
بسم الله الرحمن الرحيم

Medical Informatics

For 3rd Year Medical Students

Course CMED 301:

HEALTH INFORMATION SYSTEMS

HISs

HIS:

Components, Types and Functions

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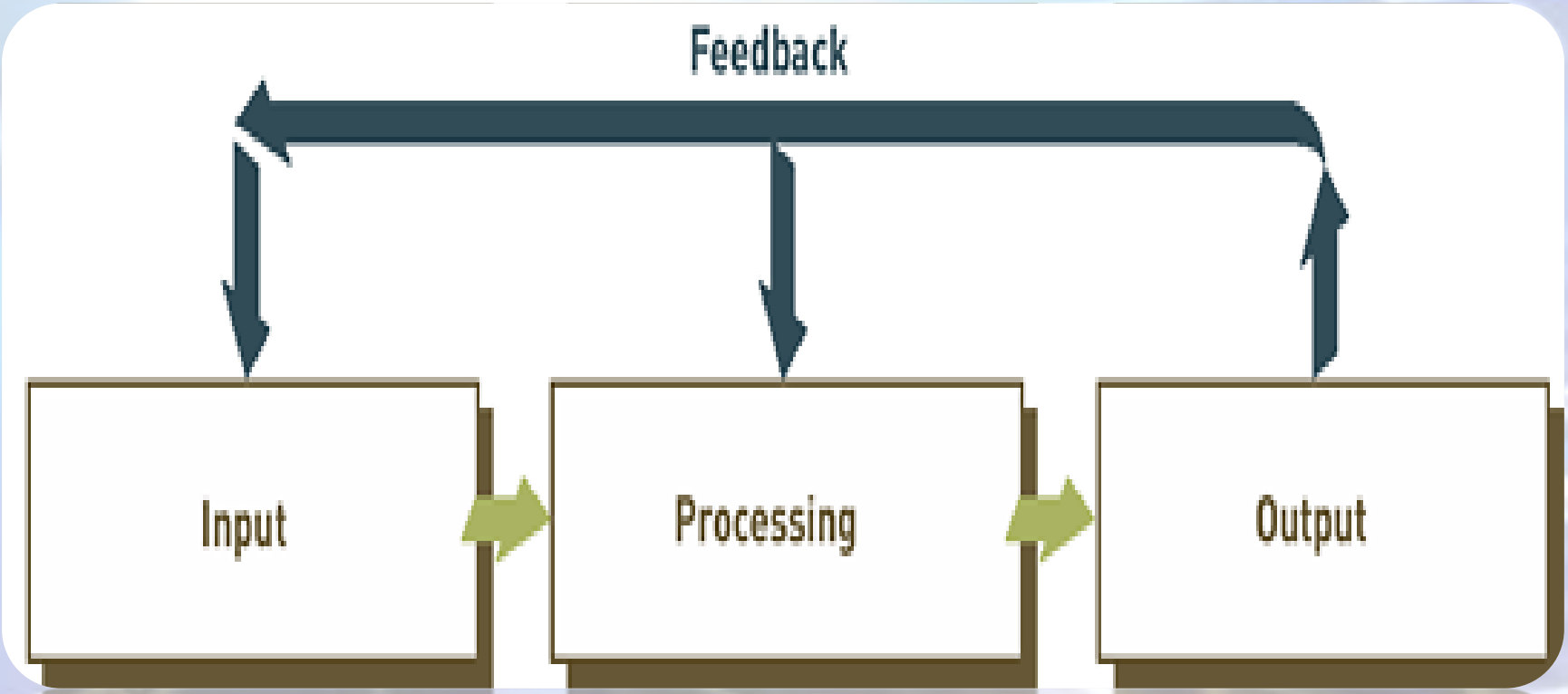
What is a System?

Generally, A **system** is an organized set of procedures for accomplishing a task. It is described in terms of:-

1) The problem to be solved;
2) The data and knowledge required to address the problem; and
3) The internal **process** for transforming the available **input** into the desired **output**

What is an Information System?



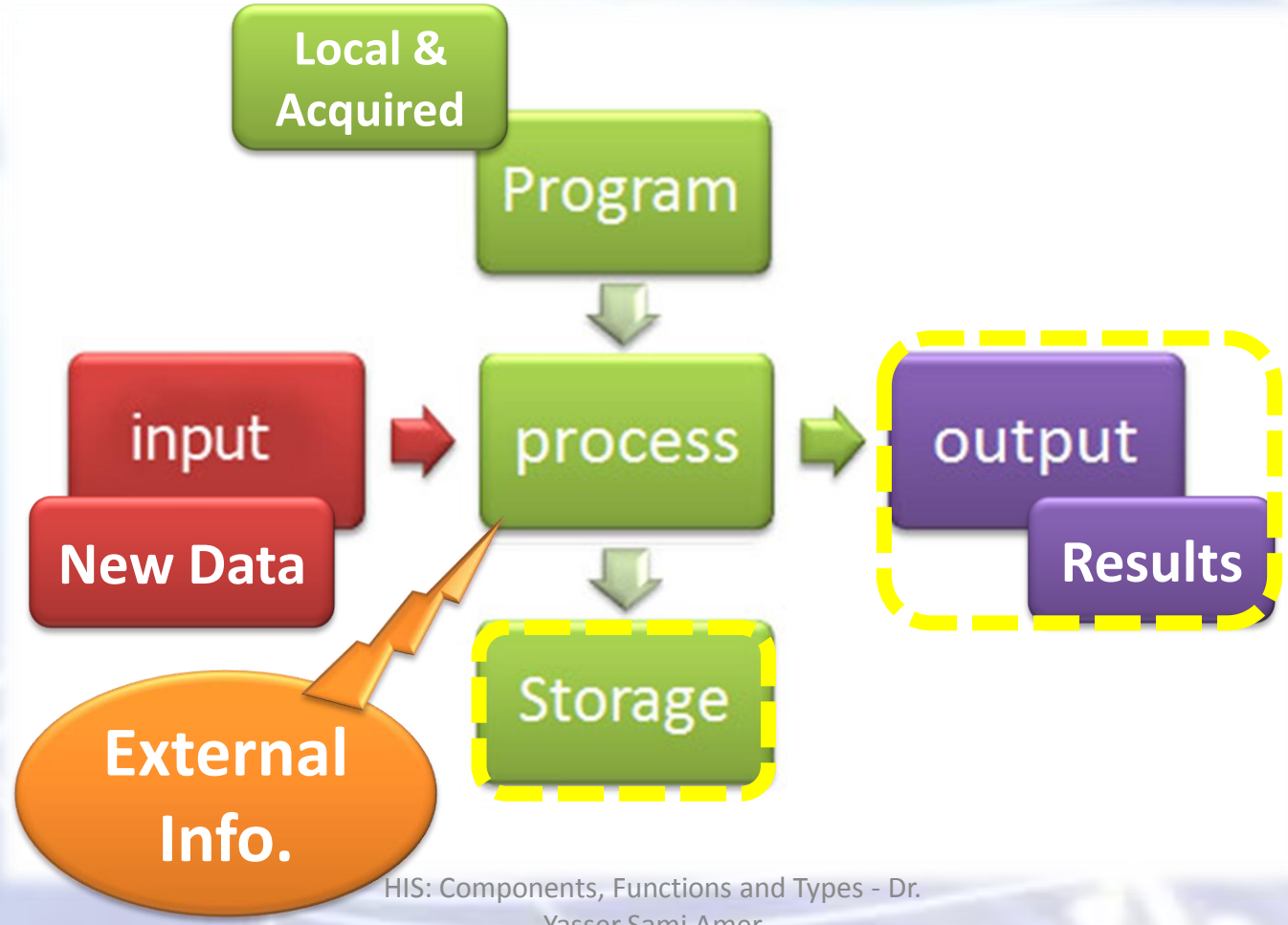
Manual and Computerized Information Systems

