Generating a Test of EHR Narrative Comprehension

Information Needs and Information Seeking Behavior

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Disclosure

I and my spouse have no relevant relationships with commercial interests to disclose.
Learning Objectives

After participating in this session the learner should be better able to:

- Generate comprehension questions from Electronic Health Records.
- Evaluate the quality of questions using Item Response Theory and crowdsourced responses.
Acknowledgements

• Hao Wu and Li Chen, Boston College
• Kathy Mazor and Hong Yu, UMMS
Motivation

Patients are being given access to their Electronic Health Records (EHRs)

EHR notes include medical terms and are difficult to understand, particularly for individuals with low health literacy

Tests of health literacy exist, but none are specific to testing a patient’s ability to read and comprehend EHR notes

The monitor has not shown any dysrhythmias or arrhythmia either prior to or during any of his spells
Process Overview
EHR Note Identification

• Pull notes from hospital database according to ICD-9 code

• Identify key medical terms in the notes and cluster according to terms

• Select note with most medical concepts from each cluster
Question-Answer Generation

- Groups of physicians and medical researchers identified important concepts in notes
- Groups wrote multiple choice questions using Sentence Verification Technique
  - Answer options: paraphrase, meaning change, and distractor
Sentence Verification Technique

**Forming Test Questions using SVT:**
Please read the following question and then examine the answer choices and choose the answer that best represents the question text.

What does the following sentence mean? “The monitor has not shown any dysrhythmias or arrhythmia either prior to or during any of his spells.”

1. He has had abnormal rhythm prior to or during his spells of chest pain
2. The monitor has shown abnormal heart rhythms before and during his spells
3. His heart rhythm is normal before and during his fainting spells

What does the following sentence mean? “Patient recently presented to the hospital with shortness of breath.”

1. Shortness of breath has many causes
2. She went to the hospital for trouble breathing
3. She visited the clinic due to shortness of iron
Question Validation

• Gather response patterns from Amazon Mechanical Turk to identify good items
  • 83 items → 55 items

• 2nd round on AMT for validation
  • All items retained
Results
## Retained/Removed Examples

<table>
<thead>
<tr>
<th>Question</th>
<th>Paraphrase</th>
<th>Meaning Change</th>
<th>Distractor</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Retained</strong></td>
<td>Pegfilgrastim 6 mg subcutaneous one dose</td>
<td>Do an under skin injection of one dose of 6 mg pegfilgrastim</td>
<td>Pegfilgrastim 6 mg epidermal one dose</td>
</tr>
<tr>
<td><strong>Removed</strong></td>
<td>Osteoporosis</td>
<td>Weakness in bones</td>
<td>Hardening of bones as we get older</td>
</tr>
</tbody>
</table>


Test Information Curve

- All items
- Item 44 removed
- Short test (14 items)
- Short test without 44

Test Information vs. Ability Level (theta)
Test Information Curve

The graph shows the test information curve with different test formats:
- **All items**
- **Item 44 removed**
- **Short test (14 items)**
- **Short test without 44**

The curve indicates that the test is most informative at low ability levels.
## Ability by Demographic

<table>
<thead>
<tr>
<th>Education Level</th>
<th>Less than High School</th>
<th>High School Diploma</th>
<th>Associates Degree</th>
<th>Bachelors Degree</th>
<th>Masters Degree or Higher</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.899</td>
<td>0.038</td>
<td>0.013</td>
<td>0.034</td>
<td>0.199</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Age</th>
<th>18-21</th>
<th>22-34</th>
<th>35-44</th>
<th>45-54</th>
<th>55-64</th>
<th>65 and older</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.493</td>
<td>0.042</td>
<td>0.066</td>
<td>0.222</td>
<td>0.212</td>
<td>0.122</td>
<td></td>
</tr>
</tbody>
</table>
Conclusion

• New instrument to assess patient EHR note comprehension
  • Generated from de-identified notes
  • Test is most informative for low ability
  • Next steps: validate test with populations where low health literacy is prevalent

• Future work: Automatic question generation for personal EHR note comprehension
  • Use patients’ own notes to test comprehension
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