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Research Article

Google allows advertisers to target the sensitive informational queries of cancer patients

Alternative cancer treatments are associated with earlier time to death when used without evidence-based treatments. Our study suggests alternative cancer clinics providing scientifically unsupported cancer treatments spent an estimated $15,839,504 on Google ads from 2012 to 2023 targeting users in the United States. The ads led to an estimated 6,717,663 website visits. Paid traffic constituted 44.4% of all website traffic. Advertisers targeted cancer patients using Google's keyword matching feature which matches ad keywords to the searches of Google users. Keywords selected by advertisers mimicked the sensitive informational search queries of cancer patients. In 2023, 20,035 unique keywords emulated searches on cancer prognosis, alternative treatments, accessing treatment, treatment options, diagnosis, specific cancers, and late-stage cancer.

Authors: Marco Zenone (1), Alessandro Marcon (2), Nora Kenworthy (3), May van Schalkwyk (1), Timothy Caulfield (2), Greg Hartwell (1), Nason Maani (4)
Affiliations: (1) Faculty of Public Health & Policy, London School of Hygiene and Tropical Medicine, United Kingdom (2) Health Law Institute, University of Alberta, Canada (3) School of Nursing and Health Studies, University of Washington Bothell, United States (4) Global Health Policy Unit, The University of Edinburgh, United Kingdom.
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Research questions

- How are alternative cancer treatment clinics using Google keyword advertising services to attract prospective patients?
- What Google keywords are alternative cancer treatment providers using in their attempt to match keywords to the Google searches of cancer patients?
- To what degree are Google ads from alternative cancer treatment clinics generating traffic to their websites based on investment?

Essay summary

- We examined Google keyword advertising strategies and traffic to alternative cancer clinics' websites between 2012–2023 using Semrush data.

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- Google keywords are selected by advertisers to match ads to the searches of Google users. We completed a thematic analysis to determine how keywords mimicked the searches of cancer patients seeking cancer information on Google.
- The results indicate alternative cancer treatment providers in two locations (Tijuana, Mexico, and Arizona, United States) spent $15,839,504 in Google search advertising in the United States, leading to 6,717,663 website visits from 2012 to 2023. Paid traffic constituted 44.4% (6,717,663/15,137,009) of all website traffic. Each website visit from a paid Google ad cost on average approximately $2.36 USD.
- Advertisers mimicked the sensitive queries of cancer patients to target them with their marketing using Google's keyword-matching feature. In 2023, 20,035 unique keywords emulated Google searches seeking information on cancer prognosis, alternative treatments, accessing treatment, treatment options, diagnosis, specific cancers, and late-stage cancer.
- The Google tools used by alternative cancer clinics exploit users' searches for information and give prominence to websites promoting treatment unsupported by scientific evidence.
- Google must urgently prohibit keywords targeting the sensitive information queries of medically vulnerable groups such as cancer patients.
- Our findings suggest that organizations serving cancer patients could better monitor, pre-emptively debunk, and debunk predatory advertising in the absence of Google meaningfully restricting sensitive search query keywords or search ads.

Implications

Our results indicate Google is offering an effective opportunity to alternative cancer clinics, which we define as businesses providing scientifically unsupported cancer treatments, to target and mimic the sensitive informational search queries of cancer patients through Google search ad keywords. Google keywords are selected by advertisers to match ads to the searches of Google users. Alternative cancer clinics are using keywords emulating searches in which cancer patients are seeking information about cancer treatment, how to access cancer treatment, their prognosis, and options for persons with late-stage cancers. Keywords used the names of leading cancer treatment centers for adults and children, such as MD Anderson and St. Jude's Research Hospital, to redirect patients seeking treatment-related information to alternative clinics. The keyword ad-matching feature provided by Google to alternative cancer clinics exploits the information-seeking behaviors of patients.