- An information system can be:
  - **Manual**
    - Example: developing patterns and trends on graph paper for stock analysis
  - **Computerized**
    - Example: using program trading to track the market and trade large blocks of stocks when discrepancies occur

Computer-Based Information Systems (CBISs)

- **Computer-based information system (CBIS):** single set of hardware, software, databases, telecommunications, people, and procedures configured to collect, manipulate, store, and process data into information.

A Computer system applies locally defined & general **procedures** to produce **results** from new **input** data, from stored data, and from information obtained from remote external sources.



COMPONENTS Of HIS

A Computer System…..

- Combines both manual and automated processes; people and machines work in concert to manage and use information.
- ***It has 3 main Components:-***

1. ***Hardware (HW)***
2. ***Software (SW)***
3. ***Customers***

HARDEWARE (HW)

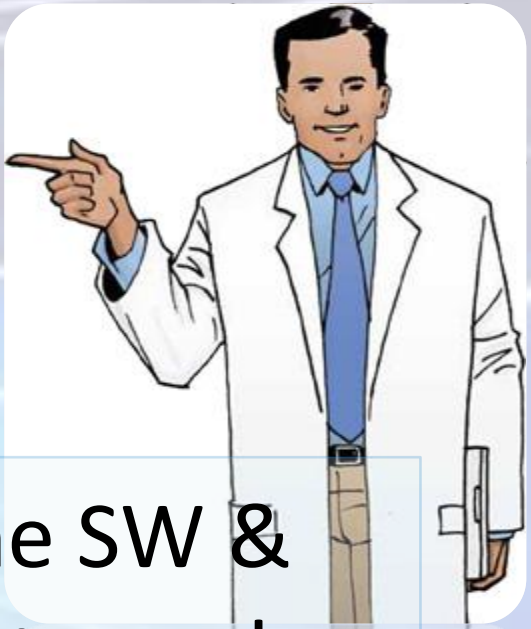
The Physical equipment, including:-

- Processing Units: (e.g. CPU: Central Processing Unit);
- Data-Storage Devices;
- Communication equipment;
- Terminals;
- Printers.

SOFTWARE (SW)

- **The Computer programs (applications) that direct the HW to carry out the automated processes – *i.e.:***
- To respond to user requests and schedules;
- To process input data;
- To store some data for long periods;
- And to communicate informative results to the users;
- At times the SW will prompt users to perform manual processes.

