

# COMP348 — Document Processing and the Semantic Web

## Week 13 Lecture 1: Natural Language Processing for Evidence Based Medicine

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# Programme

- 1 What is Evidence Based Medicine?
- 2 EBMSummariser

## Some Useful Extra Reading

- NLP of Medical Texts: project page  
<http://comp.mq.edu.au/~diego/medicalnlp/>
- EBMSummariser demo: <http://130.56.244.116:8000/>

# Programme

- 1 What is Evidence Based Medicine?
- 2 EBMSummariser

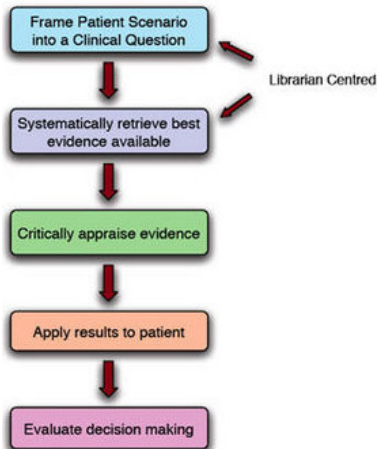
# Evidence Based Medicine



<http://laikaspoetnik.wordpress.com/2009/04/04/evidence-based-medicine-the-facebook-of-medicine/>

# Steps in EBM

[http://hlwiki.slais.ubc.ca/index.php?title=Five\\_steps\\_of\\_EBM](http://hlwiki.slais.ubc.ca/index.php?title=Five_steps_of_EBM)



# Programme

- 1 What is Evidence Based Medicine?
- 2 **EBMSummariser**

# The System

<http://130.56.244.116:8000/>

The screenshot shows a web browser window with the address bar displaying <http://130.56.244.116:8000/>. The page title is "EBMSummariser". Below the title, a message states: "If you happen to land on this page and wonder what this is all about, check our project page at Macquarie University. Use these results at your own risk!". A link "[PubMed clinical queries filters]" is visible. The main content area features a search bar with the text "Treatments for migraines" and a "Search" button. Below the search bar, there are five tabs labeled "Group 1", "Group 2", "Group 3", "Group 4", and "Group 5". "Group 3" is currently selected. Below the tabs, it says "48 results in 5 groups:". To the right of this text are buttons for "Expand All" and "Close All". The results are displayed in a list of four items, each with a "Keywords" section, a "Summary" section, a "Quality of Evidence" section with a progress bar, and a "results" section with an "Expand" button. The first result is about headache treatment, the second about acupuncture for psoriasis, the third about migraine treatment, and the fourth about menstrual migraine treatment.

EBMSummariser


If you happen to land on this page and wonder what this is all about, check our project page at Macquarie University. Use these results at your own risk!


[PubMed clinical queries filters]


Treatments for migraines Search


Group 1 Group 2 Group 3 Group 4 Group 5

48 results in 5 groups: Expand All Close All

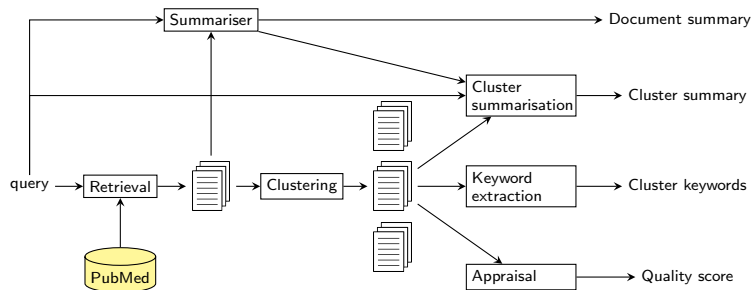
1. **Keywords:** headache; primary; chronic; stimulation; disorders **Quality of Evidence:**   
**Summary:** The aim of the study is to evaluate in a randomized, controlled, single-blind trial the effects of biofeedback associated with traditional pharmacological therapy in the prophylactic treatment of MOH. ... When faced with difficulties in reaching a precise diagnosis or in finding effective therapies, further advice should be sought from a children's headache clinic or specialist.  
10 results Expand

