An Engine for Compliance Checking of Clinical Guidelines

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Background

- **Clinical Practice Guideline (CPG)**
  - CPGs are systematically developed statements to assist practitioner and patient decisions with appropriate health care for specific clinical circumstances

- **Compliance Checking of Clinical Guidelines**
  - Clinician activities are not always compliant with guideline recommendations
  - Non-compliance reports on demand
    - Non-compliance reports are meaningful for executives of care providers who are interested in performance measurement for clinicians
    - Non-compliance reports help understand the barriers to adoption of clinical practice guidelines and could contribute towards the evolution of clinical practice guideline development
Outline

- **Definition of non-compliance categories**
  - We explored real clinical data, and identified three non-compliance categories

- **Development of an engine for compliance checking of clinical guidelines**
  - To improve clinician compliance with guidelines, we developed an engine to facilitate a computerized implementation of non-compliance reports
Non-compliance categories

- **Category I: guideline recommendations exist, and the clinician performed some activities, but not according to the guidelines**
  - This category is most common
  - For example, diabetic guidelines recommend using Metformin for overweight diabetic patients, however, in practice, Sulfonylurea was prescribed by the clinician

- **Category II: guideline recommendations exist, but the clinician did nothing**
  - For example, the diabetic guidelines recommend a referral to an appropriate specialist for diabetic nephropathy patients; however such patients did not receive any referral record

- **Category III: guideline recommendations do not exist, but the clinician performed some activities**
  - This category has an obvious benefit: it helps to avoid over-prescription
An engine for compliance checking of clinical guidelines

- Clinical data
  1.1 Make a timeline
  1.2 Mark clinician activities
    Clinician activity gleaner

- Non-compliance report
  2.1 Provide decision support
  2.2 Attach recommendations
    Guideline recommendation dispatcher

- Compliance checker
  3.1 Correlate clinician activities with guideline recommendations
  3.2 Compare clinician activities with guideline recommendations
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Clinical data

1.1 Make a timeline

1.2 Mark clinician activities

Clinician activity gleaner

Non-compliance report

Clinical data has effective time, which closely relates to the guideline recommendations

For example, a guideline may recommend a referral within a week, while the referral record may came out after 10 days – we report such incidents as non-compliance

For example, an observation of diabetes in family history is not a clinician activity

Not every piece of clinical data is a clinician activity which needs to be checked with guideline recommendations
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• A guideline recommendation consists of options, and each option is a component of clinical data.
• Guideline recommendations also have effective time.

For example, the diabetic guideline recommends either a combination of Metformin with Sulfonylurea or a combination of Metformin with Meglitinide with effective time of 1 month.

According to the effective time of guideline recommendations, we will attach them to the time line.
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3.1 Correlate clinician activities with guideline recommendations

3.2 Compare clinician activities with guideline recommendations

For comparison of \( ca \) and \( gr \) where \( ca \in C(gr) \), we need to check whether \( ca \) is one of \( gr \)'s options.

In addition to the membership of \( ca \) and \( gr \), we will check:
- numeric relationships:
  - For example, some guidelines recommend the maximum dosage.
- concept subsumption of \( ca \) and \( gr \) (aka. terminology reasoning)
  - For example, Glucophage is a subclass of Metformin.
- contextual recommendations:
  - Take reducing dosage as an example. This recommendation needs to be contextualized with dosage history, in order to automatically compare previous dosage amounts with the current dosage.
Experimental results

- **Compliance Checking Engine**
  - We have implemented our compliance checking engine in a clinical guideline-based decision support system for chronic disease management.
  - The prototype system has been successfully deployed at Peking University People’s Hospital (one of the largest healthcare providers) in China, for managing diabetes patients.

- **Clinical Guideline Computerization**
  - We computerized diabetic patient treatment guidelines as a clinical decision process to assist clinicians in two aspects:
    - provide prescription recommendations with regards to oral glucose control therapy and insulin therapy
    - make referral recommendations, for transferring patients from primary to secondary care, and vice versa
  - In total, 18 guideline recommendations are specified, six of which are contextual such as reducing dosage and adding a second drug.
Experimental results (cont’)

- **At the Pilot Phase**
  - Approximately 200 diabetic patients enrolled in our chronic disease management, 239 clinician activities were identified and 188 guideline recommendations were generated.
  - 92 non-compliance reports were identified, with 24 in category I, 32 in category II and 36 in category III.
    - Clinician activities were prone to be different from contextual guideline recommendations like reducing the dosage – as indicated by 24 in category I.
    - Most referral records were not available even though guideline recommendations towards the referrals existed – as indicated by 32 in category II.
    - Many clinicians prescribed medications which the guidelines did not recommend – as indicated by 36 in category III.
Future work

