INFORMATION SYSTEMS IN HEALTH CARE

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Lesson 7 – Winter Term 2014

Schedule

1. **Decision Support Systems**
2. **Medical Data Coding**
3. **OpenMRS**
4. **Conclusion**

Decision Support Systems

What are clinical decision rules?

- A clinical prediction rule or clinical decision rule, is a method that quantifies information from the history, examination, and basic laboratory results towards the diagnosis, prognosis and response to treatment in a specific patient.
- Benefits of clinical decision rules
  - increase the accuracy of clinicians' diagnostic and prognostic assessments.
  - reduce the uncertainty in decision making in medical practice.
- Types of clinical decision rules
  - drug-interaction checking
  - preventive care reminders
  - adverse drug event detection

Components of clinical decision rules

- Triggers
  - Events that cause a decision support rule to be invoked, e.g. prescribing a drug, ordering a laboratory test, entering a new problem on the problem list.
- Input data
  - Data elements used by a rule to make inferences, e.g. laboratory results, patient demographics, or patient's problem list
- Interventions:
  - Possible actions a decision support module can take, e.g. sending a message to a clinician, showing a guideline, logging that an event took place
- Offered choices
  - Choice that users of a clinical can make, e.g. a rule that fired because a physician entered an order for a drug the patient is allergic to might allow the clinician to cancel the new order, choose a safer alternative drug, or override the alert and keep the order as written but provide an explanation.

Example of clinical decision rules

- Monitoring patients for hypokalemia while they are taking digoxin
  - Triggers
    - A new potassium value is stored in the electronic health record.
    - The new potassium value is checked against a reference range (to determine whether the patient is hypo-, hyper-, or normokalemic)
    - If hypokalemia is detected, the medication list is checked to determine whether the patient was on digoxin. If so, the rule is triggered.
  - Input data
    - Potassium value from laboratory results
    - Reference range of potassium value
    - Patient's medication list
  - Interventions:
    - The decision support module sends a message to the responsible physician
  - Offered choices
    - Adding potassium supplementation
    - Reducing digoxin intake
    - Discontinuing digoxin intake

Computing techniques used in CDSS

- Rule-based (expert) systems
  - System where knowledge of human experts is captured in form of IF-THEN rules.
- Artificial neural networks
  - Non-knowledge-based adaptive systems that use machine learning to learn from experiences and recognize patterns in clinical information
- Bayesian networks
  - Knowledge-based systems that show probabilistic causal relationships between sets of variables, e.g. diseases and symptoms.
- Model based systems
  - Systems that uses individualized computational models of human pathophysiology to model the dynamics of a wide variety of tissues and organs.
- Data mining and machine learning
  - Systems that use a large database of existing cases in order to make probabilistic decisions, e.g. analyzing response of patients similar to current patient to decide upon the best treatment.
- Genetic algorithms
  - Non-knowledge-based systems that use iterative processes for finding an optimal solution based on patient data.

OpenEMR: Clinical Decision Rules

- http://demo.open-emr.org:2107/openemr/
- Components of a rule
  - Demographics filter criteria: specify to which patients the rule applies
  - Clinical targets: define the clinical value that triggers the rule
  - Actions: specify the desired outcome targeted by the rule
  - Reminder type: specifies where an alert pops-up when the rule is active
- Example
  - Search for a patient where the Tobacco Use Assessment rule is due
  - Enter patient‘s current tobacco life style
  - Verify that the Tobacco Cessation Intervention rule is now due
  - Enter the results of the intervention

Medical Data Coding

What is medical data coding

- Medical data coding is the administrative activity to analyze patients' medical records and translate the written documentation into universally accepted, industry-standard medical codes using a medical classification system.
- Codes are used for diagnosis, procedures, medication
- A medical classification system is a common language for describing medical data
  - Statistical classifications defines medical data using clinical concepts and categories
    - International Classification of Diseases (ICD-9)
  - Nomenclatures defines medical data using clinical concepts without categorization
    - Anatomical Therapeutic Chemical Classification System (ATC)

Methodology of medical data coding

- Purpose of medical data coding
  - submit claims to third party payer for reimbursement
  - gather statistical information
  - quality review
  - benchmarking measurement
- Steps in medical data coding
  - Abstraction: medical information is analyzed from various sources (clinical notes, laboratory results, radiology results, etc.)
  - Assignment: appropriate codes are assigned using a medical classification system
  - Review: check the assigned code against the medical documentation and the clinical setup

