Informatics 442

Revised by
Deema . Fatima . Talal . Ahmed . Mohammed

INTRODUCTION TO MEDICAL INFORMATICS

Color index:

Main Text | Female Slides | Male Slides | Extra | **Important** | Dr's Notes (previous notes)| Dr's notes 442 | Golden notes | **Textbook**

Editing file

Informatics

- The science concerned with gathering, manipulating, storing, retrieving and classifying recorded information.

Medical Informatics

- "The field that concerns itself with the cognitive, information **processing**, and communication tasks of medical practice, education, and research, including the **information science** and the **technology** to support these tasks". Greenes & Shortliffe 1990
  - What is meant by processing is gathering, manipulating, storing, retrieving.

- "Medical informatics is a rapidly developing **scientific** field that deals with the storage, retrieval, and optimal use of biomedical **information**, **data**, and **knowledge** for **problem solving** and decision making."
  Blois, M.S., and E.H. Shortliffe. in Medical Informatics: Computer Applications in Health Care, 1990, p. 20

  - The difference between information, data and knowledge:
    A patient's blood sugar is 140 —> **data**.
    A patient's blood sugar is 140 and you know that the normal range of blood sugar is less than 125 = patient has hyperglycemia —> **Information**
    Another example:Student exam
    The Grades= Data
    The mean and median of the grades to the student are information
    If we compare between the new and old grades to know if they increase or decrease= knowledge .
    Compare the results with research or data -> knowledge.

- "Medical informatics a developing body of knowledge and a set of techniques concerning the **organizational management of information** in support of medical **research**, **education**, and patient **care**....

- Medical informatics combines medical science with several technologies and disciplines in the information and computer sciences and provides methodologies by which these can contribute to better use of the medical knowledge base and ultimately to better medical care.
  " definition by Asso. of American Medical Colleges

- "Medical informatics comprises the **theoretical** and **practical** aspects of information processing and communication, based on knowledge and experience derived from processes in medical and Healthcare." Van Bemmel, J.H. "The structure of medical informatics" Medical Informatics, 9(1984), p. 175

- "Medical informatics is the application of computers, communications and information technology and systems to all fields of medicine - medical care, medical education and medical research."
  definition by MF Collen (MEDINFO '80, Tokyo, later extended).

- "Medical Informatics is the interdisciplinary study of the design, development, adoption and application of IT-based innovations in healthcare services delivery, management and planning."
  HIMSS Feb. 2019

- **Health information technology** (**HIT**) are single-entry points into a clinical world in which computational tools assist not only with patient-care matters (reporting results of tests, allowing direct entry of orders or patient information by clinicians, facilitating access to transcribed reports, and in some cases supporting telemedicine applications or decision-support functions) but also administrative and financial topics , research ,scholarly information, even office automation .

438 notes

-Data: raw material, not processed and it is not only number; it can be graphs. Data alone does not provide any meaning unless the person has a reference and a knowledge about this data.

-Information: analysis. You start to refer the data to another value to have a meaning that can be understood and later be compared to other information to get the knowledge. Examples: are mean and standard deviation.

-Knowledge: interpretation, you are trying to get a message from the information you have; you refer to other information and compare.

-In a research, data is what you collect, your target population. Information is the result of the analysis of data. Knowledge is the discussion, conclusion and recommendations.

Origin of term: "Medical Informatics" for your knowledge

Russian	French	English
informatika **1968** by Al Mikhailov, "Oznovy Informatika" ("Foundation of Informatics") structure and properties of scientific information.	**"informatique** de médecine" in **1968** university departments established with this title.	first appeared in **1970s** Columbia University changed its name from Medical Information Science to medical informatics.

History of Medical Informatics[1]

- Early names of medical informatics included **medical computing**, medical computer science, computer medicine, **medical electronic data processing**, medical automatic data processing, **medical information processing**, medical information science, medical software engineering and medical computer technology.

-(438) Dates are not important they're just to get the concept.

