

# Biomedical Informatics

Lefteris Koumakis

Hospital Information Systems (HIS)

# Hospital Information Systems (HIS)

Πληροφοριακό Σύστημα Νοσοκομείου

# HIS

- **What are Healthcare Information Services?**
  - Systems used to **collect, store, manage, and transmit healthcare information**
  - Support clinical, administrative, and financial processes
  - Improve **efficiency, accuracy, and patient care**
- In general, information systems of a healthcare facility facilitate two main group of activities, functions and services i.e.:
  - The core business of providing healthcare to its clients
  - Managing the hospital as a business entity, a provider of hospitality services and a physical facility

# Healthcare Industry Overview

- Hospitals
- Clinics
- Diagnostic laboratories
- Pharmacies
- Insurance companies
- Public health organizations

*Healthcare IT connects all these entities.*

# Digital Transformation in Healthcare

TRADITIONAL PAPER RECORDS

**VS.**

Electronic Health Records

## Time Benefits



**SPECIALISTS** spend **50 hours** or more in direct patient care because of heavy paperwork and admin duties.



**PRIMARY CARE PHYSICIANS** only spend **30-40 hours** a week in direct patient care because of heavy paperwork and admin duties.

**NURSES** using EHR have seen reductions in documentation time by up to **45%**



**USING COMPUTERS** to enter patient data increases the **completeness of the information**, so staff time spent searching for missing data decreases.

**EACH PATIENT VISIT** requires approximately **10-13 pieces of paper**.

And a large percentage of physicians see **50-99 patients a week**

So each physician accumulates around **975 new pages** of paper work each week.

**1000s** of tons of paper are consumed by the healthcare industry each year, causing storage issues and environmental harm.

**1000 TONS**

## Environmental Benefits

## ORGANIZATION

Paper-based records dispersed across different medical facilities are often incomplete, contributing to unnecessary, repeat testing and treatment. Dispersed records are also inefficient because new providers have to retrieve a patient's charts and notes from multiple offices.

EHR reduces the redundancies across healthcare providers and allows the assembly of a complete record of patient history in one easily accessible file. A complete patient record in digital format makes it easier to generate longitudinal reports that can improve extended care.

## SHARING RECORDS

Paper record systems waste valuable time because office staff has to transfer records by fax or mail. Because a patient's paper records across healthcare providers aren't stored in a centralized location, it's often difficult to put together a complete history.

With EHR, exchanging information is faster because office staff can skip the retrieval and faxing process and transfer records electronically. EHR provides access to complete medical information about a patient, so other providers don't have to fill in partial records.

## ACCESSIBILITY

Doctors' access to medical records is limited by location and office hours. This can impact your patients' health in unusual circumstances, such as in an emergency procedure or when vital medication is misplaced.

Web-based EHR provides 24/7 access to patient records and lab results from any location with internet access. Using mobile applications, physicians can access records on-the-go, between appointments or while on rounds.

## Financial Benefits



**OUTPATIENT** facilities that adopt and use an EHR over 15 years could have net savings of **\$142BILLION**



**INPATIENT** settings that adopt and use EHR over the same time period experience net savings of **\$371BILLION**

**IN 2009**, independent physician practices using EHR had almost **\$50,000 greater total revenue** per full-time physician than practices using paper-based systems.

**AFTER 5 years** of using EHR, practices reported an operating margin **10.1% higher** than practices in their first year of EHR use.

**APPROXIMATELY 4.5 MILLION** ambulatory visits related to adverse drug events occur annually in the U.S.

**ABOUT 400,000** of these instances result in hospitalization.

These adverse drug events could be avoided by using EHR to **track patient medication history** and to **flag patients** prescribed to several medications



