Designing systems to better address the problem of misinformation

By

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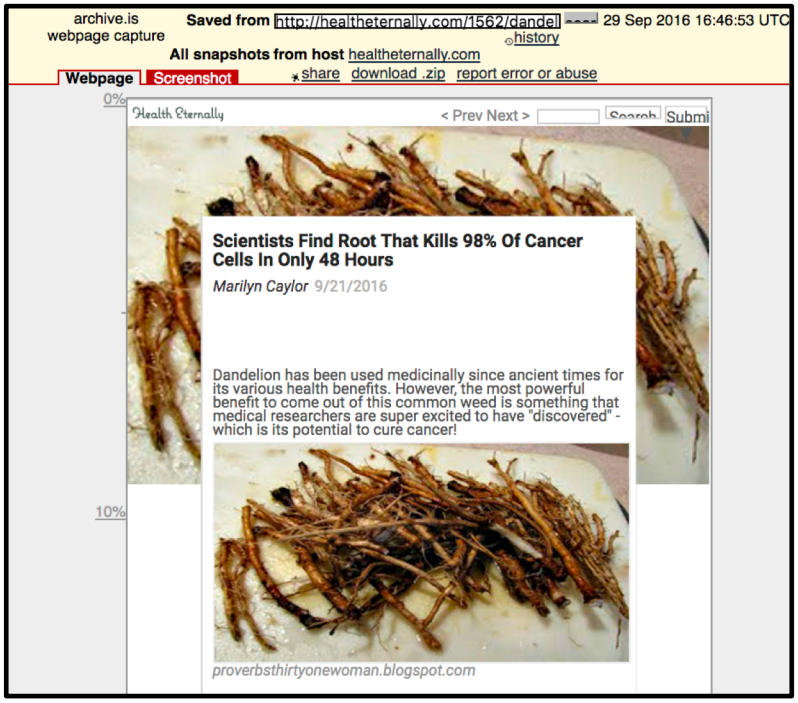
Imagine

- Your friend on social media posted an article about a cancer treatment
- The post reached 1.4 m shares
- You are curious to know more about this...
- You turn to your search engine and look up "**dandelion weed cancer**"



Integrative Medicine
Developing Your Personal Care Plan
Therapies, Classes & Workshops +
About Herbs, Botanicals & Other Products –
Overview
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Herbs, Botanicals & Other Products: FAQs
About Herbs App
Email Us
About Mind-Body Therapies
Our Research & Clinical Trials
Multimedia +

