Identifying respiratory-related clinical conditions from ED reports with Topaz

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OBJECTIVE

To evaluate how well a text processing system called Topaz can identify acute episodes of 55 clinical conditions described in emergency department notes.

BACKGROUND

Case detection from chief complaints suffers from low to moderate sensitivity. Emergency Department (ED) reports contain detailed clinical information that could improve case detection ability and enhance outbreak characterization. We developed a text processing system called Topaz that could be used to answer questions from ED reports, such as:

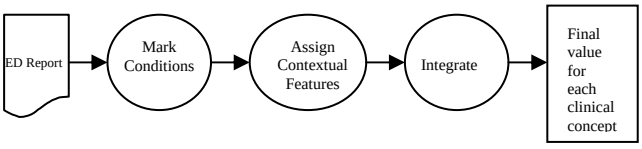
- How many new patients have come to the ED with acute lower respiratory symptoms?
- Of the respiratory patients, how many had a productive cough or wheezing?
- How many of the respiratory patients have a past history of asthma?

METHODS

Topaz identifies 55 respiratory-related clinical conditions from ED reports, assigning the value *acute, chronic, or absent* to each of the conditions in a three-step process, shown in Fig 1. In describing the modules below, we use the following example:

"Past history of pneumonia, presenting with cough and fever. Chest x-ray shows localized infiltrate."

Fig 1. Topaz assigns values to conditions with three modules.



Module 1: Mark Conditions. Using MetaMap [1], Topaz maps words to UMLS concepts and then to the 55 conditions. In the example sentence, Topaz would mark the underlined conditions:

"Past history of pneumonia. Presents with cough but denies fever. Husband recently treated for bronchitis. Discharge diagnosis pneumonia. Return if febrile"

Module 2: Assign Contextual Features. For each condition marked by Topaz, an algorithm called ConText assigns values to features useful for understanding the condition:

Existence (*present, absent*); Temporality (*recent, historical, hypothetical*); Experiencer (*patient, other*).

For the example, ConText assigns the values:

Pneumonia$_1$: *present, historical, patient*
Cough: *present, recent, patient*
Fever$_1$: *absent, recent, patient*
Bronchitis: *present, recent, other*
Pneumonia$_2$: *present, recent, patient*
Fever$_2$: *present, hypothetical, patient*

Module 3: Integrate. Topaz integrates information from individual annotations to assign a single value to each of the 55 conditions. The resulting output can be queried for detecting or characterizing outbreaks.

RESULTS

We evaluated each module separately on a test set of 60 ED reports. Reference standard annotations were provided by a single physician with feedback from Topaz, allowing the physician to change his annotations when he felt he had made a mistake.

Table 1: Performance for Module 1: Mark Conditions

TP	FP	FN	Precision	Recall	Incorrect Condition Name ^
578	3	70	89%	99%	30 (5%)

^The number of conditions Topaz marked correctly but labeled with the wrong condition name, such as labeling "chest pain on inhalation" as Non-pleuritic chest pain rather than Pleuritic chest pain.

Table 2: Performance for Module 2: Assign Contextual Features

	TP	FP	FN	Precision	Recall
Historical	22	7	22	50%	76%
Hypothetical	17	0	4	81%	100%
Negation	282	5	13	96%	98%
Experiencer	1	0	2	33%	100%

The weighted kappa score between final values assigned to the 55 conditions by Topaz compared to final values generated from physician annotations was 0.85, indicating high agreement between Topaz and a physician.

CONCLUSIONS

In spite of mistakes in marking conditions and assigning contextual features, Topaz performed similarly to a physician in assigning 55 conditions the values *acute, chronic, or absent* based on the ED report. The resulting conditions may improve our ability to detect cases of lower respiratory illness and could aid public health investigation.

[1] Aronson, A.R., *Effective mapping of biomedical text to the UMLS Metathesaurus: the MetaMap program.* Proc AMIA Symp, 2001: p. 17-21.