Customers

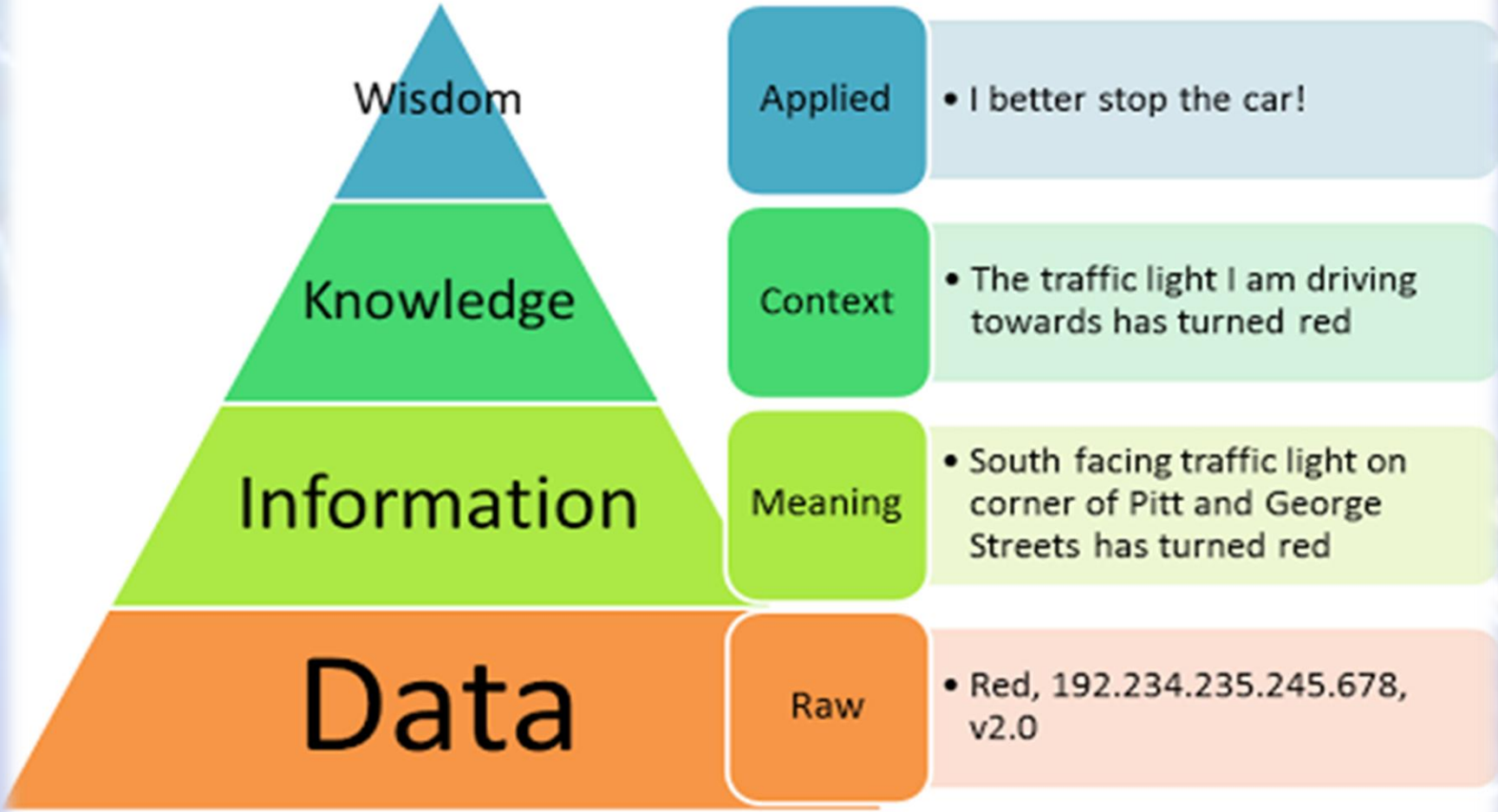


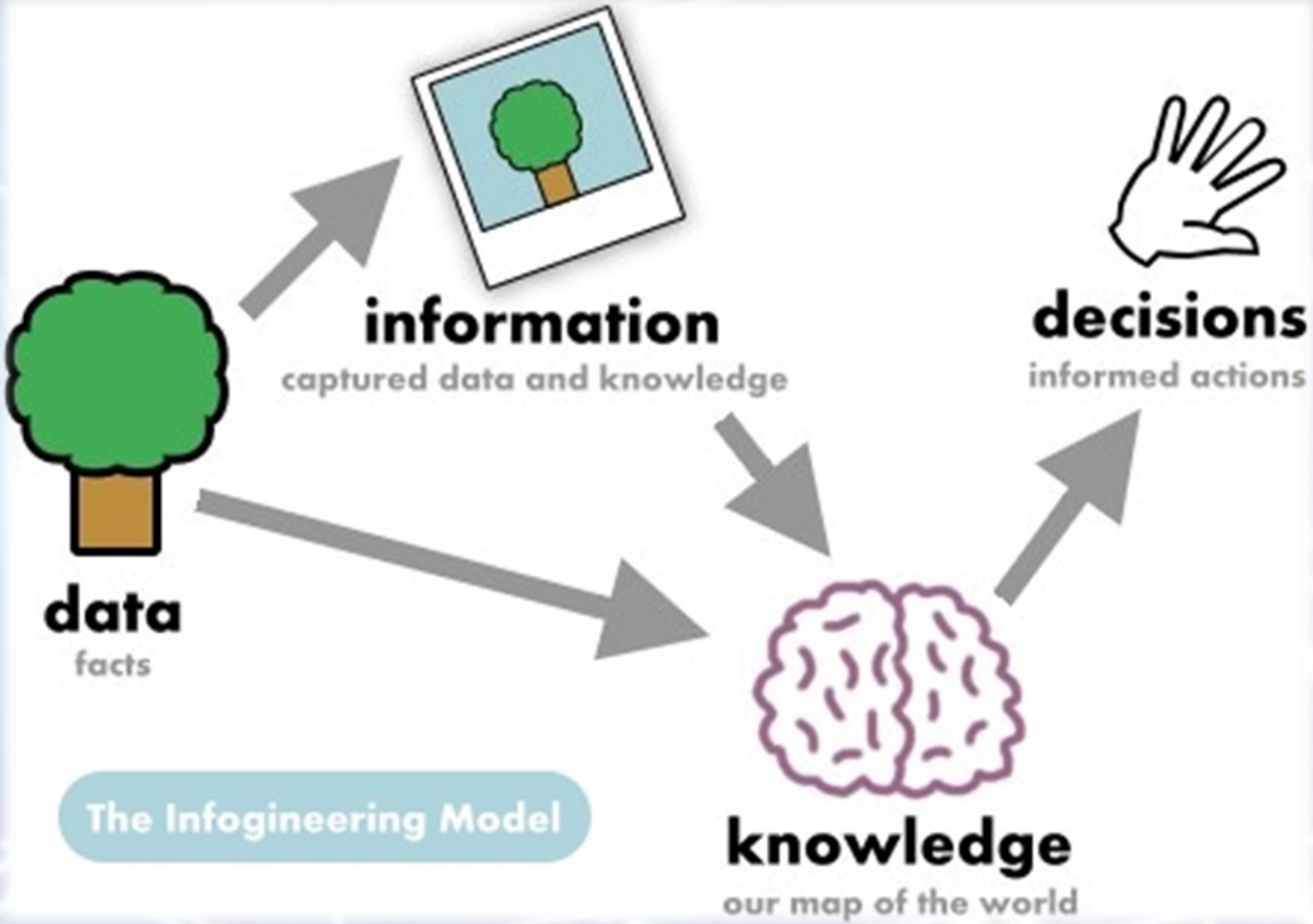
- The **Users** who interact with the SW & HW of the System, issue requests, and use the results or forward them to others; there will be *other users* who are concerned with providing input, system operations, backup, and maintenance.

HIS: Components

The basic role of a computer is the conversion of data into information.

Every piece of data must be *supplied by* a person, by another CIS, or by data collection equipment (e.g. in patient monitoring). Information that is *output* is delivered to healthcare professionals or becomes input to another CIS.


Wisdom
Knowledge
Information
Data
Applied
• I better stop the car!
Context
• The traffic light I am driving towards has turned red
Meaning
• South facing traffic light on corner of Pitt and George Streets has turned red
Raw
• Red, 192.234.235.245.678, v2.0


information
captured data and knowledge
decisions
informed actions
data
facts
The Infogineering Model
knowledge
our map of the world

Therefore!

A Medical Computer System (HIS) is a module within the overall Health Care System

- *This overall HC system determines:-*

1. The **Need for the HIS** (e.g. which data must be processed and which reports must be generated).
2. The **Requirements** for the system's operation (e.g. degree of reliability and responsiveness to requests for information). Acquisition and operation of a HIS has implications for the organization of a HCF.

Challenges

- *Installation of a new system is often faced with several challenges;*

1)Sociological*

2)Organizational

3)Technical

*Sociological Challenges

1. **Alteration of the work routine of HC workers.** It may affect the traditional roles of HC workers and the existing relationships among groups*; (e.g. physicians-nurses, nurses-patients, physicians-patients*).
2. **Important Ethical & Legal questions arise.**

[e.g. confidentiality of patient info., appropriate role of computers in patient care (esp. medical decision making), and responsibility of developers and users for ensuring correct operation of system].

Privacy-Security-Trust

PRIVACY	Only authorized (**by patient**) people can see health data
SECURITY	Data is protected from unauthorized access especially during **data transport** (Dr.- Dr., Dr.- Pt., Pt.- Dr.,…) *over the hospital NW…even more over OPEN Internet!*
TRUST	People/organizations (Dr.s, Hospitals, Pt.s) who we are interacting with electronically **ARE who they say they are**!

FUNCTIONS OF HIS

FUNCTIONS OF HIS

- Computers have been used in every aspect of HC delivery; from simple processing of business data, to collection & interpretation of physiological data, to the education of physicians and nurses.
- ***The range of basic functions that may be provided by HISs can be identified in the 8 following topics:-***

Basic Functions provided by HISs

1. Data acquisition & presentation
2. Record keeping & access
3. Communication & integration of information
4. Surveillance
5. *Information storage & retrieval*
6. Data analysis
7. Decision support
8. Education

1- Data Acquisition (DA)

- The amount of data needed to describe the state of even a single person is **huge.**
- *Health professionals require assistance with* data acquisition to deal with the data that must be collected and processed.
- Early DA systems used to provide their results only to human beings. Today they supply data directly into the patient record.

Applied Examples of DA

i. Automatic **Laboratory** analysis of specimens of blood or other body fluids *(e.g. chemistry, cell & microorg. counts,..etc.)*

ii. Computer-based **patient-monitoring systems** that collect physiological data directly from patients (e.g. vital signs, ECGs,…etc.)

iii. Medical Imaging Applications (e.g. CT, MRI, DSAngio).