## Health Benefits

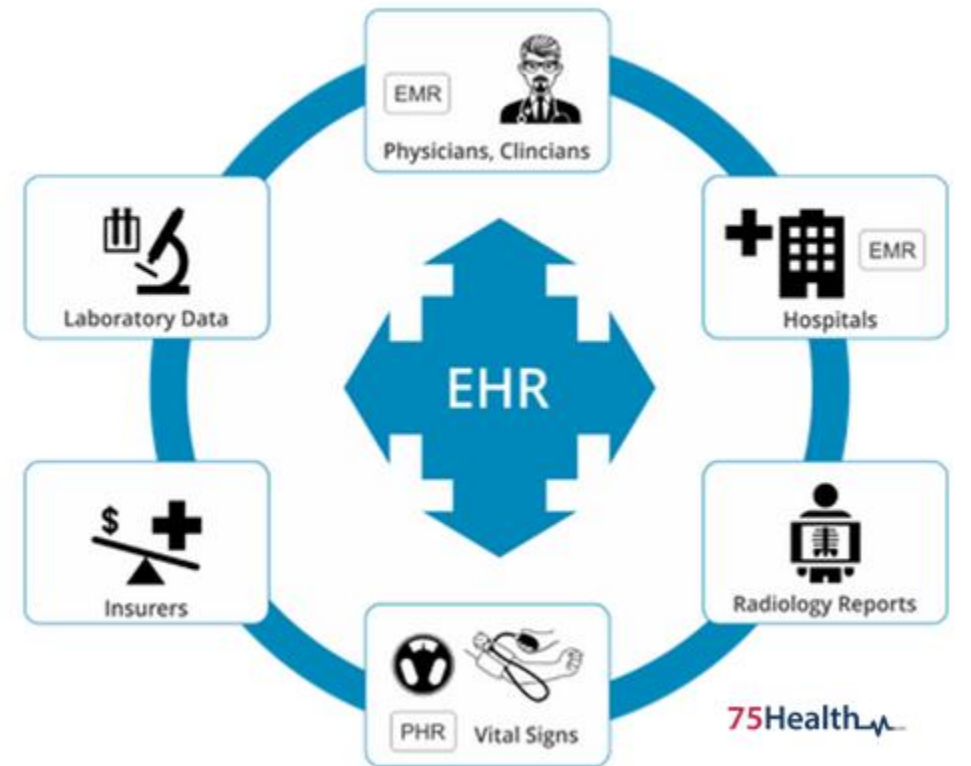
# Electronic Health Records (EHR)

Electronic Health Records contain:

- Patient demographics
- Medical history
- Diagnoses
- Medications
- Laboratory results
- Radiology reports

Benefits:

- Improved data access
- Better coordination between doctors



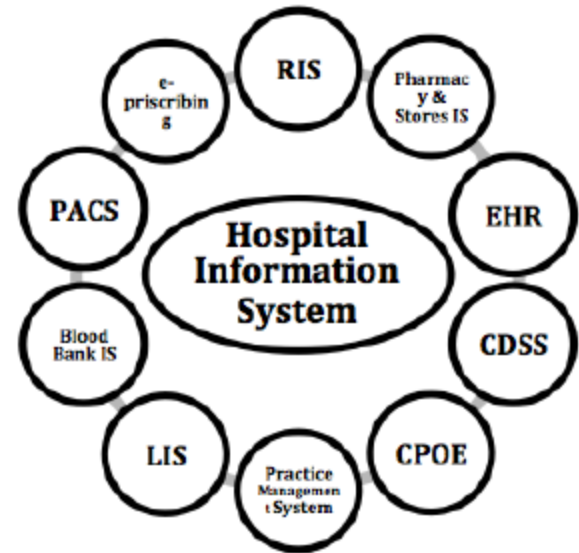
# EHR System Architecture

- Typical EHR architecture includes:
  - **User interface**
  - **Application layer**
  - **Database layer**
  - **Integration services**
  
- Technologies used:
  - Web applications
  - APIs
  - Secure databases

# Health Information Systems (HIS)

- A **Health Information System** manages:
  - Patient information
  - Hospital operations
  - Medical records
  - Administrative processes

*Goal: Efficient hospital management*



# Hospital Information System Modules

- Major modules include:
  - Patient Registration
  - Appointment Scheduling
  - Billing and Insurance
  - Laboratory Management
  - Pharmacy Management
  - Clinical Documentation

# EHR vs HIS vs PHR

□ EMR vs. EHR vs. PHR



Medical

Kugsang Jeong (handeum@gmail.com)



