MEDICAL INFORMATICS

Lecture (1)

Artificial intelligence in medicine

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Green: for the team's notes

Red: for the important notes

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Definition:

Artifical Intelligence (AI): Application of computers to areas normally regarded as requiring human intelligence. Also, devices and applications that exhibit human intelligence and behavior.

Historical definition:

in 1984, Clancey and Shortliffe provided the following definition:
'Medical artificial intelligence is primarily concerned with the construction of AI programs that perform diagnosis and make therapy recommendations.
Unlike medical applications based on other programming methods, such as purely statistical and probabilistic methods, medical AI programs are based on symbolic models of disease entities and their relationship to patient factors and clinical manifestations.'

Artificial intelligence (AI) branches :

There are several branches of AI systems. One of the most important branches is called expert system.

Expert system: a computer system that emulates the decision-making ability of a human expert.

History of the Artificial intelligence: (No need to memorize it)

Work originated out of a number of campuses, including MIT-Tufts, Pittsburgh, Stanford and Rutgers (e.g. Szolovits, 1982; Clancey and Shortliffe, 1984; Miller, 1988).

Role of AIM:

*An AI system could be running within an electronic medical record system, for example, and alert a clinician when it detects a contraindication to aplanned treatment.

*It could also alert the clinician when it detected patterns in clinical data that suggested significant changes in a patient's condition.

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Examples of the artificial intelligence applications that can be beneficial to the health workers:

Voice recognition applications: For example: the treating physician can enter the notes regarding patient presentation without writing, and this will permit saving time.

Generating alerts and reminders. In so-called real-time Situations, an expert system attached to a monitor can warn of changes in a patient's condition. In less acute circumstances, it might scan laboratory test results or drug orders and send reminders or warnings through an e-mail system.

* ***Diagnostic assistance***. When a patient's case is complex, rare or the person making the diagnosis is simply inexperienced, an expert system can help come up with likely diagnoses based on patient data.

-For example : you enter the patient presenting complain like "cough" and you enter the weight of the patient , according to that it would suggest relevant hypothesis like T.B

* ***Therapy critiquing and planning***. Systems can either look for Inconsistencies, errors and omissions in an existing treatment plan, or can be used to formulate a treatment based upon a patient's specific condition and accepted treatment guidelines

Agents for information retrieval. Software 'agents' can be sent to search for and retrieve information, for example on the Internet that is considered relevant to a particular problem. The agent contains knowledge about its user's preferences and needs, and may also need to have medical knowledge to be able to assess the importance and utility of what it finds.

For examples : In case of diabetes mellitus, if we are interested to search for the factors related to the disease either genetic or environmental , we can easily go through all diabetic patients records if they were digitalized and established in a database of diabetes mellitus .

* ***Image recognition and interpretation***. Many medical images can now be automatically interpreted, from plane X-rays through to more complex images like angiograms, CT and MRI scans. This is of value in mass screenings, for example, when the system can flag potentially abnormal images for detailed human attention.

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Table 4
Comparison of Artificial Intelligence Techniques

Type	Knowledge Representation	Unsupervised (learns from data without teacher)	Robust (can handle unforeseen data)	Adaptive (can learn new data)	Rational (can explain reasoning)
Rule-based reasoning	Production (if-then) rules	No	No	No	YES
Artificial neural network	Graphic	YES	No	YES	No
Hypertext	Textual documents with links	No	No	No	No
Bayesian network	Graphic	No	No	No	YES
CBR	Cases and indexes	No	YES	YES	YES

(From this table, all what you need to know is that artificial neural network is the most accurate one)

Note: CBR: stands for" case based recognition"
For example: you give a chest x-ray of pneumonia to the program and then you describe the abnormality, Also you give other images of tumors and other cases. Once you've made a huge data base m it would be easy to analyze similar images and cases in the future.