1950

- Medical informatics began in the 1950s with the growth of devices, and computer applications in medicine.
- The earliest use of computation for medicine was in dental projects in the 1950's at the National Bureau of Standards by Robert Ledley.
- The next step in the mid 1950s was the development of expert systems (decision support systems) such as **MYCIN (first medical informatics system)** and **INTERNEST-I**.

1968

- In 1968 homer Warner, founded the department of medical informatics at the university of Utar.

1970[2]

- In 1970 the international medical informatics association was founded. In the same year the MUMPS language and operating system was developed and used for clinical applications.

1996

- In the United States in 1996, HIPAA (Health Insurance Portability and Accountability Act) concerning privacy and medical record transmission created the impetus for large numbers of physicians to move towards using **EMR** (Electronic Medical Record) software, primarily for the purpose of secure medical billing.

NOV. 1999

- Nov 1999, TO ERR IS HUMAN: BUILDING A SAFER HEALTH SYSTEM, by the institute of Medicine
  - -(438) Analysis of previous report (to err is human) found that more than 50% of medical errors due to mishandling with patient information.
  - -(438) High recommendation to implement EMR for safety of patient not for automation.

Mar. 2001

- March 2001, CROSSING THE QUALITY CHASM: A NEW HEALTH SYSTEM FOR THE 21ST CENTURY
  - -(438) Based or retrospective studies in new york & pittsburg, that alarmed the medical community about increased mortalities due to medical errors.

1- The first practical application of automatic computing relevant to medicine was Herman Hollerith's development of a punched-card data-processing system.or the 1890 U.S.

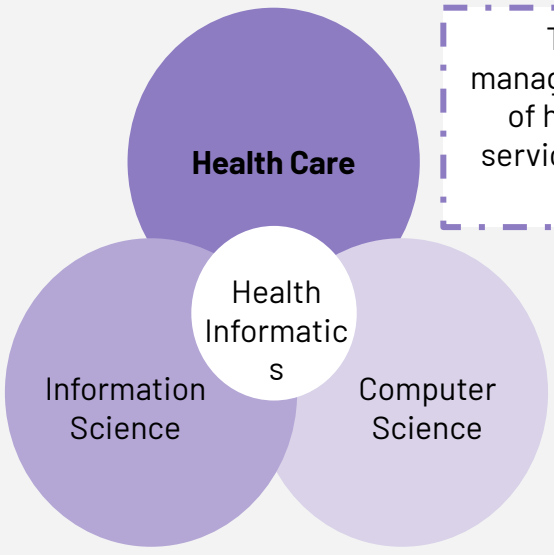
2- Biomedical-computing activity broadened in scope and accelerated with the appearance of the minicomputer in the early 1970s. These machines made it possible for individual departments or small organizational units to acquire their own dedicated computers and to develop their own application systems. **MUMPS language** (Greenes et al. 1970;Bowie and Barnett 1976), which was specially developed for use in medical applications. For several years, MUMPS was the most widely used language for medical record processing.

Why medical informatics for healthcare (Advantages)

- Improve healthcare quality
- Better data access
- Faster data retrieval and storage
- High quality data
- Support medical and non-medical decision making
- Enhance quality assurance
- Enhance outcome researches and studying programs
- Sharing medical data
- Increase healthcare organization efficiency.
- Reducing cost and achieves quality of healthcare.
- Improve staff productivity.
- Reduce redundant tests, services and information entry.
- Manage billing and payment system.
- Eliminate and reduce errors.
- Reduce duplication of efforts.
- Provide unified access to all existing data.

Health Informatics

- Health Informatics is the intersection of **information science, Information Technology,** and **health care.**
- It deals with resources, devices, & methods required to optimize the acquisition, storage, retrieval, and use of information in health and biomedicine.
- Health informatics tools include **clinical guidelines**, formal medical terminologies, information & communication systems. It is applied to the areas of nursing, clinical care, dentistry, pharmacy, public health and (bio)medical research.



