Automatic Clinical Summarization as an EHR Usability Improvement Tool

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To improve EHR usability we need to take a broad socio-technical view

- EHRs used within complex adaptive health care system consisting of high-pressure, fast-paced, and distributed settings of care

- Need to differentiate between:
  - User interface that is difficult to navigate
  - Clinical data that is not well organized
  - Order entry application is slow to respond
  - Computers only available at the nursing station
Summarization Project Goals

• Develop methodologies that:
  – Model and summarize complex, chronically-ill patients’ EHR data
  – Enhance decision making with context-appropriate, evidence-based recommendations

• To improve clinician decision-making under information overload and time pressure
Broad definition of Summarization

• Developed & published a generic clinical summarization model – AORTIS
• Describe how people think and what an EHR could do to help them...
  – Aggregation: the collection of data
  – Organization: structuring of the data
  – Reduction: culling salient information
  – Transformation: altering the data view
  – Interpretation: context-based analysis of data
  – Synthesis: combining two or more data elements

Diabetes Risk Management Summary

**Glycemic Control: Type 2 DM** (dx: 10/1/09): **HbA1c-7.0%** (10/01/10) (↓3.0% in 12 mo.) on metformin (1000 mg BID).
Glycemic control is acceptable according to ADA guidelines.

**Lipid Control:** Hyperlipidemia (dx: 10/01/09): **Total cholesterol-250 mg/dL, HDL 40 mg/dL, LDL 175 mg/dL** (10/1/10) (↑ from 180/60/125 4 mo. ago) on simvastatin (20 mg QD)
ATP III 10 yr risk of MI or death - 23% **Pat Ed: Cardiac Risk Factors**
ATP III guidelines recommend adjusting dosage.

**Blood Pressure Control:** Hypertension (dx: 10/01/09): **BP-135/90** (today) (↓ from 150/105 in 12 mo.) on Hydrochlorothiazide (25 mg QD)
JNC VII guidelines recommend adding a medication.

**Visit History:** Clinic – Urgent Follow-up (6/15/10); ED – Hospital – chest pain (6/1/10); Clinic – Well Visit (2/1/09); Clinic – Physical (10/1/09)
### Reminders
- Patient 65 yrs or older, due for Pneumovax.
- Patient 50 years old or greater, recommend influenza vaccination.
- Patient has CAD-equivalent on problem list and aspirin is not on the med list. Recommend aspirin.
- Patient with DM overdue for HbA1C (rec: q 6 months).
- Pt is overdue for colonoscopy (rec: q 10 years). FamHx indicates average risk for colorectal cancer.

### Health Monitoring

<table>
<thead>
<tr>
<th>HM Item</th>
<th>Date Last</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ophthal Exam</td>
<td>10/26/2010</td>
<td>Done</td>
</tr>
<tr>
<td>Podiatry exam</td>
<td>10/26/2010</td>
<td>Done</td>
</tr>
<tr>
<td>Bone Density</td>
<td></td>
<td></td>
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<tr>
<td>Colonoscopy</td>
<td></td>
<td></td>
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<tr>
<td>Alcohol Use Screening</td>
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<td></td>
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<tr>
<td>Smoking status</td>
<td>10/26/2010</td>
<td>Never used</td>
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<tr>
<td>Influenza Vaccine</td>
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<tr>
<td>Pneumovax</td>
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<td>Td Booster</td>
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<td>Zostavax</td>
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<td>Cholesterol</td>
<td>10/26/2010</td>
<td>Done elsewhere</td>
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<tr>
<td>Mammogram</td>
<td></td>
<td></td>
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<tr>
<td>Pap Smear</td>
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</tbody>
</table>

### Problems
- Diabetes mellitus
- Renal insufficiency
- Coronary artery disease
- Peptic ulcer disease
- Torn meniscus

### Medications
- Glyburide 5MG TABLET Take 1 Tablet(s) PO BID
- Hctz (HYDROCHLOROTHIAZIDE) 25 MG (25MG TABLET Take 1
- Neomycin SULFATE 1000 MG (500 MG TABLET Take 2) PO QID

### Procedures
- Tonsillectomy

### Allergies
- Milk Protein - Moderate
- Penicillins - Mild

### Sticky Notes
Likes to be called 4.

### Notes
- 05/14/2010 Patient Note
- 05/14/2010 Code Status/LT Note (MGH)
- 05/14/2010 Code Status/LT Note (MGH)
- 05/14/2010 Code Status/LT Note (BWH)
Current Work

• Extracting knowledge from Unified Medical Language System Metathesaurus (UMLS)
  – Using NDF-RT medication – may_treat – problem relationships

• Exploring “crowd-sourcing” techniques
  – Using problem – medication links MDs are making

• Using Association Rule mining to increase number of problems on problem list
  – Using market-basket analysis to identify undocumented patient problems

Summary

• Current state-of-the-art for summarization in commercial EHRs is limited

• Need methods to help clinicians create accurate problem lists and link appropriate medications to them
  – Use of existing ontologies requires improvements in granularity and content
  – Crowdsourcing also has great promise if we can develop better methods to enter data
  – Association rule mining has great promise – need more data
Thank you

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