The tools provided to alternative cancer clinics appear to successfully convert Google searches into website views, potentially leading cancer patients to ineffective and exploitative alternative cancer treatments. The use of alternative cancer treatment without evidence-based cancer treatment is associated with an increased risk of death (Johnson et al., 2018a, 2018b). For persons with treatable cancer, each month delaying evidence-based treatment is associated with a decrease in expected survival time (Hanna et al., 2020). For patients with end-stage cancers, alternative cancer clinics may offer false hope (Snyder, 2020), financially exploit patients (Swire-Thompson & Johnson, 2024) at the end of life, deny end-of-life care planning (Pedrosa et al., 2023), and spend time receiving ineffective treatments instead of receiving effective palliative care and spending time with family and loved ones. Alternative cancer clinics may offer treatments interfering with evidence-based cancer treatment or palliative treatment (Buckner et al., 2018). Treatments themselves may be dangerous or provided by persons unqualified to advise or administer cancer treatment (Szeto et al., 2023). The opportunities Google offers advertisers likely enable alternative cancer clinics to recruit patients for ineffective treatments and spread false cancer information (Lazard et al., 2023).

Medically vulnerable groups of people, defined as persons that may require particular support due to their illness, such as cancer patients who have exhausted their treatment options, are at particular risk of exploitation through misleading health keyword targeting. Cancer patients in the United States are also vulnerable due to high rates of uninsurance, underinsurance, and medical debt, which contribute to high levels of unmet medical needs, particularly among cancer patients. Clinics used Google keywords to target persons actively seeking treatment options in especially vulnerable situations, such as those without curative treatment options. Tailored messages matching misleading messages to the psychological profiles of cancer patients may increase patient susceptibility to pursuing alternative treatment (Acerbi, 2019; Ecker et al., 2022; Kozyreva et al., 2020). Research shows that repeat exposure to misinformation increases the likelihood of it being internalized and believed; if exposed to the same ads, patients may start to believe clinics are valid treatment options due to message repetition (Dechêne et al., 2010; Ecker et al., 2022; Unkelbach et al., 2019). Tailored messages might also appeal to people who are inclined to distrust evidence-based cancer treatments and further push them in that direction (Tangkiatkumjai et al., 2020; Welz et al., 2018). Patients, in their search for hope (Snyder, 2020), may experience optimism biases in evaluating search results, leading to ignoring or justifying red flags (Ozdemir & Finkelstein, 2018). Discerning cancer treatment credibility requires advanced training, which most patients do not have. Further compounding risks, ads matched to the patients from their keyword targeting may appear credible (Ecker et al., 2022), offering testimonials (Hawke et al., 2019), or other legitimacy indicators. Misleading keywords present unique risks to persons with unmet needs or in desperate situations.

Google keywords and search ads create, contribute, and sustain infrastructural disinformation systems. Predatory businesses spread disinformation, but Google appears to enable and perpetuate a disinformation infrastructure (Gray et al., 2020) through which bad actors can maximize their exposure and profitability. Google dominates the search engine market, holding nearly 81.95% global market share among leading search engines (Bianchi, 2024). Previous research demonstrates that Google enables and incentivizes profit from disinformation. Google's advertising systems influenced the rise of fake news during the 2016 U.S. presidential election (Graham, 2017). The incentivization of disinformation occurs from organic information dissemination through Google, too. A study demonstrated Google's algorithmic ranking and discoverability optimized the spread of disinformation related to junk news (Bradshaw, 2019). Other research has uncovered how disinformation is exacerbated through Google's paid ads infrastructure. In 2023, the Center for Countering Digital Hate (CCDH) released a report finding nearly $10.2 million was spent on fake anti-abortion Google search ads and 71% of ads used misleading narratives or stated they provided abortions when they did not (CCDH, 2023a). In a separate report, the CCDH found that Google allowed advertisers to match ads denying the existence of climate change (Dembicki, 2023) and promoted disinformation related to the Russia-Ukraine war (CCDH, 2023b). Google keywords and search ads are only one element of how misleading cancer treatment information spreads across Google platforms, with other research finding alternative cancer clinics to leverage Google Reviews to provide compelling but unverified and improbable testimonials of late-stage cancer patients being cured or achieving remission (Zenone et al., 2024).