The calculations for these computationally intensive applications cannot be done manually!

2- Record Keeping

- **Healthcare Organization (HCO) are information-intensive enterprises**; therefore collecting and record keeping is a primary function of any HIS.
- **Computers are well suited to performing tedious and repetitive data-processing tasks** (e.g. collecting/tabulating data – combining related data – formatting/producing reports..i.e. processing large volumes of data)

, Functions ar
er Sami Amer

Benefits of automated processing in Record keeping for HCOs

- Speed up services.
- Reduce direct labor cost.
- Minimize number of errors

Applied Examples of Record Keeping

- *Automated billing* (the first component installed when any hospital or clinic decides to use IT)
- *Individual Departmental HISs from specialized vendors* (e.g. *Clinical Labs*; keep tracts of orders, specimens and reports & *Pharmacy and Radiology dept.s*; connect to outside services); *Unfortunately this diversity causes difficulty in information-integration from different HISs into a coherent whole.*

3- Communication & Integration

- In hospitals and other large-scale HCOs, myriad data are collected by multiple HC professionals who work in different settings; each patient receives care from different HC providers (e.g. physicians, nurses, technicians, pharmacists,..etc.).
- Data must be available to decision-makers anytime and anywhere they are needed regardless of when or where they were obtained.

- In many HCOs; inpatient, outpatient and financial are supported by separate organizational units. Clinicians need integrated inpatient + outpatient info. For patient treatment decisions; they also may need to review data from other HCOs or from online biomedical info. Hospital administrators need integrated clinical + financial info. to analyze costs & evaluate efficiency of HC delivery.
- *Communication networks that share info. Among independent computers and geographically distributed sites are now widely available.*


A-F
G-L
M-R
T-Z
MENU
REC
Log Entry: 0012
RESEARCHER ID: 4492
Connection status
00:1509:1963 - Input signal-OK - Connection Time: 00:03:45

Applied Examples of Comm. & Integ.

- Patient records; the limitation of traditional paper-based patient records is concentration of info. in a single location, which prohibits simultaneous entry and access by multiple people. HISs and EHR systems allow distribution of many activities (e.g. admission, appointment, review lab results,….etc) to the appropriate sites.

4- Surveillance

- Timely reactions to data are crucial for quality in health care, especially when a patient has unexpected problems.
- Data overload and Data insufficiency both negatively affect good decision-making; data indicating a need for action may be available but are easily overlooked by overloaded HC professionals.

Applied Examples of Surveillance

- **Lab HIS:** routinely identify and flag abnormal test results (critical values)
- **Patient-monitoring HIS in ICUs:** detect abnormalities in patient status and sound alarms to alert nurses and physicians.
- **Pharmacy HIS:** screen incoming drug orders and warn physicians against drug interactions or patients' known drug allergies or hypersensitivity.

- Surveillance also extends beyond the HC setting; Appearance of new infectious diseases, unexpected reactions to new medications and environmental effects should be monitored.
- Thus the issue of data integration has a National or Global scope (National Health Information Infrastructure).

5- Information Storage and Retrieval*

- An essential function in all Computer ISs.
- Storage enables sharing info with people not available at the same time.
- Storage should be well organized and indexed to allow easy retrieval (e.g. EHR).
- Variety of users should be considered; different query interfaces differs for various users (e.g. clinicians, researchers, managers,…etc.)

*Information Retrieval (IR)

- Is the field concerned with the acquisition, organization and searching of knowledge-based information (Hersh, 2003).
- *It immensely broadened with advent of;* multimedia publishing, gene and protein sequences, video clipping, online content and wide range of other digital media related to biomedical education, research and patient care.
- *Digital Libraries have emerged.*

Applied Examples of Info. S & R

Medical Subject Headings (MeSH)

Is a comprehensive controlled vocabulary for the purpose of indexing journal articles and books in the life sciences; it can also serve as a thesaurus that facilitates searching. Created and updated by the United States National Library of Medicine (NLM), it is used by the MEDLINE/PubMed article database and by NLM's catalog of book holdings.

MeSH was introduced in 1963. The yearly printed version was discontinued in 2007 and MeSH is now available online only.

It can be browsed and downloaded free of charge through PubMed. Originally in English, MeSH has been translated into numerous other languages and allows retrieval of documents from different languages.

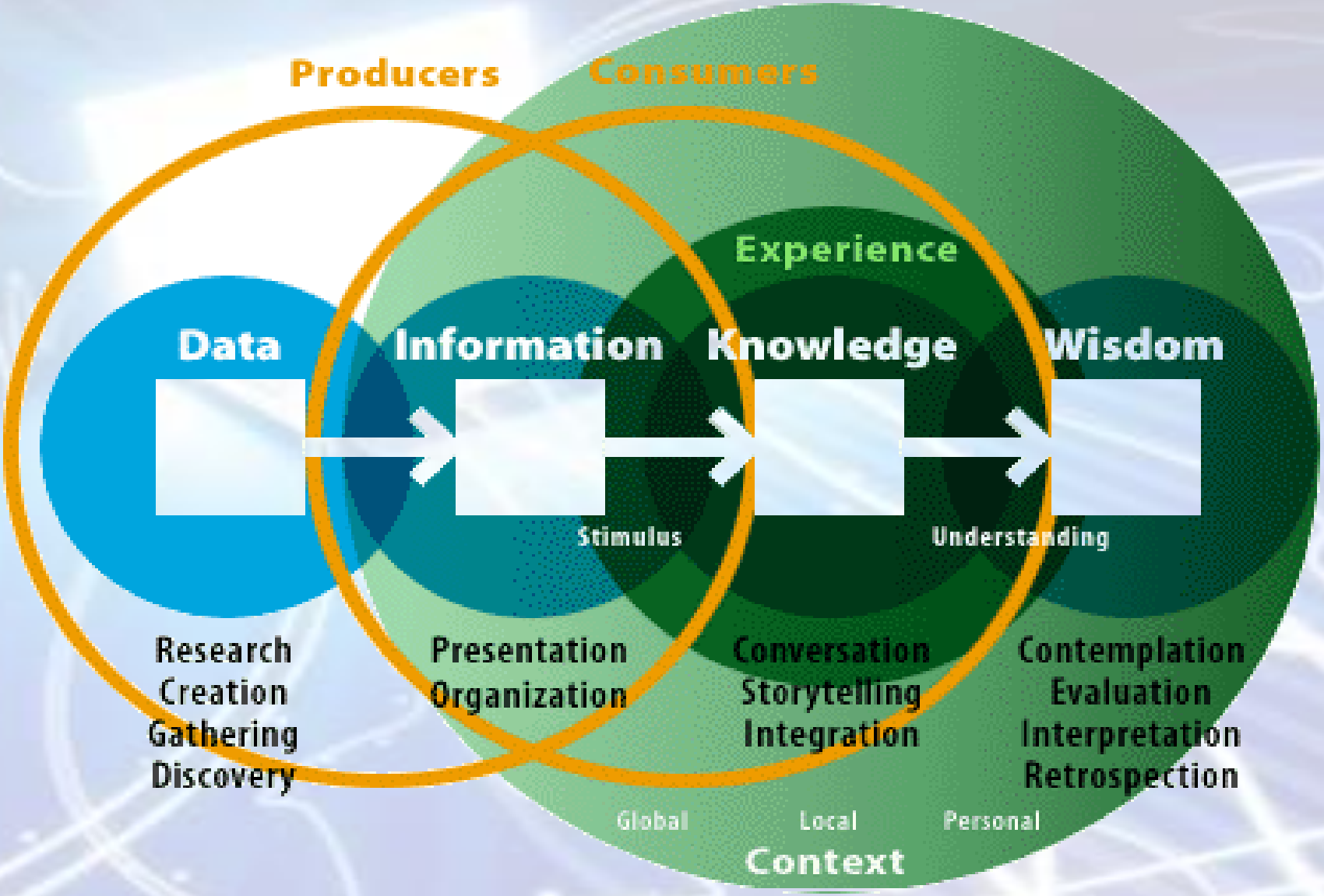
http://www.nlm.nih.gov/mesh/meshhome.html

