Medical Informatics

*Definition (Wikipedia)*

Health informatics or medical informatics is the intersection of information science, computer science, and health care. It deals with the resources, devices, and methods required to optimize the acquisition, storage, retrieval, and use of information in health and biomedicine. Health informatics tools include not only computers but also clinical guidelines, formal medical terminologies, and information and communication systems.

I.e. IT in medicine and health care!
e-health

• **Wikipedia: eHealth** (also written e-health) is a relatively recent term for healthcare practice supported by electronic processes and communication. Usage of the term varies: some would argue it is interchangeable with health informatics with a broad definition covering electronic/digital processes in health while others use it in the narrower sense of healthcare practice using the Internet.

• **Last year:** e-health is an emerging field in the intersection of medical informatics, public health and business, referring to health services and information delivered or enhanced through the Internet and related technologies. In a broader sense, the term characterizes not only a technical development, but also a state-of-mind, a way of thinking, an attitude, and a commitment for networked, global thinking, to improve health care locally, regionally, and worldwide by using information and communication technology.
HIS

• A hospital information system (HIS), is a comprehensive, integrated information system designed to manage the administrative, financial and clinical aspects of a hospital. This encompasses paper-based information processing as well as data processing systems.

• A hospital information systems (HIS) is a computer system that is designed to manage all the hospital’s medical and administrative information in order to enable health professional perform their jobs effectively and efficiently. Hospital information systems were first developed in the 1960s and have been an essential part in hospital information management and administration. Early systems consisted of large central computers connected to by dumb terminals, which are now replaced by networked computers.
Usability is important!

• What could e.g. happen if the design of an electronic medical record system results in very slow work and difficulties to find important information, or in safety problems?
Medical terminology

See e.g.:

• [en.wikipedia.org/wiki/Medical_dictionary](en.wikipedia.org/wiki/Medical_dictionary)

• It is important to speak (or at least understand) the language of the h.c. professionals (users).
• Otherwise:
  – we will not understand what they mean
  – they will not be able to explain what is important
  – they do not believe in us!
Terminology

• Terminology related to medicine
• Terminology related to health care organisation and activities
Medical terminology, e.g.

- **Akut** (acute) plötsligt uppträdande, häftigt förlopp
- **Benign/malignant** godartad/elakartad, not threatening/threatening
- **Diagnos (diagnosis)**
- **Anamnes (anamnesis)** sjukdomshistoria, patient history
- **Epikris (epicrisis)** sammanfattande bedömning av sjukdoms- och behandlingsförloppet "läkarbrev", t.ex. efter utskrivning ur sjukhuset, summary of episode
- **in vitro - e.g. in test tube** (undersökning) i provrör, t.ex. undersökning av blod eller annan lab-prov
- **in vivo** – on living patient (undersökning) på levande patient, t.ex. röntgen
- **Kronisk (cronical)** långsamt utvecklande, långsamt stationärt förlopp, stationary condition
- **Metastaser (metastasis)** dottertumörer, secondary tumor
• **palliative** - Palliative Care
• **remiss** - remission
• **symptom** sjukdomstecken
  – objective symptoms, mätbara symptom
  – subjective symptoms, symptom som patienten själv upplever
• **psychosomatic** symptoms fysiska symtom som har psykisk orsak
• **syndrome** symtomkomplex, flera sammanhörande sjukdomstecken som pekar på en viss sjukdom
• **terapi (therapy)** behandling
• **trauma** (traumatic, damage through accidents, violence etc.) skador, som uppstår vid ett skadetillfälle, t.ex. vid olycksfall
Health care terminology, e.g.

- primärvård – primary care
- sluten vård – hospital care (in-patients)
- öppen vård – out-patient care
- vårdcentral primärvårdsenhet – primary care unit
- (vård)episod – episode (all contacts for a specific health problem)
- hemtjänst – home care
- vårdgivare – care giver (deliverer)
- vårdplan – care plan
- vårdprogram – medical program
- vårdtillfälle – care encounter
- inskrivning - patient enrollment
- delegering - delegation
- konsultation - consultation
- rapportblad hemtjänstens anteckningar – care notes
- patientjournal – patient records
- läkemedelsbiverkning – adverse drug reactions
- läkemedelslista – drug/prescription list
- Lex Maria – law about reporting incidents and errors
- MAS = medicinskt ansvarig sjuksköterska (medical responsible nurse)
- OAS = omvårdnadsansvarig sjuksköterska (care responsible nurse)
Standards