The prevention, treatment and management of illness and the promotion of health and well-being through the services offered by the medical, nursing and allied health professions.

The collection, classification, manipulation, storage, retrieval and dissemination of information; The application and use of knowledge; The interaction between people, organisations and information systems.

The theoretical foundations of information and computation together with their implementation and application in computer systems.

Computer science = information technology

Biomedical Informatics (BMI)[1]

- **Biomedical Informatics:** is the interdisciplinary field that studies and pursues the effective uses of biomedical data , information, and knowledge for scientific inquiry (ex: using patients' medical records for research) , problem solving (ex: telemedicine to reach patients) , and decision making (ex: drug library), driven by efforts to improve human health. E.H. Shortliffe and Marsden S. Blois 2014
  - Biomedical informatics is the bigger umbrella for health informatics.

- **Application areas [2]:** Range from bioinformatics to clinical and public health informatics and span the spectrum from the molecular to population levels of health and biomedicine. ." AMIA amiajnl-2012

- **Scope and breadth of the discipline:** BMI investigates and supports reasoning, modeling, simulation, experimentation, and translation across the spectrum from molecules to individuals and to populations, from biological to social systems, bridging basic and clinical research and practice and the health care enterprise.

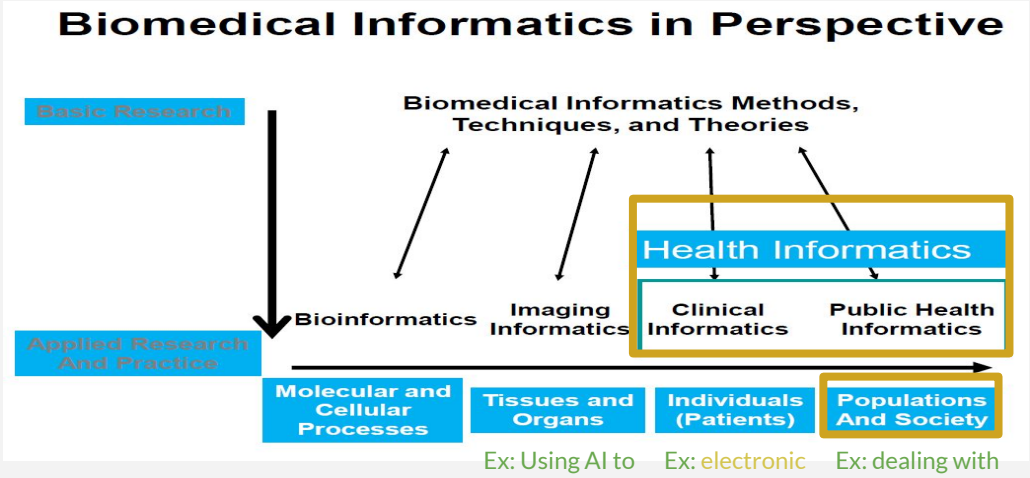
- **Theory and methodology :** BMI develops, studies, and applies theories, methods, and processes for the generation, storage, retrieval, use, management, and sharing of biomedical data, information, and knowledge.

- **Technological approach:** BMI builds on and contributes to computer, telecommunication, and information sciences and technologies, emphasizing their application in biomedicine.

1-Biomedical informatics is, by its nature, an **experimental science**, characterized by posing questions, designing experiments, perform- ing analyses, and using the information gained to design new experiments. One goal is simply to search for new knowledge, called **basic research**. A second goal is to use this knowledge for practical ends, called **applications** (**applied**) **research**.

