1- Introduction to Medical Informatics

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- References: 436 Doctor's Slides and notes , E.H. Shortliffe and Marsden

Objectives

Not Found ☹

Color index

- Doctor's notes
- Extra information and further explanation
- Important
- Main titles
- Subtitles

 This slide from doctor's slides

 This slide from the book

Medical Informatics

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

What is Medical Informatics? Medical Informatics comprises the theoretical and practical aspects of information processing and communication, based on knowledge and experience derived from processes in medicine. (Focused on information)

- Everything you do in practice is relying on information. Patient comes and The first thing we do is taking history (information). Next we look to the patient file (medical information). Then we request for tests (information) then we go to the literature (informational knowledge) and we bring all the information in front of us in order to take a decision so practitioners spend more than 50% of their time dealing with information. This science is focusing on dealing with all these information in order to take the right decision.

❖ History

- Medical informatics is believed that it began in the 1950s with the growth of information devices, and computer applications in medicine.
- Early names of medical informatics included medical computing (calculation or processing), medical computer science, medical electronic data processing, medical automatic data processing, medical information processing, medical information science, and medical computer technology. All the old names were focusing on processing
- 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 such as MYCIN (first medical informatics system) and INTERNEST-I.
- In France in 1968 university departments established with the title "informatique de medecine"
- In the United States in 1996, HIPAA (Health Insurance Portability and Accountability Act) regulations 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. باختصار هذي HIPAA يركز على الحفاظ على خصوصية معلومات المرضى ومين له الأحقية في الإطلاع على معلومات المرضى، ليه سووه؟ لأن لاحظوا في التأمين الصحي فيه بعض التعديات على حقوق المرضى فطلعوا هذا النظام للحفاظ على الخصوصية

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Medical Informatics

❖ Origin of Term "Medical Informatics"

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

Health Informatics

- what is the main function of health informatics : it basically processing the information by: acquisition (gathering) → storage → retrieval……etc. to get the optimal decision for the patient
- what do we use in health informatics (main material): data + information + knowledge
- main purposes: solving problem + decision making + contributing to knowledge + scientific inquiry
- field: clinical + education + research
- **Health informatics:** is the intersection of information science*, computer science and health care. It deals with resources, devices, & methods required to optimize the acquisition, storage, retrieval, and use of information in health and biomedicine.
- *تخصص قسم المعلومات والمكتبات: فهرسة الكتب (classification, indexing so we can get the information easily) ومب شرط تكون الفهرسة ورقيًا ممكن تكون الكترونيًا مثال عليها لمن ابحث عن معلومة من خلال كتابة keywords هذي صارت بسبب الفهرسة

- **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. medical terminology (part of health care) guideline (part of information science)

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Health Informatics

- "...the understanding, skills, and tools that enable the sharing and use of information to deliver healthcare and promote health" ---
- "Medical informatics attempts to provide the theoretical and scientific basis for the application of computer and automated information systems to biomedicine and health affairs . . . medical informatics studies biomedical information, data, and knowledge - their storage, retrieval, and optimal use for problem-solving and decision-making." Lindberg, D.A.B. NLM Long Range Plan. Report of the Board of Regents, 1987, p. 31.
- "Medical informatics is the application of computer technology to all fields of medicine - medical care, medical teaching, and medical research." Preliminary announcement for the Third World Conference on Medical Informatics, MEDINFO 80, 1977.
- أيش الفرق بين data و knowledge: ١- بالنسبة حق data فهي معناتها raw(unprocessed) مثال عليها the value of BP شوفوا هو كأني أقول لواحد عامي ترا ضغطك ١٨٠/٩٠ هو بيقولك طيب وش معنى هالشي فمجرد إني أقول الرقم وبس ماراح استفيد. ٢- بالنسبة حق knowledge فهي معناتها processed information يعني I can understand the data bc it mean things to me مثلًا في المثال حقنا لمن أعلم هالشخص أيش الطبيعي للضغط هنا خلاص الأرقام راح تكون لها معنى بالنسبة له. يعني ممكن أعرف knowledge (interpreting information received, adding relevance and context to clarify the insights of the information contains)

