Intelligent Systems

CLINICAL DECISION SUPPORT SYSTEMS AND COMPUTER-INTERPRETABLE GUIDELINES



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Summary

Clinical Decision Support Systems

- Definition
- Functions
- Examples

Computer-Interpretable Guidelines

- Definition
- Benefits of Implementation
- Approaches to the Development of Computer-Interpretable Guidelines (CIGs)
- Existing Models
- Requirements of CIG models
- Shortcomings

Objectives

- Understand the function of Clinical Decision Support Systems;
- Identify the main models for Computer-Interpretable Guidelines and their main features;
- Identify systems that support the existing models and point the differences between them;
- Identify the main requirements of CIG systems;
- Determine the shortcomings of the current models/systems;

CLINICAL DECISION SUPPORT SYSTEMS

Clinical Decision Support Systems

 The initial focus of Artificial Intelligence in Medicine (AIM) was the development of systems capable of performing diagnosis and making therapy recommendations.

HOWEVER...

- The perspective of substituting healthcare professionals was not well received;
- The performance of these systems was not sufficiently good for them to be taken seriously;
- As a consequence, the focus of AIM shifted from making a decision to supporting a decision.

Clinical Decision Support Systems

Definition

Active knowledge systems that use items of patient data to generate case-specific advice.

A system that integrates:



Clinical Decision Support SystemsFunctions

Administrative

- Support the coding of medical information;
- Documentation, authorization of procedures.

Management of Clinical Complexity

• Tracking of patients during treatment processes and inside healthcare institutions.

Cost Control

 Monitor medication orders and complementary means of diagnosis.

Decision Support

- Support diagnosis and treatment;
- Promote the use of best practices;
 - Conditionspecific guidelines.

Clinical Decision Support Systems

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Examples

Designed to interpret ECGs.

Diagnosis of heart arrhythmias.

Based on Machine Learning. General purpose system.

Set of modules, known as Help Sectors that contain the clinical knowledge in the form of

the form of logical rules.

Developed at the University of Utah. Acts on a set of clinical findings (signs, symptoms, laboratory data) to produce a ranked list of diagnoses which might explain (or be associated with) the clinical manifestations.

Access to a data base of the crude probabilities of over 4500 clinical manifestations associated with over 2000 different diseases.

DXplain

Rule-based expert system designed to diagnose and recommend treatment for certain blood infections. IF-THEN rules.

Certainty factors attached to diagnoses.

Clinical Decision Support Systems

 More on CDSSs and the use of Information Technologies (IT) and Artificial Intelligence (AI) in Medicine on:

Open Clinical

http://www.openclinical.org/

COMPUTER-INTERPRETABLE GUIDELINES

Definition

Representations of clinical guidelines in a **structured digital format**, suitable for being interpreted by **machines**.

Living Guidelines

Since the end of the 1980s different CIG models have been proposed along with software tools that enabled their **automatic processing**.

Benefits of Implementation

- Identification of all the requirements to make a decision and enable a decision only when they are gathered;
- Development of tools to verify syntactic and semantic validity;
- Reuse of knowledge. The possibility of linking guidelines together or use a guideline within another;
- Easier updating operations;
- Friendlier display of knowledge.

Approaches to the development of CIGs

Document-centric

- Using mark-up tools on the original guideline documents;
- The original document is annotated to produce a more structured format with defined elements.

Model-centric

- A representation model is defined;
- The acquisition of guidelines in the new model is done directly by healthcare professionals into the model;
- Great emphasis on the interface.

Computer-Interpretable Guidelines Approaches to the development of CIGs

Examples of tools for document-centric acquisition of guidelines include: GEM Cutter, Stepper and DELT/A.

Identification of elements in the text of the guideline.

Semantic tagging of the elements.

Mapping to a structured model.

Existing models



Existing models

- Arden Syntax
 - Developed in 1989;
 - Now a standard of Health Level 7 (HL7);
 - In continuous development.



