

Misbeliefs and Biases in Health-Related Searches

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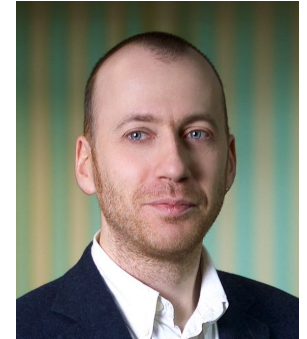
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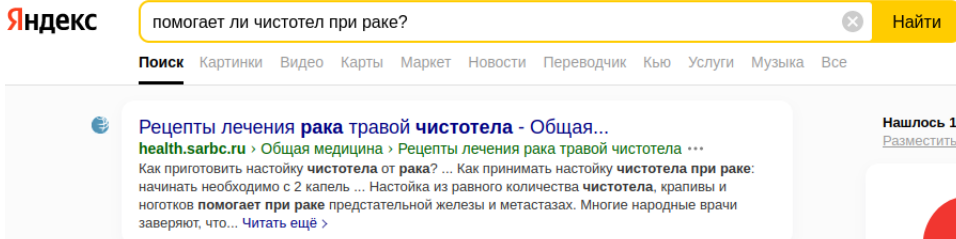
Misbeliefs and Biases in Health-Related Searches

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]

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Motivation



Does celandine help with cancer?

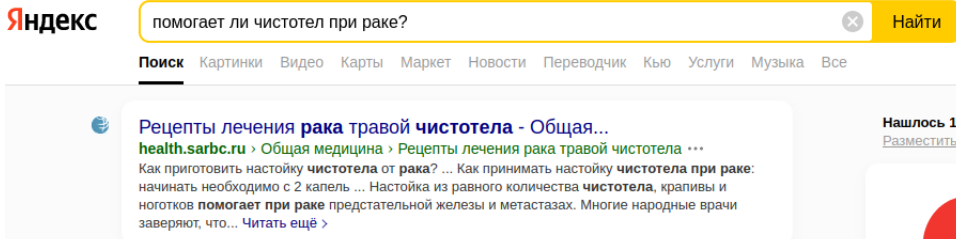
Recipes for treating cancer with celandine...

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 ...

- ❑ 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].¹

X No (maybe in future)

¹ <https://pubmed.ncbi.nlm.nih.gov/31465980/>

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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



The screenshot shows the Wikipedia article for "Medicinal plants". The page includes the Wikipedia logo, navigation links, and the main text of the article. The text discusses the history of medicinal plants, their chemical diversity, and their use in traditional medicine. It mentions the Sumerian civilization, the Ebers Papyrus, and the Greek physician Dioscorides. It also lists various biochemical classes of medicinal plants and their modern uses.

Medicinal plants, also called **medicinal herbs**, have been discovered and used in **traditional medicine** practices since prehistoric times. **Plants** synthesise hundreds of chemical compounds for functions including **defence** against **insects**, **fungi**, **diseases**, and **herbivorous mammals**. Numerous **phytochemicals** with potential or established **biological activity** have been identified. However, since a single plant contains widely diverse **phytochemicals**, the effects of using a whole plant as medicine are uncertain. Further, the **phytochemical content** and **pharmacological actions**, if any, of many plants having medicinal potential remain unassessed by rigorous **scientific research** to define efficacy and safety.^[1]

The earliest historical records of herbs are found from the **Sumerian civilisation**, where hundreds of medicinal plants including **opium** are listed on clay tablets. The **Ebers Papyrus** from **ancient Egypt**, c. 1550 BC, describes over 850 plant medicines. The Greek physician **Dioscorides**, who worked in the Roman army, documented over 1000 recipes for medicines using over 600 medicinal plants in *De materia medica*, c. 60 AD; this formed the basis of **pharmacopoeias** for some 1500 years. Drug research makes use of **ethnobotany** to search for pharmacologically active substances in nature, and has in this way discovered hundreds of useful compounds. These include the common drugs **aspirin**, **digoxin**, **quinine**, and **opium**. The compounds found in plants are of many kinds, but most are in four major biochemical classes: **alkaloids**, **glycosides**, **polyphenols**, and **terpenes**.

Medicinal plants are widely used in non-industrialized societies, mainly because they are readily available and cheaper than modern medicines. The annual global export value of the thousands of types of plants with suspected medicinal properties was estimated to be US\$2.2 billion in 2012.^[3] In 2017, the

The bark of willow trees contains **salicylic acid**, the active metabolite of **aspirin**, and has been used for millennia to relieve pain and reduce fever.^[1]

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Yandex Log Analysis

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

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 (*).

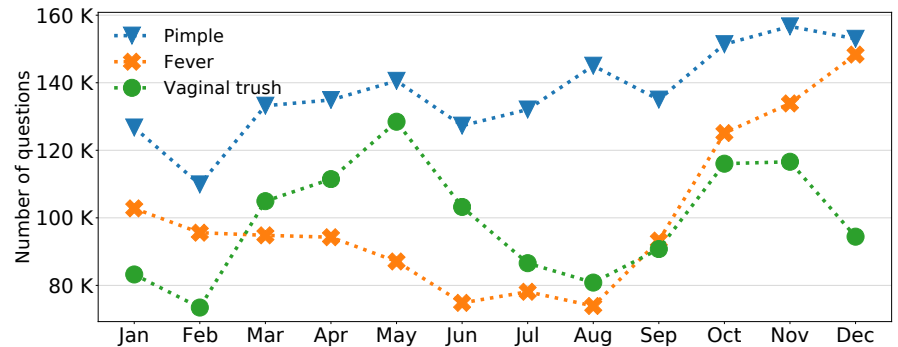
- ~71 mln. questions (5% of the log) mention some disease
- People ask more often about pimples than cancer
- Most questions are about pregnancy

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Yandex Log Analysis

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

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



Monthly trends in the Yandex log for questions mentioning one most frequent disease, symptom, or 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

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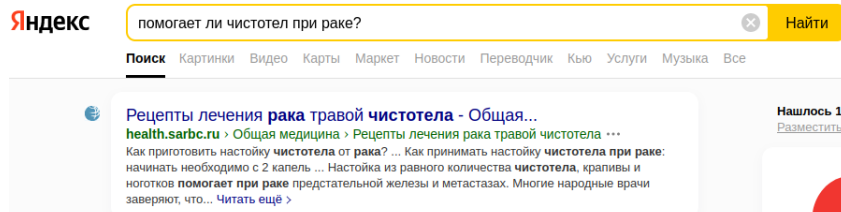
Search Result Analysis

- ❑ How search engines answer potential health-related misbelief questions
- ❑ ~1.2 mln questions contain diseases and med. plants or altern. 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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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

 G

32% positively answer questions with untrue assumptions (i.e., misbeliefs)

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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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thank you!

I also thank ACM for providing me a grant covering the attendance fees

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