Dandelion

Common Names

- Blowball
- Puffball
- Lion's tooth
- Pu gong ying
- Swine snout
- Wild endive

Jump to: For Patients & Caregivers For Healthcare Professionals

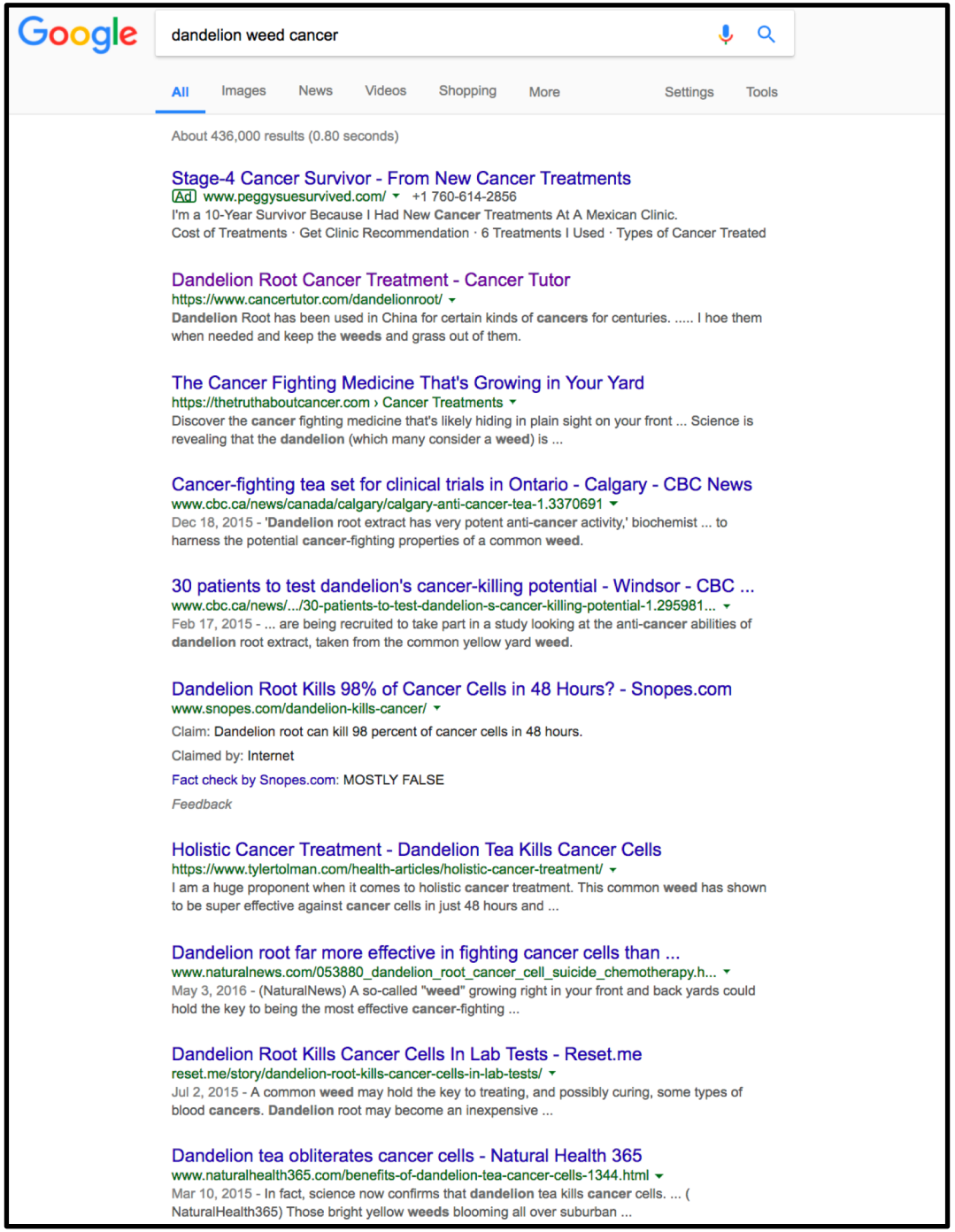
For Patients & Caregivers

How It Works

Purported Uses

Evidence-based medicine

- To treat cancer
  Laboratory studies have shown dandelion to have anticancer properties, but clinical studies have not shown this effect in humans.
- To treat diabetes
  Laboratory studies have shown dandelion to lower blood sugar, however no clinical studies have evaluated its effects in diabetic humans.



results on: 20 Sep 2017

'I'm living proof it works'

CBC: "researchers hoped to test dandelion root's potential.."

'Snopes' fact checking!

results on: 20 Sep 2017

Problem Definition

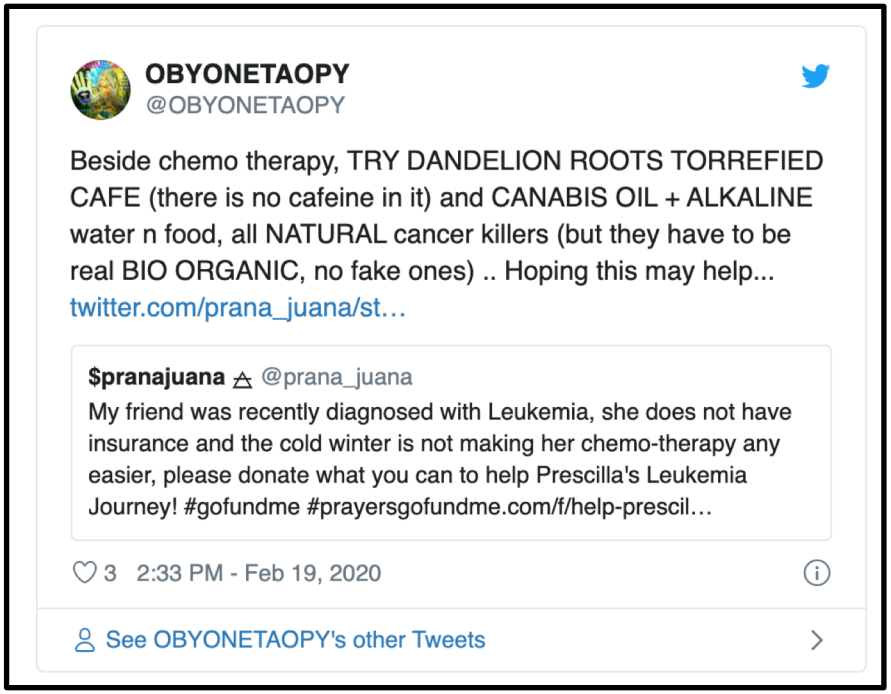
Looking at two major online platforms (online search/social media), how does online health misinformation effect people's health-related decisions?

