Misbeliefs and Biases in Health-Related Searches

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Misbeliefs and Biases in Health-Related Searches

Motivation

- 70% of people with Internet access use search engines to search about symptoms, diseases, and treatments [Fox and Duggan, 2013; Finney Rutten et al., 2019]
- Health misinformation is widespread on the web [Dai et al., 2020]
- People tend to believe that alternative medicine helps [Bhattacharya et al., 2012]
- Searchers tend to trust the top-ranked result [Pogacar et al., 2017]
- In 2013, more than 50% of search engines’ top answers to medical yes/no questions were incorrect [White, 2013]
Motivation

Does celandine help with cancer?

Recipes for treating cancer with celandine...

How to prepare celandine tincture for cancer: start with 2 drops ... Tincture of an equal amount of celandine, nettle and marigold helps with prostate cancer and metastases. Many folk doctors assure that ...

- Top 1 snippet answers yes and provides a recipe how to prepare and take
- No warning that celandine is toxic [Pantano et al., 2017]
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**Conclusion:** Our results strongly suggest that the components of the natural plant protoberberine fraction (BBR-F) extracted from C. majus may represent promising novel photosensitive agents and can be applied in cancer photodynamic therapy as natural photosensitizers [Warowicka et al., 2019].

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Research Questions

- What and how people ask search engines questions containing disease—alternative remedy pairs that represent potent. misbeliefs?

- How search engines answer such questions?
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Data

- 1.5 billion questions submitted to Yandex in 2012
- Diseases from the ICD codes (more formal, e.g., *malignant neoplasm*)
- Wikidata entities subordinate to disease (more colloquial, e.g., *cancer*)
- Medicinal plants from Wikidata and Wikipedia
- Alternative remedies like honey or leeches from Wikipedia
- 4,398 disease names; 1,007 plant names; 49 alternative remedies
Misbeliefs and Biases in Health-Related Searches
Yandex Log Analysis

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Disease</th>
<th>Frequency</th>
<th>Symptom</th>
<th>Frequency</th>
<th>Cond./State</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,124,402</td>
<td>Vaginal thrush</td>
<td>2,675,642</td>
<td>Fever*</td>
<td>11,406,708</td>
<td>Pregnancy</td>
</tr>
<tr>
<td>900,845</td>
<td>Cancer*</td>
<td>1,646,372</td>
<td>Pressure*</td>
<td>1,457,167</td>
<td>Pimple</td>
</tr>
<tr>
<td>566,079</td>
<td>Allergy</td>
<td>1,345,203</td>
<td>Pain / ache</td>
<td>896,097</td>
<td>Virus*</td>
</tr>
<tr>
<td>551,672</td>
<td>Cold / flu</td>
<td>814,583</td>
<td>Cough</td>
<td>556,700</td>
<td>Abortion</td>
</tr>
<tr>
<td>444,797</td>
<td>Hepatitis</td>
<td>520,182</td>
<td>Delay*</td>
<td>412,830</td>
<td>Bruise</td>
</tr>
<tr>
<td>432,548</td>
<td>Quinsy</td>
<td>505,529</td>
<td>Runny nose</td>
<td>366,441</td>
<td>Immunity</td>
</tr>
<tr>
<td>428,525</td>
<td>Hemorrhoids</td>
<td>353,502</td>
<td>Inflammation</td>
<td>338,112</td>
<td>Burn</td>
</tr>
<tr>
<td>424,871</td>
<td>Cyst</td>
<td>336,160</td>
<td>Oedema</td>
<td>309,114</td>
<td>Wart</td>
</tr>
<tr>
<td>405,355</td>
<td>Cellulite</td>
<td>326,507</td>
<td>Diarrhea</td>
<td>301,974</td>
<td>Miscarriage</td>
</tr>
<tr>
<td>395,747</td>
<td>Herpes</td>
<td>218,207</td>
<td>Vomiting</td>
<td>291,874</td>
<td>Intoxication</td>
</tr>
</tbody>
</table>

The ten most frequently mentioned diseases, symptoms, and conditions (states) in questions from the Yandex log. Ambiguous terms for which we cleaned the frequencies from non-medical mention variants are marked with (*).

- ~71 mln. questions (5% of the log) mention some disease
- People ask more often about pimples than cancer
- Most questions are about pregnancy
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Yandex Log Analysis

<table>
<thead>
<tr>
<th>Frequency</th>
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</tr>
</thead>
<tbody>
<tr>
<td>190,918</td>
<td>What is a vaginal thrush?</td>
</tr>
<tr>
<td>143,731</td>
<td>Why does one dream of pregnancy?</td>
</tr>
<tr>
<td>142,297</td>
<td>How to get rid of pimples?</td>
</tr>
<tr>
<td>70,123</td>
<td>How to get rid of pimples at home?</td>
</tr>
<tr>
<td>62,726</td>
<td>How to get rid of cellulite?</td>
</tr>
<tr>
<td>57,402</td>
<td>How to get rid of cellulite at home?</td>
</tr>
<tr>
<td>54,059</td>
<td>How to induce delayed periods?</td>
</tr>
<tr>
<td>52,153</td>
<td>How to boost immunity?</td>
</tr>
<tr>
<td>47,688</td>
<td>Can one make love during pregnancy?</td>
</tr>
<tr>
<td>46,749</td>
<td>How to get rid of dandruff?</td>
</tr>
</tbody>
</table>

The ten most frequent questions in the Yandex log that mention a disease, a symptom, or a condition.

- Often: definitions and how to get rid of some medical condition
- In summer less questions about fever
- Questions about vaginal thrush are peaking in spring and autumn
- Questions about pimples show the least deviation, increasing trend
- Query log data might be an additional evidence for medical studies
How search engines answer potential health-related misinformation questions

- ~1.2 mln questions contain diseases and med. plants or alter. remedies

- **Belief confirmation** like “Can hepatitis be cured with milk thistle?”

- **Established belief** like “How to drink milk thistle to cure hepatitis?”

- **Misbelief questions**: no scientific evidence that the remedy helps or clinical trials showed the opposite
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Search Result Analysis

- 30 frequent questions (15 yes/no and 15 about instructions)
  *Does celandine help with cancer?* and *How to drink celandine for cancer?*
- Cochrane, PubMed, and BioMed Explorer to find true answer
- Annotated top 10 snippets

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**Does celandine help with cancer?**

**Recipes for treating cancer with celandine...**

How to prepare celandine tincture for cancer? How to take celandine tincture for cancer: start with 2 drops ... Tincture of an equal amount of celandine, nettle and marigold helps with prostate cancer and metastases. Many folk doctors assure that ...

Answers question yes (no, not clear)
Contains recipe / instructions (or not)
No warnings (or there are)
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Search Result Analysis

Яндекс
44% positively answer questions with untrue assumptions (i.e., misbeliefs)
6% give a correct ‘no’ answer
17% contain recipes and instructions
13% contain warnings about health risks

Google
32% positively answer questions with untrue assumptions (i.e., misbeliefs)
47% correctly say ‘no’
12% contain recipes and instructions
10% contain warnings about health risks
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- Snippets tend to confirm health-related misbeliefs
- Only few snippets contain warnings
- For potential misbelief questions more attention should be put to the credibility
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I also thank ACM for providing me a grant covering the attendance fees
References