This research suggests that blocking keyword targeting of sensitive health informational queries is a critical priority. Google can restrict the types of health-related keywords available to certain advertisers. This includes removing keywords targeted to cancer, end-stage cancer patients, treatment unsupported by scientific evidence, persons seeking cancer cures, information on cancer-related clinical trials, where to seek cancer treatments, information on prognosis, or which cancer treatments to pursue. The search terms used in our study can support the development of banned keywords. Information about sensitive topics from reputable health providers or people with appropriate credentials should be elevated in search results. Restricting the keywords used by advertisers is within Google's capabilities and builds upon other strategies for deceptive health advertising (Google, 2024a). YouTube aggressively restricts certain disproven cancer treatments from marketing (YouTube, 2024). Google has shown a willingness and

capability in other health domains to deter dis- and misinformation in search results, such as for COVID-19 (Singh & Bagchi, 2020). It is a logical and necessary step for Google to not allow businesses providing scientifically unsupported cancer treatments to use their keyword services to market treatments based on sensitive health-related keywords.

Organizations serving cancer patients must monitor, pre-emptively debunk (McPhedran et al., 2023), and debunk (Chan et al., 2017) all forms of predatory advertising in the absence of Google meaningfully restricting sensitive search query keywords or search ads. Predatory cancer clinics are effectively using Google keywords to drive traffic to their websites which contain misleading cancer information. Those who advocate on behalf of cancer patients must monitor the practices of predatory clinics and understand the misleading information clinics are attempting to deliver to cancer patients. It is imperative the disinformation cancer patients are or may be exposed to from this misleading pipeline is pre-emptively addressed or debunked. Inoculation theory suggests warning of potential misinformation before its exposure can help prevent misinformation belief (Pilditch et al., 2022; Roozenbeek et al., 2022). Pre-emptive debunking can be delivered to patients from healthcare or support providers at the time of diagnosis. However, infrastructure is needed for this to occur and should be embedded within organizations serving cancer patients. Through active monitoring and pre-emptive debunking of predatory cancer clinic information, cancer patients can be inoculated against dis-and misinformation. But ultimately the burden should be placed on Google and those who regulate it to ensure its search engine technology and other products are safe for all users.

Evidence

Alternative cancer clinics' Google search advertising spend and reach

Between January 2012 and December 2023, alternative cancer clinics located in Tijuana, Mexico, and Arizona, United States, are estimated to have spent $15,839,504 USD (see Figure 1) on Google ads targeting users in the United States, leading to approximately 6,717,663 website visits from paid ads (see Figure 2). Organic traffic is estimated at 8,419,346 website visits from U.S. users. Paid traffic appears to outperform organic traffic from 2019 to 2023 amid increased investment in paid ads, whereas organic traffic outperformed paid traffic from 2012 to 2018. Paid traffic constituted 44.4% (6,717,663/15,137,009) of all website traffic. Each website visit from a paid Google ad cost on average approximately $2.36 USD, indicating very few patients are required to pursue services after a website visit for advertising to be profitable for alternative cancer clinics.

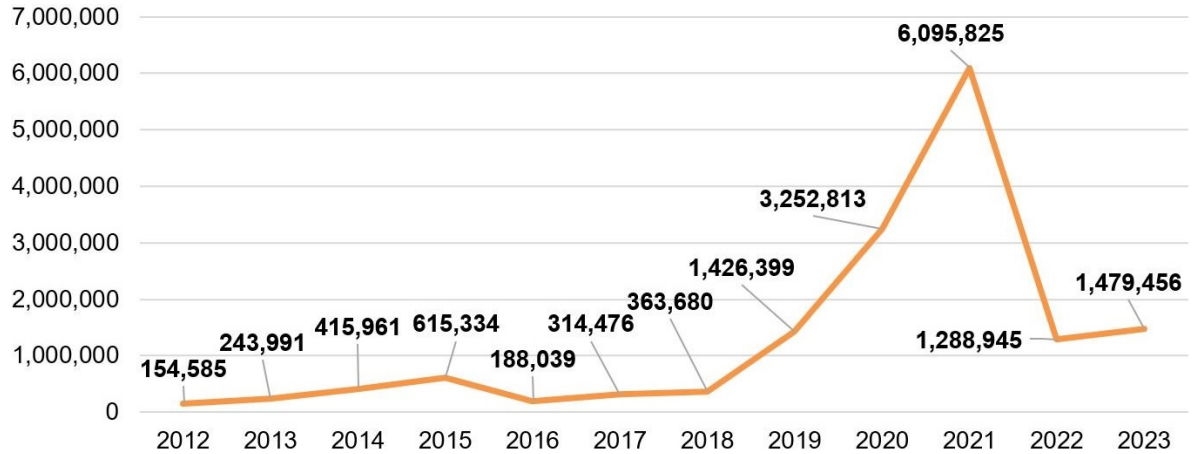

Figure 1. The alternative cancer clinics estimated Google paid advertisement spend from 2012–2023.

