A Guideline-Derived Model to Facilitate the Implementation of Test-Ordering Rules within a Hospital Information System

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Problem positioning

• Primordial role of clinical laboratory in medical decision making (admission, medication, and discharge)

Forsman RW. Why is the laboratory an afterthought for managed care organizations? Clin. chem. 1996

• Laboratory tests are not always prescribed properly (Up to 67%)


• Evidence-based laboratory guidelines for improving test ordering, specimen collection and handling procedures were formulated by expert panels of the public hospital system of Paris (AP-HP)
Problem positioning

- AP-HP’s intention to implement test ordering rules in its information system

- For a successful implementation, structured information is needed

Goal

To develop and evaluate a conceptual model for implementing test-ordering rules within a hospital information system
Various strategies for changing the test-ordering behavior of medical practitioners, have been proposed in the literature including

**Education programs**


**Redesigning the request form**


**Feedback on the number or rational basis of tests prescribed**


**Informing requesters about the costs of the tests requested**


**The use of Computerized Decision Support Systems (CDSS)**

Materials

- 30 laboratory guidelines formulated by expert panels of the AP-HP related to
  - Microbiology
  - Immunoglobulin analysis
  - Autoimmune diseases
  - HLA and associated diseases

- Two national guidelines for dyslipidemia provided by HAS
- Six international guidelines (used for validating the model)
- Heterogeneous guidelines
Hémoculture (Blood culture)

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Nom des rédacteurs : Pr M.-H. NICOLAS-CHANONIE, Pr V. JARLIER et Pr E. CAMBAU
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Validation : Collégiale de Bactériologie-Virologie-Hygiène (25/09/06)

Règles de prescription : (Prescription rules)
Prescription médicale

Type de patients concernés ou contexte clinique du patient :
Suspicion de bactériémie primaire ou secondaire à un foyer miteux

Examen à recommander car apporte un diagnostic pertinent : (Recommended tests)
Hémoculture : L'élément clé est le volume de sang prélevé à chaque ponction et non le nombre de ponctions
- volume de sang de 15 ml par ponction (0,5 à 5 ml en pédiatrie en fonction de l'âge, mais dans des flacons adaptés à ce plus petit volume) ; 10 ml dans le flacon aérobie et 5 ml dans le flacon anaérobie

MALADIE COELIAQUE (Coeliac disease)

Version n°1 date de rédaction : 24 mars 2006 date de révision : 30 septembre 2008
Experts du groupe de travail : Dr Chantal ANDRE, Dr Catherine JOHANET, Dr Pascale NICAISE, Dr Bernard WEILL
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Date de validation : 7 octobre 2008

Indications :
- Diagnostic de maladie cœliaque
- Suivi de l'observance du traitement (régime sans gluten)

Examen à recommander car apporte un diagnostic pertinent
Seule la recherche des anticorps anti-endomysium et des anticorps anti-transglutaminase a actuellement sa place dans le diagnostic de la maladie cœliaque. Si elle est positive, elle permet de confirmer la suspicion clinique et de décider d'une biopsie de l'intestin grêle
• Test ordering rules were extracted

• Clinical situations were considered for test ordering rules
  Example: Iterative ordering for ANCA is indicated three to six months after the former request
  Situation 1: ANCA is reordered before 3 months (Test overuse)
  Situation 2: ANCA is not reordered after 6 months (Test underuse)

• Analyzing clinical situations led to extraction of conditions

• Conditions were categorized using UML modeling

• Validation of the model

• Mapping to HL7 RIM
Results
Test ordering rule

Has for condition

Condition

Atomic Condition

Set of conditions

Set of conditions related by AND

Set of conditions related by OR

Has for action

Test ordering rule

Action

Automatic decision : Boolean

Prescription

No prescription
Conditions

Atomic Condition

Conditions related to laboratory tests
- Terminology: String
- Label: String
- State: String
- Value: String
- RequestTime: Date
- ResultTime: Date
- Code: String

Conditions related to family history
- Terminology: String
- Label: String
- Use: String
- Utilization rate: String
- Unit: String

Clinical conditions
- Terminology: String
- Label: String
- Code: String
- State of the condition: String

Pathological conditions

Physiological conditions

Démographic conditions
- Age: Date
- Operator: String
- Gender
- Sex: Boolean

Conditions related to medical treatments

Conditions related to medication
- Terminology: String
- Drug code: String
- Label: String
- Dose: Real
- Unit: String
- Start Date: Date
- Stop Date: Date

Conditions related to vaccinations
- Terminology: String
- Label: String
- Code: String
- Up to date patient: Boolean

Imaging
- Type of imaging: String
- Result: String

Surgical treatment
- Type of surgery: String
- Result: String

Hospitalization

Triggers:
- New lab test order
- New prescription
- Lab result
- Clinical problem
## Mapping conditions to HL7 RIM

<table>
<thead>
<tr>
<th>Condition classes</th>
<th>Mapping to HL7 RIM classes and attributes</th>
</tr>
</thead>
</table>
| Imaging, Family history, Pathological conditions, Physiological conditions, Habits | Observation  
MoodCode: EVN  
Code: CD  
Value: ANY |
| Surgical treatment                                     | Procedure  
MoodCode: EVN  
Code: CD |
| Hospitalization                                        | PatientEncounter  
MoodCode: EVN  
EffectiveTime: GTS |
| Laboratory test                                        | Observation  
MoodCode: EVN/RQO  
Code: CD  
Value: ANY  
ActivityTime: GTS  
EffectiveTime: GTS |
| Age                                                    | Person  
BirthTime: TS |
| Gender                                                 | Person  
AdministrativeGenderCode: CE |
| Medication, Vaccination                                | SubstanceAdministration  
MoodCode: EVN  
Code: CD  
EffectiveTime: GTS  
DoseQuantity: IVL <PQ>  
RateQuantity: IVL<PQ> |
Discussion

- Feasibility of implementing test ordering rules

- The model clarifies the information elements that have to be formalized and coded in EHR (Test orders, laboratory results, clinical conditions, procedures, medical treatments)

- The model is generalizable

- Why not using existing models to integrate guidelines in computer-interpretable formats?
  - Declarative: not a formal computational model aimed at guideline execution
  - Not conceptualized for test ordering rules
Discussion

• Alert fatigue: a common cause of overriding decision support systems alerts by clinicians
• The ability of the model to show the reminders according to the user

• Mapping to HL7: exchanging data between different information systems

• Implementing test-ordering rules enables further evaluation of reminder effects

• Formulation of new laboratory guidelines
Thank you for your attention