laboratory Information System (LIS)
Pharmacy Information System (PIS)
Critical Care Information System (CCIS)
Document Management
Resource Scheduling
ELECTRONIC MEDICAL RECORD (EMR)
Patient Management
Order Management
HOSPITAL INFORMATION SYSTEM (HIS)
Common System Applications e.g. Operations, Securities, etc.
Picture Archiving & Communication System (PACS)
STANDARDS
FINANCIAL INFORMATION SYSTEM
ADMINISTRATIVE SYSTEMS
General Ledger
Billing & A/R
Fixed Assets
Accounts Payable
Human Resources
Materials Management
Payroll

Levels of integration

How to define “integrated healthcare”?

Shareable EHR with HISs

- Sharing of HISs information must be at multiple levels:
  - **At institution level**
    - A healthcare institution must be able to share patients' information generated by ***its HISs***
  - **At national level**
    - A healthcare institution must be able to share patients' information generated by other ***national healthcare institutions*** (i.e., Hospitals, Medical Lab centers, Doctors' clinics)
  - **At international level**
    - A healthcare institution must be able to share patients' information generated by other ***international healthcare institutions***

Shareable EHR with HISs

- Not all healthcare institutions (i.e., doctors' clinics, healthcare and radiology centres, medical labs, hospitals, etc.) adopt sharable EHR
- The "meaningful use" of EHR requires healthcare institutions to share information that is generated and managed by HISs

Models of Integrated Healthcare (or EHR Adoption)

- **Model-1**: Waegeman's Model of EHR development
  - Defined first in 1996
  - Redefined in 2002

- **Model-2**: The Healthcare Information and Management Systems Society (HiMSS) Model of EHR Adoption

Five Levels of Electronic Health Records: Waegeman's Levels 1996

- Level 5: Electronic Health Record (comprehensive)
- Level 4: Electronic Patient Record (spans across organizations)
- Level 3: Electronic Medical Record (organization level)
- Level 2: Computerized Medical Record (e.g documents scanning)
- Level 1: Automated Medical Record (e.g. clinical information systems)

(Waegemann, 1996)

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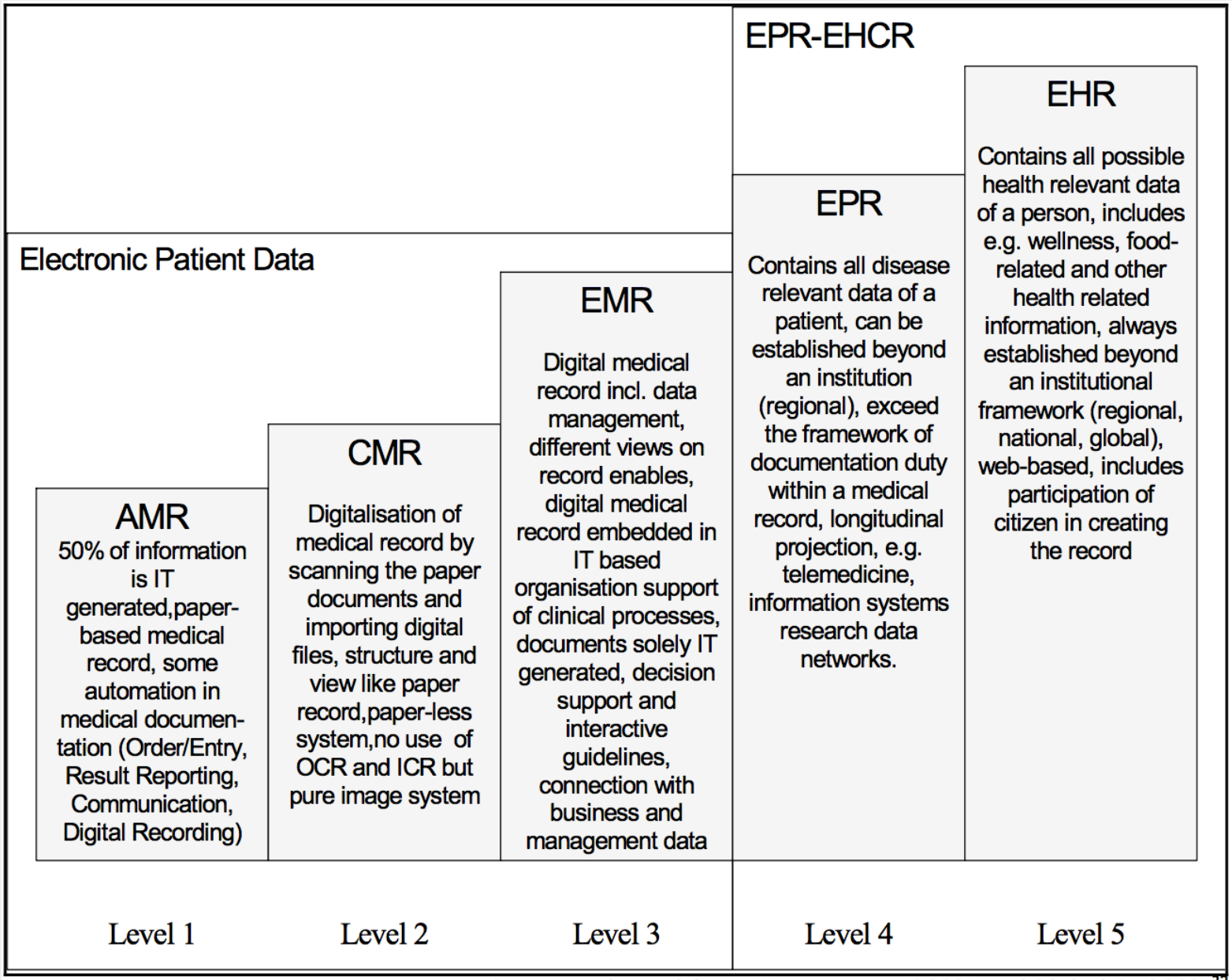
Five Levels of EHRs: Waegeman's Levels refined in 2002



Source: adapted from Waegemann (2002) and Blobel B (2003)[32]