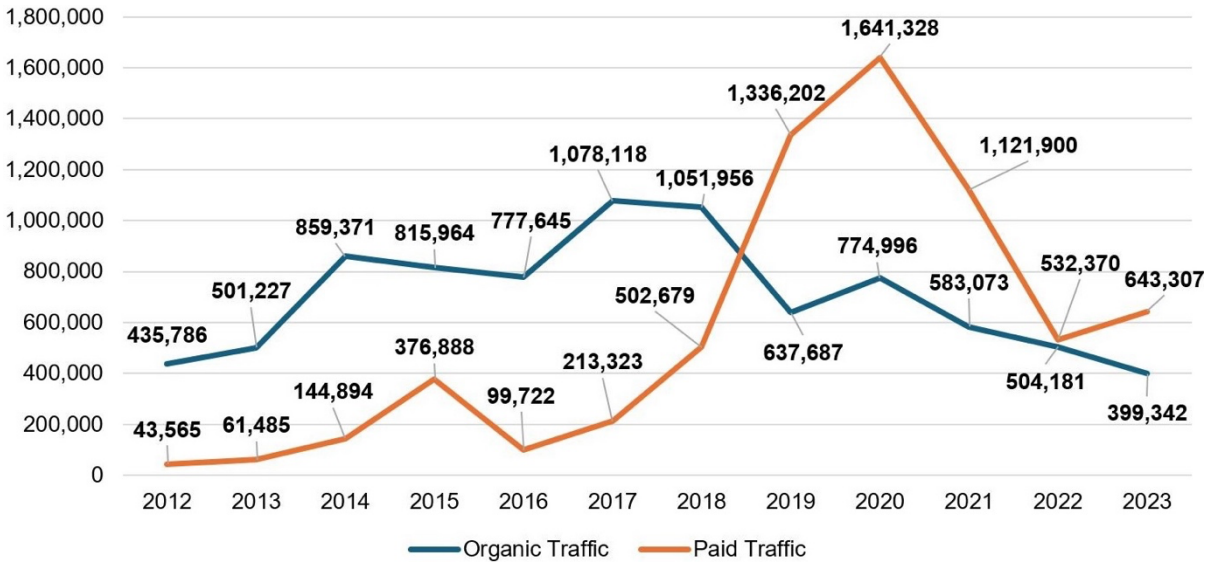

Figure 2. The alternative cancer clinics estimated Google paid and organic traffic from 2012–2023.

The trends in advertising spend and paid traffic appear to rise significantly in 2019 ($363,680 in 2018 vs. $1,426,399 in 2019) and during the initial phases of the COVID-19 pandemic in 2020 ($3,252,813). The ad spend peaked in 2021 during the pandemic at $6,095,825. The trends may reflect the shift to online forms of recruitment during the COVID-19 pandemic or patients potentially spending more time online. It may also reflect the consequences of delayed screening due to hospital closures, which may have resulted in more severe cases (Burus et al., 2024).

Themes

From January 2023 to December 2023, alternative cancer clinics used a total of 20,035 unique keywords to emulate the informational searches of persons with cancer, their families, or others searching for cancer-specific information. The informational search themes found across ad keywords mimicked by alternative cancer providers are summarized in Table 1.

Table 1. *Ad keyword informational themes to match alternative cancer clinic Google search ads to patients from January 2023 to December 2023.*

Information Sought	Characterizations	Example
Prognosis	Information on life expectancy by cancer type and stage; survival rates; expected length of time before death or disability; if they are expected to die from cancer	"stage 4 metastatic rectal cancer prognosis"
Accessing treatment	*Evidence-based treatment:* Best specialty cancer hospitals or treatment centers in a specific geographic area; how to access treatment; contact information of treatment providers; treatment providers for low-income groups or specific insurance plans; the names of leading and well-known cancer hospitals or treatment centers; clinical trial information and recruitment; provider names; [cancer type]+ specialist *Alternative treatment:* where to get alternative treatment; name of alternative cancer clinic (including competitors name)	"best breast cancer oncologist in Denver"