What is common between them?

6- Data Analysis

Raw data as acquired by computer systems are detailed and voluminous. Data analysis systems must aid decision makers by reducing and presenting the intrinsic information in a clear understandable form.

Presentations should use graphs to facilitate trend analysis and compute secondary parameters *(means, standard deviations, rates of change,…etc.)* to help spot abnormalities.


Producers
Consumers
Experience
Data
Information
Knowledge
Wisdom
Stimulus
Understanding
Research
Creation
Gathering
Discovery
Presentation
Organization
Conversation
Storytelling
Integration
Contemplation
Evaluation
Interpretation
Retrospection
Global
Local
Personal
Context

Applied Examples of Data analysis

- *For Researchers:* Clinical research systems have modules for performing powerful statistical analyses over large sets of patient data. However, they should have insight into the methods being used.
- *For Clinicians:* graphs are essential for interpretation of data and results.

7- Decision Support

- *In the end, all functions hereby described support decision making by HC professionals.*
- The distinction between DSSs and ISs that monitor events and issue alerts is not clear-cut; both differ primarily in the degree of data interpretation and recommendation of patient-specific actions
- ***Medical practice <u>is</u> medical decision making.***

Applied Examples of Decision Support

- Clinical consultation HISs
- Event Monitoring HISs
- Nursing HISs

SEPARATE LECTURE!!!

8- Medical Education

- Rapid growth in biomedical knowledge and in the complexity of therapy management has produced an environment in which students cannot learn all they need to know during training – THEY MUST LEARN HOW TO LEARN AND MUST MAKE A LIFELONG EDUCATIONAL COMMITMENT.

- IT is an increasingly important tool for accessing and managing medical information (both patient-specific and more general scientific knowledge)
- Computers also can play a direct role in the education process.

The application of Computer/ IT to education is often referred as;

- ✓Computer-Assisted Learning
- ✓Computer-Based Education (CBE)
- ✓Computer-Aided Instructions (CAI)

Modes of Computer-Based Learning *(8)*

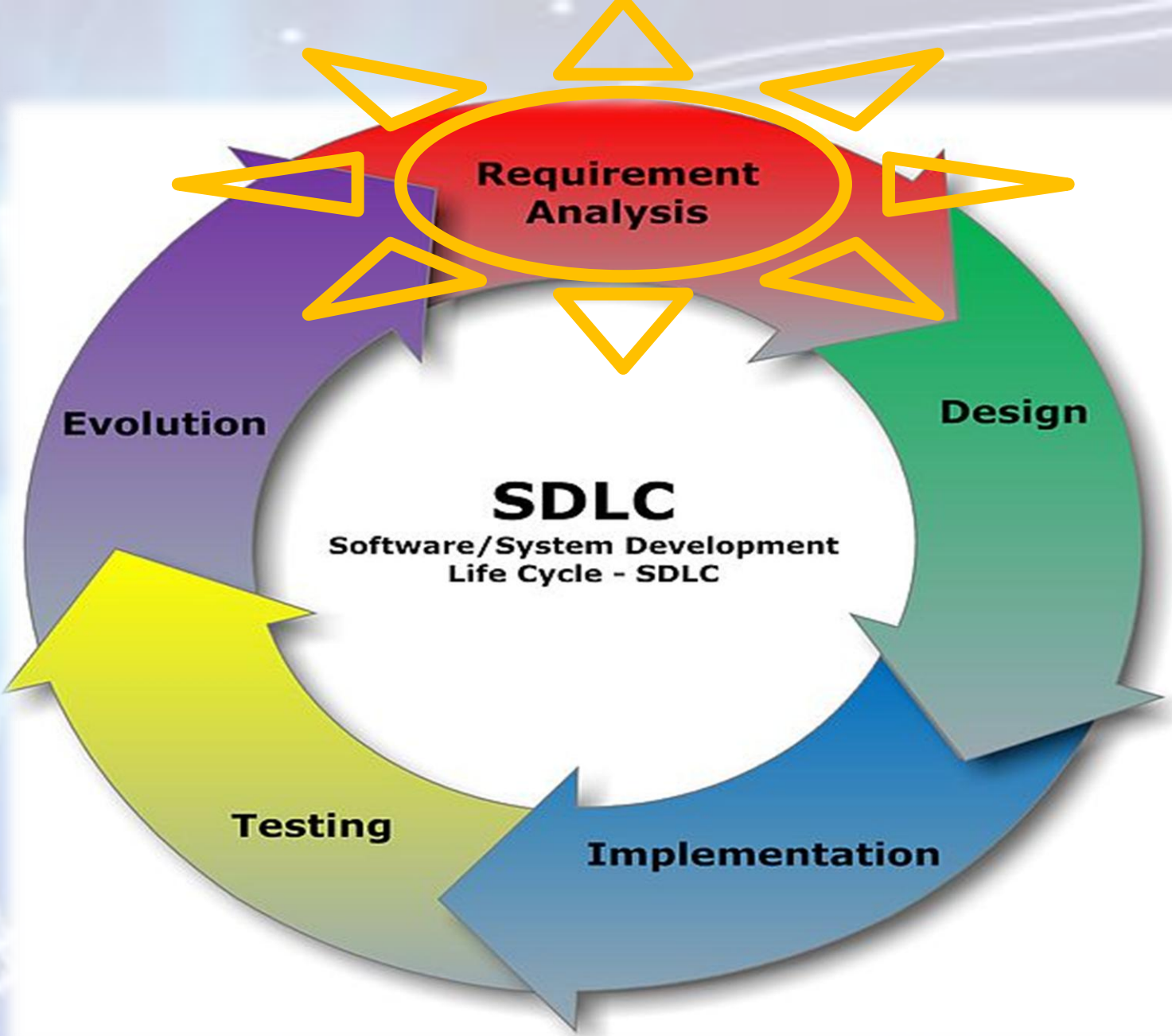
1) **Drill & Practice** (earliest; present then MCQs: poorest students!)
2) **Didactic: The Lecture** (video of lecture & slides; adv. No time/place limit – disadv. No Qs answered)
3) **Discrimination Learning** (process that teaches students differentiate between different clinical manifestation: program: series of examples of increasing complexity)
4) **Exploration vs. Structured Learning** (unlike Drill/Practice; it encourages experimentation & self-discovery by choosing any action in any order)