2. **Keywords:** acupuncture; review; neurological; effectiveness; psoriasis **Quality of Evidence:**   
**Summary:** We report the case of a patient with a known history of psoriasis who was treated for chronic migraines with acupuncture. ... The results showed that acupuncture mechanism study focused on the regulation and control of the relevant neurotransmitters/neuromodulators of migraine, such as calcitonin gene-related peptide (CGRP), serotonin (5-HT), nitric oxide (NO), etc.  
6 results Expand

3. **Keywords:** migraine; patients; treatment; clinical; impact **Quality of Evidence:**   
**Summary:** However, theories point to infections such as the Epstein-Barr virus, medications such as topiramate and associated migraines. ... We have previously provided evidence that reduction of homocysteine with a vitamin supplementation can reduce the occurrence of migraine in women.  
17 results Expand

4. **Keywords:** menstrual; migraine; options; review; treatment **Quality of Evidence:**   
**Summary:** Three drugs have been studied as potential inhalable treatments for acute migraine: dhydroergotamine (MAP0004), prochlorperazine (Staccato prochlorperazine), and loxapine (Staccato loxapine). ... The aim of this study was to evaluate the efficacy, safety, and tolerability of non-invasive vagus nerve stimulation for the prophylactic treatment of menstrual migraine/menstrually related migraine.

# Architecture of EBMSummariser





# Retrieval of Relevant Documents

## PubMed

- <https://www.ncbi.nlm.nih.gov/pubmed/>
- More than 28 million citations from biomedical literature.
- API via the Entrez Programming Utilities (E-utilities).

The screenshot displays the PubMed web interface. At the top, the NCBI logo and navigation links are visible. The search bar contains the text 'treatment migraines'. Below the search bar, there are options to 'Cancel RSS', 'Create alert', and 'Advanced'. The left sidebar contains filters for 'Article types', 'Text availability', 'Publication dates', 'Species', and 'Clear all'. The main content area shows 'Best matches for treatment migraines:' with a list of search results. The first result is 'COX inhibitors for the treatment of migraine' by Silberstein SD et al. (2014). Below this, there is a 'Search results' section showing 'Items: 1 to 20 of 16248'. The first result is 'A review of vagus nerve stimulation as a therapeutic intervention' by Johnson RL, Wilson CG. The second result is 'Genetic alterations affecting the genes encoding the enzymes of the kynurenine pathway and their association with human diseases' by Boros FA, Bohár Z, Vicseli L. On the right side, there is a 'Sort by:' section with 'Best match' and 'Most recent' options. Below this is a 'Results by year' bar chart. At the bottom right, there is a 'PMC Images search for treatment migraines' section showing several image thumbnails.

# Single-document Summarisation

## Regression-based Summarisation

- On a training set, all sentences are annotated with a score of importance.
- We train a regression system (Support Vector Regression) to learn to score the sentences.
- We choose the top  $n$  sentences.

## Features

- tf.idf of the words in the sentence.
- Cosine similarity with the tf.idf of the words in the question.

# Clustering

## K-means Clustering

- We haven't covered clustering in this unit ...
- Clustering attempts to find groups of similar documents.
- We used k-means clustering.
- Each document is represented as a vector.
  - tf.idf of the words in the document.
- K-means uses Euclidean distance between vectors.
- The number of clusters  $K$  is simply the square root of the total number of documents retrieved:

$$K = \sqrt{N}$$

# Cluster Appraisal

## Regression

- The training data uses the Strength of Recommendation Taxonomy (SORT) with three levels.
- We map the levels to a number from 0 to 1.
  - $A \rightarrow 1$ ,  $B \rightarrow 0.5$ ,  $C \rightarrow 0$
- The resulting numbers are the target score.
- We use Support Vector Regression to learn to score the clusters.

## Features

- tf.idf of the document (title and abstract).

# Cluster Summarisation

## Steps

- 1 Score each sentence in the cluster.
- 2 Select the top 2 sentences.

## Sentence Scoring

- Obtain the individual summary of each document.
- Concatenate all summaries into one document.
- Perform regression-based summarisation of the resulting document.
  - Same features as for single-document summarisation.

# Keyword Extraction from Clusters

## Cluster centroid

- Each document in the cluster is represented as a vector.
  - This is the same vector that is used by K-means to find the clusters.
- The centroid of a cluster is the average of all document vectors.

## Extraction of Keywords

- 1 Find the cluster centroid, each element in the centroid represents one word.
- 2 Select the  $n$  elements in the centroid with highest value.
  - Ignore words that appear in the query.
  - Ignore words with low tf.idf score.