Information Sought	Characterizations	Example
Treatment information	What treatments are used for specific cancer types; new or recently approved treatment options; the best treatments to pursue; information on specific cancer treatments; information on cancer fighting diets; symptoms of specific treatments; alternative treatment names; which alternative treatments to pursue; alternative treatment instructions; natural treatment options; seeking if it is safe to forego evidence-based treatment in favor of alternative treatment; research on specific therapies; therapies	"best natural alternative to chemotherapy"
Diagnosis and living with cancer	Persons recently diagnosed with cancer; undergoing imaging for suspected cancer; expectations on living with cancer; symptoms to expect with cancer; social support and non-treatment advice; diet information for living with cancer [not intended to treat cancer]; survival narratives, symptom and pain descriptions	"invasive ductal carcinoma diagnosis"
Cancers	Specific types of cancer; specific types of cancer by stage; metastasis sites; tumor sites; what cancer stages mean; understanding a specific cancer type	"what is stage 3 cervical cancer"
Non-cancer related keywords and unknown acronyms	Diabetes; other diseases; exercises unrelated to cancer; diet information unrelated to cancer; medical treatments not for cancer; information on weight loss; seeking or accessing healthcare unrelated to cancer; lowering blood sugar; unknown acronyms	"natural remedies to lower blood sugar"

Advertisers targeted queries seeking information on cancer prognosis. This included prospective searches in which the search sought information on life expectancy by specific cancer type or stage ("stage 4 metastatic rectal cancer prognosis"), survival rates ("stage 4 cancer survival rate"), expected length of time before death or disability ("how long can you live with stage 4 melanoma"), likelihood of death ("is stage four breast cancer terminal"), stories of cancer survivors ("miracle stage 4 cancer survivors"), and the rates of success for specific treatments ("can immunotherapy cure stage 4 colon cancer"). These targets often sought to benefit from a practice that has been termed as "exploiting hope" among cancer patients (Snyder, 2020).

Advertisers used keywords mimicking users seeking information about how to access or find their best options for cancer treatment. Keywords emulated information on the best hospitals or treatment centers in a specific geographic area ("best breast cancer oncologist in Denver") and treatment centers for low-income groups or specific insurance plans ("does Medicare cover breast cancer treatment"). Advertisers used the names of world-leading cancer centers as keywords to show their ads to prospective customers ("MD Anderson") including for pediatric populations ("St. Jude's Research Hospital"). These keywords exploited users' efforts to "shop around" for care options by redirecting them to untrustworthy treatments.

Keywords sought to attract searches from prospective users expressing an interest or seeking information on alternative therapies. Emulated keywords included alternative treatment names ("rife therapy cancer"), which alternative treatments to pursue ("best alternative treatment for glioblastoma"), instructions ("how to use soursop for cancer treatment"), natural treatment options ("natural lymphoma treatment"), terms indicative of wanting to avoid evidence-based cancer treatment options ("best natural alternative to chemotherapy"), and where to get alternative treatment ("best alternative cancer

treatment centers in the world"), including the names of specific alternative clinics. Clinics used the names of their competitors in ad keywords.

Keywords emulated informational searches seeking information on cancer treatment options. Advertisers used keywords inquiring what treatments are used for specific cancer types ("lung cancer stage 3 treatment"), new or recently approved treatment options ("new prostate cancer treatment 2023"), which treatments are best to pursue ("best treatment for colorectal cancer"), information on specific cancer treatments ("chemo for rectal cancer"), and terms related to clinical trial recruitment and other experimental treatments ("clinical trials esophageal cancer").

Advertisers sought to match keywords to people recently diagnosed with cancer, undergoing diagnostic testing for cancer (both who have and have not met with a clinician), and living with cancer. Keywords included queries searching for resources for persons recently diagnosed with cancer ("invasive ductal carcinoma diagnosis"), undergoing imaging for suspected cancer or for preventative purposes ("breast lump biopsy what to expect"), expectations on living with cancer following diagnosis ("living with mesothelioma") including which symptoms to expect from the cancer itself and treatment ("symptoms of cancer of the cervix"), and signs of cancer ("early signs of breast cancer symptoms"). These keywords exploited patients who sought to become better informed about their diagnosis and expectations for living with cancer.