BioMedical Informatics (BMI)

- **Biomedical Informatics (BMI):** is the interdisciplinary field that studies and pursues the effective uses of biomedical data, information, and knowledge for scientific inquiry (scientific question e.g. research), problem solving , and decision making, driven by efforts to improve human health . E.H. Shortliffe and Marsden S. Blois 2014
- **Scope and breadth of 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. المقصد إننا نسوي فحوصات وتجارب و نمذجة من مستوى الذرات (مثل في الأدوية) أو على مستوى المجتمع عن طريق البحوث لحل مشاكل أو اتخاذ قرارات كله من أجل زيادة صحة الإنسان

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BioMedical Informatics (BMI)

- **Theory and methodology:** BMI develops, studies, and applies theories, methods, and processes for the generation, storage, retrieval, utilization, 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.

From the book

- Biomedical informatics and basic sciences uses the results of past experience to understand, structure, and encode findings to make them suitable for processing

- Biomedical informatics is an **experimental science** characterized by posing questions, designing experiments, performing analyses, and using the information to design new experiments. By: **1-Basic research**: simply to search for new knowledge. **2-Applications (applied) research:** to use the knowledge for practical ends.

Application of Medical Informatics

- **Telemedicine:** 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. بدت في الفاكس إنهم ينقلون معلومات المرضى للمستشفي ثم يشخصون لهم الأطباء عن بعد، حاليًا من الأمثلة عليها إن الصور حقت الأشعة تنرسل لمستشفى آخر، يعني أخذنا صورة الأشعة في الطوارئ من مستشفى الملك عبدالعزيز بس مافيه استشاري للحالة هذي يقدر استشاري من الملك خالد يشوفها عنده في الجهاز ويشخص الحالة

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Application of Medical Informatics

From the book

- Years ago medicine used the telephone as a standard vehicle for facilitating patient care. If we extend the audio channel “telephone” to include our visual sense as well, typically relying on the Internet as our communication mechanism, the concept of telemedicine emerges.
- The use of telemedicine has subsequently grown rapidly, and there are specialized settings in which it is proving to be successful and cost-effective (e.g. rural care, international medicine, teleradiology, telepathology and video-based care of patients in prisons).

- **Telehealth:** The delivery of health related **services**, enabled by the innovative use of technology, such as videoconferencing, **without the need for travel.**

- أيش الفرق بين telemedicine and tele-health؟ الأولى تعني فقط بتشخيص المرضى وعلاجهم الثانية تعنى بتقديم خدمات للمرضى، مثلًا الكبار بالسن نتأكد من مراقبته وهو في بيته (مثلًا جهاز يشوف إذا المريض طاح ولا لا)

- **ehealth:** 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. جميع التطبيقات التي تقدم رعاية صحية (مثلًا تطبيقات تعطي معلومات عن: نبض القلب، تواصل مع المستشفى، معلومات المرضى...الخ). It comprehensive to all types of healthcare and healthcare professionals

- **Evidence Based Medicine:** 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 findings. The advantage is that the practice can be kept up-to-date with published knowledge. evidence based medicine has 3 pillars: 1- use the latest information (up-to-date). 2- Clinical expertise: the investigation that I do. 3- the patient value (the patient less likely to get hurt). e.g. of EBM clinical trial.

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Terminology

- **Bioinformatics:** The collection, organization, and analysis of large amounts of biological data, **using computers** and databases[1]. 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 disciplines. basically bioinformatics focusing on using informatics on the molecular level e.g. using computer science for genetic research. Bioinformatics is facing challenge to train professional staff

- أيش يعني mining؟ يعني process the data from large data so we se it to tar decision نجد علاقات تفسر الأمراض أو علاقات تفسر ليه هذا الدوا ما يشتغل، من الأمثلة على mining: مثلًا سابقًا كان علاج السرطان بلأشعة ما يشتغل على بعض المرضى، لمن سووا بحوث على الجينات لاقوا إن ذوو البشرة السمراء ما يستفيدون، معناته لمن استخدمنا bioinformatics (بحث على مستوى الجينات) حلينا مشكلة!