PHR

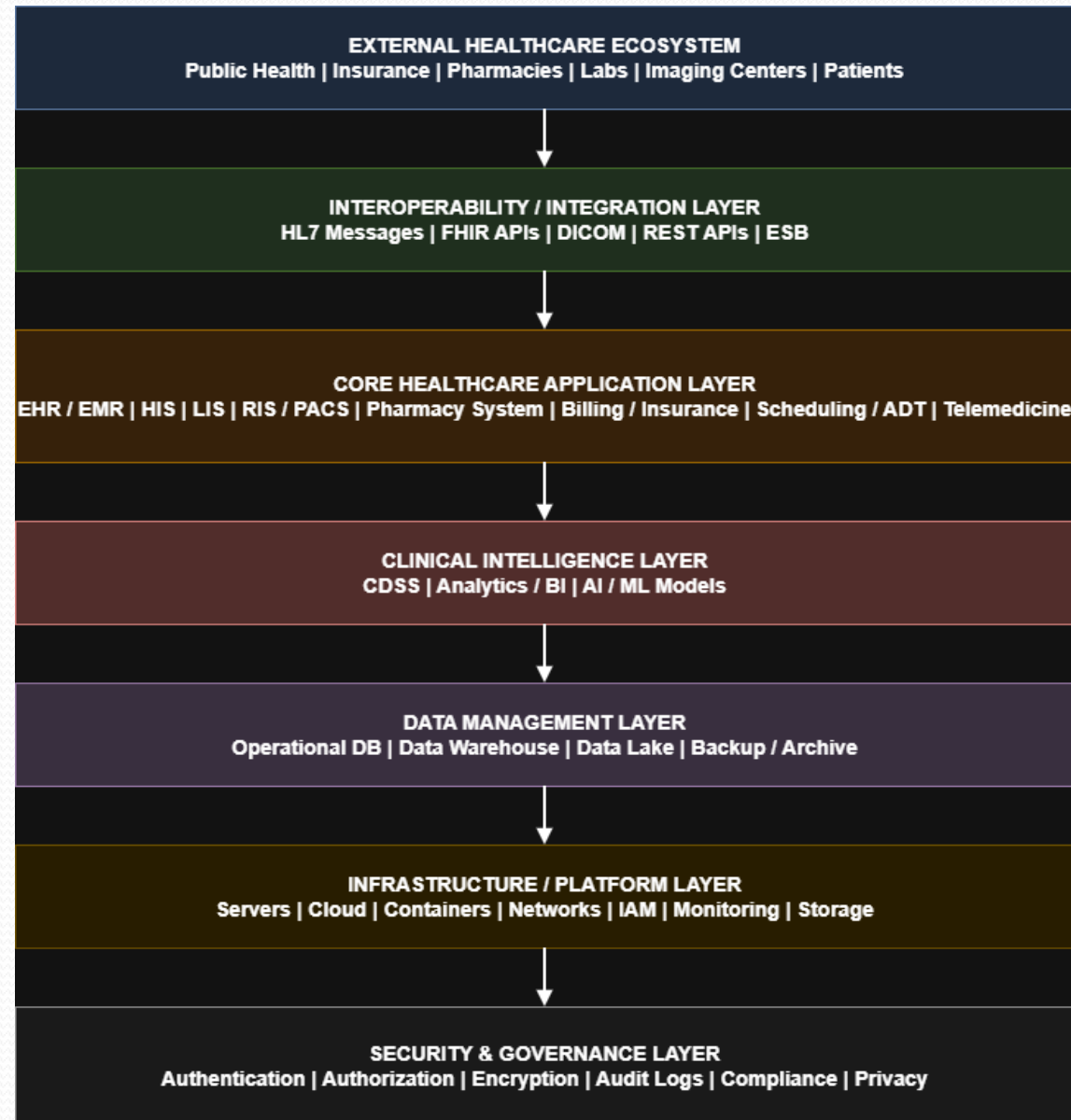


Disease Mgmt.