Advertisers matched searches for specific cancers to ads. This included keywords which matched the specific type of cancer a person would search for ("invasive ductal carcinoma"), including by stage ("stage 3 non cell lung cancer"), metastasis sites ("prostate cancer metastasis to bone"), tumor sites ("tumor in liver"), seeking information on what the cancer stage means ("what is stage 3 cervical cancer"), or seeking to understand a specific cancer ("what is triple negative breast cancer").

Methods

Data collection

We retrieved Semrush domain and advertising analytics of alternative cancer clinics operating in Tijuana, Mexico (*n* = 21), and Arizona, United States (*n* = 13) from January 2012 to December 2023 through two data pulls. We chose to study alternative cancer clinics—defined as businesses providing treatments unsupported by scientific evidence—in these two locations because it is not possible to list the full range of alternative treatments or identify all the clinics that offer alternative treatments globally. The clinics selected are located in two jurisdictions—Tijuana, Mexico, and Arizona, United States—known for their lenient regulations related to alternative cancer treatment provision. We identified the clinics through Google searches in which we sought to identify alternative treatment options in both areas and stopped once we could no longer identify other clinics. The sampled clinics are described by others as "predatory" and "quack" providers attempting to exploit desperately ill persons (Jarry, 2023). Clinics offer a range of alternative treatments and make unsupported claims about the efficacy of their treatments.

Semrush is a market intelligence platform providing information on a range of online activities, including Google keyword ad targeting (Semrush, 2024). Semrush is applied in other studies examining the informational queries of groups seeking medical care (Abeck et al., 2023; Fittler et al., 2022; Nanda et al., 2021; Wackerbarth et al., 2021). Semrush provides data estimates on any public website's organic traffic, paid Google ads website traffic, paid Google ads website traffic cost, and the keywords an advertiser uses in their Google search ads to match to the searches of Google search users.

In our use of Semrush, we performed two separate data pulls for each alternative cancer clinic to understand (1) their website traffic and paid traffic cost (organic and paid website traffic, paid traffic cost) and (2) the Google search ad keywords used to match their ads to Google users. Importantly, the retrieved

data for this study is only from audiences in the United States. The data collection steps are explained in detail and visually in the Appendix.

The first data pull consisted of accessing the Semrush "domain overview" dashboard of each alternative cancer clinic and exporting their organic website traffic, paid website traffic, and the cost of paid website traffic from 2012 to 2023 to a CSV file. Semrush summarizes this information in a chart on the domain overview which is exportable. After completing this for each clinic, we created an Excel workbook which aggregated the totals for each clinic by year. We then reported the aggregated totals.

The second data pull consisted of accessing the Semrush "advertising reach" dashboard to access the historical paid search positions of each alternative cancer clinic, which specifies the Google keywords used to match ads to user searches. This dashboard provides the option to search and export the Google search ad keywords used by each alternative clinic by month/year. We searched and exported the paid search for each month of 2023 by each alternative cancer clinic in our sample. We did this only for 2023 to ensure feasibility. Each Google search ad can have many keywords attached to it. The exported CSV from Semrush contained other information on paid search positions (for example, the search position the ad appeared in Google search results) but we only were interested in the keyword for our analysis. All the exported files were compiled in an Excel spreadsheet and the duplicates were removed, leading to the identification of 20,035 unique keywords (which can include phrases) used by alternative cancer clinics to match their ads to the search queries of cancer patients in 2023.

It is important to acknowledge the data retrieved has limitations. The data is drawn from Semrush, which provides useful insights through its advanced data collection strategies and models, but it is not a replacement for the actual data, which can only be provided by Google or the alternative cancer clinics themselves. This data is not available, though, and the Semrush estimates are therefore useful and appropriate to use in absence of data sharing from Google and the clinics.