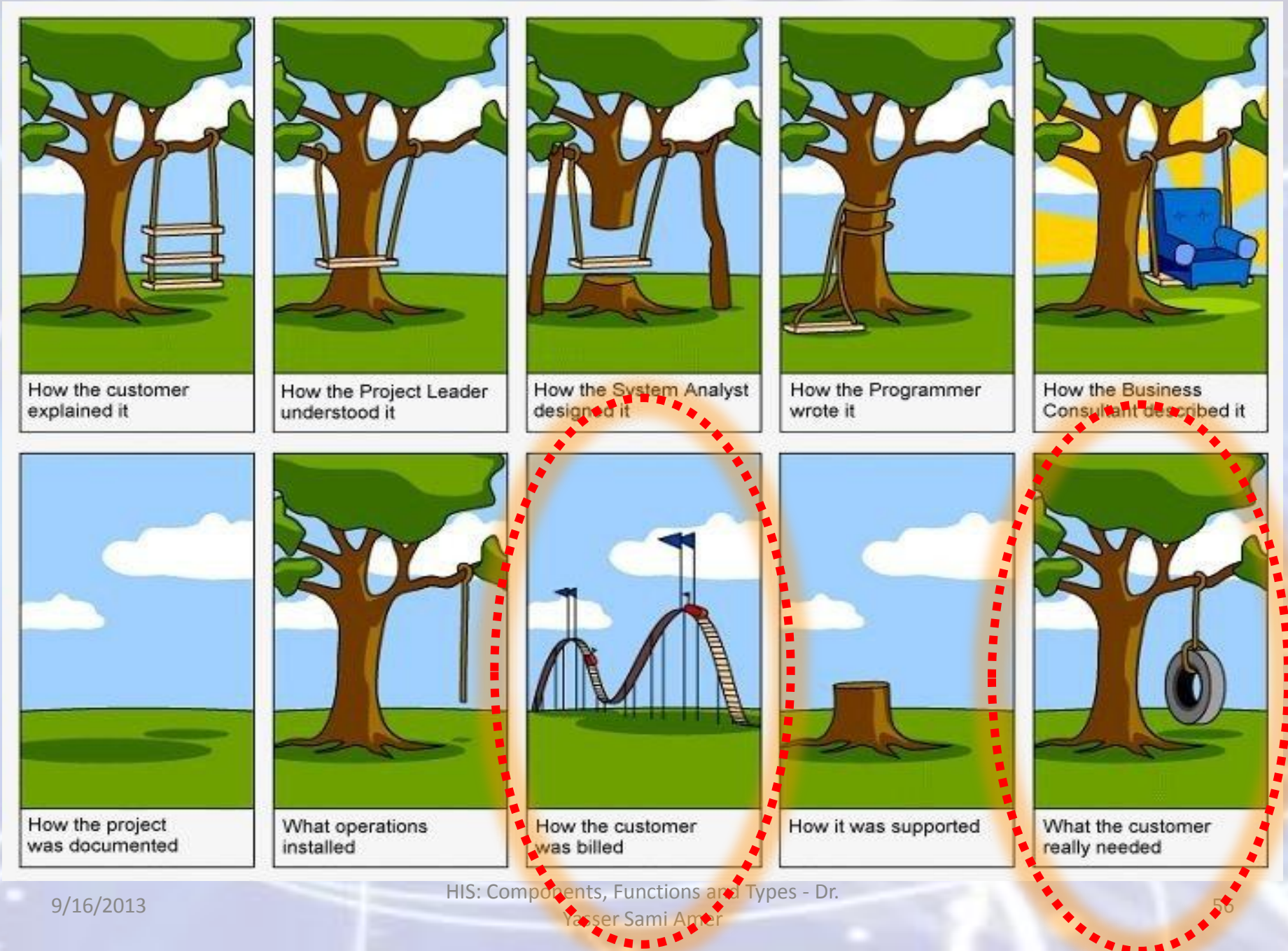
Modes of CBL (cont'd)

5) Constrained vs. Unconstrained Learning
6) Construction (most effective but difficult to implement on computers)
7) Simulation (static or dynamic programs – immersive simulated environments – procedure trainers)
8) Feedback & Guidance (interaction –like)
9) Intelligent Tutoring Systems (some differntiate Coaching vs. Tutoring: more proactive systems)

SDLC = Software/ System Development Life Cycle
دورة حياة تطوير نظم المعلومات (البرمجيات)

1. Requirements Analysis
2. Design
3. Implementation
4. Testing
5. Evolution


Requirement Analysis
Design
Implementation
Testing
Evolution
SDLC
Software/System Development Life Cycle - SDLC


How the customer explained it
How the Project Leader understood it
How the System Analyst designed it
How the Programmer wrote it
How the Business Consultant described it
How the project was documented
What operations installed
How the customer was billed
How it was supported
What the customer really needed