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Shareable EHR with HISs

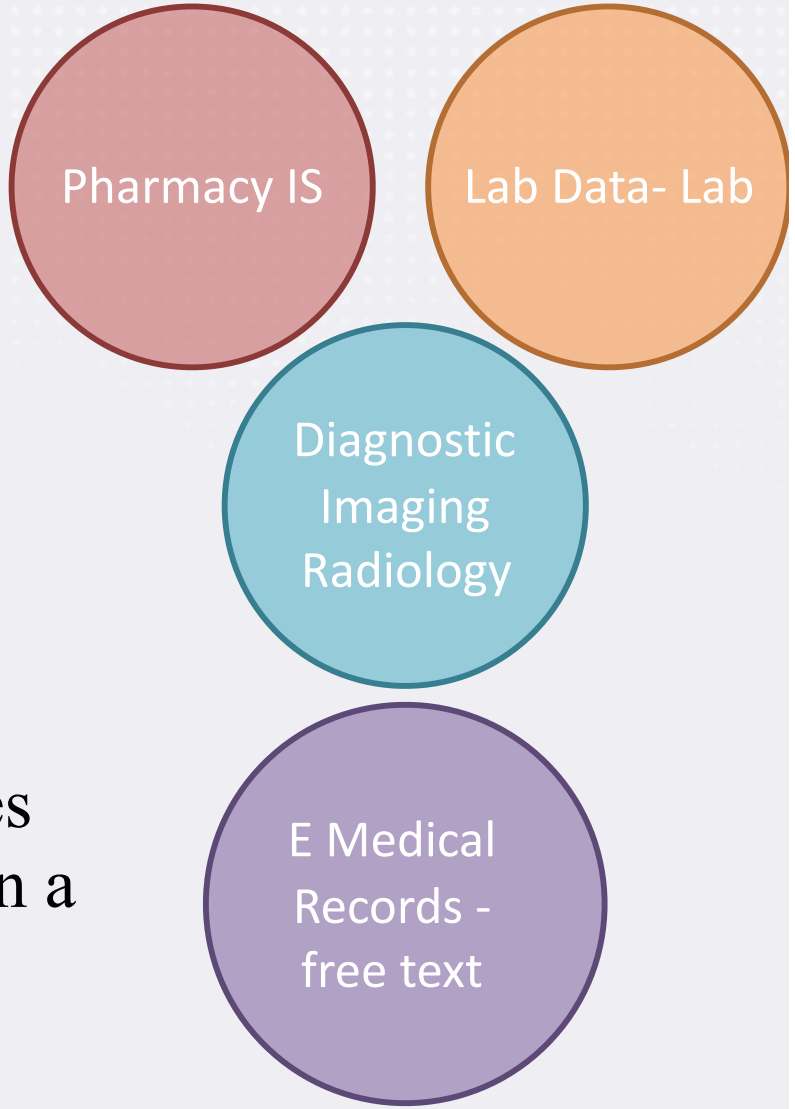
- The Healthcare Information and Management Systems Society (HiMSS) identify an **EHR adoption model**
  - It consists of eight level stages (0 - 7) that measures the adoption and utilisation of shared EHR Functions
  - It aims to promote and support healthcare institutions to adopt EHR and integrate it with their HISs

Shareable EHR Adoption Model…

- **Level (0)**
  - The organization has not installed all of the three key ancillary clinical information systems
    - Laboratory IS
    - Pharmacy IS
    - Radiology IS
  - Paper-based records are the only means of storing and accessing clinical information

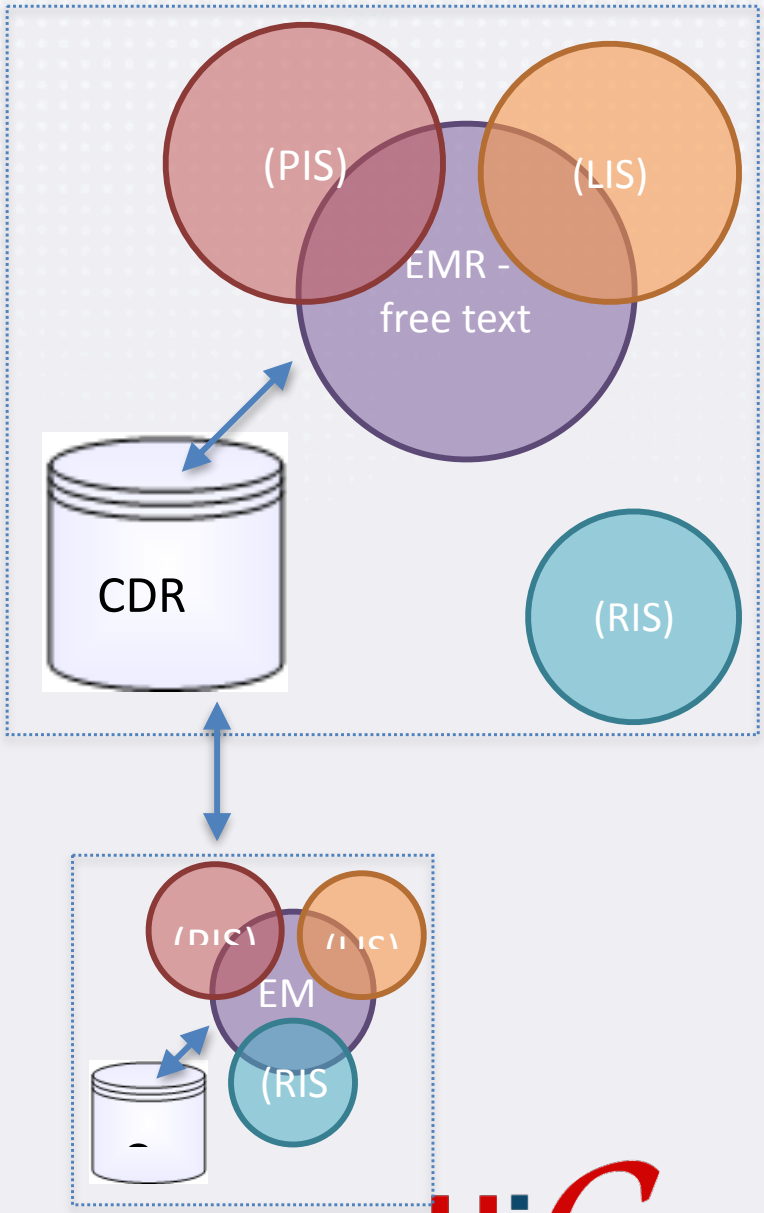
Shareable EHR Adoption Model…

- **Level (1)**
  - The organization has installed all of the three key ancillary clinical information systems
    - Laboratory IS
    - Pharmacy IS
    - Radiology IS
  - Electronic storage of healthcare notes – normally as **free text** - are stored in a patient record



Shareable EHR Adoption Model…

- **Level (2)**
  - Major ancillary clinical systems feed data to a clinical data repository (CDR)
    - The CDR provides physician access for reviewing all orders and results.
    - The CDR contains a controlled medical vocabulary, and the clinical decision support/rules engine (CDS) for rudimentary conflict checking.
    - Information from document imaging systems may be linked to the CDR at this stage.
  - The hospital may have health information exchange (HIE) capability at this stage and can share (part of) information it has in the CDR with other healthcare providers.