- biomedical informatics (BMI) is inherently motivated by problems encountered in a set of applied domains in biomedicine. The first of these historically has been clinical care (including medicine, nursing, dentistry, and veterinary care), an area of activity that demands patient-oriented informatics applications,We refer to this area as **clinical informatics**. It includes several sub-topics and areas of specialized expertise,including patient-care foci such as **nursing informatics**, **dental informatics**, and even **veterinary informatics**.Furthermore, **medical informatics** reserved for those applied research and practice topics that focus on disease and the role of physicians. Closely tied to clinical informatics is **public health informatics.**Two other large areas of application overlap in some ways with clinical informatics and public health informatics. These include **imaging informatics** (and the set of issues developed around both radiology and other image management and image analysis

Finally, there is the burgeoning area of **bioinformatics**, which at the molecular and cellular levels is offering challenges that draw on many of the same informatics methods as well. At the next level, workers focus on tissues and organs, which tend to be the emphasis of imaging informatics work (also called **structural informatics).**



4 main subdivisions

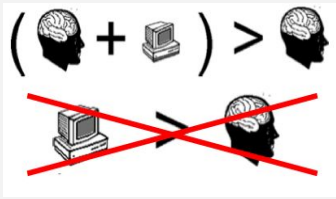
Ex: Using AI to interpret mammograms

Ex: electronic medical record, request a prescription.

Ex: dealing with epidemics, social media, surveillance.

The Fundamental Theorem of Biomedical Informatics

-Charles friedman proposed the fundamental theorem of biomedical informatics which states that "a person working with an information resource is better than that same person unassisted".
- Information resources are usually, but do not have to be, computer-based.



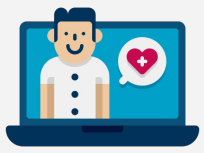
Bioinformatics

- The collection, organization, and analysis of large amounts of biological data, using computers and databases.
- Historically, bioinformatics concerned itself with the analysis of the sequences of genes and their products (proteins), but the field has since expanded to the management, processing, analysis, and visualization of large quantities of data from genomics, proteomics, drug screening, and medicinal chemistry.
- Bioinformatics also includes the integration and "mining" of the ever-expanding databases of information from these (biological) disciplines.

- Closely tied to clinical informatics is **public health informatics** .where similar methods are generalized for application to populations of patients rather than to single individuals . clinical informatics and public health informatics share many of the same methods and techniques.

Applications of Medical Informatics

1- Telemedicine



It is composed of the Greek word τελε (tele) meaning 'far', and medicine.
It is therefore the delivery of medicine at a distance.
-**A more extensive definition** is that it is the use of modern telecommunication and information technologies for the provision of clinical care to individuals located at a distance and to the transmission of information to provide that care.
- (438) **Examples** of telemedicine:
    1. Teleconsultation (this requires the consultant to have an access to the patient information so he/she can do the consultation).
    2. Teleradiology.

2- Telehealth

The delivery of health related services, enabled by the innovative use of technology, such as videoconferencing, without the need of travel

-(438) Telehealth was established because of the aging age group who need a support especially those who are lonely to provide support at home and also for home monitoring and health education.

clinical services (doc-patient) — **telemedicine** VS **telehealth** — related health services (everything else)

Telehealth is not a bigger umbrella than telemedicine, they're different and not correlated to each other.

3- E-health

Also written e-health, is a relatively recent term for healthcare practice which is supported by electronic processes and communication, some people would argue the term is interchangeable with Health Informatics.

- **Four essential components** make the e-health:

1. Medical knowledge (data, information, knowledge) that lends itself to being stored in computer files (digital format).
2. People who are willing/able to share, apply and use this knowledge.
3. Data processing equipment to record, store and process this data.
4. Telecommunication facilities to transfer (exchange) this data electronically between remote locations.

-(438) E-health was used for business reasons (selling and buying medical devices and drugs).
Nowadays is used for all applications used for healthcare such as heartbeat monitors .. etc

- **Telehealth vs E-health:** E-health is much more than tele-health as tele is a limiting factor to the form of technology in health. E-health could be at distance or local.
- E- health = أي استخدام إلكتروني لتطبيقات صحية. Tele-health, Telemedicine e prescription هم تحت E-health.