Proposed Solution - Social Media

- Detect and track misinformation in social media
- Content analysis, ML, observational studies

> Can we automatically detect medical rumors?

> Who propagates questionable medical advise?



Health Misinformation User Modeling in Twitter

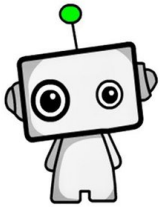
Topic Definition

Tweet Collection

Rumor

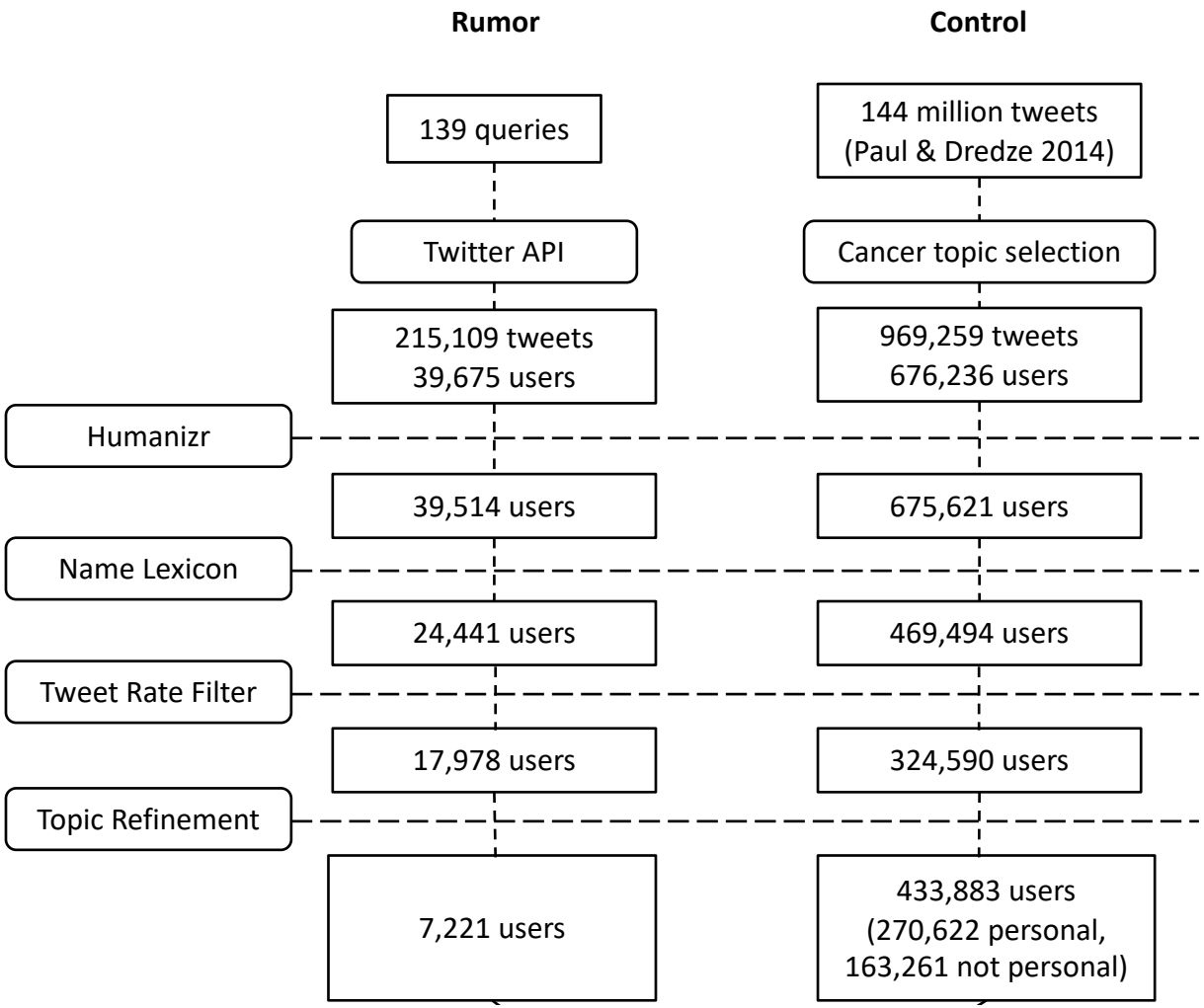
Control

User Selection



Relevance Refinement

User Selection



Can we **predict** the "rumor spreading" behavior?

- Look at all the tweets before a users posts a tweet about the rumor
  - Rumor users: tweets before the first rumor post
  - Control users: (no date for first rumor!) sample users' dates from a normal distribution having mean and variance of first rumor in Rumor dataset
- At least 100 tweets of 4,212 rumor users, sample control users

Can we **predict** the "rumor spreading" behavior?

- Use following feature types:
  - User features
  - Tweet features
  - Entropy: the intervals between posts to measure the predictability of retweeting patterns
  - LIWC (Linguistic Inquiry and Word Count): psycholinguistic measures shown to express user mindset
- Train logistic regression classifier to identify users that might be talking about rumors in the future using their historical timeline