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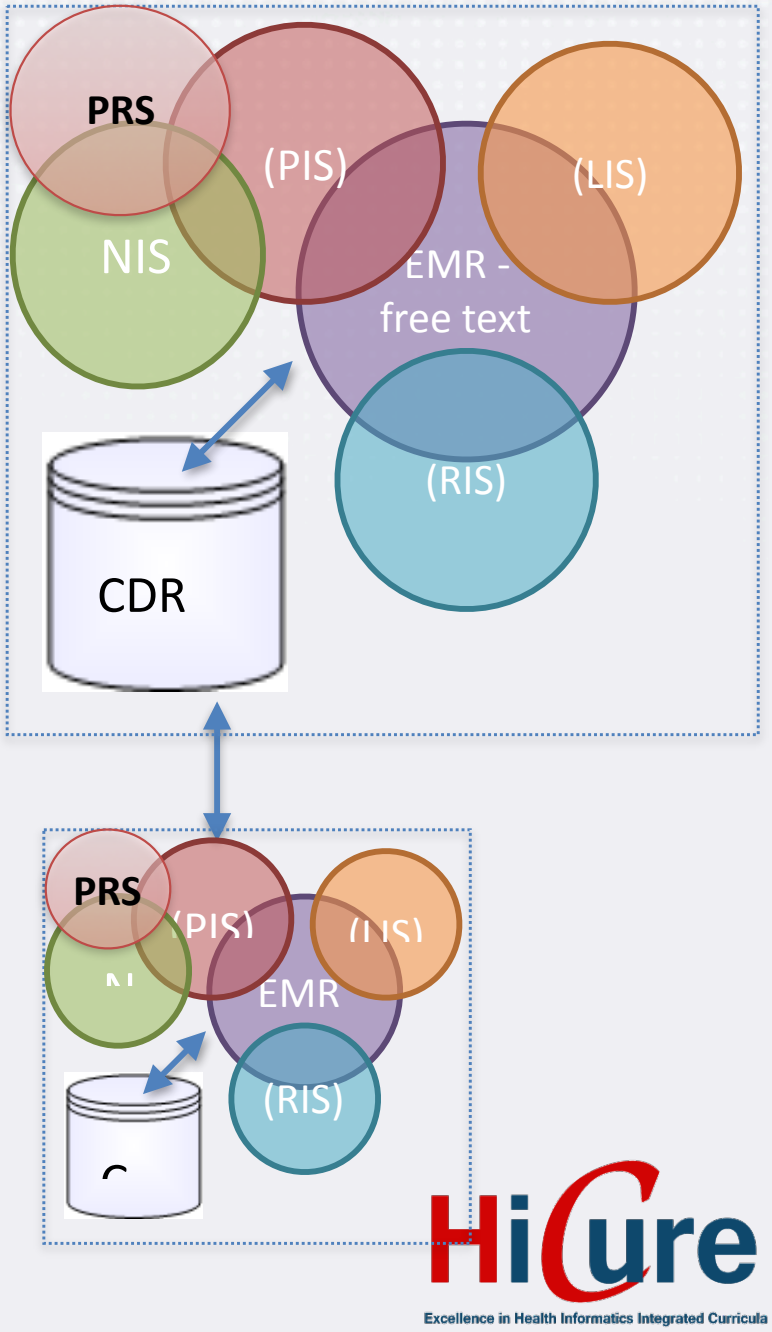
Shareable EHR Adoption Model…

- **Level (3)**
  - Nursing/clinical documentation (e.g. vital signs, flow sheets, nursing notes, etc.) is required, implemented and integrated with the CDR
    - Care plan charting is scored with extra points
  - The electronic Patient Registration System (**PRS**) or Patient Master Index system is implemented.
  - Medical image access from Radiology information system (**RIS**) is available for access by physicians outside the Radiology department via the organisation's intranet.



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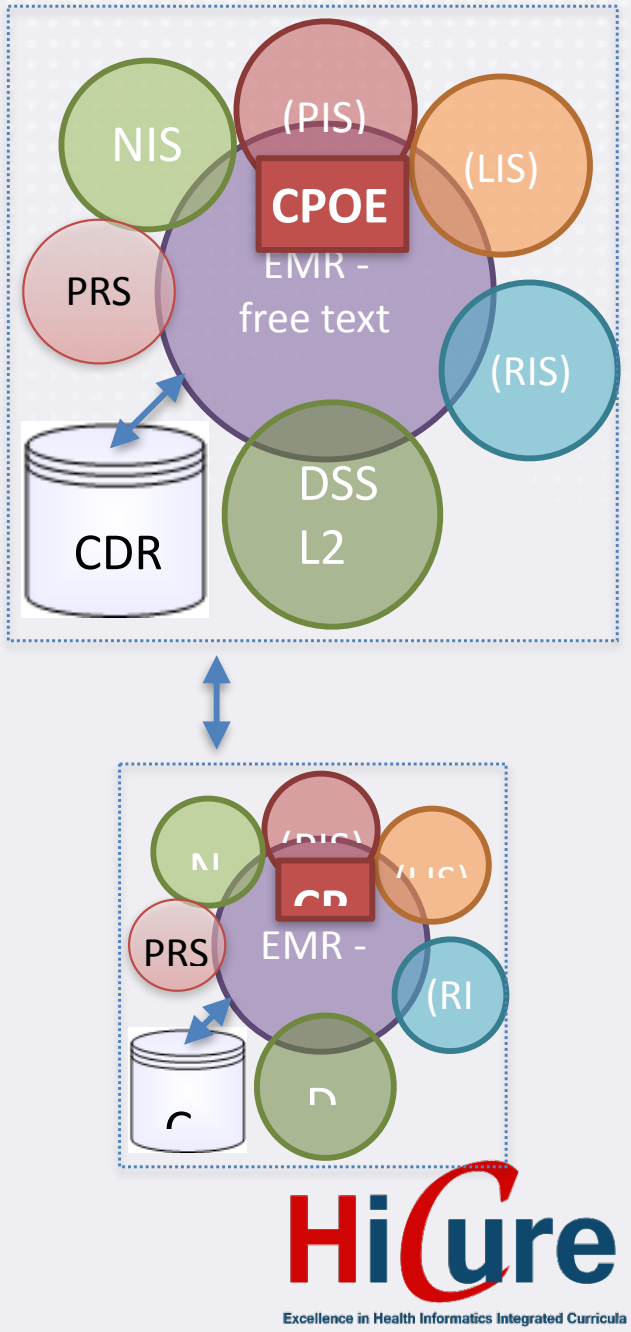
Shareable EHR Adoption Model…

- **Level (4)**
  - Computerised Practitioner Order Entry (CPOE) for use by any clinician licensed to create orders is added to the nursing, laboratory, radiology, and CDR environment
  - The ***level two*** *of* ***clinical decision support (DSS)*** capabilities related to evidence-based medicine protocols.
  - This stage is considered achieved if one inpatient service area has implemented CPOE with physicians entering orders and completed the previous levels (i.e., 1, 2, and 3)



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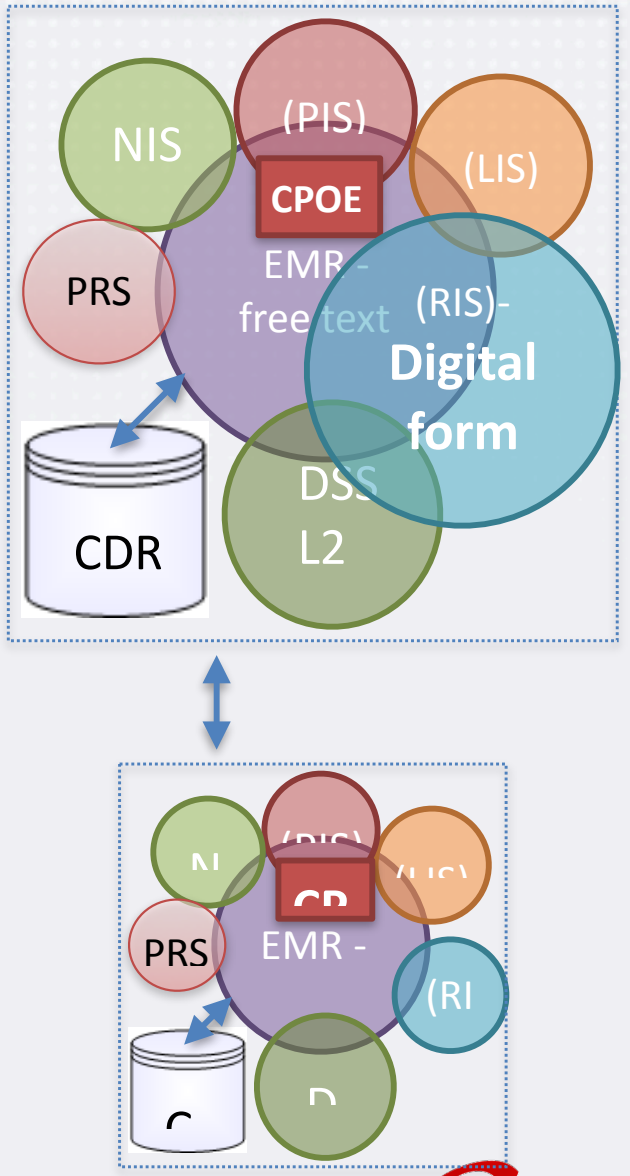
Shareable EHR Adoption Model…

- **Level (5)**
  - A full complement of RIS systems provides medical images to physicians via an intranet and communicates all film based images to different departments
  - Cardiology RIS and document imaging are scored with extra points.