From Telemedicine to E-health:

- The practice of telemedicine will become more prominent and will be part of the mainstream of Healthcare.
- It will become increasingly difficult to differentiate telemedicine from many other uses of technology in the delivery of healthcare.
- E-health is all inclusive and captures the use of Internet technologies and the rise of the information economy. This includes: **information technology**, **telecommunication technology**, **Data transmission protocols** and **techniques**.
- E-Health is all inclusive and captures all types of Healthcare and Healthcare professionals: it is not limited to medicine and not limited to doctors.

4- Electronic medical records

EMR is A general term describing computer-based patient record systems. It is sometimes extended to include other functions like order entry for medications and tests, amongst other common functions.

- EMR is important for decision support.

438 notes

- if a patient had a pacemaker and you wanted to do an MRI, this system will prevent the MRI from taking place avoided the complications.
- Another example is drug-drug interaction and allergies.

5- Dental informatics

- is the name given to the application of information technology to dentistry.
- It is often considered a subset of Medical Informatics and Biomedical Informatics.
- (438) Dental practice use medical informatics more than medical practice because these practitioners take the case from A to Z alone.

6- Distance learning

- With aid of telecommunications technologies and internet, distance learning is now widely applied in may universities, eg: Open University.
- It is now possible to earn university degrees from home, at every level from bachelor's to doctorate.

7- Nursing informatics

- Nursing Informatics is a specialty of Health Informatics (like Medical Informatics, Consumer Health Informatics, and Telehealth) which deals with the support of nursing by information systems in delivery, communication, documentation, administration and evaluation of patient care and prevention of diseases.

438 notes

- Nursing depend on informatics a lot because they do a lot of documentations.
- Another example, a nurse can't give a patient a medication until they check the patient code with a device that has all patients information about the drugs.

8- Continuing Medical Education (CME)

Definition: The science of medicine advances at such a rapid rate that much of what is taught becomes outmoded, and it has become obligatory for physicians to be lifelong learners, both for their own satisfaction and, increasingly, as a formal government requirement to maintain licensure.

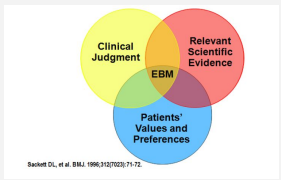
- Doctors who practice in rural areas or other more isolated locations may face considerable obstacles to obtain hours for CME.
- The cost of web-based or online CME is much lower than the cost of traditional CME.
- (438) Blackboard used in our college is an example and also DXR.

9- Evidence based medicine

Definition: "EBM is the process of systematically reviewing, appraising and using clinical research findings to aid the delivery of optimum clinical care to patients."

- Entails a system that provides information on appropriate treatment under certain patient conditions.
- A healthcare professional can look up whether his/her diagnosis is in line with latest (up-to-date) scientific research.
- The advantage is that the practice can be kept up-to-date with published knowledge.
- The integration of best research evidence with clinical expertise and patient values' which when applied by practitioners will ultimately lead to improved patient outcome.
- EBM falls under the education area in health informatics.

- There are **three main pillars or components of EBM:**
  1. **Best evidence (Relevant Scientific Evidence):** clinical research that has been conducted using rigorous methodology.
  2. **Clinical expertise (judgment)** refers to the clinician's cumulated education, experience and clinical skills.
  3. **Patients preferences, values and concerns** which patient brings to a clinical encounter.



- It is clear that EBM depends on the structured knowledge databases that contains the most recent and valid clinical research output. It is the integration of best and latest evidence with clinical expertise and patient values component could improve the clinical practice outcome and patients' satisfactions.

438 notes

- **Why EBM is part of informatics?** Because all knowledge must be up to date and get these we need a medium for that in which all can reach and also a fast one.
- **What is the difference between evidence based practice and none?** Latest knowledge!
- EBM is found to reduce errors. The knowledge has to be structured.

10- Hospital Information System

HIS: is a comprehensive information system dealing with all aspects of information processing in a hospital.