- **Biomedical Informatics:** computer & information science biology medicine

Biomedical Informatics

From the book

- **Clinical informatics (medical informatics):** applied research and practice topics that focus on disease and the role of physicians and demands patient-oriented informatics application
- **Public Health Informatics:** similar methods of medical information are generalized for application to populations of patients rather than to single individuals يعني نسوي بحث يفيد المرضى والمعالجين لكن على مستوى كبير جدًا وليس على مستوى شخص واحد أو منظمة واحدة
- **Imaging (structural) Informatics:** the set of issues developed around both radiology and other image management and image analysis domains such as pathology, dermatology
- **Biomolecular Imaging:** involves both bioinformatics and imaging informatics concepts
- **Consumer Health Informatics:** includes elements of both clinical informatics and public-health informatics
- **Pharmacogenomics:** the effort to infer genetic determinants of human drug response which requires the analysis of linked **genotypic** and **phenotypic** databases, so it is the intersection of bioinformatics and clinical informatics

[1] Another definitions is "the use of computers by necessity to enable any study in any field of the life science

Application of Medical Informatics

- **Electronic Medical Record:** 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.

❖ **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. يتقدم علم الطب بمعدل سريع لدرجة أن الكثير مما يتم تدريسه يصبح عتيقًا ، وقد أصبح إلزامياً على الأطباء أن يكونوا متعلمين مدى الحياة ، وذلك من أجل إرضائهم الذاتي ، وبشكل متزايد ، كمطلب حكومي رسمي للحفاظ على الترخيص
- 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.

- **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.

- **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. من الأمثلة عليها اللاب توبات الموجودة على العربات الموجودة في كل جناح، تكون الممرضة تكتب اسم الدوا وطريقة إعطاء الدوا والجرعة الصح فالدكتور يستخدم الدوا الصح بالطريقة الصح والجرعة الصح

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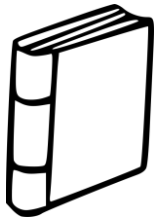
Terminology



Chapter: 1

- **Medical computer science:** refer to the subdivision of computer science that applies the methods of the larger field to medical topics
- **Information science** (occasionally used in conjunction with computer science): originated in the field of library science and is used to refer to management of both paper-based and electronically stored information. It's now drawing evolving interest under the name cognitive science. It is now under the name **cognitive science**
- **Biomedical computing** or **biocomputation:** implying only that computers are employed for some purpose in biology or medicine. it includes such topics as (medical statistics, record keeping, and the study of the nature of medical information itself).

❖ Biomedical informatics

- Early people were using the terms (**medical computing** + **medical information science**) but these terms confused with library science so they changed them into **medical informatics**, but this term seem to be more clinically so they changed it into **health informatics**, but this term exclude the biology research so they changed into **biomedical informatics**
- **So it is (medical computing + medical information science → medical informatics → health informatics → biomedical informatics)** ☹ عارفه إنها خرابيط وتحوس بس محطوطة بالكتاب بالغامق فأخاف تكون مهمة وتجي بالإختبار

❖ History

- The first practical application of automatic computing relevant to medicine was by punched-card data-processing system in epidemiologic and public health surveys هنا يقول أول كان فيه نظام بالكمبيوتر يكون فيه صفحة مليانه مربعات، واحنا نظلل المربع أو نتركه فاضي، هذا النظام كانوا يستخدمونه عشان بحوث الإبيدميولوجي بالطب (يسوون استبيان مثلًا عن عدد المصابين بمرض ما ويستخدمون هذا النظام عشان يحللون النتائج فبالتالي يعرفون المرض منتشر أكثر عند مين)
- One early activity in biomedical computing was the attempt to construct systems that would assist a physician in decision making, the other activity was a total **hospital information system** (system that concern just on the hospital information)