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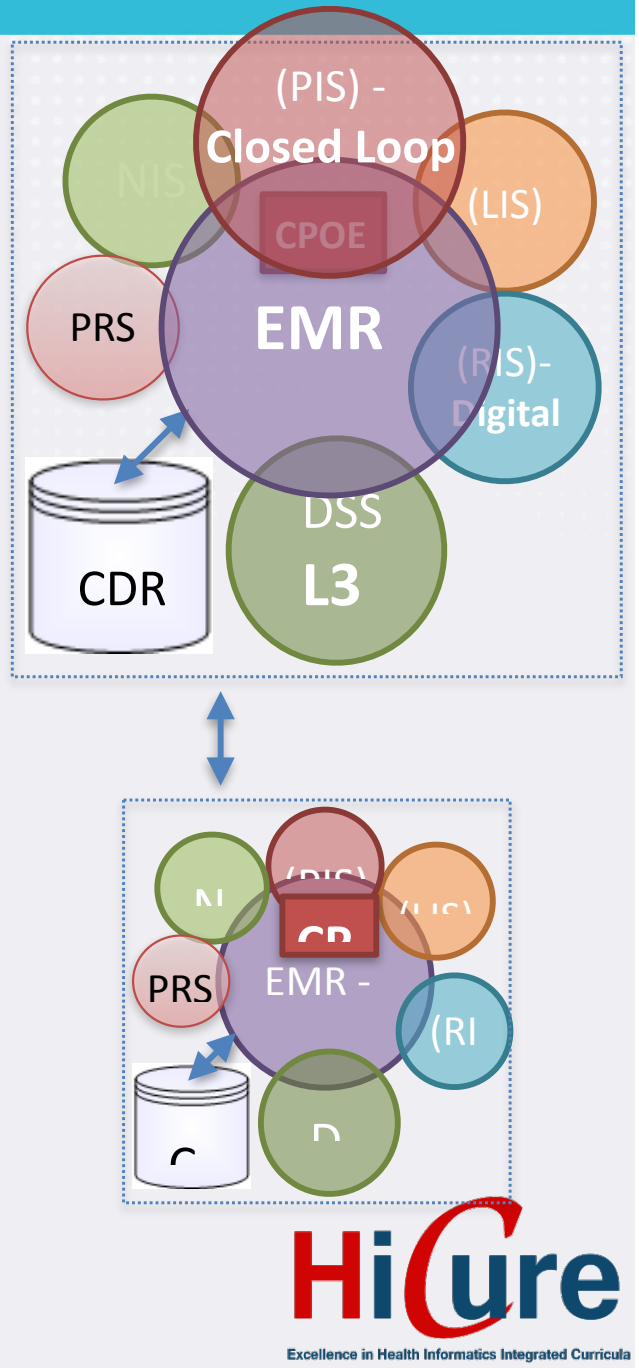
Shareable EHR Adoption Model…

- **Level (6)**
  - Full physician documentation with structured templates and discrete data is implemented for: *progress notes*, *consult notes*, *discharge summaries* or *problem list* & *diagnosis list maintenance*.
  - **Level three** of ***clinical decision support*** provides guidance for all clinician activities related to protocols and outcomes in the form of variance & compliance alerts
  - The closed loop of medication administration with bar-coded unit dose medications environment is fully implemented



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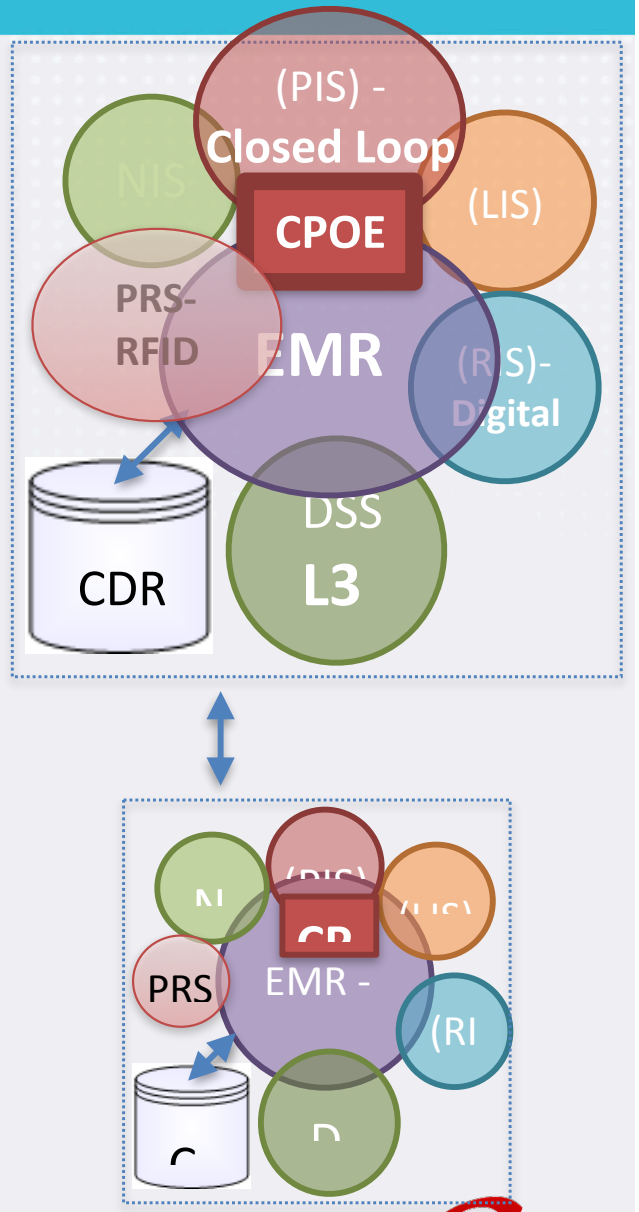
Shareable EHR Adoption Model…

- **Level (6) – cont.**
  - The PRS and bar-coding or other auto identification technology - such as radio frequency identification (RFID) - are implemented and integrated with CPOE and pharmacy to maximise point of care patient safety processes for medication administration.
  - The "*five rights*" of medication administration are verified at the bedside with scanning of the bar-code on the unit does medication and the patient ID.



