Iterative refinement of SemLink to enhance patient readability of discharge summaries

Mehnaz Adnan
With: Jim Warren, Martin Orr
University of Auckland
Discharge Summary

- Synopsis of patient condition
- Communicate post-discharge framework of care

In New Zealand:
- Hard copy to patient on discharge
- Transmitted via HL7 message to GP

- National strategy calls for personal health portals by 2014
- Auckland region is rolling out Shared Care Planning portal for indicated groups
We Know That ...

• Consumers play an important role in managing their post-discharge care

• Availability of easily understandable discharge information can:
  • provide patients a better understanding of their disease process and expectations
  • enhance patient’s education and compliance
  • reduce the likelihood of hospital readmission
Known Issues

- Patients’ literacy levels
- Language
- Medical terminology
- Abbreviations
- Lack of explanations of complex clinical concepts
What we did

- Collaborated with Waitemata District Health Board (WDHB), Auckland
- Collected 200 de-identified hard copies of Electronic Discharge Summaries 08) - 50 each from Adult & Rehabilitation (ATR), Emergency, Medicine, Surgery
- Analysed EDS information to identify quality issues for patients by:
  - Automated text analyses
  - Panel assessment
EDS Quality Issues - Summary

• Inadequate advice to patient
• Use of difficult vocabulary
• Incomplete advice to GP
• Irrelevant information (particularly cut-and-paste lab test results)
• Incomplete follow up advice
Research questions / objectives

So…

How can we get better information in the discharge summary?

And how can we support the patient (or family member) as a reader?
Semantic Annotations in SemLink

- EDS Text
- EDS Annotation Tool
- Clinical Vocabularies
- ontology
- Annotations
- Annotated EDS
- Synonyms
- Hyperlinks
<table>
<thead>
<tr>
<th>Type</th>
<th>Resource(s) Name</th>
<th>Available Online From</th>
</tr>
</thead>
</table>
| Clinical Vocabulary         | • Open-Access Collaborative Consumer Health Vocabulary  
                              • WDHB approved abbreviation | http://consumerhealthvocab.org |
| Consumer Health Search Engines | • MedlinePlus  
                              • WebMD  
                              • Healthline  
                              • Patient UK  
                              • Medsafe  
                              • Yahoo! Health | http://medlineplus.gov/  
                              http://www.webmd.com/  
                              http://www.healthline.com/  
                              http://www.patient.co.uk/  
                              http://www.medsafe.govt.nz/Consumers  
                              http://health.yahoo.com/ |
Open Access Collaborative’s initiative to bridge the gap between consumer and health professionals vocabulary.

- **Myocardial Infarction**: Heart attack
  - Frequency-based term score
  - Context-based term score
  - Context-based concept score
  - String-level difficulty
  - Concept-level difficulty
CHV Scores

Familiarity of term range between 0 & 1

- 0.8 - 1.0  “likely”
- 0.5 - 0.8  “somewhat likely”
- 0 - 0.5   “not likely”
Note: This clinical management section is taken from “Barretto, S., S. Chu, et al. (2006). "National Discharge Summary: Data Content Specifications Version 1.0"
Flow Chart of Hyperlink Generation

1. CHV/Abbreviation Database
2. Extract Synonyms
3. CHV Preferred Term/Abbreviation Long Form
4. Index Results from First Page
5. Find Term Frequency Score in Page Titles
6. If any Page Term Frequency > 0
   - Yes: Return Page with Highest Term Frequency Score
   - No: Page Not Found
7. 1. MedlinePlus
       2. WebMD
       3. Healthline
       4. Patient UK
       5. Medsafe
       6. Yahoo! Health
Coughing up blood: MedlinePlus Medical Encyclopedia

Contents of this page:
- Alternative Names
- Definition
- Considerations
- Causes
- Home Care
- When to Contact a Medical Professional
- What to Expect at Your Office Visit
- References

Alternative Names
Hemoptysis; Spitting up blood; Bloody spurt

Definition
Coughing up blood is the spitting up of blood or bloody mucus from the lungs and throat (respiratory tract).

Hemoptysis is the medical term for coughing up blood from the respiratory tract.

Considerations
Coughing up blood is not the same as bleeding from the mouth, throat, or gastrointestinal tract.