Types of HISs

Types of HISs

1. Subject-based Systems
2. Task-based Systems
3. Care Access Internet Systems
4. Administrative Health Care Services

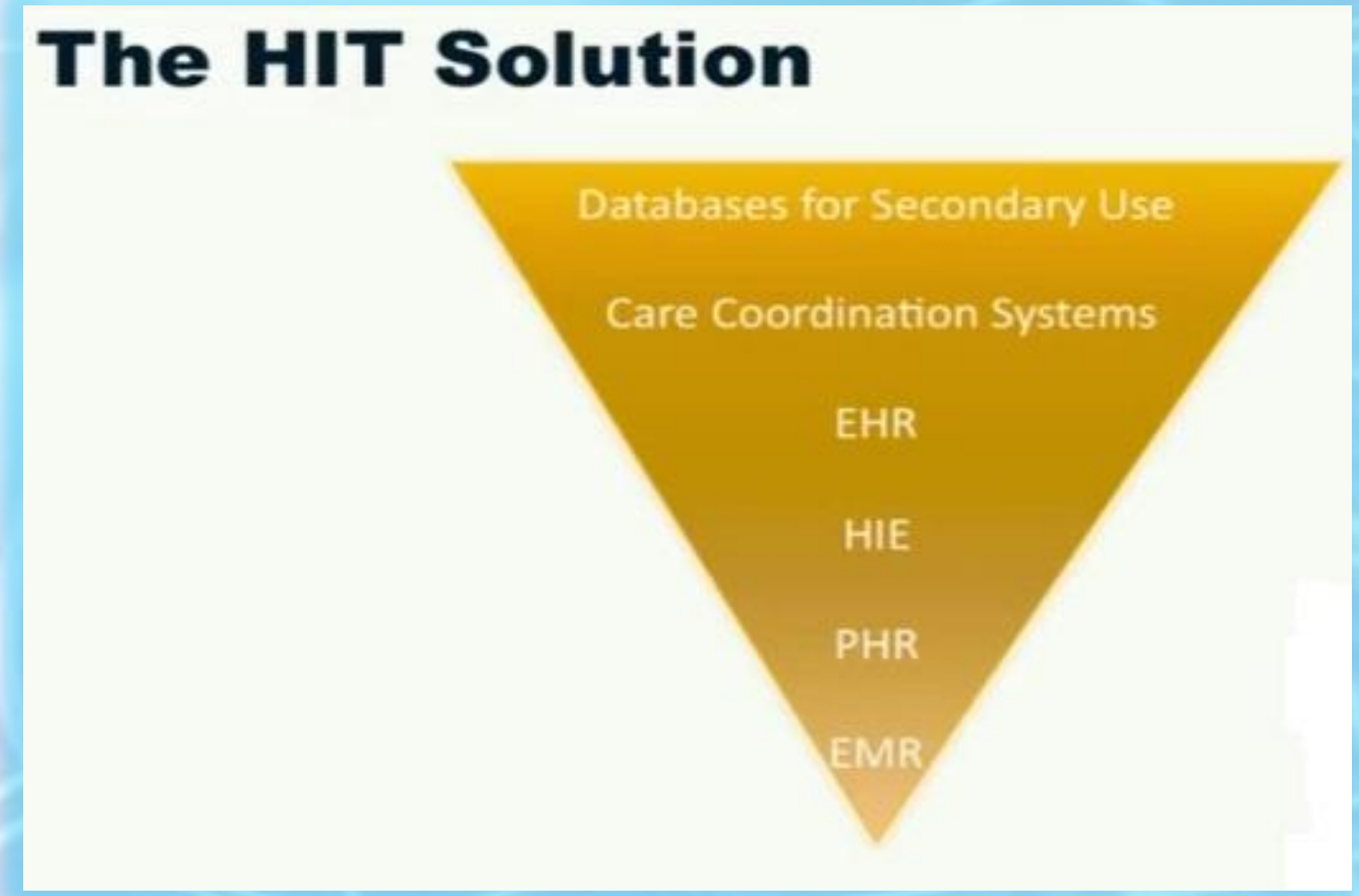
HISs are MISs that capture and display data related to the delivery of health care services. An HIS is not just a system of computers HW and SW. It includes;

- ✓ ***CPGs,***
- ✓ ***medical terminology dictionaries,***
- ✓ ***Interfaces***
- ✓ ***various diagnostic devices***
- ✓ ***other clinical and business information DBs (e.g. lab, pharmacy and diagnostic imaging***
- ✓ ***public health and medical research purposes.***

(1) Subject-based Systems

- Doctors can see their patient's medical record on a computer screen
- The most well-known type of health information system is the **Electronic Medical Record (EMR) or Electronic Health Record (EHR),** which is the electronic equivalent of a patient's paper chart. The EHR is a subject-based system that captures and stores information based on a patient's name or medical record number. It may also display information based on a physician's name.

EMR-PHR-HIE-EHR-CCS



- The **Master Patient Index (MPI)** is also a subject-based system. It lists all the patients who have ever been treated in a hospital or clinic. Typically, the MPI system serves as the foundation DB for all other patient-related systems, both clinical and administrative, such as patient scheduling, medical records, billing, claims processing and business decision support.

(2) Task-based Systems

- They are those that capture and report information about specific health care-related tasks such as laboratory, diagnostic imaging and medication management (pharmacy) systems. These systems are driven by the MPI system and they capture information and copy it to the EHRs system.
- MRI, laboratory tests and other diagnostic information is captured by task-based HISs.

(3) Care Access Internet Systems

- Secure internet access allows patients and physicians to view medical records from any location
- EHRs give providers and patients easy access to timely health information. Using secure internet portal systems, **patients** can: view their MRs, including test results; update their demographic information; schedule an appointment; request a prescription refill, or communicate with the doctor or nurse.

- **Care access portals** also allow physicians to remotely monitor patients with chronic conditions such as heart disease and chronic obstructive pulmonary disease (COPD). **Small self-adhesive wireless electronic devices**, some as small as a bandage that can be attached to a patient's chest directly over the heart to monitor heart, respiratory rates and fluid levels. Data is transmitted by via a secure portal system to the patient's electronic medical record and, if necessary, to a physician's smart phone so that the patient's condition can be monitored in real time.

(4) Administrative Health Care Services

- **Decision support software** helps managers plan for the future
- **Administrative health care systems** extract information from clinical systems and use it to manage daily operations, such as scheduling appointments and billing insurance carriers or patients for services rendered.
- DSSs extract data from various clinical and administrative HISs and compile it in various ways to identify trends, analyze costs, or solve problem areas in operations (e.g. an increase in number of patients with Type II diabetes may indicate that a health care provider must expand its diabetes education services).

Another classification HCISs

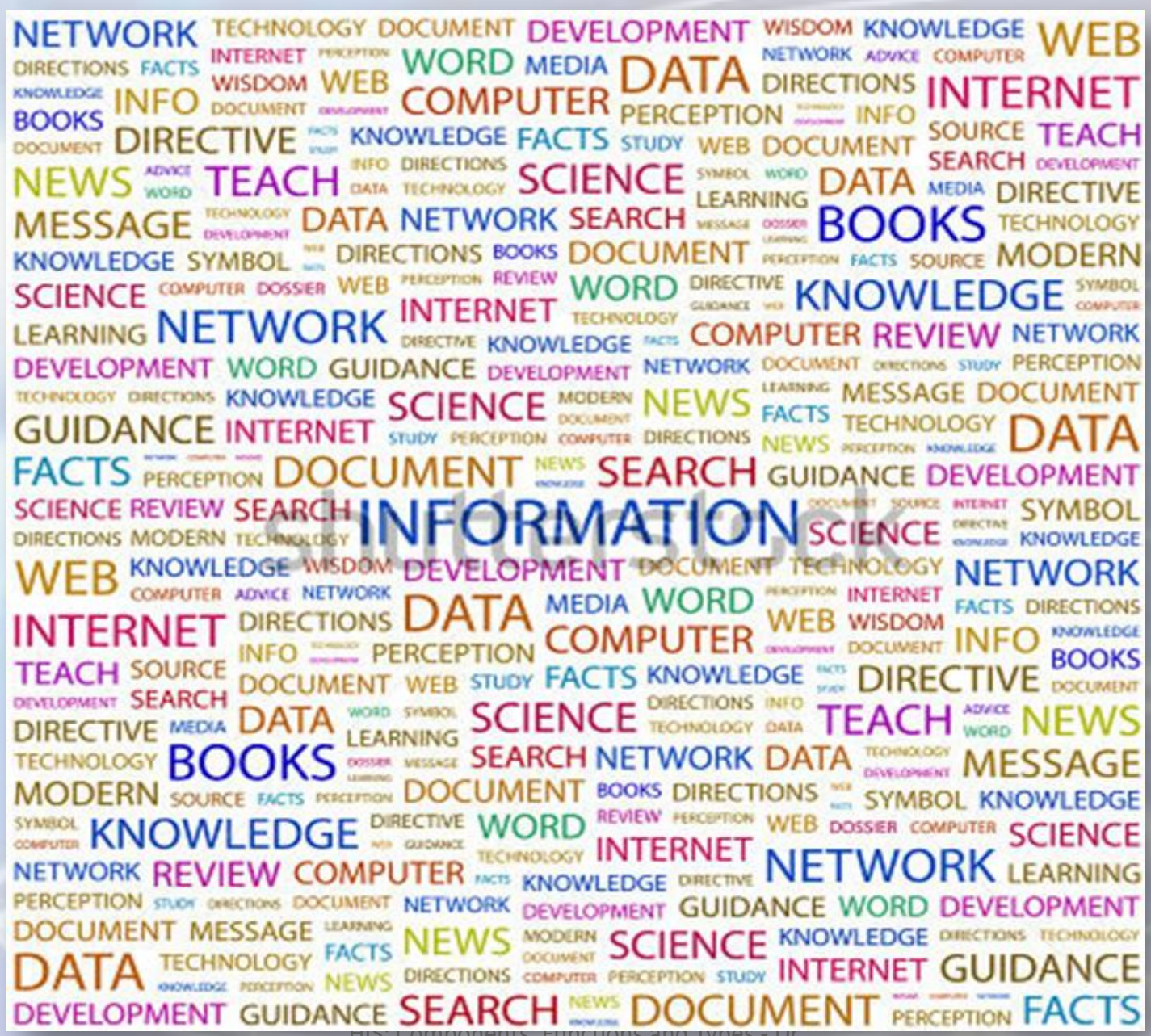
- **Administrative information system**
  - Contains primarily administrative or financial data
  - Used to support the management functions and general operations of the health care organization
- **Clinical information system**
  - Contains clinical or health-related information relevant to the provider in diagnosing, treating and monitoring the patient's care