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“five rights” of medication administration

Every registered clinician/nurse is legally responsible for the correct administration of drugs. This includes the five “rights” of administration:

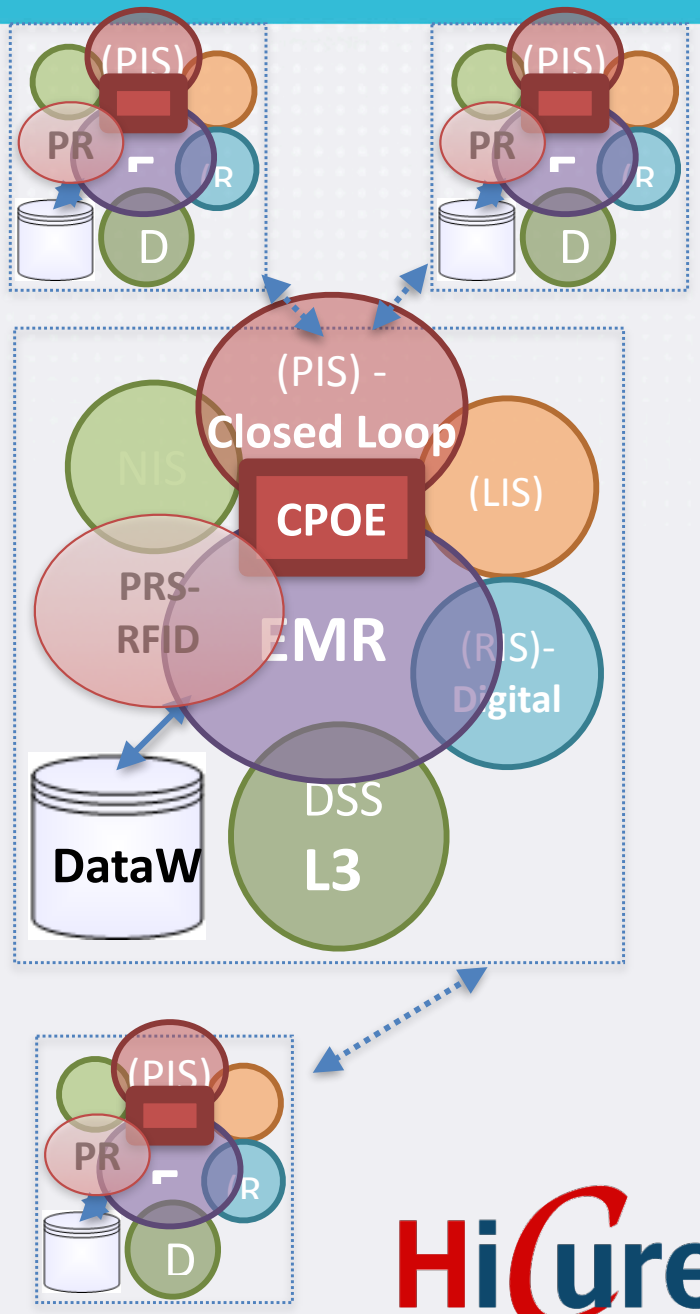
- **Right patient** - check the patient name & hospital number against the chart & I.D. band. ask the patient to state his/her name, & their date of birth (D.O.B)

- **Right drug** - check the drug three times: before removing it from the trolley or shelf, when the drug is removed from the container, before the container is returned to storage, check the expiry date of the drug

- **Right dose** - check the dose, read the container label, calculate the dose
- **Right route** – check and only give the medications by the route designated
- **Right time** -check and give the medication at the prescribed time (within 20 minutes of the prescribed time)

Shareable EHR Adoption Model…

- **Level (7)**
  - The hospital no longer uses paper-based patient record to deliver and manage patient care
  - Also, it has a mixture of discrete data, document images, and medical images within its EMR environment.
  - Data warehousing is being used to analyze patterns of clinical data to improve quality of care, patient safety, and care delivery efficiency.
  - Clinical information can be readily ***shared*** with all entities that are authorised to treat the patient, or a health information exchange (i.e., other non-associated hospitals, ambulatory clinics, employers, payers and patients in a data sharing environment)



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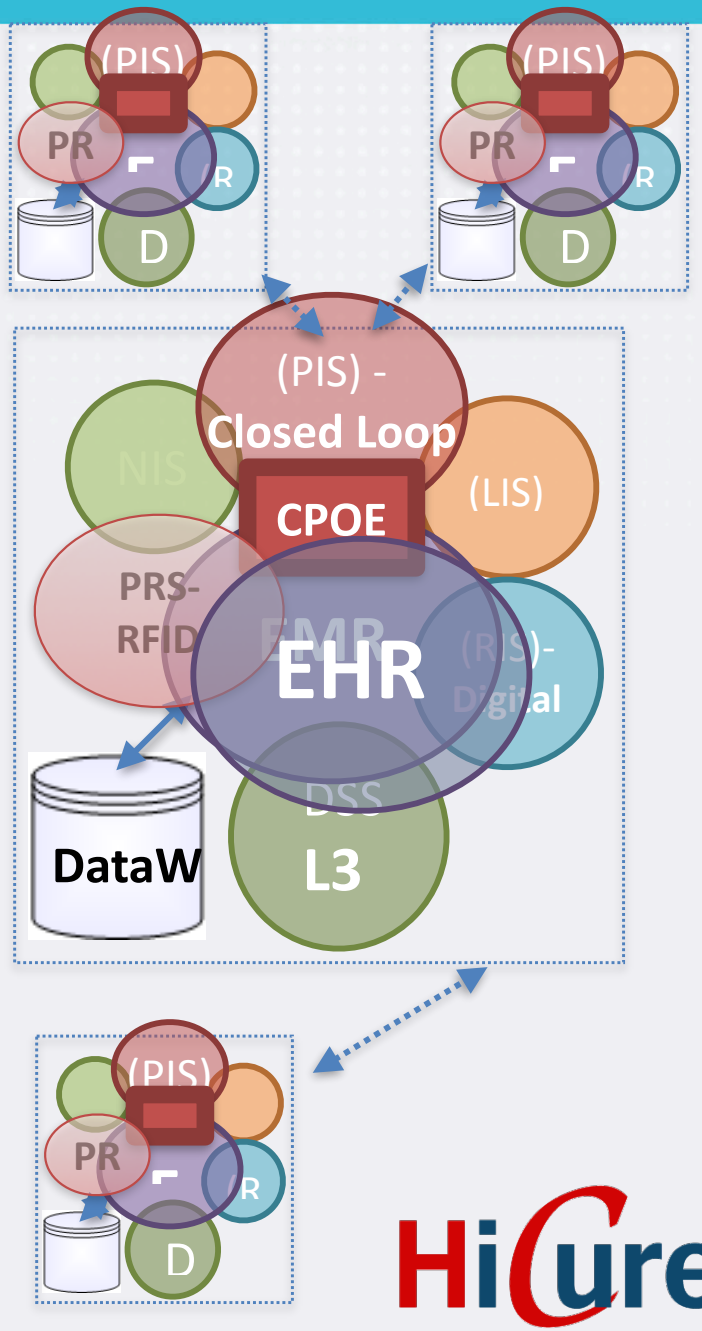
Shareable EHR Adoption Model…

- **Level (7) – cont.**
  - The hospital demonstrates summary data continuity (full integrated healthcare) for all hospital services (e.g., inpatient, outpatient, ED, and with any owned or managed ambulatory clinics).
  - Blood products and human milk are included in the closed-loop medication administration process.