SNOMED-CT
Systematized Nomenclature of Medicine – Clinical Terms

- Snomed CT contains codes for about 360 000 concepts within the health and welfare services, e.g. for detailed description of diseases and body functions, laboratory investigations, procedures and interventions. By giving a Snomed CT code for a specific key word in the health care records, all electronic health care record systems, both national and international, can thereby understand the concepts referred to. From a long-term perspective, there are great expectations regarding Snomed CT’s importance for the health and welfare services’ computerised documentation systems.
• Snomed CT
• SNOB - A SNOMED Browser
Medical informatics
A short overview

• History – related to IT
• First applications in the late 1950-ies.
• First application in Uppsala 1960 (clinical lab – data processing)
• Rapid development in more technical areas
• Rapid development in administrative areas
• Slow development in clinical support systems (medical record, decision support..), but now rapidly increasing (since 2000)
• Newest trend: Patient empowerment
Application areas, e.g.

• Clinical information systems (e.g. patient medical records, laboratory data)
• Image and signal processing
• Modelling and simulation
• Knowledge representation and decision support systems
• Statistics and epidemiology
• Telemedicine/eHealth network services
• Virtual reality
Models and Simulation

• The use of mathematics and computer modelling for describing and analysing medical systems

• The use of simulators in education and training
Simulators in training

- http://www.simulatorcentrum.se/home/ and http://www.camst.se/
- The Center for Advanced Medical Simulation offers systematic training of technical and non-technical skills in high fidelity simulators for students and health care staff. This improves patient safety and decreases the risk of medical mistakes.
  - * Human Patient Simulator (HPS)
  - * Sim Man
  - * MIST (Minimal invasive surgical trainer)
  - * ProMIS (Hybridsimulator with 3D tracking system)
  - * VIST (Vascular intervention system training)
  - Simulators for surgical and gynecological laparoscopy
  - Simulators for endoluminal intervention
    - * GI Mentor (gastroscopy including ERCP, colonoscopy)
    - * Uro Mentor (endourology)
    - * AccuTouch (gastroskopy including ERCP, colonoscopy, bronchoscopy)
Modelling in medicine

• Modelling for understanding medical processes, e.g. diseases
• Modelling and simulation for supporting the care processes.
  – Intensive care (fluid balance etc)
  – Dose planning in radiotherapy (calculate optimal radiation, control treatment)
Decision support systems

• Knowledge based systems
• Expert systems
• To represent expert knowledge to support decision-making in clinical situations
• Applications e.g. in:
  – Diagnosis and therapy
  – Analysis of large data sets
  – Interpretation of signals e.g. ECG, X-ray...
  – Automatic analysis of images
“Expert systems”

• The dilemma of expert systems......
• “You need to be an expert in order to use the expert system correctly – and if you are, then you don’t need the system”
Epidemiology

• Studies of health and diseases in large populations
• Analysis of relations between risks and diseases
• Need for statistical methods
  – E.g. “screening” a population for diseases, breast cancer.
• “Non intuitive results”
  – E.g. most positive findings are “false positive”, requires more advanced investigations that can cause problems for the patient (many healthy patients will be harmed by the procedure as such...)
Telemedicine/eHealth

- Tele-diagnostics
- Tele-monitoring
- Tele Home care
- Tele-surgery
- Distance teaching
- Patients access to own data (medical records, lab data, book appointments...)
  - Problems???
Virtual reality

e.g. tele-surgery
Bioinformatics

- Bioinformatics is the application of information technology to the field of molecular biology. Bioinformatics entails the creation and advancement of databases, algorithms, computational and statistical techniques, and theory to solve formal and practical problems arising from the management and analysis of biological data. Over the past few decades rapid developments in genomic and other molecular research technologies combined developments in information technologies have combined to produce a tremendous amount of information related to molecular biology.
Biomedical modelling, e.g. cell kinetics
Understand the dynamics of the system

• Design of new experiments to verify hypotheses.
• Test of hypotheses concerning the dynamics of the system
Cell cycle model

- Cell is born
- G1 phase time
- S phase time
- G2 phase time
- M phase time
- Cell splits
- Two new cells are born
Example

Cells are killed, but the structure is restored again.

**Fig. 6** Crypt cell mass per villus as a function of time after injection of ara-C. With kind permission of N. Wright [17].