Examples of Administrative Applications

- **Patient administration systems**
  - Admission, Discharge, and Transfer Registration
  - Scheduling
  - Patient billing or Accounts receivable
  - Utilization management
- **Financial management systems**
  - Accounts payable
  - General ledger
  - Personnel management
  - Materials management
  - Payroll
  - Staff Scheduling

Examples of Clinical Applications

- **Ancillary information systems**
  - Laboratory
  - Radiology
  - Pharmacy
- **Other clinical information systems**
  - Nursing documentation
  - Electronic medical record (EMR)
  - Computerized provider order entry
  - Telemedicine and telehealth
  - Medication administration


NETWORK TECHNOLOGY DOCUMENT DEVELOPMENT WISDOM KNOWLEDGE WEB
DIRECTIONS FACTS INTERNET PERCEPTION WORD MEDIA DATA NETWORK ADVICE COMPUTER
KNOWLEDGE INFO WISDOM WEB COMPUTER DIRECTIONS INTERNET
BOOKS DOCUMENT DIRECTIVE PERCEPTION INFO
DOCUMENT KNOWLEDGE FACTS STUDY WEB DOCUMENT SOURCE TEACH
NEWS ADVICE WORD TEACH INFO DIRECTIONS SCIENCE SEARCH DEVELOPMENT
DATA TECHNOLOGY SYMBOL WORD DATA MEDIA DIRECTIVE
MESSAGE TECHNOLOGY DEVELOPMENT DATA NETWORK SEARCH LEARNING BOOKS TECHNOLOGY
KNOWLEDGE SYMBOL DIRECTIONS BOOKS DOCUMENT MESSAGE DOSSIER MODERN
SCIENCE COMPUTER DOSSIER WEB PERCEPTION REVIEW WORD PERCEPTION FACTS SOURCE
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SYMBOL KNOWLEDGE DIRECTIVE WORD REVIEW PERCEPTION WEB SYMBOL KNOWLEDGE
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KNOWLEDGE PERCEPTION NEWS DIRECTIONS COMPUTER PERCEPTION STUDY INTERNET GUIDANCE
DEVELOPMENT GUIDANCE SEARCH NEWS DOCUMENT PERCEPTION FACTS

Where are we in Saudi Arabia?

Where are we in KSA?

For over 40 years, Saudi Arabia has been the Health Informatics leader within the Middle East.

In the early 1970's, the **King Faisal Specialist Hospital** was the first hospital to locally build and implement a hospital information system (HIS). It was such an achievement for the time that they were referred to as the first Automatic Hospital in the Middle East. Since then, many Health informatics achievements have been attained by Saudi HCOs. In 2010, the **National Guard Health Affairs** received the first prize in the Middle East for Electronic Medical Record implementation.

KSA Projects in progress:

- Development of a National EHRs
- King Abdullah Arabic Encyclopedia
- MOH – EHR Strategy
- Mobile healthcare initiatives *and much more*.

KSA has committed billions of dollars to the improvement of the *Electronic Health (E-Health) Strategy* within the Kingdom to improve healthcare service delivery and patient care.

IHME

Institute for Health metrics and Evaluation

Kingdom of Saudi Arabia Health Tracking Project

www.healthmetricsandevaluation.org

Institute for Health Metrics and Evaluation

IHME is a Research Institute formed in 2007 that is working in the area of Global health statistics and evaluation at the University of Washington in Seattle, USA.

KSA Health Tracking Project

- Since 1970, the KSA has achieved rapid economic growth, an associated expansion of educational attainment, and an advanced epidemiological transition dominated by non-communicable diseases and conditions.
- **Saudi Arabia's MOH is modernizing the country's HIS** in an effort to deliver integrated and comprehensive health care services. This is part of the government's plan to promote general health and prevention of diseases countrywide.

To achieve this, KSA is partnering with IHME on a multiyear collaboration to create an integrated health surveillance system for the MOH to monitor long-term and real-time burden of disease to inform national and subnational health priorities for policymakers. The new HIS will link all available data sources, including hospital records, pharmacy records, and surveys.

IHME is uniquely positioned to design a comprehensive, multisource surveillance system in KSA given the Institute's experience designing and piloting a system in King County, Washington, to monitor and understand chronic disease disparities and risk factors.

IHME-KSA Project

Key Activities

1. Provide a baseline study of the burden of disease at the national level
2. Scale up an integrated surveillance system
3. Conduct a subnational burden of disease study

For details of activities and expected impact go to:

http://www.healthmetricsandevaluation.org/research/project/kingdom-saudi-arabia-health-tracking

2011 Riyadh Valley Company of KSU (a Saudi Gov. owned investment firm), Cerner and Al Zamil announce Joint Healthcare Technology venture in KSA

- **Old News Video (6/2011)**

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Where are we in Our University Hospitals?

Every hospital and health system grapples with complexity, efficiency and the risk of human error in patient care.

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eSiHi
electronic System for Integrated Health Information
صحي الإلكتروني
Designed by Ghada Al-Baki

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QUESTIONS

THANK YOU FOR LISTENING!