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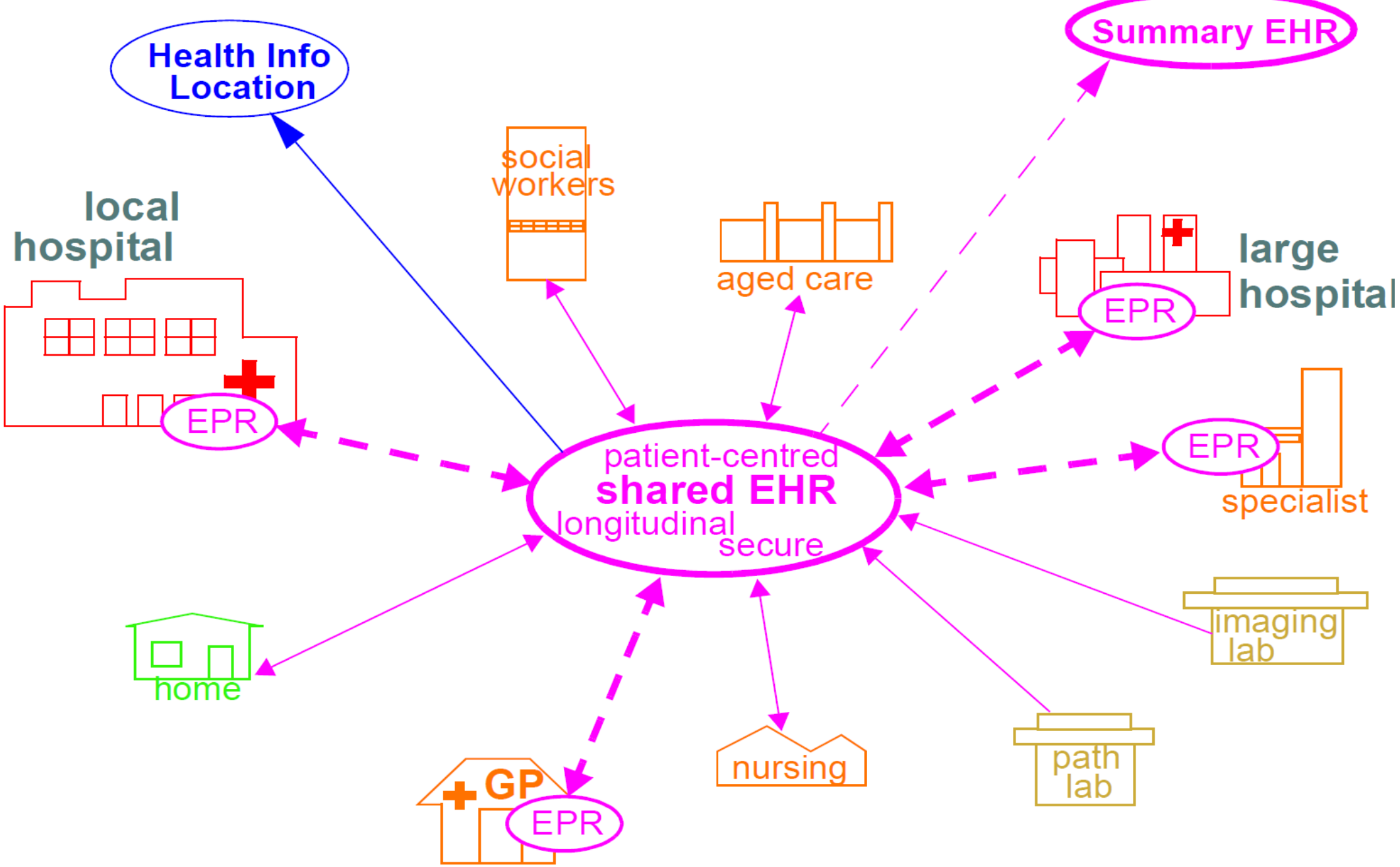


Shared EHR

http://www.openehr.org – 05/02/2017

Health care Integration

How to integrate healthcare data?

Why is sharing or exchanging of Clinical Data needed ?

- Patients moves!?
  - When a patient moves to another location, their Patient Record should go with them and be immediately useable.
    - Ability to Transfer EMR between independent sites, to allow new clinicians abilities to append to the record
- Care at multiple sites
  - typical in healthcare, patient uses multiple sites
    - A real (or virtual) summary record with real time remote access to patient records
  - for patient referrals
    - Access to specialised consultancy or special healthcare centres
- For health management purposes at organizational or national levels.

EHR data interoperability

- To achieve level (7) of shareable EHR adoption model, EHR data must be ***interoperable***.

- EHR ***data interoperability*** refers to the ability of HISs (that create, exchange and consume EHR data) to have clear shared expectations or understanding about:
  - the contents (its structure and data-model)
  - the context (the circumstances of how it was taken), and
  - the meaning of that data.

What does Interoperability mean?

- Interoperability
  - Ability of two or more systems or components to **exchange** information *[functional interoperability]* and to **use** the information that has been exchanged *[semantic interoperability]*

    [IEEE and HL7]

- Two main types of interoperability:
  - *Syntactic interoperability: two systems can interoperate at technical levels, i.e. the two systems can communicate information or knowledge at technical details, including data structure or model.*
  - *Semantic interoperability: two systems can interoperate at content levels: i.e. the two systems have the same meaning of content (i.e. information) being shared.*

EHR data interoperability

- Sharing can occur at multiple levels
  - Human readable form (e.g. free text)
  - Document level sharing (e.g. a structured document)
  - Messages (e.g. a message about specific medical issue, e.g. a lab test/pathology item)
  - Content
    - Document images
    - Free form data
    - Structured data

- Interoperability, to be efficient, should occur in a machine readable form, where machines can communicate without human intervention.

