Management Article

Medical Informatics

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Introduction

Medical Informatics has been emerging as a discipline in its own right over the past quarter century. It deals with the storage, retrieval, sharing and optimal use of biomedical information, data and knowledge for problem solving and decision-making. It touches on all basic and applied fields in biomedical science and is closely tied to modern information technologies, notably in the area of computer and communication.

The domain of medical informatics is determined by the intersection of the terms medicine and informatics. The first term indicates the area of research; the second one indicates its methodology. 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.

Medical Informatics

Medical informatics has been the first science that connects all traditional medical disciplines. It cuts across all fields of medicine through different basic and applied concepts. Some of the basic sciences in medical informatics include: computer science, information science, cognitive science, and decision sciences. Others would fall under the applied science category such as: software and computer engineering, clinical epidemiology, and bioengineering. Medical Informatics ranges from

- Hospital Information Systems
- Decision Support System
- Electronic Patient Records
- Bio Informatics
- Medical Imaging
- Telemedicine

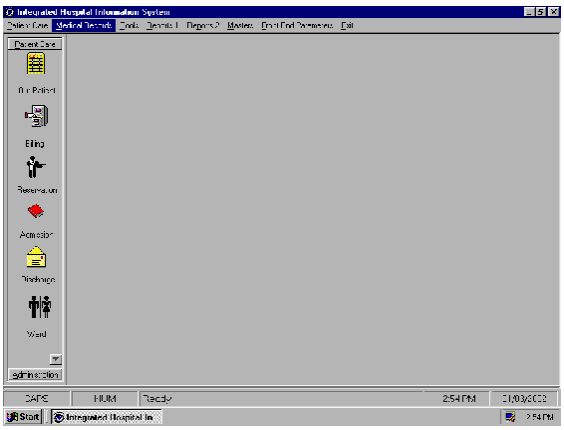
Hospital Information System

Hospital information system is intended to support the acquisition, storage, manipulation, and distribution of information throughout the organization. Basically it covers the following areas, The derived benefits of

Clinical	Administration
- Outpatient Registration	HRD
- Reservation, Admission, Discharges	Inventory Control
- Surgery Scheduling	Financial Accounting
- Patient Care	Cost Accounting
- Pharmacy	
- Medical Records Index	
- Patient billing and accounting	
- Diet Planning	