Existing models

Arden Syntax

```
maintenance:
 title: Alert on low hematocrit;;
library:
 purpose: Warn provider of new or worsening anemia.;;
knowledge:
 type: data-driven;;
 data:
   blood count storage := event {'complete blood count'};
   hematocrit := read last { 'hematocrit' };
   previous hct := read last ({'hematocrit'} where it occurred before
                    the time of hematocrit);;
 evoke: blood count storage;;
 logic:
   if hematocrit is not number then conclude false; endif;
   if hematocrit <= previous hct-5 or hematocrit<30 then conclude true;
   endif::
  action:
   write "The patient's hematocrit ("|| hematocrit ||") is low or
           falling rapidly.";;
end:
```

Existing models

- Guideline Interchange Format (GLIF)
 - Developed in 1998 (GLIF3);
 - Created by Intermed Collaboratory;
 - Follows a Task Network Model (TNM);
 - Guidelines as flowcharts.



Existing models

• Guideline Interchange Format (GLIF)



Existing models

- PROforma
 - Developed in the middle of the 1990s;
 - Created by the Advanced Computation Laboratory of Cancer Research ;
 - Also follows a Task Network Model (TNM);
 - Guidelines as a graph where every node represents a task.

Representation Primitives



Existing models

PROforma

😢 InferMed - Composer [ibs]				
<u>File Edit View Iools Run Window Help</u>				
E-O IBS	Plans assess V Scale 100% V Task Attributes			
Signs and Symptoms				
Do baseline tests	Non_IB5_diagnosis (action)			
	Gene	neral Att	ributes 🔺	
EOB test	Nam	ne No	n_IBS_diagnosis	
Findoscony or X	Do baseline tests	tion No	n IBS diagnosis	
Referral	Dasemile rests Desc	cription Dia	agnosis of condition other than IBS	
	Goal	al		
	Prec	condition res	ult offibs diagnosis) = non ibs	
Type of IBS	Trior	ner		
E Treatment	Postant Post	teondition nat	ient referred - true	
E O Diarrhoea Dominant	Referral	condition pa		
Prescribe Clomic		ameters	•	
Prescribe Antisp	Actio	on Att	nbutes	
Explanation and		cedure Pa	tient's signs and symptoms do not supp	
Evolusion di	Conb	itext		
	Non IBS Insta	ance Att	ributes	
	Paren	ent Plan	-	
Prescribe Laxati	Optic	ional No		
Explanation and	Auto	omatic No	-1	
Dietary Advi	Type of IBS	#74.5		
Exclusion di		Precondition: A condition which must hold before the task can be activated		
Prescribe SSRI	durin	during enactment.		
A Boughothorsou				
15/07/98 16:06				

Existing models

- Asbru
 - Developed in the middle of the 1990s;
 - Resulted from a collaboration between Stanford University and Vienna Technology University;
 - Guidelines defined as knowledge roles;
 - Emphasis on temporal restrictions on the execution of tasks.

Existing models

• Asbru

Knowledge Roles



Existing models

• Asbru

Temporal Annotations

Latest Starting Shift (LSS) Earliest Finishing Shift (EFS)

Latest Finishing Shift (LFS)

Earliest Starting

Shift (ESS)

Maximum Duration (MaxDu)

Minimum Duration (MinDur)

Existing models

• Asbru



Existing models

- Standards-Based Sharable Active Guideline Environment (SAGE)
 - The result of collaboration of 6 research groups (IDX Systems, Nebraska Medical Center, Intermountain Health Care, Apelon Inc., Stanford Medical Informatics and the Mayo Clinic);
 - A guideline is a recommendation set, which is composed as a graph of nodes;
 - Emphasis on standards.

Existing models

Standards-Based Sharable Active Guideline Environment
 (SAGE)



Existing models

(SAGE)

Standards-Based Sharable Active Guideline Environment



Requirements of CIG models



Shortcomings



In the next session...

- Ontologies
- Ontology Web Language (OWL)
- CompGuide ontology for Computer-Interpretable Guidelines

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