CDSS – Part II
Clinical Decision Support

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- # What have you learned so far?

  - **Health Information Systems**

  - **Electronic Health Record**

  - **Medical Error and how to overcome ME**

Functions of Health Information Technology:

- **Improve Clinical Outcomes/ Enhance Patient Care**

- **Efficiency and Effectiveness**

- **To improve decision making**

Star Trek & Diagnostic Device

Futuristic ….

* In *Star Trek*- point diagnostic device to patients and device determine
    * What is the problem ?
    * How serious damage is?
* In Star Trek- Diagnostic device is the "Clinical Decision Support"
* Societal Concerns
    * Can computers replace doctors in making decisions?
    * What kinds of decisions can computers make?
    * How good will computers be?
    * What will the effects be on the practice of medicine, on medical education and on relationship among colleagues or between physicians and patients?

Clinical Decision Support System (CDSS)

* Definition:

   Provide clinicians or patients with computer-generated clinical knowledge and patient-related information, intelligently filtered or presented at appropriate times, to enhance patient care ” [1]

Elements of CDS [1]

* Knowledge
  * Provide evidence to meet physician information needs
  * Meta-analysis of Randomized Controlled trials as evidences
* Patient-specific Information
  * Medication List
  * Problem Lists
  * Lab results and other clinical data

Elements of CDS [1]

* Filtered
  * Gathering and presenting pertinent data
* Presented at appropriate time
  * Provider able and ready to act on the information
* Enhance Patient Care
  * Error prevention
  * Quality improvement
  * Lab results and other clinical data

MYCIN [2]

* Gives ADVICE to clinicians
* Used Artificial Intelligence
* Production Rules– knowledge gathered from discussions among experts

Example:

Rule 507

Comprised of conditional statement (IF-THEN)

Decision Making in Medicine [2]

* Uncertainty
  * What is the diagnosis?
  * What should the intervention be?
  * What is the latest research that gives evidence the intervention really works?

  Examples:
  * Should John gets another chemotherapy?
  * Should Mr. James undergo a third operation?
  * Should Mrs. Blackwood be given hepatitis B vaccination as an intervention?
* To ensure specificity and sensitivity

Sensitivity & Specificity- Wikipedia

Sensitivity & Specificity- Wikipedia

The fecal occult blood (FOB) screen test was used in 2030 people to look for bowel cancer

		Patients with bowel cancer (as confirmed on endoscopy)		
		Condition Positive	Condition Negative	
Fecal Occult Blood Screen Test Outcome	Test Outcome Positive	True Positive (TP) = 20	False Positive (FP) = 180	Positive predictive value = TP / (TP + FP) = 20 / (20 + 180) = 10%
	Test Outcome Negative	False Negative (FN) = 10	True Negative (TN) = 1820	Negative predictive value = TN / (FN + TN) = 1820 / (10 + 1820) ≈ 99.5%
		Sensitivity = TP / (TP + FN) = 20 / (20 + 10) ≈ 67%	Specificity = TN / (FP + TN) = 1820 / (180 + 1820) = 91%	

Why CDS?[1]

1. Questions
* Unanswered Questions
* Some doubts

Why CDS?[1]

2. Information

* Unmet information need
* Cannot process information
* Lack of time
* Unsatisfied information need
* Unrecognized information need

Why CDS? [1]

3. Inquiry
   * Needs time
   * Resource Intensive (Evidence, Literature, Knowledge)

   Solutions are needed…. CDS can help provide ALERTS and REMINDERS
   * To avoid errors and increase patient safety– new knowledge discovery – average 17 years to take evidence into clinical practice
   * CDS embedded in EMR to improve patient safety and reduce medical error

Clinical Decision Support System (CDSS) [3]

* CDSS in Patient Monitoring Systems
  * Example: ECG that gives out warning
* CDSS embed in Electronic Medical Record (EMR) and Computerized Patient Order Entry (CPOE)
* Example: Send reminders/warnings in test results, drug-drug interaction, dosage errors etc.
* Formulating Diagnosis
* Formulating Treatment

Roles of Computer in Decision Support or Clinical Decision Support (CDS)

CDSS in Prescription [4]

* Guiding prescribing practices
* Flagging adverse drug reactions
* Identify duplication of therapy

Characterizing CDSS[1]

* System Function
* Mode of Giving Advice
* Style of Communication
* Underlying Decision Making Process

Evidence Based Medicine & CDSS [1]

"…use of current best evidence in **making decisions** …….."[2, **pg. 194**]