Wellness

# Typical Architecture



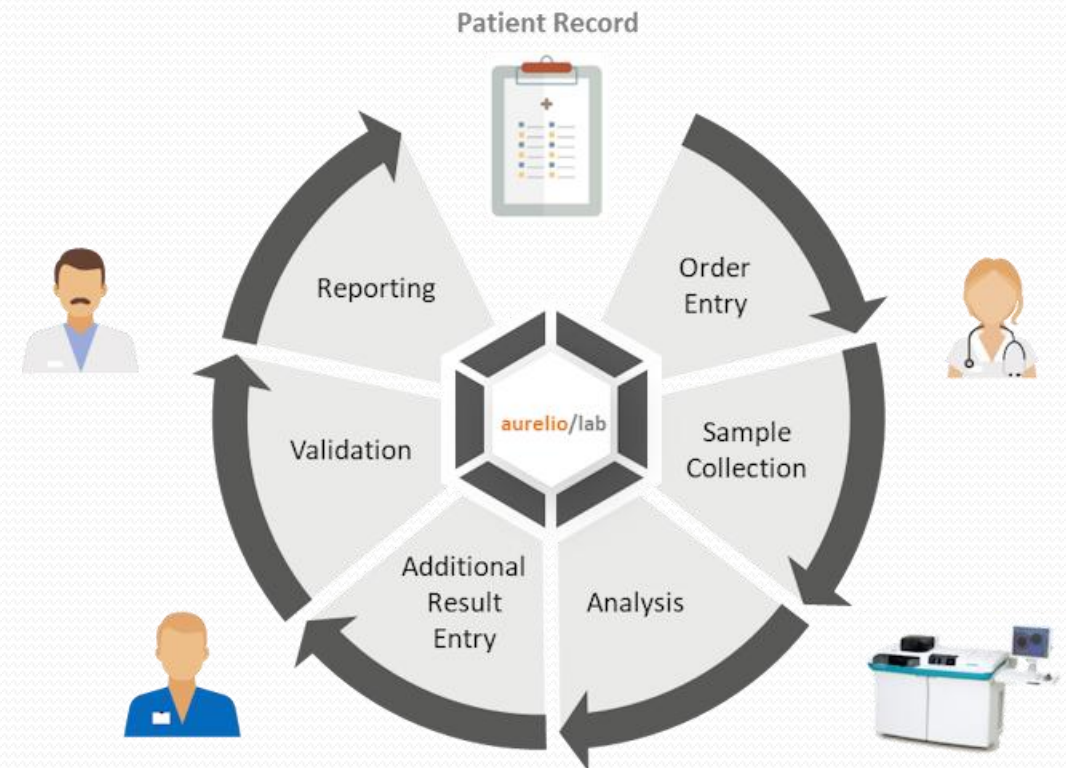
**Biomedical Informatics**

# Health Information Exchange



# Laboratory Information Systems (LIS)

- LIS manages laboratory workflows:
  - Test ordering
  - Sample tracking
  - Test results processing
  - Reporting results to doctors
- Benefits:
  - Faster diagnostics
  - Reduced human error



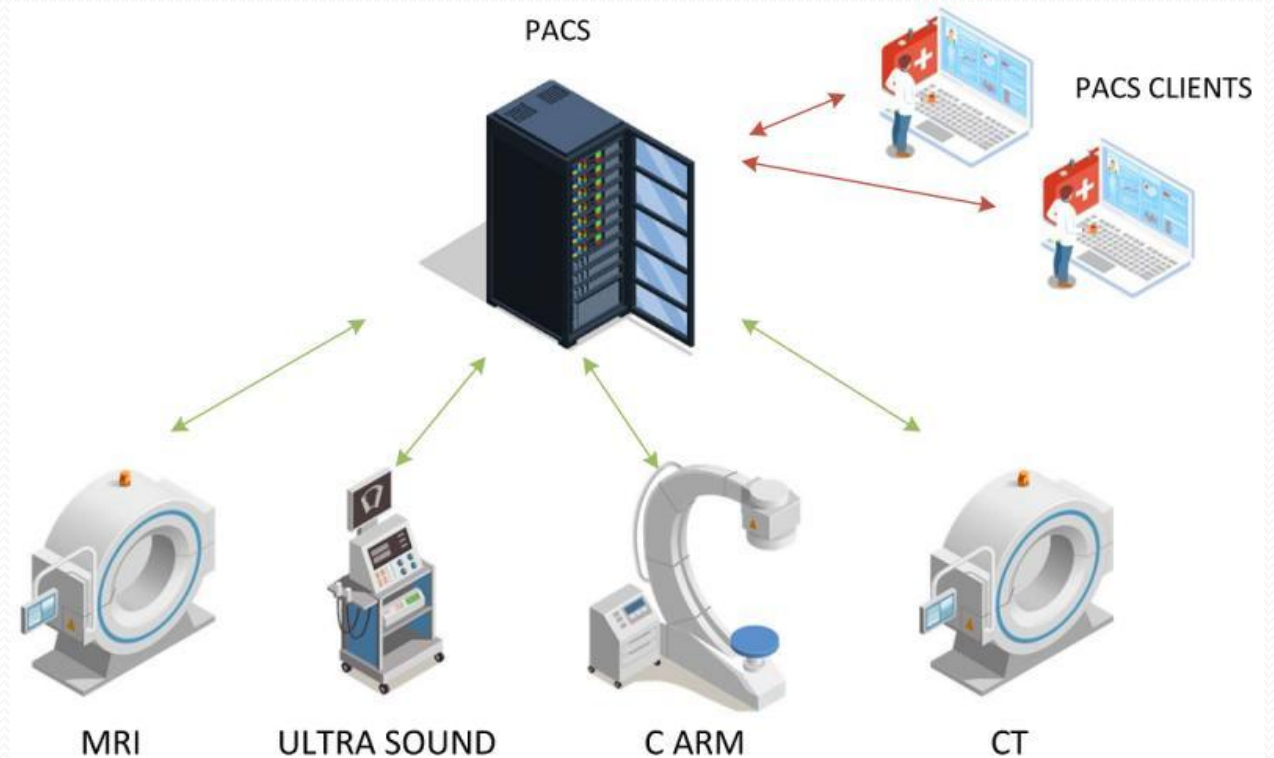
# Radiology Information Systems (RIS)