the HIS includes

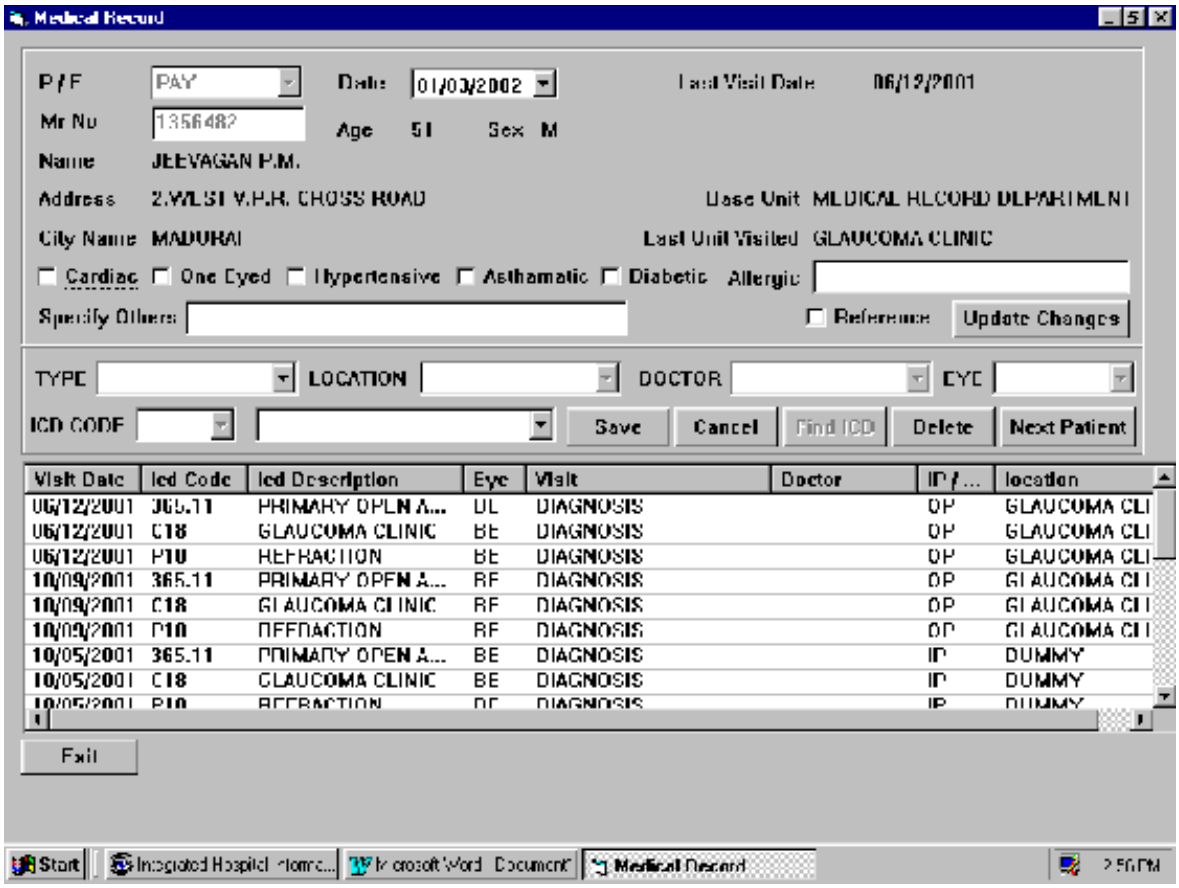
- Reduction in clerical work
- Fast information retrieval
- Centralized patient care data
- Improved accountability and accuracy of information
- Cost efficient



Electronic Patient Record Systems

Electronic Patient Records have to some extent been used in medicine for many years. It is designed to potentially improve the capture and integration of patient information from diverse sources and thereby improve the effectiveness and efficiency of patient care. It provides

- Access to lifetime patient information (data, text, image, voice and motion-video)
- Support for clinical decision making.
- Flexible design and tailored reporting capabilities.
- Protection of patient and provider confidentiality.
- Defined vocabulary and standardized coding.
- Documentation as a by-product of patient care.
- Connectivity with other local and remote systems and
- Electronic support for secondary users (eg. Payers, policymakers, researchers) Benefits of EPR will be:
- Increased quality of patient care



Electronic Patient Record Systems

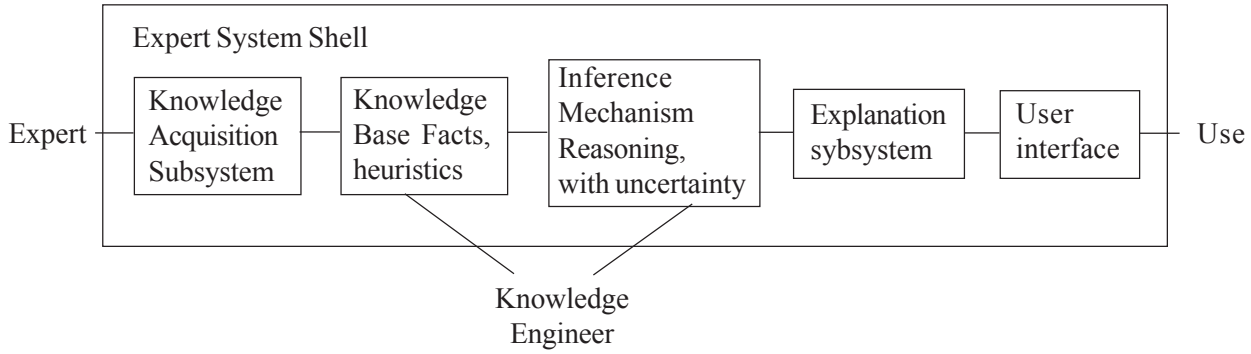
- Reduction in paperwork
- Improved work flow process
- Immediate access to real time information
- Higher quality of documentation

Expert System

An expert system tool, or shell, is a software development environment containing the basic components of expert systems.