Figure 2: Logistic regression with LASSO regularization model, predicting whether a user posts about a rumor, with forward feature selection.
McFadden R2 = **0.90**

Significance levels:
p < 0.0001 ***, p < 0.001 **, p < 0.01 *, p < 0.05 .

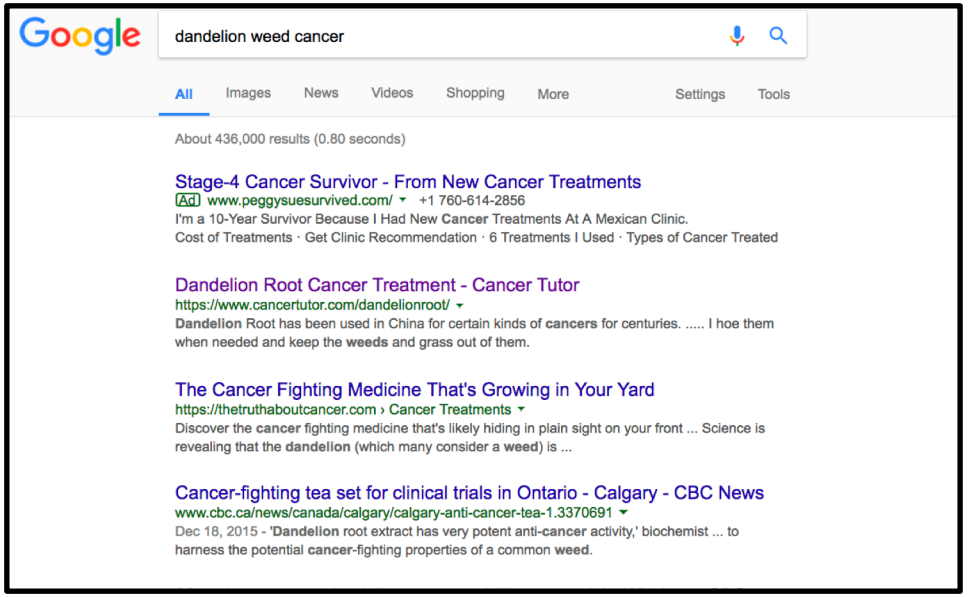
variable	coefficient	std. error	p-value
(Intercept)	-6.160	1.405	***
Avg syllables per word	17.120	0.660	***
Is verified	-40.310	42310	
Percentage uppercase / lowercase	-0.201	0.018	***
Word count	1.491	0.131	***
SMOG readability score	-0.753	0.123	***
Percentage uppercase	0.191	0.019	***
Character count	-0.163	0.024	***
Number of cancer tweets	0.001	1.9E-04	***
LIWC48: ingest	1.839	0.722	*
Negative word count	-1.460	0.262	***
URL count	3.364	0.505	***
Is retweet	4.947	0.790	***
word2vec count	-0.634	0.165	***
LIWC55: focuspast	-1.636	0.567	**
LIWC37: tentat	2.531	0.859	**
Number of sentences	-0.610	0.205	**
LIWC32: male	-1.820	1.000	
Interval entropy	0.508	0.105	***
Account age	-0.001	2.7E-04	***
LIWC23: posemo	-0.490	0.384	
LIWC61: time	-1.431	0.378	***
LIWC13: adverb	1.758	0.536	**
LIWC20: number	2.936	1.317	*
Statuses count	7.1E-05	2.6E-05	**
LIWC42: hear	-4.742	1.799	**
Has 1st person pronoun	-1.504	0.662	*
LIWC62: work	1.591	0.665	*
LIWC40: percept	1.217	0.754	