Ideally:

*EBM that uses Randomized Controlled Trial studies

*High quality literature

Weaker forms:

*Expert opinion

Interventions– are not based on FORMAL studies – found in BMJ

BMJ – one of the leading source of EBM studies

http://www.bmj.com/research

Constructing DSS[1]

* Elicitation of Medical Knowledge
* Reasoning and Representation
* Validation of System Performance
* Integration of DSS Tools

Types of CDSS [1]

1) Documentation Tool

    * Provide complete documentation

    *Well-designed order form

    * Required fields & Proper information

    * Reduce error of Omission by providing selection

    * Provide **coded data** for CDSS

Types of CDSS [1]

Types	Sub-types	Examples
1. Documentation Tool		
	1.1 Patient Assessment Form	Pre-visit questionnaires
	1.2 Nursing Patient Assessment Form	Inpatient admission assessment

Types of CDSS [1]

Types	Sub-types	Examples
1. Documentation Tool		
	1.3 Clinical Encounter Patient Form	Intelligent Referral Form
	1.4 Departmental/ multidisciplinary clinical documentation forms	Emergency department documentation
	1.5 Data Flowsheets	Immunization flowsheet

Types of CDSS [1]

2) Relevant Data Presentation

* Display relevant data –including costs

* Pertinent Data are displayed

* Complex Data – to show overall picture

* To highlight needed ACTIONS

Types of CDSS [1]

Types	Sub-types	Examples
2. Relevant Data Presentation		
	2.1 Relevant data for ordering	Display of relevant lab tests when ordering a medication
	2.2 Choice list	Suggest dose choice lists

Types of CDSS [1]

Types	Sub-types	Examples
2. Relevant Data Presentation		
	2.3 Practice status display	ED tracking display
	2.4 Retrospective/ aggregate reporting/ filtering	Physician "report cards"
	2.5 Environment parameter report	Recent antibiotic sensitivities

Types of CDSS [1]

3) Order Creation Facilitators

* Adherence to Standards (Guidelines)
* Making the right things EASIEST TO DO

4) Protocol and Pathway Support

* Provide support for multi-step care plan , protocol and pathway

Types of CDSS [1]

Types	Sub-types	Examples
3. Order Creation Facilitators		
	3.1 Single-order completers- consequent orders	Prompt Order Consequent Order Suggestions
	3.2 Order sets	General Order Set Post Op Order Set
	3.3 Tools for complex ordering	Guided Dose Active Guidelines

Types of CDSS [1]

Types	Sub-types	Examples
4. Time-based checking & protocol/ pathway support		
	4.1 Stepwise processing of multi-step protocol	Tools for Monitoring and supporting patient clinical pathway
	4.2 Support for managing clinical problems	Computer assistant management algo

Types of CDSS [2]

5) Reference Information & Guidance

* Address recognized needs from physicians & patients
* "Infobuttons" – linked to references/standards

6) Reactive Alerts and Reminders

* Data entry level
* Immediate notification for errors and hazards
* Lack of an order- reminder
* Contradictions to a procedure

Types of CDSS [1]

Types	Sub-types	Examples
5. Reference Information and guidance		
	5.1 Context-insensitive	General Link from EMR to a reference program
	5.2 Context-sensitive	Direct link to a specific reference program

Types of CDSS [1]

Types	Sub-types	Examples
6. Reactive Alerts & Reminders		
	Alerts to prevent potential errors	Drug Allergy Alerts Drug Interaction aler Under/Overdose Alert

Summary

* CDS

 Provide clinicians or patients with computer-generated clinical knowledge and patient-related information, intelligently filtered or presented at appropriate times, to enhance patient care" [1]

References

[1] Carter, J.H. (2008) . Electronic Health Records, 2nd edition, American College of Medicine.

[2] Shortliffe, E.H., Cimino, J.J. (2006).*Biomedical informatics: computer applications in health care and biomedicine*, 3rd Edition, Springer.

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[3] Jaspers , M.N.W, Smeulers, M., Vermuelen, H., Peute, L.W. (2010). Effects of clinical decision-support systems on practitioner performance and patient outcomes: a synthesis of high-quality systematic review findings. *Journal of American Medical Informatics Association,* No 18, pp. 327-334.

[4] Moxey, A., Robertson, J., Newby, D., Hains, I. , Williamson, M., Pearson, S.A. (2008). Computerized clinical decision support for prescribing: provision does not guarantee uptake. *Journal of American Medical Informatics Association,* No 17, pp. 25-33.