1. Knowledge base

A store of factual and heuristic knowledge. An ES tool provides one or more knowledge representation schemes for expressing knowledge about the application domain. Some tools use both frames (objects) and IF-THEN rules. In PROLOG the knowledge is represented as logical statements.



2. Reasoning engine

Inference mechanisms for manipulating the symbolic information and knowledge in the knowledge base to form a line of reasoning in solving a problem. The inference mechanism can range from simple *modus ponens* backward chaining of IF-THEN rules to case-based reasoning.

3. Knowledge acquisition subsystem

A subsystem to help experts build knowledge bases. Collecting knowledge needed to solve problems and build the knowledge base continues to be the biggest bottleneck in building expert systems.

4. Explanation subsystem

A subsystem that explains the system's actions. The explanation can range from how the final or intermediate solutions were arrived at to justifying the need for additional data.

5. User interface

The means of communication with the user. The user interface is generally not a part of the ES technology, and was not given much attention in the past. However, it is now widely accepted that the user interface can make a critical difference in the perceived utility of a system regardless of the system's performance.

Artificial Intelligence

The field of artificial intelligence attempts to understand intelligent entities of human beings. AI addresses one of the ultimate puzzles. How is it possible for a slow, tiny brain whether biological or electronic to perceive, understand, predict and manipulate a world far larger and more complicated than itself? How do we go about making something with those properties? These are hard questions, but unlike the search for faster than light travel or an antigravity device, the researcher in AI has solid evidence that the question is possible.

The four possible goals to pursue in artificial intelligence:

- Systems that think like humans
- Systems that think rationally
- Systems that act like humans
- Systems that act rationally

Historically all four approaches have bee followed. As one might expect, a tension exists between approaches centered around humans and approaches centered around rationality. A human centered approach must be an empirical science, involving hypothesis and experimental confirmation. A rationalist approach involves a combination of mathematics and engineering.

Robots

Robots, a man made machine that can perform work or other actions normally performed by humans. Most robots today are used in factories to build products such as cars and electronics. Others are used to explore underwater and even on other planets. Robots have three main components

- Brain - usually a computer.
- Actuators and mechanical parts - motors, pistons, grippers, wheels, gears.
- Sensors - vision, sound, temperature, motion, light, touch,etc.With these three components, robots can interact and affect their environment to become useful.

Some Expert Systems Used In Medicine Area

Some ES's used in medicine and their qualities have been classified. Let us have a look at some of these ES's [4-14].

MYSIN is used during the diagnosing and treatment periods of the infectious diseases. This system is very helpful for the physicians lacking of expertise at these diseases. For instance, when there is a need to treat a patient, who has already had an operation for the infection urgently, this system works. When compared with a specialist, MYSIN is more successful for the treatment of some diseases (such as bacterium and meningitis). The knowledge needed for the system has been devised based on rules and written in LISP.

CASNET (Causal Assosiational NET work) system has been mainly developed for diagnosing glaucoma eye disease. In this system, the disease is not regarded as a static condition but as a dynamic process; and this system can model this process in the way of cause-result form of physiological conditions. This system can also be used for other eye disorders. Ophtalmologs have established that the system is very close to the performance of a specialist.

Internist system (1970) has been designed for the diagnosing of the internal diseases. The clinical look of the disease, the results of lab analysis and the history of the disease etc. are inserted into the system. The system can define the probable diagnosis, depending on these data, and later it can pick out the most probable one for the disease.