- This encompasses human information processing as well as data processing machines.
- As an area of Medical Informatics the aim of HIS is to achieve the best possible support of patient care and administration by electronic data processing.
- **HIS elements:**
  1- Patients care (clinical documentation, order entry, OR...)
  2- Patients administration (registration, outpatient, inpatient, ER...)
  3- Financial & admin services.
  4- Materials (inventory, purchase, engineering management...)
  5- Clinical support (labs, pharmacy, radiology...)

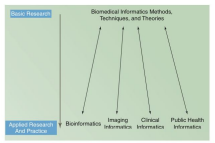


Fig. 1.19 Biomedical informatics as basic science. We view the term biomedical informatics as referring to the basic science discipline in which the development and evaluation of new methods and theories are a primary focus of activity. These core concepts and methods in turn have broad applicability in the health and biomedical sciences. The informatics subfields indicated by the terms across the bottom of this figure are accordingly best viewed as application domains for a common set of concepts and techniques from the field of biomedical informatics. Note that work in biomedical informatics is motivated totally by the application domains that the field is intended to serve (thus the two-headed arrows in the diagram). Therefore the basic research activities in the field generally result from the identification of a problem in the real world of health or biomedicine for which an informatics solution is sought (see text)

Biomedical informatics relationship to Biomedical Science and Clinical Practice:

The exciting accomplishments of biomedical informatics, and the implied potential for future benefits to medicine, must be viewed in the con- text of our society and of the existing health care of potential areas of application (Fig. 1.19). The analogy with other **basic sciences** is that biomedi- cal informatics uses the results of past experience to understand, structure, and encode objective and subjective biomedical findings and thus to make them suitable for processing. This approach supports the integration of the findings and their analyses.

Biomedical informatics Relationship to Computer Science :

early 1960s (when health- computing experts occasionally talked about and, in a few instances, developed special medical terminals) have people assumed that biomedical applications would use hardware other than that designed for general use.

The question of whether biomedical applications would require specialized programming languages might have been answered affirmatively in the 1970s by anyone examining the MGH Utility Multi-Programming System, **known as the MUMPS language** (Greenes et al. 1970;Bowie and Barnett 1976), which was specially developed for use in medical applications. For several years, MUMPS was the most widely used language for medical record processing.

Biomedical informatics relationship to Biomedical Engineering :

Biomedical engineering departments emerged 40 years ago, when technology began to play an increasingly prominent role in medi- cal practice.16 The emphasis in such departments has tended to be research on, and development of, instrumentation (e.g., as discussed in Chaps. 19 and 20, advanced monitoring systems, specialized transducers for clinical or laboratory use, and image-enhancement techniques for use in radiology), with an orientation toward the development of medical devices, **pros- theses**, and specialized research tools.

Applying a computer (or any formal computation) to a physical problem in a medical context is no different from doing so in a physics laboratory or for an engineering application. The use of computers in various **low-level processes** (such as those of physics or chemistry) is similar and is independent of the application In biomedicine, however, there are other **higher-level processes** carried out in more complex objects such as organisms (one type of which is patients). Many of the important informational processes are of this kind. In light of these remarks, the general enterprise known as **artificial intelligence** (**AI**) can be aptly described as the application of computer science to high-level, real-world problems.

Integrating Biomedical Informatics and Clinical Practice:

We can summarize several global forces that are affecting biomedical computing and that will determine the extent to which computers are assimilated into clinical practice: (1) new developments in computer hardware and soft- ware; (2) a gradual increase in the number of individuals who have been trained in both medicine or another health profession and in BMI; and (3) ongoing changes in health care financing designed to control the rate of growth of health- related expenditures

The new hardware technologies have made powerful computers inexpensive and thus available to hospitals, to departments within hospitals, and even to individual physicians. The broad selection of computers of all sizes, prices, and capabilities makes computer applications both attractive and accessible. Technological advances in information storage devices,17 including the movement of files to the “cloud”, are facilitating the inexpensive storage of large amounts of data, thus improving the feasibility of data-intensive applications, such as the all- digital radiology department

Clinical personnel will continue to be unwilling to use computer- based systems that are poorly designed, confusing, unduly time-consuming, or lacking in clear benefit (see Chaps. 4 and 6). As they become more sophisticated in the use of computers in other aspects of their lives, their expectations of clinical software will become only more demanding.