# Training Data: Journal of Family Practice's "Clinical Inquiries"

## Which treatments work best for hemorrhoids?

### Evidence-based answer

Excision is the most effective treatment for thrombosed external hemorrhoids (strength of recommendation [SOR]: B, retrospective studies). For prolapsed internal hemorrhoids, the best definitive treatment

is traditional hemorrhoidectomy (SOR: A, systematic reviews). Of nonoperative techniques, rubber band ligation produces the lowest rate of recurrence (SOR: A, systematic reviews).

### Evidence summary

External hemorrhoids originate below the dentate line and become acutely painful with thrombosis. They can cause perianal pruritus and excoriation because of interference with perianal hygiene. Internal hemorrhoids become symptomatic when they bleed or prolapse (TABLE).

### For thrombosed external hemorrhoids, surgery works best

Few studies have evaluated the best treatment for thrombosed external hemorrhoids. A retrospective study of 231 patients treated conservatively or surgically found that the 48.5% of patients treated surgically had a lower recurrence rate than the conservative group (number needed to treat [NNT]=2 for recurrence at mean follow-up of 7.6 months) and earlier resolution of symptoms (average 3.9 days compared with 24 days for conservative treatment).<sup>1</sup>

Another retrospective analysis of 340 patients who underwent outpatient excision of thrombosed external hemorrhoids under local anesthesia re-

ported a low recurrence rate of 6.5% at a mean follow-up of 17.3 months.<sup>2</sup>

A prospective, randomized controlled trial (RCT) of 98 patients treated nonsurgically found improved pain relief with a combination of topical nifedipine 0.3% and lidocaine 1.5% compared with lidocaine alone. The NNT for complete pain relief at 7 days was 3.<sup>3</sup>

### Conventional hemorrhoidectomy beats stapling

Many studies have evaluated the best treatment for prolapsed hemorrhoids. A Cochrane systematic review of 12 RCTs that compared conventional hemorrhoidectomy with stapled hemorrhoidectomy in patients with grades I to III hemorrhoids found a lower rate of recurrence (follow-up ranged from 6 to 39 months) in patients who had conventional hemorrhoidectomy (NNT=14).<sup>4</sup> Conventional hemorrhoidectomy showed a nonsignificant trend in decreased bleeding and decreased incontinence.

A second systematic review of 25 studies, including some that were of

lower quality, showed a higher recurrence rate at 1 year with stapled hemorrhoidectomy than with conventional surgery.<sup>5</sup>

### Nonoperative techniques? Consider rubber band ligation

A systematic review of 3 poor-quality trials comparing rubber band ligation with excisional hemorrhoidectomy in patients with grade III hemorrhoids found that excisional hemorrhoidectomy produced better long-term symptom control but more immediate postoperative complications of anal stenosis and hemorrhage.<sup>6</sup> Rubber band ligation had the lowest recurrence rate at 12 months compared with the other nonoperative techniques of sclerotherapy and infra-red coagulation.<sup>7</sup>

### Fiber supplements help relieve symptoms

A Cochrane systematic review of 7 RCTs enrolling a total of 378 patients with grade I to III hemorrhoids evaluated the effect of fiber supplements on pain, itching, and bleeding. Persistent hemorrhoid symptoms decreased by 53% in the group receiving fiber.<sup>8</sup>

### When surgical hemorrhoidectomy is recommended

The American Society of Colon and Rectal Surgeons recommends adequate fluid and fiber intake for all patients with symptomatic hemorrhoids. For grade I to III hemorrhoids, the society states that banding is usually most effective. When office treatments fail, the society recommends surgical hemorrhoidectomy (SOR: B).

