

A Study on the Use of Search Engines for Answering Clinical Questions

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Evidence Based Medicine

Evidence Based Medicine (EBM)

- ▶ Individual clinical expertise
- ▶ External evidence

Finding External Evidence

- ▶ Evidence-based summaries (e.g. UptoDate, the Cochrane Library)
- ▶ Clinical literature (e.g. PubMed)

Question Answering for EBM

Problems Facing the Practitioner

(Ely et al. 2002)

- ▶ Limited time available
- ▶ Difficulty in formulating the question
- ▶ Difficulty in synthesising multiple bits of evidence

Question Answering

1. Analyse the question
 - ▶ Classification (e.g. Evidence Taxonomy)
 - ▶ Query expansion (e.g. using MeSH terms)
 - ▶ Identify key information (e.g. PICO)
2. Select the documents (e.g. use a search engine)
3. Find the answer

Purpose of This Research

Goal

To assess the possibilities of using QA technology for EBM

Method

1. Gather a list of questions and answers
2. Send the questions to available search engines and QA systems
3. Manually search for the answers in the results

Evidence Taxonomy

(Ely et al. 2002)

I. Clinical (193 questions)

A. General (141 questions)

1. Evidence (106 questions)

a. Intervention (71 questions)

What is the drug of choice for epididymitis?

b. No Intervention (35 questions)

How common is depression after infectious mononucleosis?

2. No Evidence (35 questions)

What is the name of that rash that diabetics get on their legs?

B. Specific (52 questions)

What is causing her anaemia?

II. Non-clinical (7 questions)

How do you stop somebody with five problems, when their appointment is only long enough for one?

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Corpus

- ▶ Parkhurst Exchange website
- ▶ <http://www.parkhurstexchange.com>
- ▶ Selected 50 medical questions
 - ▶ Criteria: select relatively simple questions
- ▶ Manually simplify the questions

Parkhurst Exchange Screenshot

The screenshot shows a web browser window with the URL <http://www.parkhurstexchange.com/>. The browser's address bar and tabs are visible at the top. The website header features a banner with a photograph of four medical professionals and the text "PARKHURST EXCHANGE SOLUTIONS FOR THE PATIENTS YOU SERVE". Below the banner, the date "TUESDAY, JANUARY 19, 2010" is displayed. A navigation menu includes links for "HOME", "CLINICAL", "COLUMNS", "MD TOOLS", and "YOU".

The main content area is divided into two columns. The left column is titled "QUESTION OF THE WEEK" and contains the following text: *How can you distinguish between an infant with a blocked tear duct and one with conjunctivitis? What is the natural timeline for an infant with recurrent blocked tear duct?* Below the text are two buttons: "ASK A QUESTION" and "SEARCH Q&A". A link "> THE ANSWER" is also present.

The right column features the article "10 things you should know about... Osteoarthritis". The first item in the list is: "1. A quiet revolution has transformed our understanding of OA. We still don't know quite what it is, but we no longer believe it's caused by 'wear and tear.' That's why exercise — both weight-bearing and not — is now highly recommended. The benefit is greatest if there's weight loss. Losing 10% of weight can reduce OA knee pain by 25%. Assure patients that joint pain during exercise is not joint damage. ...". A link "> READ MORE" is located at the bottom right of the article.

At the bottom of the page, there is a "PRACTICE MANAGEMENT" section with a right-pointing arrow.

Example of Question and Answer

Title

Is watermelon allergenic?

Question

“A 16-year-old female patient had an urticarial reaction from watermelon. She now avoids eating it,” writes ABDULRAHEM LAFTAH, MD, of Watson Lake, Yukon. “What substance in watermelon would have caused the attack, and are there other related foods she should now stay away from?”