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Terminology (from the book)

- **Biomedical engineering:** The department that tend to be research on, and development of instrumentation advanced monitoring systems, specialized for clinical or laboratory use, and image-enhancement techniques for use in radiology, with an orientation toward the development of medical devices, **prostheses**.
- **Artificial Intelligence (AI):** the application of computer science to high-level, real-world problems.

Why Medical Informatics for Healthcare?

1. Improve Healthcare quality
2. Better data access
3. Faster data retrieval and storage عشان ما يصير فيه ضياع لمعلومات المرضى
4. High quality data مب مثل ملفات المرضى الورقية اللي صعب نقراها
5. Support medical and non-medical decision-making
6. Enhance quality assurance أقدر أشوف أيش قاعدين يسوون حاليًا للمريض
7. Enhance out-come researches and studying programs
8. Provide unified access to all existing data
9. Eliminate and reduce errors
10. Increase healthcare organization efficiency
11. Reducing cost and achieves quality of healthcare
12. Reduce duplication of efforts (if I am doing research to the patient I should not do radiology, labs…etc. again, I already have it bc it is electronically available)
13. Improve staff productivity
14. Sharing medical data مفيدة جدًا في البحوث بحيث أقدر أرجع لمعلومات المرضى لو سويت بحوث عليهم
15. Reduce redundant tests, services and information entry
16. Manage billing and payment system

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Health Informatics الدكتور قال مهم جدًا هذا السلايد

Education	Research	Administration	Clinical	Additional	Telecommunication
• E-learning[1] • Online education • Distance learning (digital library) • CME • Evidence based medicine[2] • Problem based medicine	• Medical standards • Database[3] • Data mining • DSS • Statistical Analysis • Modeling[4]	• PMI[5] • PM • FM	• Scheduling • Research • Electronic medical record • Computerized physician order entry	• PACS (Picture Archiving and Communication System) • ICU • Labs • Pharmacy • Nursing	

- Research + Clinical = Evidence Based Medicine
- Research + Administration + Clinical + Additional = HIS (Hospital Information System)
- Clinical + Telecommunication = Telemedicine
- Clinical + Telecommunication + Additional[6] = Telehealth

[1] مثل قسم stimulation center الموجود في medical education

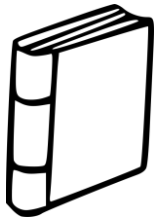
[2] ليش نحطه في التعليم؟ لأن لمن نصير ندور على المعلومات المبنية على البراهين عشان نعالج، هذا نوع من أنواع التعليم

[3] إننا نستخدم databases التي تحتوي على معلومات المريض مسبقًا من أجل البحث

[4] مثال عليها في تجربة سووها بحيث جهاز يقرا الصور الإشعاعية للثدي وتحاليل المختبر ثم يشخص إذا فيه سرطان أو لا مقارنة بتشخيص طبيب استشاري ولمن انتهت التجربة لاقوا إن الجهاز دقة تشخيصه ١٠٠٪ عكس الاستشاري اللي كانت ٧٠٪ مما يعني إن تطبيق informatics مفيد جدًا للمرضى

[5] Patient Master Index (the main information of the patient should be written once e.g. name, date of birth, gender, vaccination, allergy…etc.) it concern with registration, out and in patient

[6] more than one specialty (e.g. doctors + nurses + pharmacists…etc.) so health information can be applied to different areas such as nursing, dentistry, pharmacy, biology



