Patient-Centered Information Systems

TUG

Medical Informatics 1
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Patient-Centered Information Systems

• Primary Care
• Clinical Departmental Systems
• Clinical Support Systems
• Nursing Information Systems
Primary Care

• First-line health care (General Practitioners)
• Medical Software

Primary Care

• Primary care information systems: developments
  – Evidence-Based Medicine http://www.cochrane.de
  – E.g. http://www.healthgate.at
Clinical Departmental Systems

Computers in clinical departments

- Administrative support
- Patient data collection
- Decisions
- Monitoring
- Reporting
- Assessment
- Research
Internal Medicine

- Oncology
  - Oncology registration systems
- Nephrology
  - Monitoring dialysis
- Endocrinology
  - Diabetes
- Hematology
  - Hemophilia

Internal Medicine

- Endoscopy

- Organ Transplants
  - Eurotransplant (Leiden, NL); 3000 transplants per year
Cardiology

- Electrocardiography
- Coronary angiography
- Cardiac scintigraphy
- Echocardiography

Clinical Departmental Systems

- Neurology
- Pediatrics
- Obstetrics (and gynecology)
- Surgery
- Psychiatry

- Virtual reality, augmented reality
Clinical Departmental Systems

- Critical Care
  - Patient Data Management Systems
    - Data acquisition
    - Data reduction
    - Error checking
    - Information display
    - Decision support
    - Integration (also systems outside the ICU)
    - Ethical and legal aspects (auditing)
    - Research
    - Efficiency
Clinical Support Systems

Clinical Support Departments

- Radiology
- Physiological functional laboratory
- Pathology
- Clinical Chemistry
- Pharmacy
Radiology Information Systems

The main goal of RIS is to support both the medical and administrative functions of radiology.

Imaging Systems

- Subtraction Angiography
- Computed Tomography
- Magnetic Resonance Imaging

Overview of tasks in a radiology information system
Radiology Information Systems

- PACs
- Light box: better brightness
- DICOM

Function Laboratories

Examine the function of organs or organ systems (as a function of time)

- Heart (ECG, echocardiography, scintigraphy, angiography)
- Respiratory system (spiography)
- Nervous system (EEG, EMG)
- Visual control system (EOG)
- Auditory system (audiography)
Function Laboratories

Schematic diagram of systems operational in different function departments

Function Laboratories

Electrocardiography

Schematic diagram of modular ECG processing
Function Laboratories

Prior knowledge for ECG signal processing

- ECG is a quasiperiodic signal, but it may also contain stochastic components (atrial flutter, fibrillation, or ventricular fibrillation)
- It has one dominant waveform, but it may also contain multiform extrasystoles
- Frequency domain between 0.15 and 150 Hz
- Disturbances (loose electrodes, 50 or 60 Hz, pacemaker pulses, EMG)
- Amplitude range: -10 mV to +10 mV
- Different application areas (diagnostic, ambulatory monitoring, screening, intensive care, research)

Function Laboratories

Report of a computer processed ECG
Function Laboratories

Spirography

- Lung function measurements (flows, volumes, pressures)
- Respiratory gases (pCO₂, pO₂)

Function Laboratories

EEG

- Stochastic signal
- Frequency analysis (FT)
- Evoked potentials

Evoked potentials in seven EEG leads resulting from stimulation by light flashes.
Pathology Laboratory

- Diagnosis in the pathology laboratory
- The diagnostic process
- Potential sources of diagnostic errors
- The role of computers in pathology

Pathology Laboratory

Diagnosis in the pathology laboratory

- Postmortem
- Diagnosis from observations of tissue or separate cells taken from live patients
  - Paraffin slice (tissue: histology, cells: cytology)
  - Frozen tissue
Pathology Laboratory

The diagnostic process

• Focus on certain features (extensive training)
  – Selection of relevant features
  – Comparison with reference knowledge
  – Verbal expression
  – Diagnostic classification

Disagreement Figures in Pathology Diagnoses.
Pathology Laboratory

Potential sources of diagnostic errors

• Context (e.g. parathyroid tissue)
• Optical effects
• Random errors
• Systematic influences

Pathology Laboratory

The role of computers in pathology

• Education (electronic textbooks)
• Research
• Making observations objective (morphometry, cytometry)

- Number of mitoses
- Size and shape of nuclei
- Size and relative position of nucleoli
- Chromatin pattern
- DNA content and ploidy
- Nucleus/cytoplasm ratio
- Surface measurements
- Absorption of chemical markers

Examples of Parameters in Cytometry
Clinical Chemistry and Hematology

- Confirm a suspected diagnosis
- Monitor the effects of treatment
- Exclude or screen for the presence of disease
- Assess the prognosis once a diagnosis has been made

Schematic representation of subsystems operational in clinical chemistry
Clinical Chemistry and Hematology

Schematic representation of tasks performed by a laboratory information system during a test request cycle

- Request processing
- Sample processing
- The preanalytical phase
- The analytical process
- Reporting
- Management information
- Electronic reporting of clinical laboratory test results
Clinical Chemistry and Hematology

• Request processing
  – Mark-sense forms
• Sample preprocessing
  – Bar code

Clinical Chemistry and Hematology

• The preanalytical phase
• The analytical process

The process of first-line authorization in clinical chemistry
Clinical Chemistry and Hematology

- Reporting
- Management information
  - GLP
- Electronic reporting of clinical laboratory test results
  - Health Level 7 (HL-7) standard http://hl7.org
  - Euclides (European Clinical Laboratory Information Data Exchange Standard)
- LIMS (http://www.lims.de)

Hospital Pharmacy

Care-related activities

- Keeping records of medication of patients
- Checking prescriptions
- Provide information concerning prescription of drugs and administration

Logistic activities

- Purchasing drugs
- Keeping stock
- Manufacturing drugs
- Distributing drugs
Hospital Pharmacy

- Processes in hospital pharmacy
- Computer applications in the hospital pharmacy
  - Level 1: electronic communication
  - Level 2: supporting logistics (stocks etc ...)
  - Level 3: computation of drugs and optimal stock parameters
  - Level 5: pharmacokinetic models, knowledge base

Hospital Pharmacy

- Basic functionality

Schematic overview of a task in a hospital pharmacy system