- RIS supports radiology departments:
  - Imaging scheduling
  - Patient tracking
  - Radiology reporting
  - Integration with imaging systems



# PACS (Picture Archiving and Communication System)

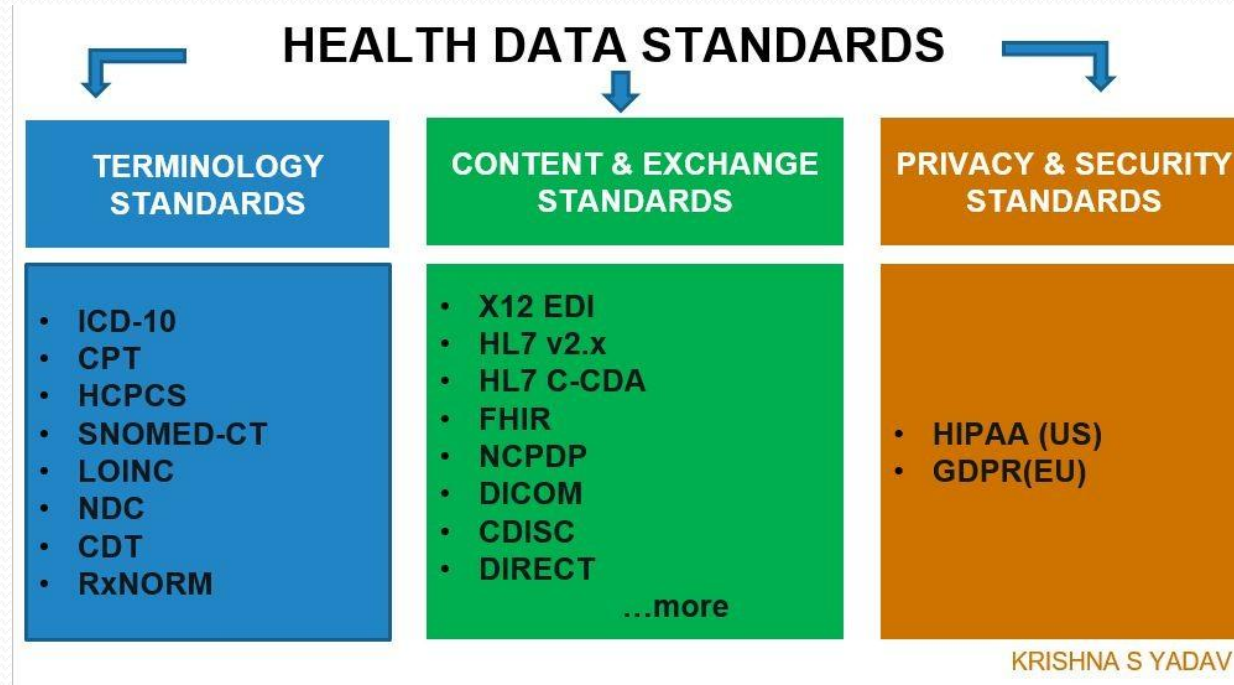
- PACS stores and manages medical images
- Examples:
  - X-ray
  - CT scans
  - MRI scans
  - Ultrasound images
- Benefits:
  - Digital storage
  - Faster access
  - Remote viewing



# Healthcare Data Standards

- Healthcare systems communicate using standards
- Important standards:
  - **HL7** – health data exchange
  - **DICOM** – medical imaging format
  - **FHIR** – modern healthcare APIs

*These ensure interoperability.*



KRISHNA S YADAV

# Healthcare Interoperability

- Different systems should be able to **exchange and use data**.
- Examples:
  - Hospital ↔ Laboratory
  - Hospital ↔ Pharmacy
  - Hospital ↔ Insurance
- Key technologies:
  - APIs
  - HL7 messages
  - FHIR resources