- **To develop a rating mechanism for non-compliance reports**
  - The importance and severity of non-compliance varies, and some incidents could be classified as acceptable variability while others may fall into the category of fatal violations

- **To implement a platform for interaction with clinicians**
  - When non-compliance is detected out, clinicians can provide on the spot a short comment about why is doing differently

- **To apply non-compliance reports to clinical outcome analysis**
  - e.g., to generate insights that indicate whether a clinician’s degree of compliance with a guideline, corresponds to better achieved outcomes
Q & A

Thank You

감사합니다  
多謝  
โปรกูน

Спасибо  
Gracias

شكراً  
Obrigado

Grazie

多謝

ありがとうございました  
धन्यवाद
Related work

- To investigate the reasons (or motivations) for non-compliance, using research methods such as surveys, questionnaires, interviews and panels
  - Differently, this paper more focuses on the nature of non-compliance – we defined three non-compliance categories
  - In this paper, not manually, but automatically, non-compliance reports will be generated by our compliance checking engine

- To evaluate guideline execution, using computational logic and using temporal logic
  - They defined logical rules or formulas for guidelines and translates clinical data into logical facts or statements, and by running a rule or proof engine, outputs the evaluation result
  - Such work typically disregards non-compliance cases when some clinician activities or guideline recommendations are absent – in contrast, that’s our contribution
  - Besides, we consider the effective time, membership, numeric relationships, concept subsumption, and contextualization, for detection of differences between guideline recommendations and clinician activities – these are not mentioned in related work
Sample

Clinical Data

Date: 2010-03-27  
Site: Health Center A  
Birthday: 1935-07-21  
Height: 160 cm  
Weight: 60 kg  
FBG: 9.1 mmol/l

Date: 2010-04-10  
Site: Clinic B  
Physician: Bob  
Diagnosis: DMII

Date: 2010-07-10  
Site: Hospital C  
Height: 160 cm  
Weight: 65 kg

Date: 2010-07-10  
Site: Hospital C  
Physician: Ken  
HbA1c: 7.6%

Date: 2010-07-12  
Site: Hospital C  
Physician: Ken  
Prescription: Sulfonylurea

Date: 2010-10-15  
Site: Hospital C  
Physician: Lisa  
Prescription: Metformin

Guideline Recommendation

[1] diabetic guidelines recommend transferring newly-diagnosed diabetic patients to hospitals in 1 week

[2] diabetic guidelines recommend using Metformin for overweight diabetic patients

[3] diabetic guidelines recommend doing HbA1c lab test every 3 months

non-compliance report

<table>
<thead>
<tr>
<th>Date</th>
<th>Site</th>
<th>Physician</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010-04-10</td>
<td>Clinic B</td>
<td>Bob</td>
<td>Category II: no referral record</td>
</tr>
<tr>
<td>2010-07-12</td>
<td>Hospital C</td>
<td>Ken</td>
<td>Category I: not Metformin</td>
</tr>
<tr>
<td>2010-10-15</td>
<td>Hospital C</td>
<td>Lisa</td>
<td>Category III: over-prescription</td>
</tr>
</tbody>
</table>
Compliance checking

Date: 2010-03-27  
Site: Health Center A  
Birthday: 1935-07-21  
Height: 160 cm  
Weight: 60 kg  
FBG: 9.1 mmol/l

Date: 2010-04-10  
Site: Clinic B  
Physician: Bob  
Diagnosis: DMII

Date: 2010-07-10  
Site: Hospital C  
Height: 160 cm  
Weight: 65 kg  
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Date: 2010-07-12  
Site: Hospital C  
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Site: Hospital C  
Physician: Ken

Date: 2010-07-12  
Site: Hospital C  
Physician: Ken

Date: 2010-10-15  
Site: Hospital C  
Physician: Lisa  
Prescription: Metformin

If FBG>=7.0 mmol/L then DMII diagnosis

To transfer to hospital in 1 week if newly diagnosed

Using Metformin for overweight diabetic patients

If FBG>=7.0 mmol/L then DMII diagnosis

Category II: no referral report

Category I: not Metformin

Category III: over-prescription

Compliant

non-compliance report