Chapter: 1

Integrated Access to Clinical Information: The Future Is Now

- Encouraged by health information technology (HIT) vendors, most healthcare institutions are seeking to develop integrated computer-based information-management environments.
- These 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) but also administrative and financial topics (e.g., tracking of patients within the hospital, managing materials and inventory), research (e.g., analyzing the outcomes associated with treatments and procedures, supporting clinical trials, and implementing various treatment protocols), scholarly information (e.g., accessing digital libraries, supporting bibliographic search, and providing access to drug information databases), and even office automation (e.g., providing access to spreadsheets and document-management soft- ware).
- Another theme in the changing world of health care is the increasing investment in the creation of **standard order sets**, **clinical guidelines**, and **clinical pathways** to recurring management problems. Several government and professional as well as individual provider groups often putting an emphasis on using clear evidence from the literature creating such **evidence-based guidelines**

The importance of Electronic Health Record (EHR)

- One argument that warrants emphasis is the importance of the EHR in supporting **clinical trials** which is experiments in which data from specific patient interactions are pooled and analyzed in order to learn about the safety and efficacy of new treatments or tests and to gain insight into disease processes that are not otherwise well understood

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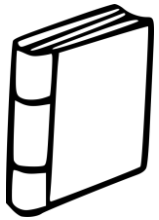

Chapter: 1

Communications Technology and Health Data Integration

- The **Internet** began in 1968 as a U.S. military research in Advanced Research Projects Agency (ARPA). **Internet** was known as the **ARPANET.** The challenge facing widespred use of internet as health information resource by general public was language barries
- Novel mechanism for allowing a defense computers, to share data files with each other and to provide remote access which is now known as **backbone network**
- Value for non-military research recognized, and by 1973 the first medically related research computer had been added. Today, the Internet is ubiquitous, accessible
- The explosive growth of the Internet did not occur until the late 1990s, when the World Wide Web which triggered the growth of medical information that is freely available. It was introduced and popularized, Why? Navigating the Web is highly intuitive requires no special training provides a mechanism for access to multimedia information that accounts for its remarkable growth as a worldwide phenomenon.

The Goal: A Learning Health Care System

- straightforward use of electronic health records for direct patient care (writing notes, asking for investigations…etc.) does not meet some of the requirements, we can use the information on research or community-based clinical trials to develop standards for prevention and treatment, with major guidance from biomedical research.
- **learning health care system:** the notion of a system that allows us to learn from what we do, unlocking the experience that has traditionally been stored in unusable form in paper charts, we can envision an interconnected community of clinicians and institutions, building digital data resources using electronic health records. يعني باختصار إننا نقدر نستخدم السجلات الإلكترونية في بناء أنظمة ومعلومات جديدة، بدل ما كنا نستخدمها بس من أجل معلومات المريض. أضرب لكم مثال جيت شفت سجلات المرضى كبار السن اللي يصير لهم كسر بالحوض ولاحظت نسبة كبيرة منهم تطيح بالمستشفى لأن بالأسياب أو بدورات المياه ما فيه حدائد يتمسكون فيها بالتالي أطلع نظام إنه لازم تتوفر هذي الحدائد

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Questions

1. A regulation that makes the physicians to move towards using EMR for the purpose of secure medical billing and patient privacy:

A. MYCIN B. INTERNEST-I C. HIPPA D. WHO

Answer: C

2. A research find out that there is an association between the gene EGFR and lung cancer. What type of informatics has been applied here?

A. Bioinformatics B. Nursing informatics C. Continues medical education D. E-health

Answer: A

3. A 56 years old male came to KKUH from Abha because of uncontrolled hypertension, after giving him the medications the doctor gave him a device that measures his BP and whenever it rises to very high level it automatically calls 911, what type of informatics application for this gentlman?

A. ehealth B. telecommunication C. tele-health D. biomedical informatics

Answer: C

4. the intersection of bioinformatics and clinical informatics to infer genetic determinants of human drug response which requires the analysis of linked genotypic and phenotypic databases:

A. Medical informatics B. Pharmacogenomics C. Biomolecular Imaging D.telemedicine

Answer: B

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