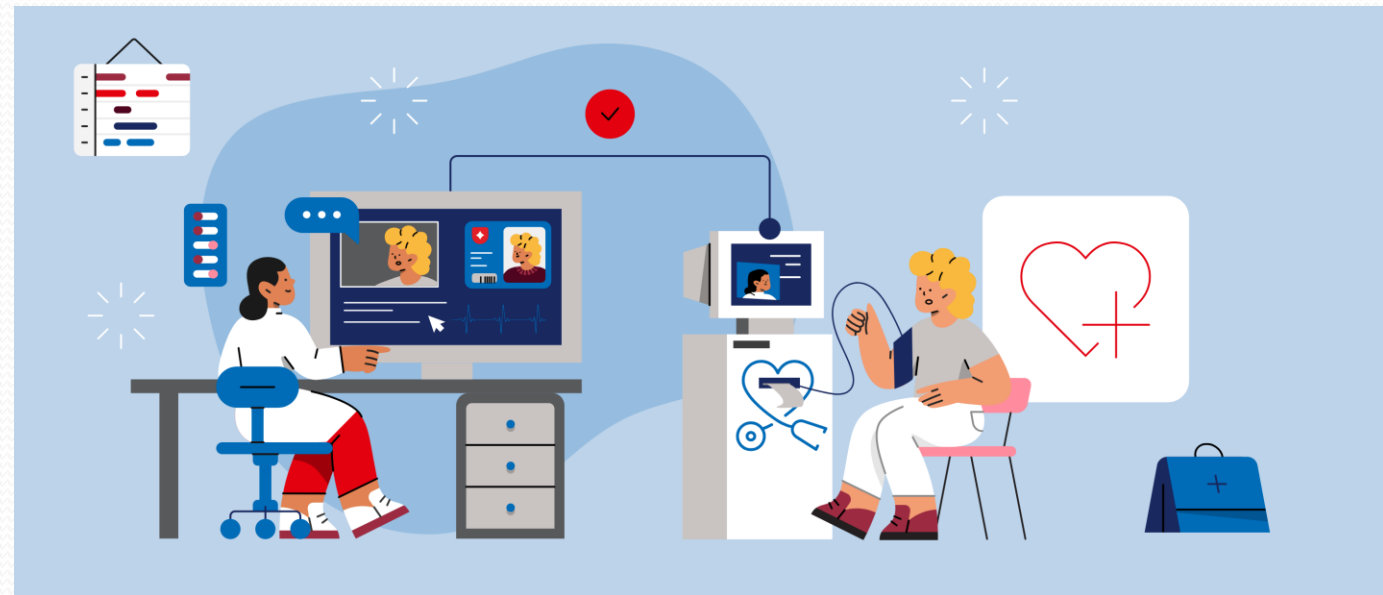


# Data Security in Healthcare

- Healthcare data is sensitive.
- Security methods:
  - Encryption
  - Authentication
  - Role-based access control
  - Secure data transmission
- Systems must follow regulations.
- Examples:
  - **GDPR** – Europe
  - **HIPAA** – United States
- Goals:
  - Protect patient privacy
  - Secure personal health data

# Telemedicine Systems

- Telemedicine enables **remote healthcare services**.
- Examples:
  - Video consultations
  - Remote diagnostics
  - Digital prescriptions
- Benefits:
  - Improved access to healthcare
  - Reduced hospital visits



# Artificial Intelligence in Healthcare



# Artificial Intelligence in Healthcare

AI applications include:

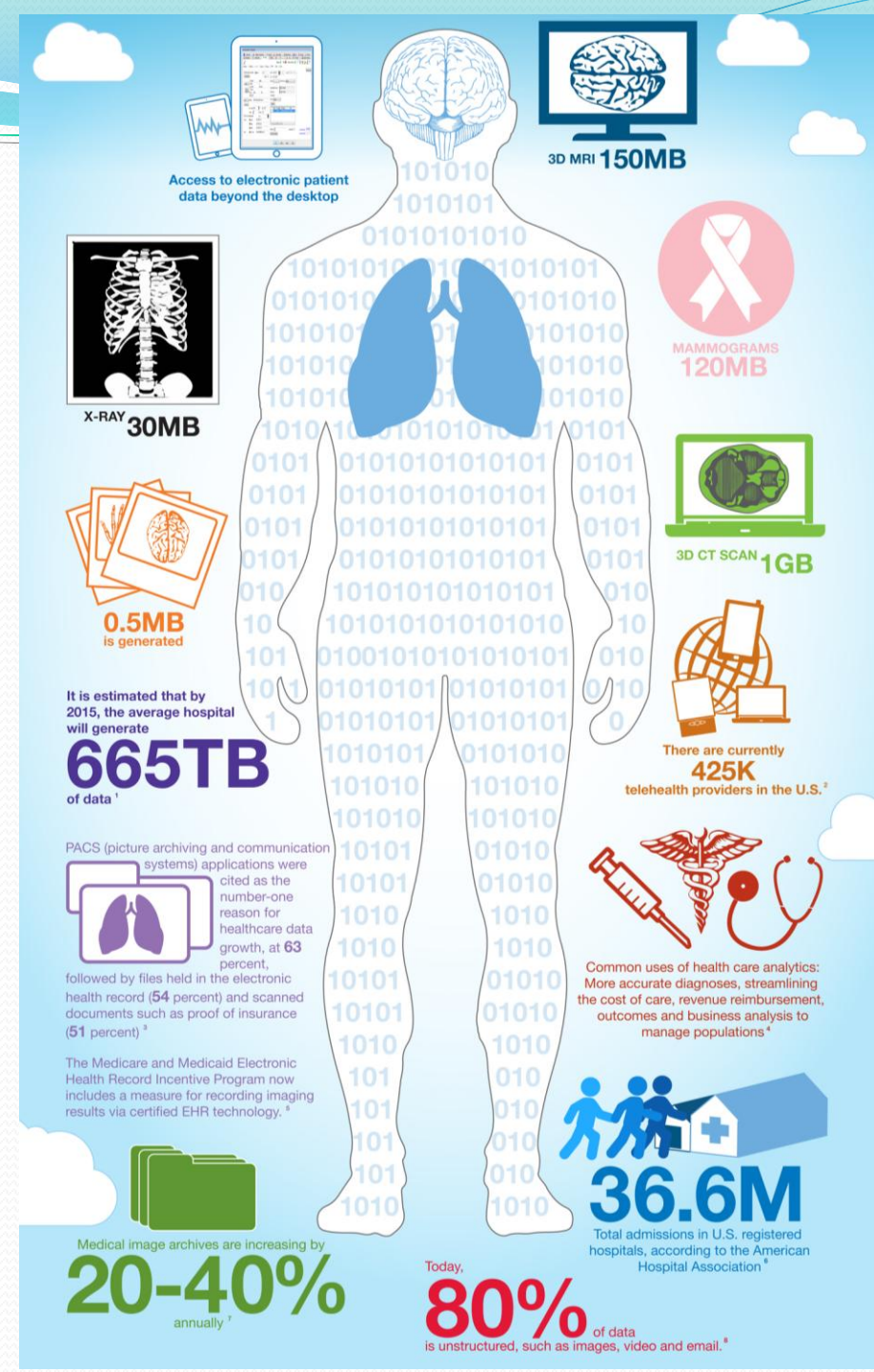
- Medical image analysis
- Disease prediction
- Clinical decision support
- Drug discovery

