



information  
engineering  
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# Syntactical Negation Detection in Clinical Practice Guidelines

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# Motivation

Identification of negated phrases in clinical practice guidelines (CPGs)

... expressing absence of certain conditions or diseases in patients ...

... describing treatment options that should not be taken into account for a patient

Improvement of automated processing of CPGs

Natural language of CPGs complicates Negation Detection

Former works handle medical documents of more restricted writing style

# Methodology

Analysis of CPGs regarding negations

Categorization of negations in five classes

Identification of rules applicable for each negation class

Usage of MetaMap Transfer (MMTx) for text analysis

Implementation: **NegHunter**

# Discrimination into Negation Classes

1. Adverbial Negation
2. Prepositional Negation
3. Intra-Phrase Triggered Negation
4. Adjective Negation
5. Verb Negation

# 1 - Adverbial Negation

Adverbs as triggers

Usage of verb combinations and trigger words “not”, “never”

Active and Passive Voice

“Guideline developers do **not** recommend **chemotherapy**.”

“**Chemotherapy** is **not** recommended.”

## 2 - Intra-Phrase Triggered Negation

Trigger contained in phrase

“no”, “without”, “inappropriate”,  
“ineffective”, ...

“Evidence obtained from at least  
one well-designed controlled study  
without randomisation.”

# 3 - Prepositional Negation

Triggers are phrases which are followed by prepositions

“absence of”, “lack of”, “freedom from”,  
“free of”, “none of”

“Freedom from pain is an important indicator for the status of the patient.”

# 4 – Adjective Negation

Adjectives as triggers

“ineffective”, “inappropriate”, ...

“A superficial shave biopsy is inappropriate for suspicious pigmented lesions.”



# 5 - Verb Negation

Verbs as triggers

“lack”, “deny”, ...

“The patient lacks a good health status.”

# Example: Rules for Adverbial Negation

“Guideline developers do **not** recommend **chemotherapy.**”

## Rules for active voice:

<Adverbial Negation Active Voice> ::=  
    <Active Negation Trigger> <Arbitrary Phrase Thread>  
    <Negated Phrases>

<Active Negation Trigger> ::=  
    (<Verb Phrase> <Adverb Trigger> <Verb Phrase>) |  
    (<Be Verb> <Adverb Trigger> <Verb Phrase -ing>) |  
    (<Verb Phrase> <Adverb Trigger> <Verb Phrase> <Verb Phrase>)

<Adverb Trigger> ::= “not” | “never”

<Verb Phrase -ing> ::= <Verb Phrase> “ing”

<Negated Phrases> ::= [<Noun Phrase>] [<Noun Phrase>] [<Noun Phrase>]

<Arbitrary Phrase Thread> ::= <Arbitrary Phrase except Noun Phrase>  
    (<Arbitrary Phrase except Noun Phrase> <Arbitrary Phrase Thread>)

# Evaluation

14 guidelines to evaluate NegHunter algorithm

Generation of “gold standard”

558 sentences containing 615 negated concepts

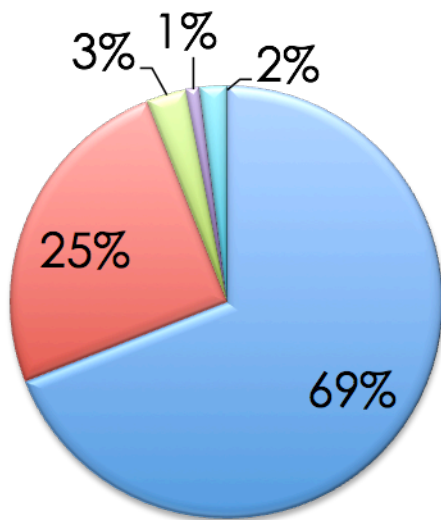
Usage of Recall and Precision

$$\text{Recall} = \frac{\sum \text{Identified Relevant Targets}}{\sum \text{All Existing Relevant Targets}}$$

$$\text{Precision} = \frac{\sum \text{Identified Relevant Targets}}{\sum \text{All Identified Targets}}$$

# Results

Distribution of Negations



| Negation Class                  | Recall        | Precision     |
|---------------------------------|---------------|---------------|
| Adverbial Negation              | 77.81%        | 60.32%        |
| Intra-Phrase Triggered Negation | 91.48%        | 97.94%        |
| Prepositional Negation          | 94.74%        | 78.26%        |
| Adjective Negation              | 83.33%        | 100%          |
| Verb Negation                   | 88.89%        | 55.17%        |
| <b>Overall</b>                  | <b>83.92%</b> | <b>69.36%</b> |

# Conclusion & Future Outline

Automatic negation detection saves a lot of time

Promising results with syntactical approach

Easy extensibility of NegHunter

Integration of a semantic component

„We did not treat the infection“ vs.  
„We did not detect the infection.“

Graduation of negations

„Chemotherapy is not always recommended as a treatment.“