EHR data interoperability

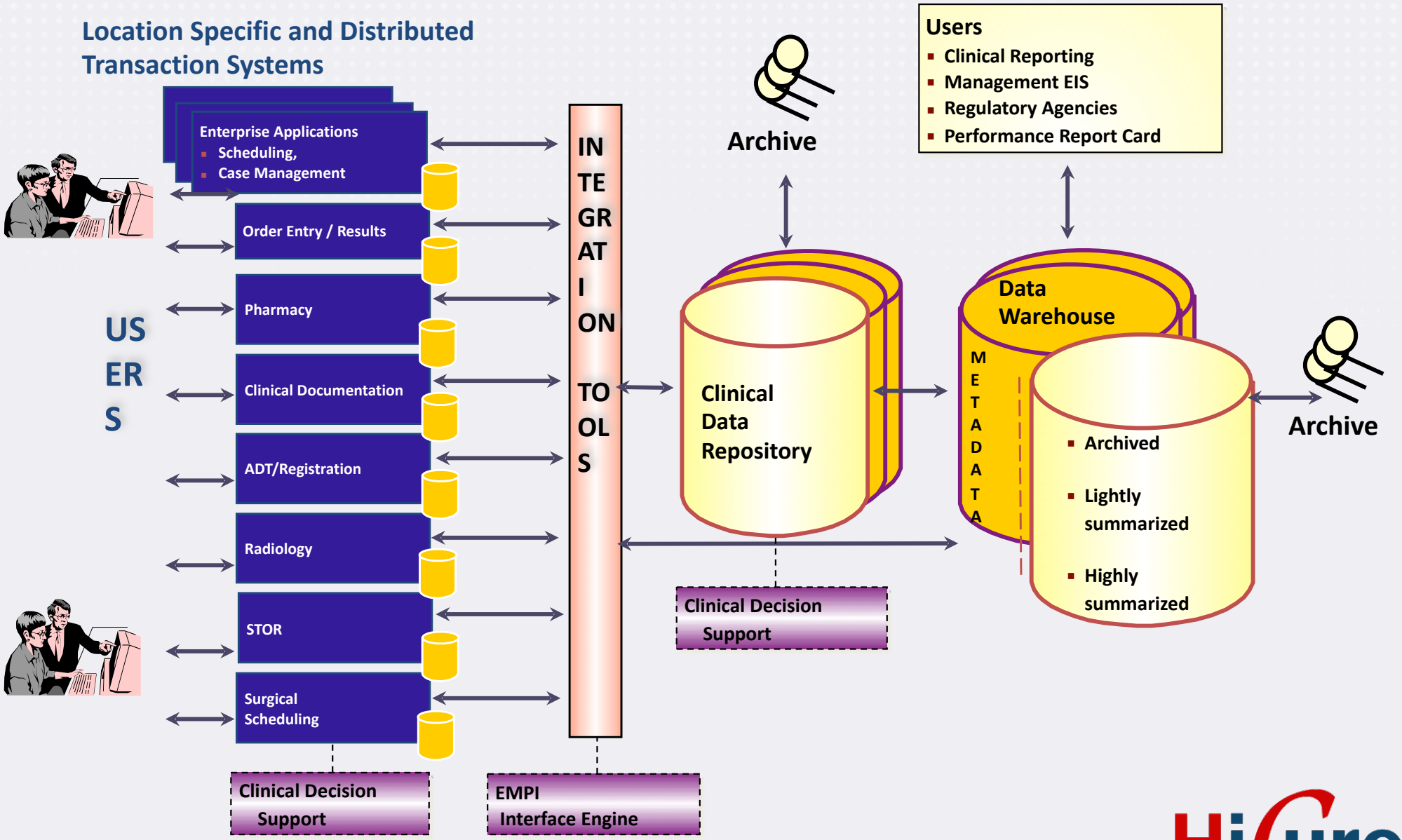
- To achieve a machine readable form
  - Health information systems should have a common repository
  - Health information systems should communicate using a common language & terminologies.

- To achieve, a number of ***Health standards*** (HS) have been developed and used to achieve EHR data interoperability.
- To automate sharing or exchange of data, health Standards should be represented in a machine readable form, i.e. in a form machines or computers can read, process and act upon/ make decisions about.

How to achieved Integrated Healthcare?

- To achieve Integrated Healthcare, in which HISs seamlessly communication, standards must be developed to address both types of interoperability :
  - Syntactic interoperability: to address, we require standards developed that define an agreeable structure (or representation) of health data,
    - i.e. for health record/data-model, health data exchange/ messaging, system/document architecture
  - Semantic interoperability: to address, we require standards developed that define the meaning of health content:
    - i.e. for health terminology, vocabulary or coding standards.

Clinical Systems: Integration



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Purpose of Standards

- Maintaining long term, meaningful, comparable, and compatible information on both patient health and care
- Maintaining well defined information structure
  - which allows modular development and expandability of the health information systems
- Achieving flexibility and cost-effective evolution of information systems
  - Both in their design and development and with no information loss
- Can achieve integrated health information environment
- Ensuring security of data and information handling procedures in the systems
- Compatibility of hardware and software applications

Types of health standards




STANDARDS

DATA

Analysis

- Statistics
- Research
- Clinical Trials
- Surveillance

KNOWLEDGE

- Patient Safety
- Quality
- Low cost
- Accessible

PROCESS

- Public/Private Partnership
- Vendor/Provider Partnership

Privacy, Security, Trust, Integrity

Types of Health Standards

1. Medical terminology/vocabulary or coding standards
   - Define standard code-sets for generally used concepts, terms, entity names, disease names, procedures, laboratory tests, observations, clinical findings, body structure names, etc.
   - e.g. ICD9/10, SNOMED-CT etc.
2. Electronic Health record or Data–model standards
   - Define system modules and module structures, the interfaces between modules, and operations/processes
   - openEHR/CEN 13606, etc.
3. Health data exchange or messaging standards
   - Provide a comprehensive framework for **exchange, integration, sharing, and retrieval** of electronic health information
   - HL7 v2.x/v3.0,
   - ISO/HL7 27931 etc.

WILL BE COVERED

WILL BE COVERED Partly

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Types of Health Standards

4. Architecture or Model-oriented System standards
   - Define elements of a health system architecture to support different health functions
   - e.g. CDA: Clinical Document Architecture
   - e.g. ISO 12967, ISO 10781, ENV 12443, etc.

WILL BE COVERED-partly

5. Data formats standards
   - Define data formats for different types of health data for laboratory data, medical images
   - e.g. DICOM etc.

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6. Workflows and Process-oriented standards
   - describe the semantics of **clinical concepts & processes** to support **continuous care** of an individual within an organisation and across organisations
   - CEN 13940 etc.

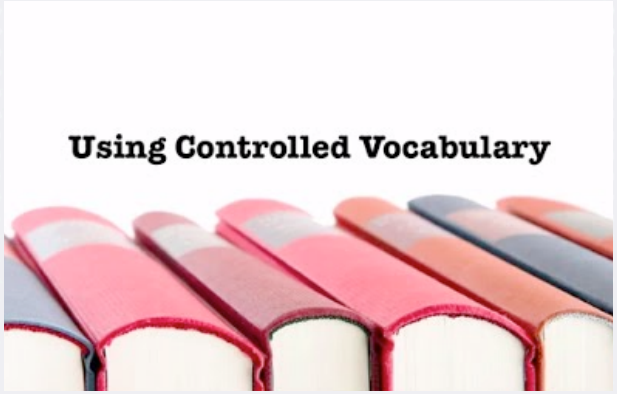
Health Standard Organizations

Many **Not-for-profit organisations** are involved in Health Informatics standardization process including:

- American Society for Testing and Materials (ASTM),
- Healthcare Information and Management Systems Society (HIMSS)
- CEN (European Committee for Standardisation) (e.g. CEN/TC215, CEN 13606)
- ISO (International Standard Organisation) (e.g. ISO/TC215)
- Health Level Seven International (HL7)
- ANSI (American National Standards Institute)
- Institute of Electrical and Electronic Engineers (IEEE)
- World Health Organisation (WHO)
- European Patients Smart Open Services (epSOS)
- GS1 Healthcare
- Digital Imaging and Communications in Medicine (DICOM)

Clinical Data Terminology/Vocabulary/ Coding Standards

- Controlled Medical Terminology/ Vocabulary:
  - **ICD9/ICD10** (International Classification of Diseases, ver. 9/ver. 10)
  - **SNOMED -CT** (Standardized Nomenclature of Medicine, Clinical Terms)
  - **LOINC** (Logical Observation, Identifiers, Names and Codes) – Lab results
  - **RxNorm** (normalized naming system for generic and branded drugs)
  - **RCT** (Read Codes Terms, ver. 2.x, ver. 3.x) – specific to the UK
  - **NLM UMLS** (Unified Medical Language System): inclusive of all coding systems, and mapping between them



