Search for science: smart search-linked discussion forums

The Internet, it seems, knows an awful lot about me. For example, it knows that I recently searched "cheap men's watches", and now web advertisements never fail to recommend thrifty timepieces to me. The vast trove of consumer behavior data contained within search logs has made the data stored by search engines like Google an invaluable tool for everyone from company executives to journalists (1), but academia has been much slower to adopt its use. Science is ultimately about asking questions, and today, when people have questions, they often first ask Google. If we want to make biomedical research a part of the daily dialog, search engines can be the ultimate catalyst. I propose using Knowledge Graph technology to link search users to the scientific discussions relevant to their interests.

In 2012, Google introduced an addition to its Search feature known as Knowledge Panels (2). Rather than simply displaying search results, Google Search began displaying panels that summarized key information about the search topic alongside the traditional list of search results. Though simple sounding, these Knowledge Panels were part of an ambitious endeavor to transform Search from being just a connector between the user and websites into a "smart" service that anticipates and answers questions the user has regarding a particular subject. Importantly, Google is able to anticipate the questions a user will most likely be interested in because it has aggregate search data from countless other users. This aggregate data is used to create a "Knowledge Graph" that tells Google that, for example, people who search "Tom Cruise" likely are interested in which upcoming movies he is in and also how tall he is. In 2015, Google introduced Knowledge Panels for medical topics in collaboration with the Mayo Clinic (3). Now, a query for "angina" returns a vivid turquoise box showing a man clutching his chest with key medical information below.
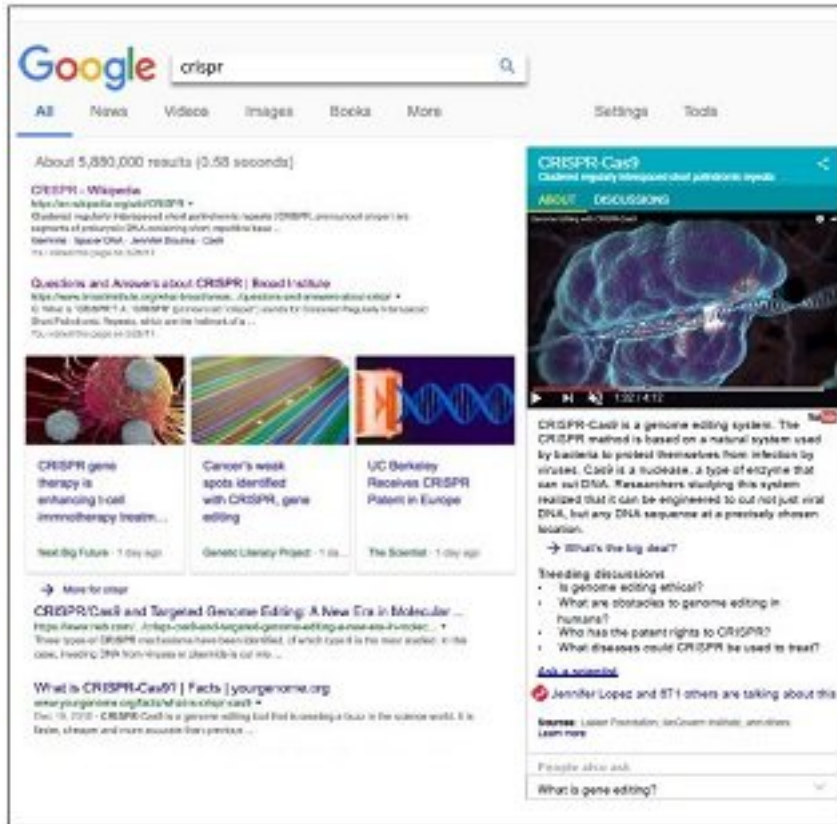
Figure 1A. Mock depiction of Knowledge Panels with links to discussion forums for scientific topics, using CRISPR-Cas9 as an example. The description of CRISPR-Cas9 is excerpted from the YouTube video shown above, courtesy of the McGovern Institute (6).

There is a tremendous opportunity within the Knowledge Graph structure to take Search to yet another higher level: moving from facts to discussion. People talk about topics that are relevant to their lives and that they have opinions about. Breakthroughs in biomedical research touch our lives in increasing ways, and it is these areas where science and society intersect that draw the most public interest. Imagine a query for "CRISPR", the exciting genome editing tool that has recently garnered much controversy (4). At the moment, such a query returns highlighted news stories about CRISPR/Cas9 and a list of search results. Now imagine if instead, the search returned an enhanced Knowledge Panel with a "Trending Discussions" feature (Figure 1A). Such a search would not only summarize information, but it would also draw users into discussion forums of the major questions surrounding CRISPR and the field of genome editing at large.