Proposed Solution - Online Search

- Understand how search results influence decisions
- Controlled laboratory studies

> What factors contribute to people's final health-decisions?

> How can we help people make correctly informed decisions?



The study

- Participants had to classify the medical treatments as
  - *Helpful:* Treatment has direct positive effect
  - *Unhelpful:* Treatment is ineffective or has a direct negative effect
  - *Inconclusive:* Unsure about the effectiveness
- Each participant classified a total of four medical treatment

Medical treatments

- The medical treatments and associated medical conditions were all formulated as “Does X help Y?”
- Each medical question was classified as *helpful* or *unhelpful*, as determined by the Cochrane Review by White and Hassan.
- Each participant answers 2 questions (2 helpful and 2 unhelpful)

Examples:

- Unhelpful: “Do insoles help back pain?”
- Helpful: “Does caffeine help asthma?”

Experimental Conditions

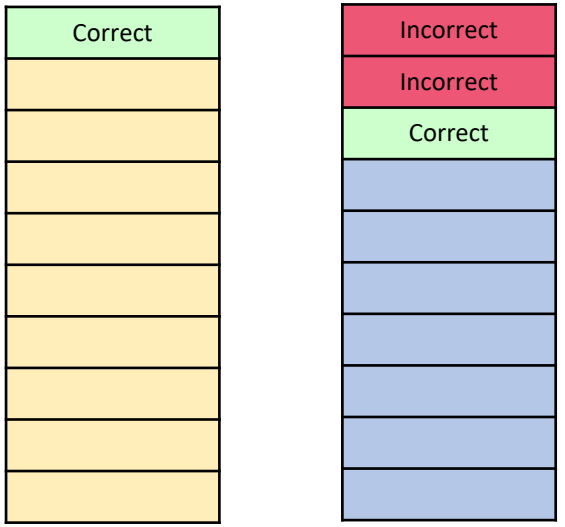
Search Result Bias

- 8:2 ratio of results
- 8 correct, 2 incorrect
- 2 correct, 8 incorrect

➢ 10 ×10 Graeco-Latin square to fully balance the experimental conditions with the treatments

Topmost Correct Rank

- Always had a correct result at rank 1 or rank 3



User performance

Accuracy

- Fraction of correct decisions
- A correct response agrees with the *authoritative answer*

➢Generalized linear (logistic) mixed effect model for stat. sig

Harm

- Fraction of harmful decisions
- A harmful decision is opposite of the *authoritative answer*
- *Inconclusive* is not considered a harmful decision

Experimental Details

- Total of 16 participants were asked to think aloud while they used search results to determine the efficacy of health treatments
- Procedure:
  - Concurrent think-aloud with eye tracking and video recording
  - Retrospective: Video recording reviewed by participants *post hoc* with further information elicited
  - Final questionnaire
- Think-aloud data transcribed and coded

Results – Search results bias

Results Bias	Correct decisions	Harmful decisions
Correct	0.67 ± 0.08	0.06 ± 0.03
Incorrect	0.32 ± 0.06	0.28 ± 0.06

Independent Variable	Dependent Variable	Pr(>Chisq)
Search Result Bias	Correct Decision	<< 0.001
Topmost Correct Rank	Correct Decision	0.8

Results – Coding

No	Name	Participants	References
C1	Majority	14	36
C2	Authoritativeness	13	153
C2	Stats & studies	12	20
C6	Advertisements	7	16
C7	Date	7	15
C8	References	7	12
C9	Negative information	6	15
C10	Information representation	5	18
C12	Prior_belief	5	8
C14	Readability	4	8
C13	Relevance	4	7
C15	Past_experience	3	3
C16	Text_length	3	3
C17	Images	2	6
C18	Rank	2	4
C19	Social_factor	1	2

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The majority of the search results stating that the treatment helps or that the treatment does not help or looking for a consensus of different search results.