Answer

Watermelon does contain allergenic proteins that could provoke an IgE-dependent urticarial response. You can refer the patient for allergy skin testing to determine if this fruit was indeed the culprit. Watermelon belongs to a family of foods associated with ragweed pollen. These include cantaloupe, honeydew, zucchini, banana, cucumber and chamomile tea. Individuals suffering from ragweed allergic rhinitis may develop symptoms, often mild, after eating these foods. This is particularly true during or following hay fever season, when their IgE to ragweed is the highest.

Example of Question Simplification

Original

Regardless of any other recommendations, should family doctors be immunized with Pneumovax and Menactra or Mejugate?

ANDREY BLITZER, MD, Thornhill, ON

Simplified

Should family doctors be immunized with Pneumovax and Menactra or Mejugate?

Examples of Simplified Questions

Question

Is watermelon allergenic

When to introduce solids to infants

Should family doctors be immunized with Pneu-
movax and Menactra or Menjugate

Can cell phones cause cancer

How much folic acid — 400 g, 1 mg, 5 mg —
is recommended before conception and during
pregnancy

How to beat recurrent UTIs

How to recognize autism in adults

Does skin colour affect vitamin D requirements

Category

No Intervention

Intervention

Intervention

No Intervention

Intervention

Intervention

No Intervention

No Intervention

Search Engines and QA Systems

Search Engines

- ▶ PubMed
- ▶ Google
- ▶ Google on PubMed

QA Systems

- ▶ MedQA (system often not working)
- ▶ Answers.com and BrainBoost
- ▶ OneLook

Question Processing

Method

If a question does not retrieve any relevant results in any of the systems, apply one level of processing until at least a result is returned by a system.

Levels of Processing

Level	Description	Original Question	Processed Question
1	Introduce synonyms/hypernyms	infectious	bacterial
2	Replace abbreviations	BP	blood pressure
3	Introduce general medical terms	What is shoulder frozen	What is shoulder frozen syndrome
4	Eliminate additional terms	Are there any contraindications to dental office visits in pregnancy	Dental office visits in pregnancy
5	Express medical context	What is the evidence that antibiotics change the course of the disease in infectious conjunctivitis	Are antibiotics recommended for bacterial conjunctivitis

Answer Extraction

- ▶ Manual inspection
- ▶ Limit to 10 first links
- ▶ Abstracts only
- ▶ Judge if the abstract contains the answer

Results of Question Processing

Level	1	2	3	4	5
Use	5.41%	10.81%	10.81%	45.95%	27.03%

Legend

Level Processing level

- 1 Synonyms/hypernyms
- 2 Abbreviations
- 3 Add general medical terms
- 4 Eliminate additional terms
- 5 Rephrase using medical context

Use How often the level was applied

Mean Reciprocal Rank of Systems

	Source	MRR
Intervention	Google	0.54
	Google on PubMed	0.35
	PubMed	0.24
	Answers.com	0.10
	MedQA	0.04
	OneLook	0.04
No Intervention	Google	0.80
	Google on PubMed	0.41
	Answers.com	0.38
	PubMed	0.27
	OneLook	0.04
	MedQA	0.04

$$MRR = \frac{\sum_{i=1}^n \frac{1}{rank_i}}{n}$$

Location of the Answer

	Abstract	Results	Conclusions
Non Intervention	43.48%	17.39%	26.09%
Intervention	57.89%	10.53%	26.32%

	Recommendations	Purpose	Methods
Non Intervention	0.00%	8.70%	4.35%
Intervention	5.26%	0.00%	0.00%

Conclusions

- ▶ Main question processing errors are due to extra terms
- ▶ Answers to all questions found in the top 10 documents
- ▶ Google is best
 - ▶ Even better than Google on PubMed
- ▶ PubMed's query expansion method didn't help much
 - ▶ Google's ranking outweighs PubMed's query expansion

Further Work

- ▶ Use more questions
- ▶ Use more complex question
 - ▶ Is there a source of realistic questions with their answers?
- ▶ Test a re-ranked version of PubMed
 - ▶ e.g. PubFocus
- ▶ Use other evaluation measures
 - ▶ MRR doesn't judge quality of the answer presented

Questions?

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