In order to make these discussion forums possible, I propose a partnership between Google and major scientific journals to use search data to continuously monitor the most searched topics related to biomedical research. The most commonly searched topics can be assigned to experts in the field in the same way that journals invite scientists to write review papers on major topics. However, instead of writing a review, these scientists will serve as the moderators of the discussion threads relating to their topic. The existing immense demand for such a scientific forum is best illustrated by the success of the AMA ("ask me anything") discussions held by scientists on the popular website Reddit. Stephen Hawking's AMA garnered more than 3,000 comments over 24 hours (5). By tying such a discussion thread to the existing structure of the search engine, we can connect laypeople with scientists in the informal forum of the Internet. Once these forums are in place, there are also numerous opportunities to publicize discussions in order to draw as many people into the conversation as possible. For example, the most trending topics could be advertised on the web, and celebrities could be invited to participate and ask questions. The other advantage of search-linked science forums is their ability to rapidly respond to the news. Non-experts often first encounter scientific terms when they become newsworthy. CRISPR and Zika are both excellent examples of how search trends for biomedical topics are driven by news stories (Figure 1B,C). Such spikes in search interest are transient, so it would be especially advantageous for users on Google to encounter the trending discussion forums and be able to react with questions and opinions immediately.
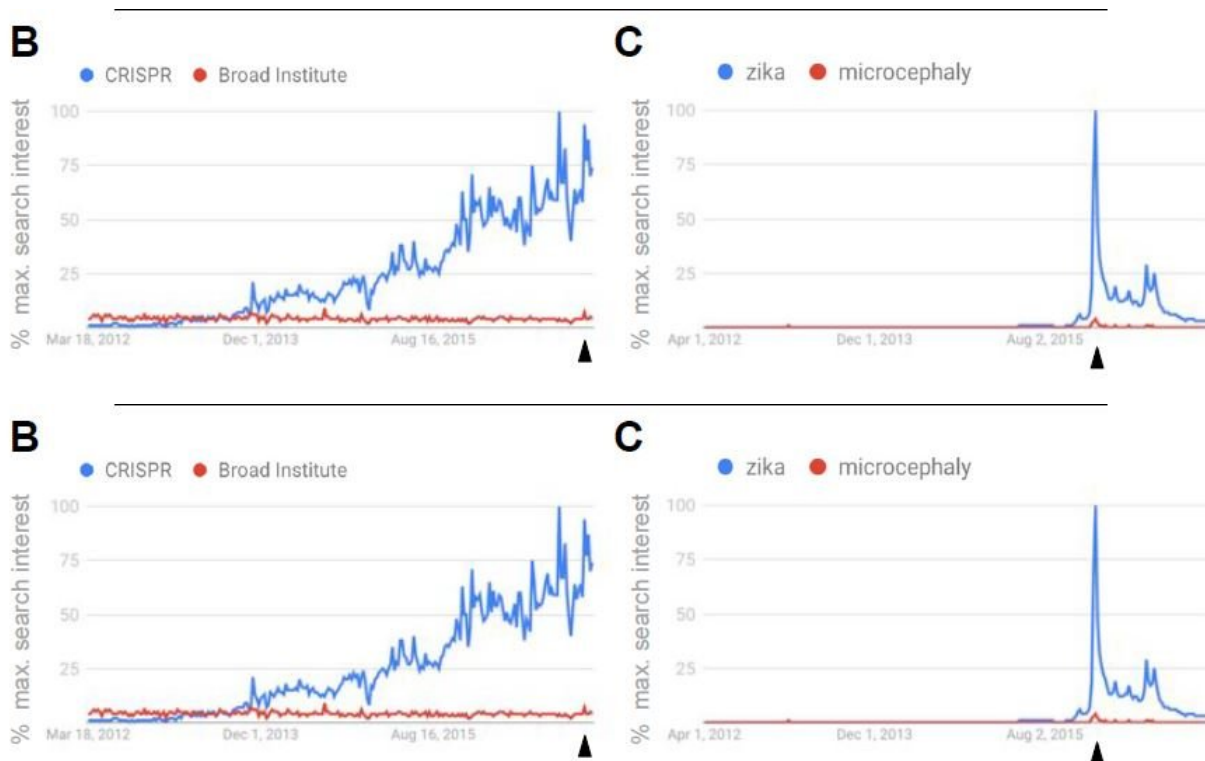
Figure 1 B and C. B) Google Trends search volumes for "CRISPR" and "Broad Ins*tute". Arrowhead: In February, 2017 the Broad Instute won a controversial patent dispute over CRISPR. C) Google Trends search volumes for "zika" and "microcephaly". Arrowhead: In October 2015, Brazil reported an increased incidence of microcephaly among infants, later to be associated with Zika virus infection (7).

As scientists, if we want to engage with the public and generate support, the best questions to start answering are the ones that people are already asking. Smart search technology can bring people to the conversations they're likely interested in, paving the way for the science forums of the future.

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3. Verel, D. Google to reshape how it provides health information, Mayo clinic joins as

partner. *MedCity News*, Feb 10, 2015, accessed March 23, 2017.

4. Ledford, H. Broad Institute wins bitter battle over CRISPR patents. *Nature,* 542, 401. Published online Feb 15, 2017, accessed March 29, 2017.

5. Stephen Hawking AMA forum. *Reddit.com*, originally posted Oct 8, 2015, accessed March 23, 2017.

6. McGovern Institute for Brain Research at MIT *et al*. Genome editing with CRISPR-Cas9. *Youtube.com* video, posted Nov 5, 2014, accessed March 29, 2017. https://www.youtube.com/watch?v=2pp17E4E-O8

7. World Health Organization. The history of Zika virus. *WHO International*, last updated 2017, accessed March 29, 2017.