Blood that comes up with a cough often looks bubbly because it is mixed with air and mucus. It is usually bright red, although it may be rust-colored. Sometimes the mucus may only contain streaks of blood.
Clinical Management
81 year old man with past history of 60 pack-years cigarette smoking, admitted after 3 days of progressive dyspnoea, tachypnoea and haemoptysis. Bronchoscopy performed on 23/03 reviewed haemorrhagic growth about 1.5 cm in diameter at right bronchus 2.5 cm distal to the tracheal bifurcation. Appears consistent with squamous cell carcinoma. Brush biopsy taken. Developed post-biopsy acute lower respiratory tract infection, haemoptysis and acute confusion. Confusion resulted in a fall and laceration to right forearm. Treated with IV fluids, IV Ceftriaxone, oxygen, nebulised Salbutamol. Improvement after 3 days, changed to oral Cefuroxime. Histology result pending. Discussion with patient and family who requested no further investigations or treatment for that problem, except support and palliative care if/when needed. Mild Iron Deficiency Anaemia.
Readability Measure – SMOG Index

• SMOG index corresponds roughly to the US grade level of education needed to comprehend the text

• Health literature ideally be written at a SMOG score of 5 or less to be understandable by most consumers of hyperlinked pages *

• Hyperlinked pages distributed into six score categories based on SMOG index less than or equal to 5, 8, 10, 12, 16 or 20

Reading level of hyperlinked pages

SMOG index of hyperlinked Web pages
Refinement

• First select the title-specific Web pages having SMOG score less than or equal to 5 followed by SMOG scores less than or equal to 8, 12, and 20 respectively

• Testing
  • Selected every tenth term from a frequency-sorted list of unique preferred terms
  • Found total of 137 preferred terms
After Refinement

- Hyperlink success: 89%
- No page has a readability score of 5 or less
- 82.6% have SMOG index of 8 or less
- MedlinePlus provided most of the Web pages with readability score 8 or less (with 45 pages)
Further iterative refinement protocol

- Closely examined performance on a series of example Clinical Management sections
  - 2 from NeHTA
  - 6 random from our EDS corpus
- Iterative feedback (from co-authors, one practicing clinician)
- Explore fixes
- Iterate
Iterative refinement outcomes

• Title term frequency (TF) threshold
  – 0.5 is a little low (e.g. ‘childhood leukaemia’ is poor title choice for hyperlink on ‘leukaemia’); using TF strictly > 0.5

• Dictionary interfaces
  – If there’s no entry from our health consumer sites

• UMLS mapping
  – CHV did not map enough terms; use UMLS mapping with lack of CHV entry as indication for hyperlink
  – Use semantic types to condition search (e.g. different sources best for drugs)

• ‘Non-difficult terms’ list
  – List of ‘stop words’ and other words (e.g. ‘forearm’)
Further work done

- Have undertaken panel assessment of all hyperlinks for a sample of 8 (distinct from iterative refinement) EDS
  - Queried relevance and helpfulness
  - About 65% topically relevant
  - MedlinePlus resources dominant in successful links
  - Dictionary resources dominant in failures
  - Drugs and procedures most successfully linked
    - 2.65, 2.90 of 3 mean relevance
  - Findings and body parts much less successful
    - 1.43 of 3 mean relevance
Future Directions

• Further refinement of linking algorithm
  – Deeper assessment of resource relevance (i.e. does this page contain the sorts of things the patient needs to know for a drug | for a procedure | for a…).

• Experiment with consumer users
  – Both for more detailed assessment of the discharge summary reading challenges and on how they use a hyperlinked EDS

• Deployment contexts
  – PHR: good context to provide tailored hyperlinking
  – Post-discharge follow-up staff: support them in explaining key concepts to patients
Contact & Further reading

Mehnaz Adnan  madn002@aucklanduni.ac.nz  Jim Warren  jim@cs.auckland.ac.nz

Assessment of Text Characteristics of Electronic Discharge Summaries:


Hospital Panel Assessment of Electronic Discharge Summaries:

• Adnan, M., Warren, J., Orr, M., Ewens, A., Scott, J. & Trubshaw, S., “The Quality of Electronic Discharge Summaries for Post-Discharge Care: Hospital Panel Assessment and IT to Support Improvement,” Health Care and Informatics Review Online, 2010, 14(4), pg 8-17

Methods/Results of Recent Studies:

• Adnan, M., Warren, J., Orr, M., “Iterative refinement of SemLink to enhance patient readability of discharge summaries”, in Health Informatics Conference (HIC'2013), Adelaide, Australia, July 2013 [this paper!].