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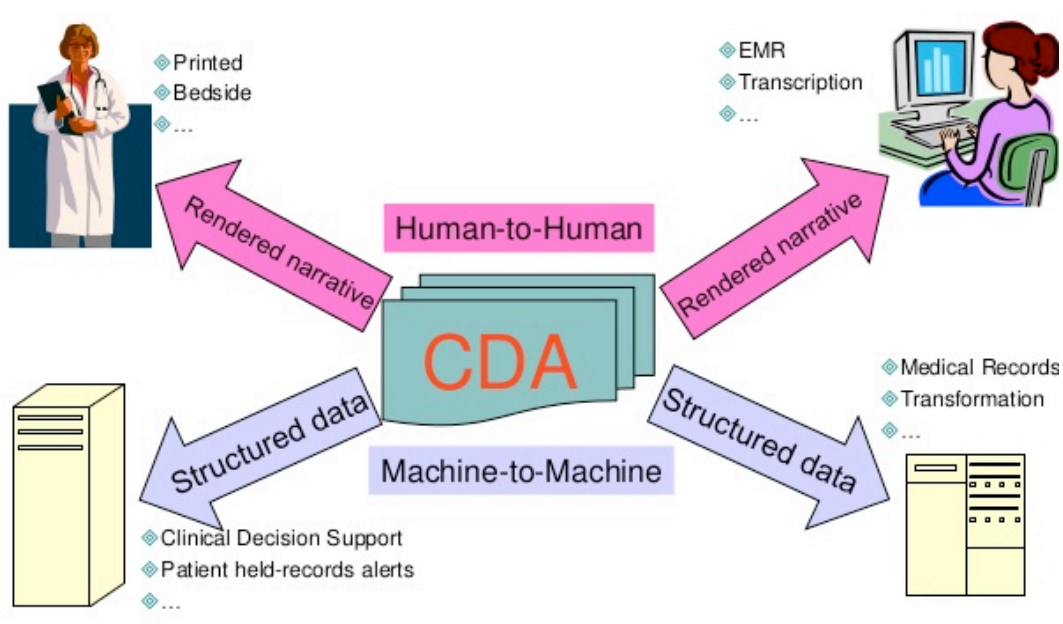
Clinical Data model and exchange Standards

- Data-model and Architectural standards:
  - ***open*EHR/ CEN 13606** (EHR Model standard)
  - **CDA** (Clinical Document Architecture)
  - CCR (Continuity Care Records)
- Data Exchange standards:
  - **HL7** (Health Level 7, v 2.x, v 3.x)



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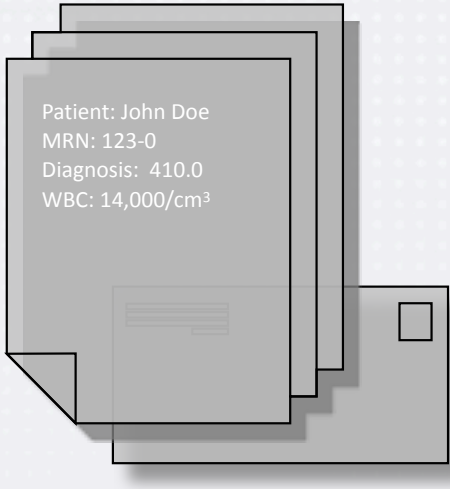
Clinical Data format and Privacy Standards



- Data Format standards:
  - DICOM (Digital Imaging and Communications in Medicine)- messages for images

- Privacy and Confidentiality:
  - **HIPPA** (Health Insurance Portability and Accountability Act)

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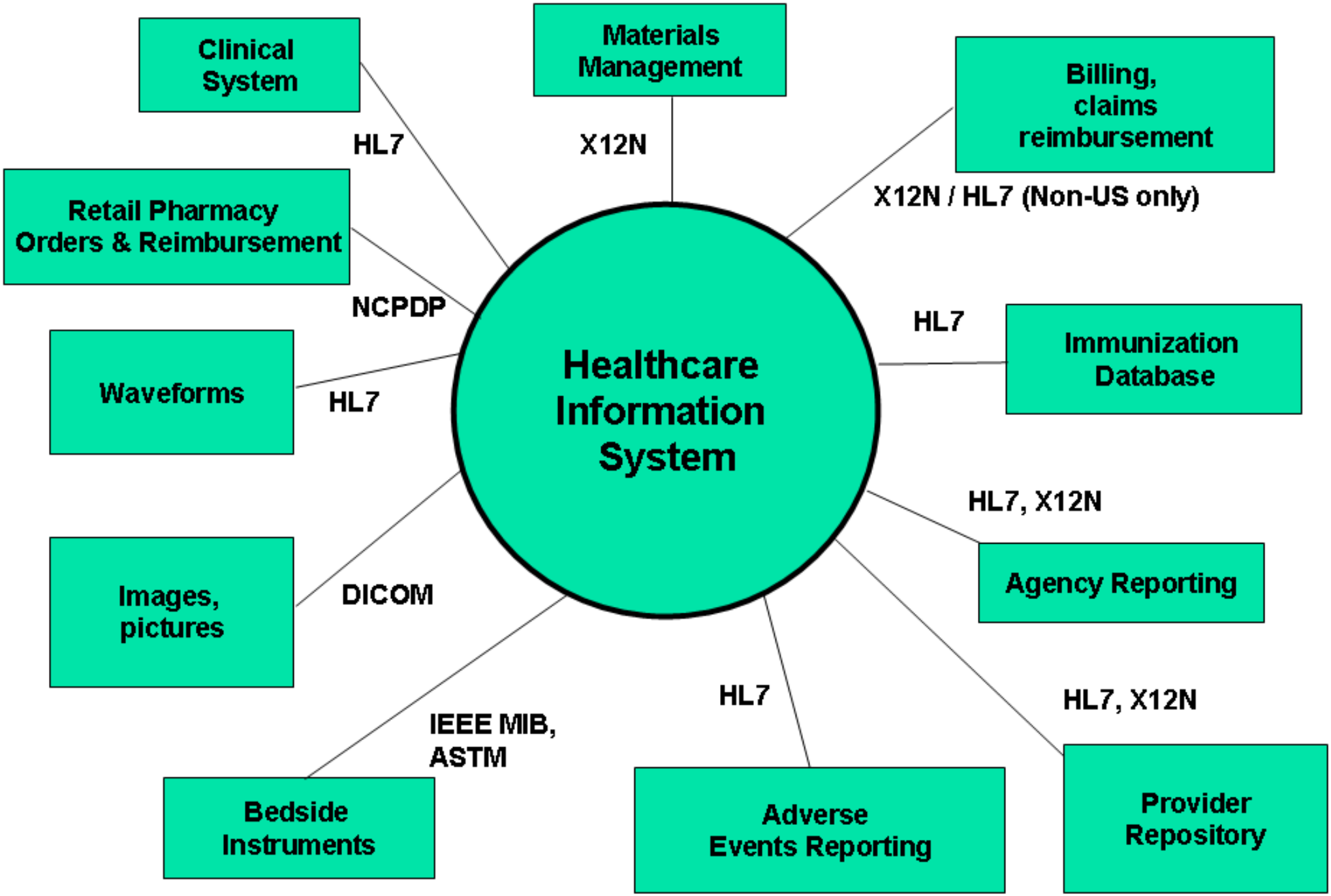

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Thanks!

Any questions?

You can find me at:
Email: @ritaj