The second factor is the increase in the number of professionals who are being trained to understand the biomedical issues as well as the technical and engineering ones. Computer scientists who understand biomedicine are better able to design systems responsive to actual needs and sensitive to workflow and the clinical culture.

The third factor affecting the integration of computing technologies into health care settings is managed care and the increasing pressure to control medical spending. The escalating tendency to apply technology to all patient-care tasks is a frequently cited phenomenon in modern medical practice

In summary, rapid advances in computer hardware and software, coupled with an increasing computer literacy of healthcare professionals and researchers, favor the implementation of effective computer applications in clinical practice, public health, and life sciences research. Furthermore, in the increasingly competitive health care industry, providers have a greater need for the information management capabilities supplied by computer systems. The challenge is to demonstrate in persuasive and rigorous ways the financial and clinical advantages of these systems

All the notes in this page are from 438's R.

HIS

- كلهم موجودين في HIS

Telehealth

- نفس الفكرة اذا كان عندي اشياء من clinical area of biomedical informatics and telecommunications and labs etc اقدر اسوي telehealth.

BIOMEDICAL INFORMATICS

EDUCATION

- E-learning
- Online education.
- Distance learning (DL).
- Continued medical education (CME).
- Evidence based medicine (EBM).
- Problem based medicine (PBM).

RESEARCH

- Medical standards
- Database
- Data mining
- DSS
- Statistical Analysis
- Modeling

Modeling = النمذجة.

CLINICAL

- Scheduling
- Research
- EMR
- Computerized physician order entry.

TELECOMMUNICATION

ADDITIONAL

- PACS (Picture Archiving and communication system)
- ICU
- Labs
- Pharmacy
- Nursing

ADMINISTRATION

- PMI
- PM
- FM

healthcare/clinical practice

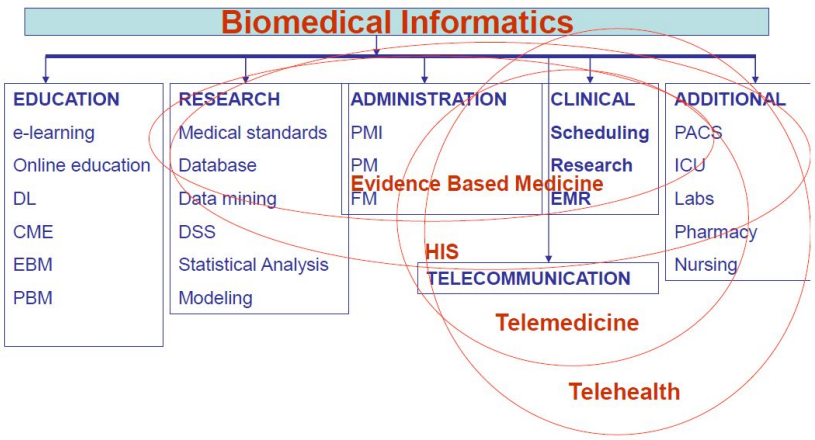
Evidence based medicine

- اذا عندي databases etc and اقدر اسوي اسئلة و ابحث عنها EMR

Telemedicine

- اذا عندي telecommunication and scheduling and CPOE etc اقدر اسوي telemedicine.