OpenEMR: ICD-9 Diagnosis

- http://smsos.fbmi.cvut.cz/openemr
  - Administration -> Codes

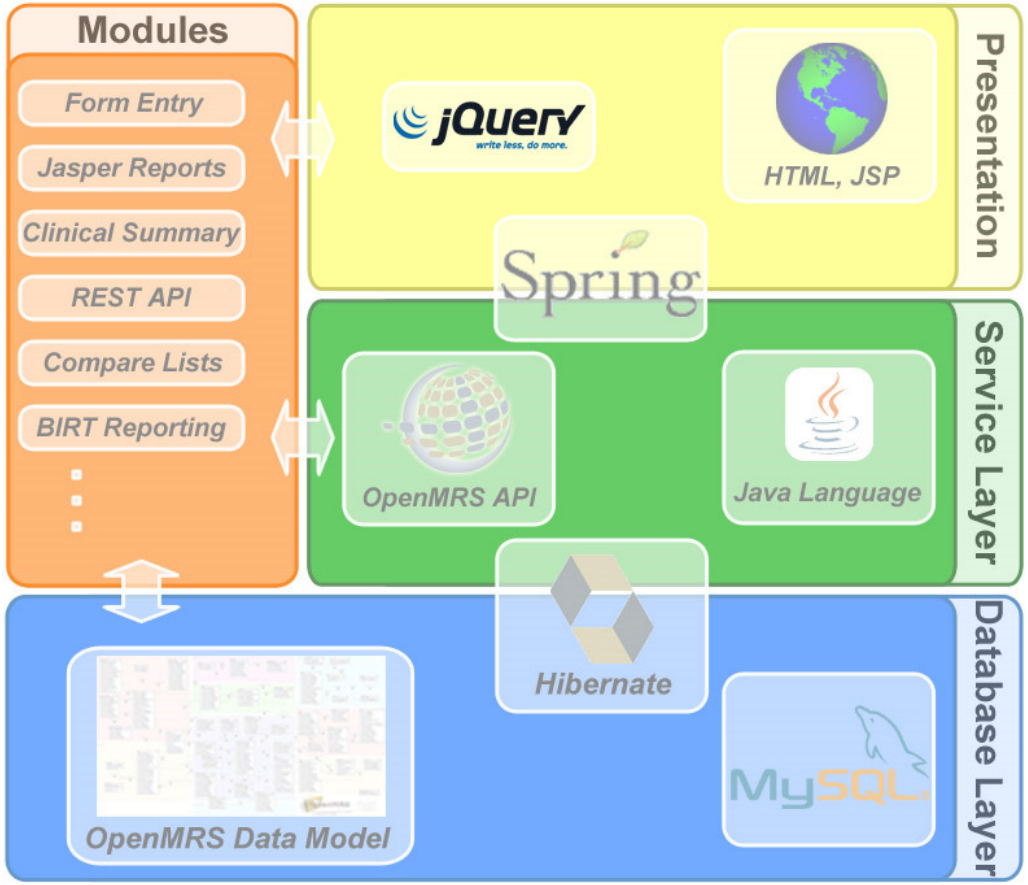
OpenMRS

OpenMRS

- OpenMRS is a software platform and a reference application over which electronic medical records (EMR) systems can be built upon.
- Features
  - tool for gathering patient information in encounters (in clinic or hospital visits), observations in those encounters, and notes.
  - summaries, reports, graphs and views critical for statistical analysis of disease progression and/or treatment effectivity
  - the world's largest international collaboration in health care software
  - Data is gathered and stored using concepts, which are question-answer information which can be entered in a form.
  - The concept dictionary remains open and generic

OpenMRS Architecture

- Presentation layer
  - Web-based user interface
- Modules
  - Self-contained packaged components
- Service layer
  - API for modules development
- Database layer
  - MySQL
- Connectors
  - Java Spring and Hibernate.



OpenMRS

- http://smsos.fbmi.cvut.cz:8080/openmrs
- Tutorial
  - Create a new patient
    - Enter demographics, contact, provider, etc.
  - Start a visit and open a new encounter
    - Enter a brief description, alergies
    - Enter system checks, vitals
    - Add current vaccines, allergies, medial problems, medications
  - Close the visit
  - Schedule your patient for next Tuesday

Homework

- Elaborate on the computing techniques underlying clinical decision support systems (Rule-based (expert) systems, Artificial neural networks, Bayesian networks, Model based systems, Data mining, Genetic algorithms).
- Create your own clinical decision rule in your OpenEMR test system following the below guidelines:
  - http://open-emr.org/wiki/images/c/ca/Clinical_Decision_Rules_Manual.pdf
- Send your essay as editable document (e.g. MS Word format) by Nov 16

Syllabus of lectures and tutorials

		Lectures (45 min)	Tutorials (45 min)
Lesson 1	Sep 30	Medical Informatics and IS definition	OpenEMR
Lesson 2	Oct 7	HW infrastructure of IS	OpenEMR
Lesson 3	Oct 14	Operation systems	GaiaEHR
Lesson 4	Oct 21	Databases of IS	SQL
~~Lesson 5~~	~~Oct 28~~		
Lesson 6	Nov 4	Clinical oriented IS	SQL
Lesson 7	Nov 11	Decision support systems Medical data coding	OpenMRS
Lesson 8	Nov 18	Data and communication standards	OpenMRS
Lesson 9	Nov 25	Phase and IS development principles	UML
Lesson 10	Dec 2	Standard implementation methodology	Programing in PHP and MySQL
Lesson 11	Dec 9	Standard implementation methodology	Programing in PHP and MySQL
Lesson 12	Dec 16	Presentation of practical project and final exam	

Plan for next week

- Data and communication standards
- OpenMRS