AI improves **diagnostic accuracy**.

- Machine learning models analyze healthcare data.
  - Predicting disease risk
  - Detecting anomalies
  - Personalized treatment plans
- Algorithms:
  - Neural networks
  - Random forests
  - Deep learning

# Big Data

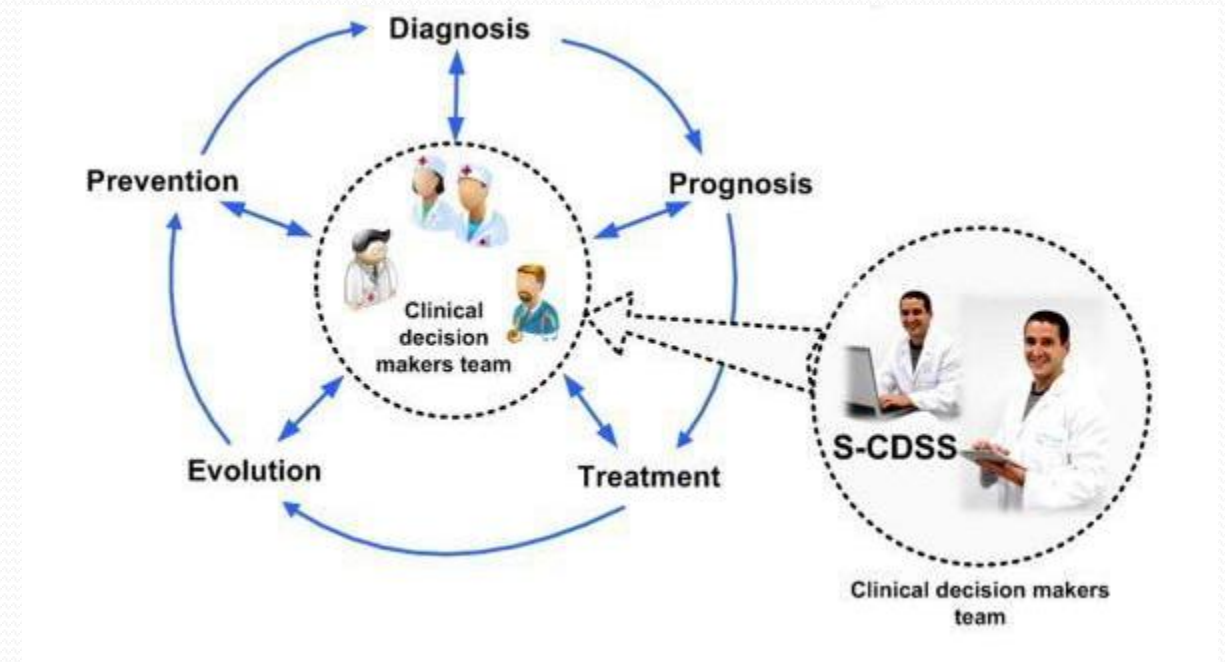
- Healthcare generates massive datasets.
- Sources:
  - Hospitals
  - Wearable devices
  - Genomic data
  - Clinical trials
- Applications:
  - Population health analysis
  - Disease outbreak prediction