Medical Imaging

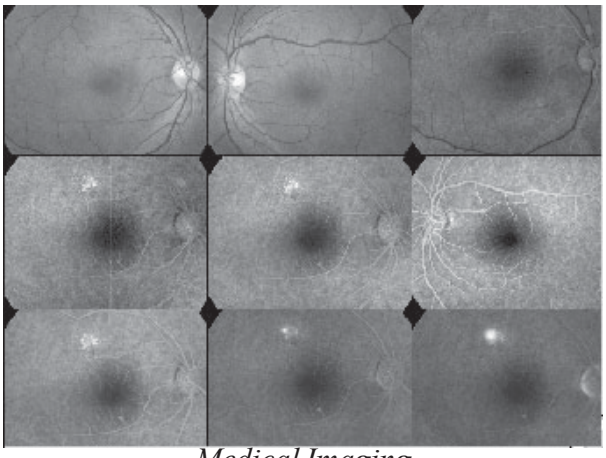
In the past decade notable advances and new approaches in medical imaging have resulted from new concepts and developments in computer science and applied mathematics. Today the computer-assisted images are generated in digital subtraction radiology, ultrasonography, x-ray computed tomography (CT), emission computed tomography with single photon (SPECT) or positron (PET) and nuclear magnetic resonance (NMR), fluoroscopy.

Virtual Reality

Virtual reality is one of the hottest research and development areas in the computer industry today. Its potential applications range from medical imaging and interior design to intercontinental video conferencing and the exploration of future worlds. Virtual reality systems use computers to create simulated environments that can be entered and interacted with by using special equipment such as goggles and data gloves. One of the most time consuming tasks in a VR system is the generation of the images. Purposes will be,

- To improve health care in clinical settings and in patient homes
- To facilitate new discoveries and the interpretation of complex data being generated in the basic biomedical sciences, with an emphasis on molecular biology and genomics
- To enhance the quality of imaging modalities, plus the generation and use of virtual environments
- To improve the understanding of public health and the ways in which new knowledge can be derived from information regarding populations on patients

Note that a virtual environment can represent any three-dimensional world that is either real or abstract. This includes real systems like buildings, landscapes, underwater shipwrecks, spacecrafts, archaeological excavation sites, human anatomy, sculptures, crime scene reconstructions, solar systems, and so on. Of special interest is the visual and sensual representation of abstract systems like magnetic fields, turbulent flow structures, molecular



Medical Imaging

models, mathematical systems, auditorium acoustics, stock market behavior, population densities, information flows, and any other conceivable system including artistic and creative work of abstract nature. These virtual worlds can be animated, interactive, shared, and can expose behavior and functionality.

Bio-Informatics

Bio-Informatics is a new interdisciplinary science that studies and explores biological issues with the methods of informatics. Biology has become more and more complex in recent years. Huge amount of data has been published from environmental, genetic, or medical studies. Data, that is of great value if correctly joined and evaluated. Bio-Informatics has the means to store and evaluate these data. The areas the bio-Informatics will probably include:

- Visualization of biological systems
- Modeling of biological reactions and cellular regulation
- Design of regulatory networks
- Gene function analysis
- Data mining and statistics
- Protein structural analysis, modelling, and design
- Bioinformatical algorithms
- Modelling of evolutionary processes
- Modelling of ecological processes
- Neuro science and neuro informatics
- Processoral engeneering
- Programming synthesis and screening robots
- Programming bio computers and bio chips

Artificial Neural Networks

Artificial Neural networks are collections of mathematical models that emulate some of the observed properties of biological nervous systems and draw on the analogies of adaptive biological learning. The key element of the Artificial Neural Network paradigm is the novel structure of the information processing system. It is composed of a large number of highly interconnected processing elements that are analogous to neurons and are tied together with weighted connections that are analogous to synapses.

Telemedicine

Telemedicine is the use of medical information exchanged from one site to another via electronic communications for the health and education of the patient or healthcare provider and for the purpose of improving patient care. This exchange is based on still pictures, video, text and voice. Images from a video or still camera with voice are captured by a computer sent across to a computer in a distant location over phone lines or satellite. The computer at the distant location reproduces the images, video, sound and text on the monitor. Such images can be x-rays, flourescein pictures, angiogram, video of movements etc. An expert at the remote location is then able to discuss the case and offer suggestions in diagnosis and management. Telemedicine offers many benefits including,

- Improved access to healthcare
- Improved continuity of care, patient education and timely treatment
- Improved access to medical records and information
- Improved delivery of health care by bringing the wider range of services such as radiology, mental health services and dermatology to underserved communities and individuals in urban and rural areas
- Improved cost control by helping to avoid unnecessary patient trips and allocation of resources to outlying areas.