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Extending an Uncertainty Taxonomy for Suspected Pneumonia Case Review

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Objective

We sought to classify evidence that supports, refutes, or contributes uncertainty when reviewing cases of suspected pneumonia. We extend an existing taxonomy of uncertainty to classify these phenomena with the goal of improving existing Natural Language Processing (NLP) algorithms.

Introduction

Natural language processing algorithms that accurately screen clinical documents for suspected pneumonia must extract and reason about whether these mentions provide evidence that supports, refutes, or represents uncertainty. Our efforts extend existing algorithms [1] and taxonomies [2] that can be leveraged by NLP tools for more accurate handling of uncertainty for suspected pneumonia case review.

Methods

We conducted an automated screening of all outpatient encounters occurring at the VA Salt Lake City Health Care system between 01/01/2009 and 01/01/2012 to identify a cohort of suspected cases of pneumonia. Screening criteria included: a) presence of ICD-9 code for pneumonia and b) presence of an electronic physician note and/or same day chest imaging report. We then selected a random sample of 200 cases, 457 documents (216 physician notes and 241 corresponding chest imaging reports).

All cases were reviewed by a pulmonologist, an internist, and six allied health professionals. Using an annotation tool called eHOST [3] and criteria based on the CDC pneumonia case definition, reviewers classified evidence into three semantic classes for words or phrases that a) *support*, b) *refute,* or c) are *uncertain for suspected pneumonia.* Three reviewers (A1, A2, A3) conducted a thematic review applying a clinical uncertainty taxonomy to map those snippets marked as uncertain (3,150 unique snippets) into 12 categories of uncertainty (Table 1). We report ranges of pair-wise inter-annotator agreement (IAA) and annotations for each semantic class. We also report IAA for mapping uncertain evidence snippets to our uncertainty taxonomy and distribution stratified by document source.

Results

A total of 30,872 annotations were generated for *supports* (20,477, 66.3%), *refutes* (6,688, 21.7%), and *uncertain* (3.707, 12.1%). Range for pair-wise IAA across all semantic classes was (0.40-0.73) and individually for *supports* (0.61-0.81), *refutes* (0.46-0.65), *uncertain* (0.19-0.47). We observed substantial IAA between reviewer pairs for mapping the uncertain evidence snippets into 12 categories of uncertainty (Table 1): A1/A2: 0.86, A1/A3: 0.89, A2/A3: 0.82.

Conclusions

We have extended an existing taxonomy of uncertainty and applied it to suspected pneumonia case review, deepening understanding of how uncertainty is expressed in clinical texts for suspected pneumonia. Despite substantial annotator variability in identifying supporting, refuting or uncertain evidence we observed high agreement for classification of evidence snippets to a taxonomy of uncertainty.

Table 1. Distribution of Evidence Snippets

	Physician Notes	Chest Imaging Notes
Uncertainty Category	N (%)	N (%)
Radiology Finding	102 (3.24)	591 (18.76)
Radiology Interpretation/Diagnosis	56 (1.78)	405 (12.86)
Radiology Finding - link - Radiology Interpretation/Diagnosis	124 (3.94)	962 (30.54)
Symptom	83 (2.63)	2 (0.06)
Physical Finding	221 (7.02)	5 (0.16)
Diagnosis	284 (9.02)	6 (0.19)
Image Quality	4 (0.13)	79 (2.51)
Source	1 (0.03)	0 (0)
Anatomic Location	2 (0.06)	10 (0.32)
Indication for exam	39 (1.24)	36 (1.14)
Symptom/Finding - link - Diagnosis	92 (2.92)	4 (0.13)
Other	29 (0.92)	13 (0.41)

Keywords

Natural Language Processing; Chart Review; Pneumonia

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