Original diagram for doctor's slides



Summary

Informatics	• The science concerned with gathering, manipulating, storing, retrieving and classifying recorded information.
Medical Informatics	• The field that concerns itself with the cognitive, information **processing**, and communication tasks of medical practice, education, and research, including the **information science** and the **technology** to support these tasks • is a rapidly developing **scientific** field that deals with the storage, retrieval, and optimal use of biomedical **information**, **data**, and **knowledge** for **problem solving** and decision making. • The difference between information and data: A patient's blood sugar is 140 --> **data**. A patient's blood sugar is 140 and you know that the normal range of blood sugar is less than 125 = patient has hyperglycemia --> **Information**. • Medical informatics comprises the **theoretical** and **practical** aspects of information processing and communication, based on knowledge and experience derived from processes in medical and Healthcare. • The next step in the mid 1950s was the development of expert systems (decision support systems) such as **MYCIN (first medical informatics system)** and **INTERNEST-I**. • Informatika = one of the origin terms of medical informatics used by russia. • In the United States in 1996, HIPAA (Health Insurance Portability and Accountability Act) concerning privacy and medical record transmission created the impetus for large numbers of physicians to move towards using **EMR** (Electronic Medical Record) software, primarily for the purpose of secure medical billing. • Better data access and Enhance quality assurance are advantages of the use of medical informatics in health care.
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Biomedical Informatics (BMI)	• **I**s the interdisciplinary field that studies and pursues the effective uses of biomedical data , information, and knowledge for scientific inquiry (ex: using patients' medical records for research) , problem solving (ex: telemedicine to reach patients) , and decision making (ex: drug library), driven by efforts to improve human health. - Biomedical informatics is the bigger umbrella for health informatics. • **Application areas:** Range from bioinformatics to clinical and public health informatics and span the spectrum from the molecular to population levels of health and biomedicine. ." • Health informatics subfields are clinical informatics and public health informatics. • Ex of clinical informatics is EMR. • Public health informatics is concerned with clinical application on the population.
Bioinformatics	• The collection, organization, and analysis of large amounts of biological data, using computers and databases. • Historically, bioinformatics concerned itself with the analysis of the sequences of genes and their products (proteins), but the field has since expanded to the management, processing, analysis, and visualization of large quantities of data from genomics, proteomics, drug screening, and medicinal chemistry. • Includes the integration and "mining" of the ever-expanding databases of information from these (biological) disciplines.
Telemedicine	2 Definitions: • Delivery of medicine at a distance. • The use of modern telecommunication and information technologies for the provision of clinical care to individuals located at a distance and to the transmission of information to provide that care.
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MCQs

1- The term Medical Informatics was first used by:

A- Robert ledley
B- The book "TO ERR IS HUMAN: BUILDING A SAFER HEALTH SYSTEM"
C- Columbia University.
D- The book "CROSSING THE QUALITY CHASM: A NEW HEALTH SYSTEM FOR THE 21ST CENTURY"

2- The Fundamental Theorem of Biomedical Informatics states that:

A- Person > computer.
B- Person + computer > computer.
C- Person + computer > person.
D- Person < computer.

3- Health Informatics is the intersection of:

A- Information science, Information Technology, and health care.
B- Clinical informatics, public health informatics, and Bioinformatics.
C- Information science, information technology.
D- Public health informatics and bioinformatics.

4- Which of the following statements is true:

A- Four elements that make E-health are: medical knowledge , willing people, Data processing equipment, telecommunication facilities.
B- Tele-health is more than E-health.
C- E-health is exclusive to physicians.
D- The practice of E-health can only be done locally.

5- Clinical guidelines are tools of which of the following:

A- Health informatics.
B- Medical informatics.
C- Biomedical informatics
D- Bioinformatics.

6- Teleradiology is an example of:

A- Telehealth.
B- Telemedicine.
C- Distance learning.
D- Nursing informatics.

Answers key

1- C 2- C 3- A 4- A 5- A 6- B

Members Board

Informatics 442

Team leaders

Ghada Bin Slmah

Rand AlJarallah

Meshari Alshathri

Team members

Raneem Alwatban

Nawaf Alrefaei

Sara Almajed

Fatima Halawi

deema aljuribah

Maram Beyari

Raid almadi

Mohammed alzeer

Layan Aldoukhi

Amani Alotaibi

Fay aldossari

Hazem almalki

Abdulaziz Saad Alqahtani