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The trustworthiness and reliability of the source of information.

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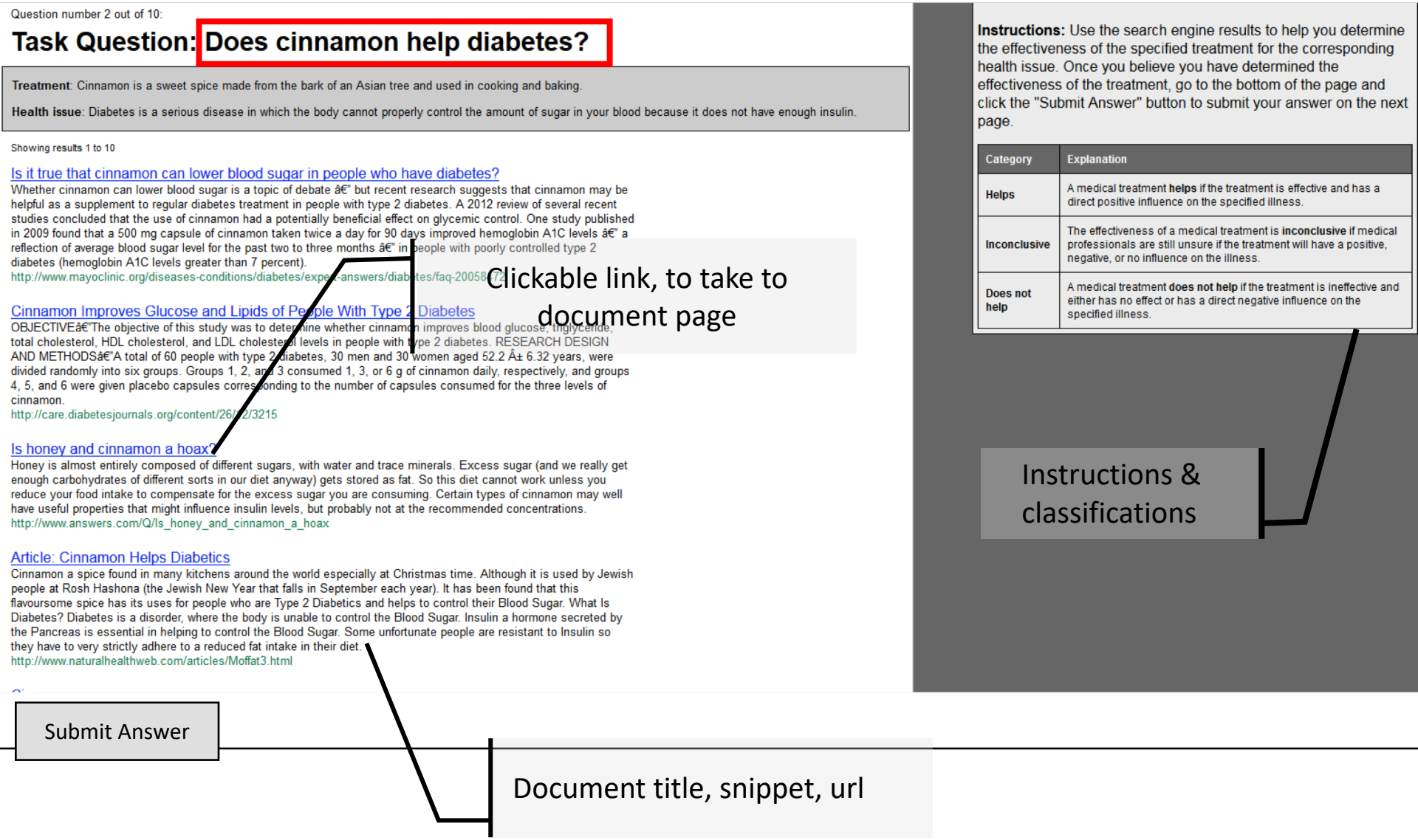
The quality of the search results page such as the presence of ads, research studies or reference/citations.