The society recommends excision of thrombosed hemorrhoids less than 72 hours old and expectant treatment with

### Classification of symptomatic internal hemorrhoid

GRADE	DESCRIPTION
I	Hemorrhoids do not protrude
II	Hemorrhoids protrude but reduce spontaneously
III	Hemorrhoids protrude and by hand
IV	Hemorrhoids are permanent

Source: Madoff RD, et al. *Gastroenterology*. 2004.<sup>12</sup>

hemorrhoids that present early. Surgical hemorrhoidectomy should be reserved for when conservative treatment fails and for patients with symptomatic grade III and IV hemorrhoids.<sup>10</sup>

### References

1. Greenstein J, Williams SB, Young HA, et al. Thrombosed external hemorrhoids: outcome after conservative or surgical management. *Dis Colon Rectum*. 2004;47:1493-1498.
2. Jorgensen J, Bach S, Stubbings SH, et al. Excision of thrombosed external hemorrhoids under local anesthesia: a retrospective evaluation of 340 patients. *Dis Colon Rectum*. 2003;46:1226-1231.
3. Perotti P, Antropoli C, Molino D, et al. Conservative treatment of acute thrombosed external hemorrhoids with topical nifedipine. *Dis Colon Rectum*. 2001;44:405-409.
4. Jayaraman S, Colquhoun PH, Mathew RA. Stapled versus conventional surgery for hemorrhoids. *Cochrane Database Syst Rev*. 2006;(4):CD005393.
5. Tjandra JJ, Chan MK. Systematic review on the procedure for prolapse and hemorrhoids (stapled hemorrhoidectomy). *Dis Colon Rectum*. 2007;50:878-892.
6. Shanmugam V, Thaha MA, Rabindranath KS, et al. Systematic review of randomized trials comparing rubber band ligation with excisional hemorrhoidectomy. *Br J Surg*. 2005;92:1481-1487.
7. Johanson JF, Rimm A. Optimal nonsurgical treatment of hemorrhoids: a comparative analysis of infrared coagulation, rubber band ligation, and injection sclerotherapy. *Am J Gastroenterol*. 1992;87:1600-1606.
8. Alonso-Coello P, Guyatt G, Heels-Ansell D, et al. Laxatives for the treatment of hemorrhoids. *Cochrane Database Syst Rev*. 2005;(4):CD004640.

# The XML Contents I

```
<record id="7843">
<url>http://www.jfponline.com/Pages.asp?AID=7843&issue=September_2009&UID=</url>
<question>Which treatments work best for hemorrhoids?</question>
<answer>
  <snip id="1">
    <sniptext>Excision is the most effective treatment for thrombosed
external hemorrhoids.</sniptext>
    <sor type="B">retrospective studies</sor>
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      <longtext>A retrospective study of 231 patients treated
conservatively or surgically found that the 48.5% of patients
treated surgically had a lower recurrence rate than the
conservative group (number needed to treat [NNT]=2 for
recurrence at mean follow-up of 7.6 months) and earlier
resolution of symptoms (average 3.9 days compared with 24 days
for conservative treatment).</longtext>
      <ref id="15486746" abstract=" Abstracts/15486746.xml">Greenspon
J, Williams SB, Young HA ,et al. Thrombosed external
hemorrhoids: outcome after conservative or surgical
management. Dis Colon Rectum. 2004; 47: 1493–1498.</ref>
    </long>
    <long id="1.2">
      <longtext>A retrospective analysis of 340 patients who underwent
outpatient excision of thrombosed external hemorrhoids under
local anesthesia reported a low recurrence rate of 6.5% at a
mean follow-up of 17.3 months.</longtext>
      <ref id="12972967" abstract=" Abstracts/12972967.xml">Jongen J,
```



## The XML Contents II

Bach S, Stubinger SH ,et al. Excision of thrombosed external hemorrhoids under local anesthesia: a retrospective evaluation of 340 patients. Dis Colon Rectum. 2003; 46: 1226–1231.</ref>

</long>

<long id="1.3">

<longtext>A prospective, randomized controlled trial (RCT) of 98 patients treated nonsurgically found improved pain relief with a combination of topical nifedipine 0.3% and lidocaine 1.5% compared with lidocaine alone. The NNT for complete pain relief at 7 days was 3.</longtext>

<ref id="11289288" abstract="Abstracts/11289288.xml">Perrotti P, Antropoli C, Molino D ,et al. Conservative treatment of acute thrombosed external hemorrhoids with topical nifedipine. Dis Colon Rectum. 2001; 44: 405–409.</ref>

</long>

</snip>

</answer>

</record>

# Take-home Messages

- Natural Language Processing technology to help the medical doctor find the best clinical evidence.
- The current system is a collection of simple approaches.
- For more details, see <http://comp.mq.edu.au/~diego/medicalnlp/>

# What's Next

Interested to know more?

- Friends of COMP348 (Facebook group)  
<https://www.facebook.com/groups/187767448495983/>