



ReleMed: A Sentence-Level Search Engine for MEDLINE

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The Search Problem: High Retrieval & Low Specificity

PubMed®/MEDLINE® features comprehensive coverage of the biomedical literature. However, the sheer size of the database (over 16 million records) produces challenges for the searcher.

Challenge 1: How do you eliminate irrelevant articles without missing the relevant ones?

Eliminating irrelevant articles by increasing the search specificity must be balanced by retrieving almost all of the relevant articles – known as sensitivity. Methods that eliminate increasingly more of the irrelevant articles will also tend to miss more of the relevant articles.

A highly sensitive search, such as the PubMed query in Figure 1, returns a large proportion of false positives: in this case, more than half, for a false positive rate (FPR) of 52%.

Challenge 2: Can your search results display the most relevant articles first?

Currently, PubMed presents false positive (FP) articles mixed among true positives (TPs) right from the start of the retrieval set. Results cannot be sorted by relevance to the user's query.



Figure 1. PubMed query (sids or "sudden infant death") AND (infection or infectious or "communicable diseases")

The Solution: ReleMed

The lead author created a Web-based search engine, ReleMed™, that addresses these two challenges by:

- Employing sentence-level matching of search terms to attain a higher degree of retrieval specificity without sacrificing sensitivity.
- Sorting the search results in descending order based on a relevance score that moves the majority of the FP records down the list of results.



Figure 2. ReleMed interface

The ReleMed Premise:

- The majority of MEDLINE search queries are multi-word (83%).
- According to linguistic principles, the chance of the words having a relationship between them is greater when they occur in the same sentence.
- PubMed's default search identifies records with the requested words or MeSH, but not necessarily the relationship between the words.
- So, create a system to find records where search words occur within the same sentence, for this implies a relationship between the words.

Inside ReleMed

- Defining sentences:** Different sentence types within the MEDLINE record are defined:
 - The article title.
 - Sentences in the abstract (nine on average).
 - MeSH terms, which are concatenated together and treated as one sentence.
- Defining relevance:** Several levels of 'relevance' were created based on different combinations of the sentence types mentioned above.
- Finding synonyms:** Search terms are mapped to the UMLS® Metathesaurus. Synonyms are added to the search using 'OR'.

Relevance level	Query must match
1	T and A and M
2	T and A
3	T and M
4	A and M
5	T
6	A
7	M
8	TAM

T = title
A = at least one abstract sentence
M = concatenated MeSH terms
TAM = title, abstract, and MeSH

Figure 3. The eight relevance levels defined by ReleMed

ReleMed Display

Key features of the ReleMed results display include:

- Records sorted by the eight defined relevance levels.
- Search words highlighted in context for easy browsing.



Figure 4. Example of ReleMed retrieval

Appearance of Relevant Results

The true positive rate (TPR) in ReleMed is greatest at the beginning of the list of results; but in PubMed, TPR may reach its maximum anywhere.

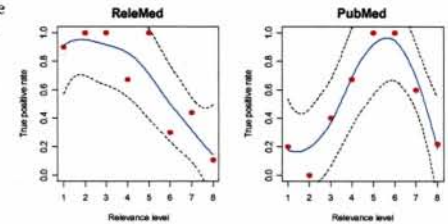


Figure 5. Sample search results judged for relevance and grouped in order of appearance in the search results

ReleMed Performance

Sample searches were run in both PubMed and ReleMed. The first ten results from each search were blinded and judged to be either 'relevant' or 'not relevant'. The percentage of relevant results was calculated for each search system and compared.

Search Examples	Precision	
	PubMed	ReleMed
Relation between temperature and heart failure	40%	90%
Relation between infection and celiac disease	20%	70%
Role of radiation in Down Syndrome	30%	60%

Figure 6. Percentage of first ten articles judged to be relevant

Conclusions

The amount of text a searcher is willing or able to scan is limited. By using sentence level matching, ReleMed delivers higher specificity, reducing false positive articles. Also, by displaying results by relevance, the most useful articles are shown first. Last, by displaying only the matching sentences and highlighting the search words, ReleMed shrinks the text, and the time the searcher spends for the 'scan & eliminate' process.