Quality

Conclusion

- Mixed-method approaches to address the health misinformation in online search and social media
- Social media:
  - Detection - automatically detecting Twitter users who may post questionable information
  - Intervention- attempting to change those individuals' views
  - Prevention - quickly identifying and limiting the spread of misinformation
- Online search:
  - Traditional search needs to incorporate a notion of negative gain to incorrect information

SERP Page:


Question number 2 out of 10:
Task Question: Does cinnamon help diabetes?
Treatment: Cinnamon is a sweet spice made from the bark of an Asian tree and used in cooking and baking.
Health issue: Diabetes is a serious disease in which the body cannot properly control the amount of sugar in your blood because it does not have enough insulin.
Showing results 1 to 10
Is it true that cinnamon can lower blood sugar in people who have diabetes?
Whether cinnamon can lower blood sugar is a topic of debate â€" but recent research suggests that cinnamon may be helpful as a supplement to regular diabetes treatment in people with type 2 diabetes. A 2012 review of several recent studies concluded that the use of cinnamon had a potentially beneficial effect on glycemic control. One study published in 2009 found that a 500 mg capsule of cinnamon taken twice a day for 90 days improved hemoglobin A1C levels â€" a reflection of average blood sugar level for the past two to three months â€" in people with poorly controlled type 2 diabetes (hemoglobin A1C levels greater than 7 percent).
http://www.mayoclinic.org/diseases-conditions/diabetes/expert-answers/diabetes/faq-20058
Cinnamon Improves Glucose and Lipids of People With Type 2 Diabetes
OBJECTIVEâ€"The objective of this study was to determine whether cinnamon improves blood glucose, triglyceride, total cholesterol, HDL cholesterol, and LDL cholesterol levels in people with type 2 diabetes. RESEARCH DESIGN AND METHODSâ€"A total of 60 people with type 2 diabetes, 30 men and 30 women aged 52.2 Â± 6.32 years, were divided randomly into six groups. Groups 1, 2, and 3 consumed 1, 3, or 6 g of cinnamon daily, respectively, and groups 4, 5, and 6 were given placebo capsules corresponding to the number of capsules consumed for the three levels of cinnamon.
http://care.diabetesjournals.org/content/26/12/3215
Is honey and cinnamon a hoax?
Honey is almost entirely composed of different sugars, with water and trace minerals. Excess sugar (and we really get enough carbohydrates of different sorts in our diet anyway) gets stored as fat. So this diet cannot work unless you reduce your food intake to compensate for the excess sugar you are consuming. Certain types of cinnamon may well have useful properties that might influence insulin levels, but probably not at the recommended concentrations.
http://www.answers.com/Q/Is_honey_and_cinnamon_a_hoax
Article: Cinnamon Helps Diabetics
Cinnamon a spice found in many kitchens around the world especially at Christmas time. Although it is used by Jewish people at Rosh Hashona (the Jewish New Year that falls in September each year). It has been found that this flavoursome spice has its uses for people who are Type 2 Diabetics and helps to control their Blood Sugar. What Is Diabetes? Diabetes is a disorder, where the body is unable to control the Blood Sugar. Insulin a hormone secreted by the Pancreas is essential in helping to control the Blood Sugar. Some unfortunate people are resistant to Insulin so they have to very strictly adhere to a reduced fat intake in their diet.
http://www.naturalhealthweb.com/articles/Moffat3.html
Instructions: Use the search engine results to help you determine the effectiveness of the specified treatment for the corresponding health issue. Once you believe you have determined the effectiveness of the treatment, go to the bottom of the page and click the "Submit Answer" button to submit your answer on the next page.
Category
Explanation
Helps
A medical treatment helps if the treatment is effective and has a direct positive influence on the specified illness.
Inconclusive
The effectiveness of a medical treatment is inconclusive if medical professionals are still unsure if the treatment will have a positive, negative, or no influence on the illness.
Does not help
A medical treatment does not help if the treatment is ineffective and either has no effect or has a direct negative influence on the specified illness.
Clickable link, to take to document page
Instructions & classifications
Submit Answer
Document title, snippet, url