-Example of the AIM: artificial neural network

Definition: is a mathematical model inspired by biological neural networks. A neural network consists of an interconnected group of artificial neurons, and it processes information using a connectionist approach to computation

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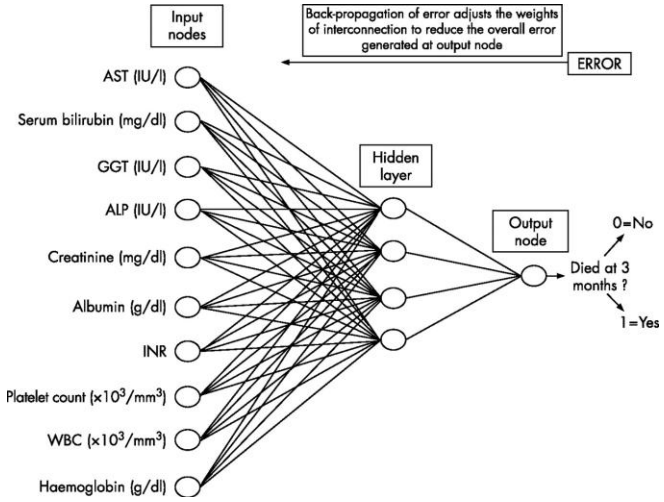

Explanation:

For example: we take the LAB results of the liver function test of normal people and we label this group as normal

Then we take the lab results of abnormal liver function test of patients with pancreatic cancer who are propably dead and we lable them as diseased.
Once we have collected all the data , the system will integrate the information and make a model with hidden layer and then it will be stored in the system.
For any future case, once you enter the data the system will calculate the probability of having pancreatic cancer.

Benefits of AI:
1- it promotes saving time
2- reducing medical errors
But remember, they can't replace the physcians

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Items which are necessary to build a successful decision support system:

Table 5
Recipe for Success: Building a Successful Decision Support System

Ingredient	Instructions for Preparation
Availability	Make the system readily available at workstations in clinics, inpatient wards, intensive care units, laboratories, and radiology departments, preferably by means of a central computer system or network. (Many excellent programs are on isolated computers in a laboratory or office and are infrequently used)
Ease of use	Make the user interface uniform, intuitive, and fast. Physicians have many demands on their time and will not tolerate a system that requires a large amount of data entry or that responds after long pauses
Integration	Embed the system within the physician's usual clinical functions. A system that helps interpret mammograms should be part of the reporting process
Collaboration	Assist and support the physician's decision-making process; do not usurp it. Let the computer present information; let the physician integrate it into a decision
Accuracy and consistency	Test the system rigorously. Validate the system's knowledge and evaluate its performance and acceptability
Awareness of limits	As with people, problems can occur at the boundary between knowledge and ignorance. The system should know the limits of its knowledge and inform the physician accordingly
Good medicine	Solve important problems. The system should demonstrably and significantly improve the quality and cost-effectiveness of medical care, and ultimately improve the health of patients

Why AI is not commonly used in practice?

l- **Lack of EMR (Electronic Medical Record**)
2- Poor user interface
3- Change needs time
4- Technophobia or computer illiteracy of healthcare workers.

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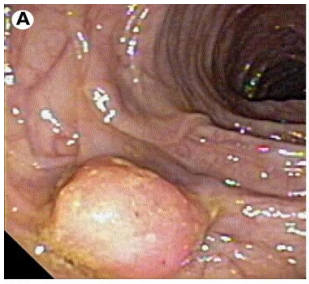

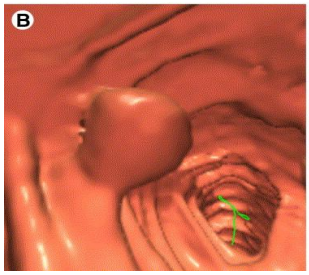

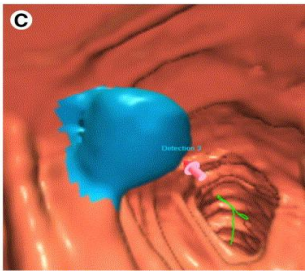

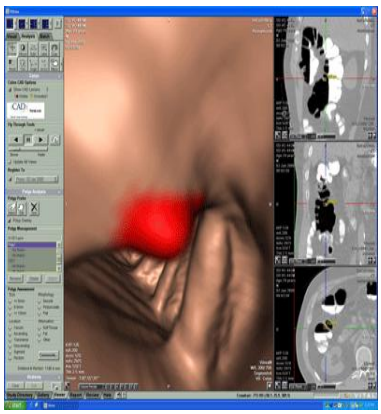

These images show masses in the colon using colonoscopy and C.T, you can pick from the system some choices like the size of the mass that you want to detect, and you can ask the system to the highlight the abnormality for you.

Good luck ☺