# Clinical Decision Support Systems (CDSS)

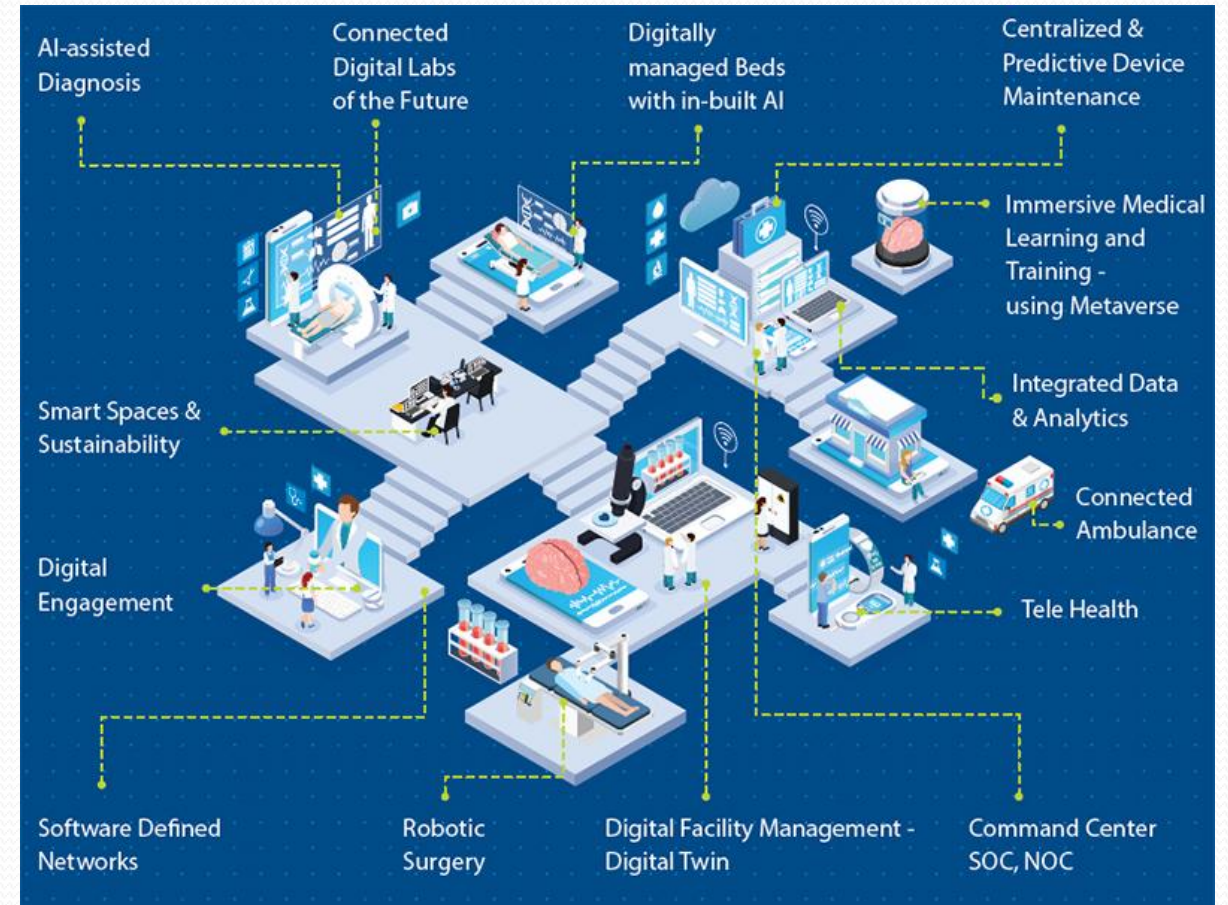
- CDSS helps doctors make better decisions.
  - Drug interaction alerts
  - Diagnostic suggestions
  - Treatment recommendations

*Often integrated with EHR systems.*



# Future trends

- Future healthcare technologies include:
  - AI-driven diagnostics
  - Personalized medicine
  - Digital twins of patients
  - Smart hospitals
  - Robotics in surgery



# Conclusion

- Key points:
  - Healthcare IT is rapidly evolving
  - Computer scientists play a critical role
  - Advanced technologies are transforming healthcare

***Opportunities for innovation are enormous.***