Analysis

We performed a thematic analysis to understand how keywords emulated the potential informational search terms and phrases from cancer patients. Thematic analysis is a useful method to generate unanticipated insights, analyze the main points of large datasets (Nowell et al., 2017), and yield understanding of complex data (Braun & Clarke, 2006; Cassell & Symon, 2004; Nowell et al., 2017). The approach is informed by grounded theory which is useful for the novel exploration of topics for which little is known and to generate exploratory hypotheses (Glaser, 2002; Glaser & Strauss, 1999; Harkin et al., 2017). We followed the thematic analysis steps outlined by Braun & Clark (2006) consisting of data familiarization, initial code generation, theme searching, reviewing themes, defining themes, and reporting. We employed the recommendations of Nowell et al. (2017) to increase trustworthiness in each step of the analysis. The detailed steps of our analysis are available in the methods appendix. The analysis was completed according to steps outlined in the Standards for Reporting Qualitative Research Guidelines (O'Brien et al., 2014) to ensure our analysis followed qualitative research best practices. The study did not seek or require ethical approval. The data is non-traceable to any human subjects and keywords are targeted towards public audiences.

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Competing interests
The authors declare no competing interests.

Ethics
Not applicable.

Data availability
All materials needed to replicate this study are available via the Harvard Dataverse:
https://doi.org/10.7910/DVN/OMZCRL

Appendix: Methods supplement

Data collection

Data pull 1: The image below demonstrates the "domain overview" dashboard which was searched for each alternative cancer clinic. The chart in the green box was exported to CSV for each clinic and aggregated with the other clinics to understand cumulative website organic and paid traffic, as well as paid traffic cost. The clinic searched in this example is anonymized.

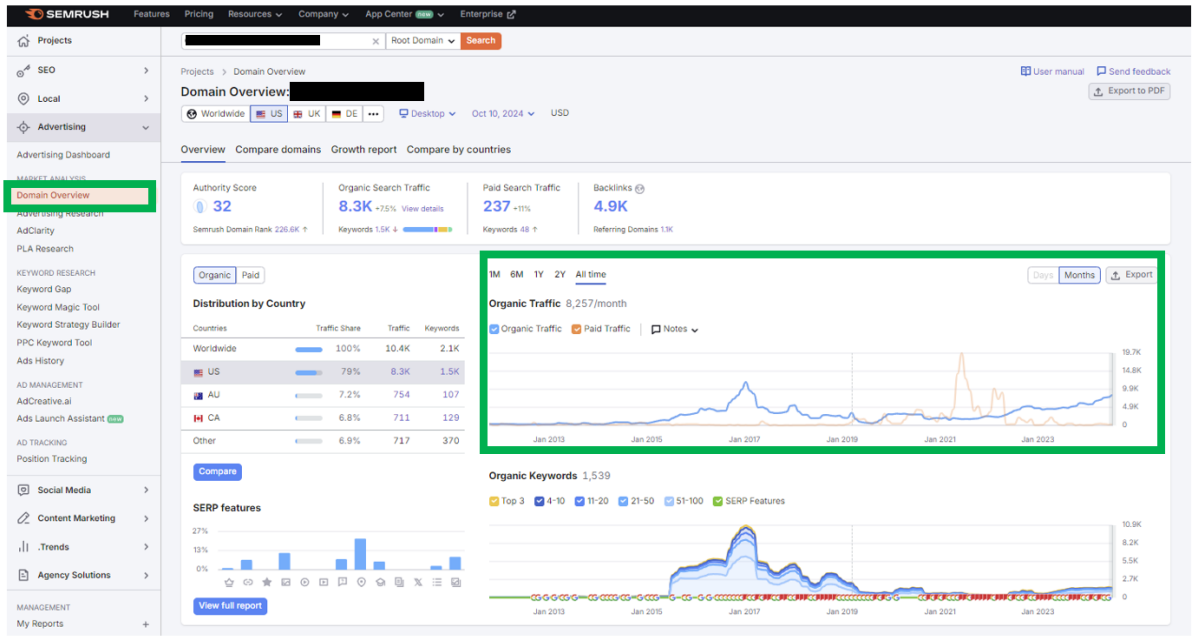

Figure A1. Collection of alternative cancer clinic organic traffic, paid traffic, and paid traffic cost.

Data pull 2: The image below demonstrates the "advertising research" dashboard which was searched for each alternative cancer clinic by each month of 2023. The bottom part of the image shows the exportable keywords, which were exported to CSV. There were other data that was possible to collect but we only were interested in the keywords used for the purpose of this analysis. After exporting the keywords used by each alternative cancer clinic by month in 2023, we removed the duplicates, identifying 20,035 unique keywords. The clinic searched in this example is anonymized.

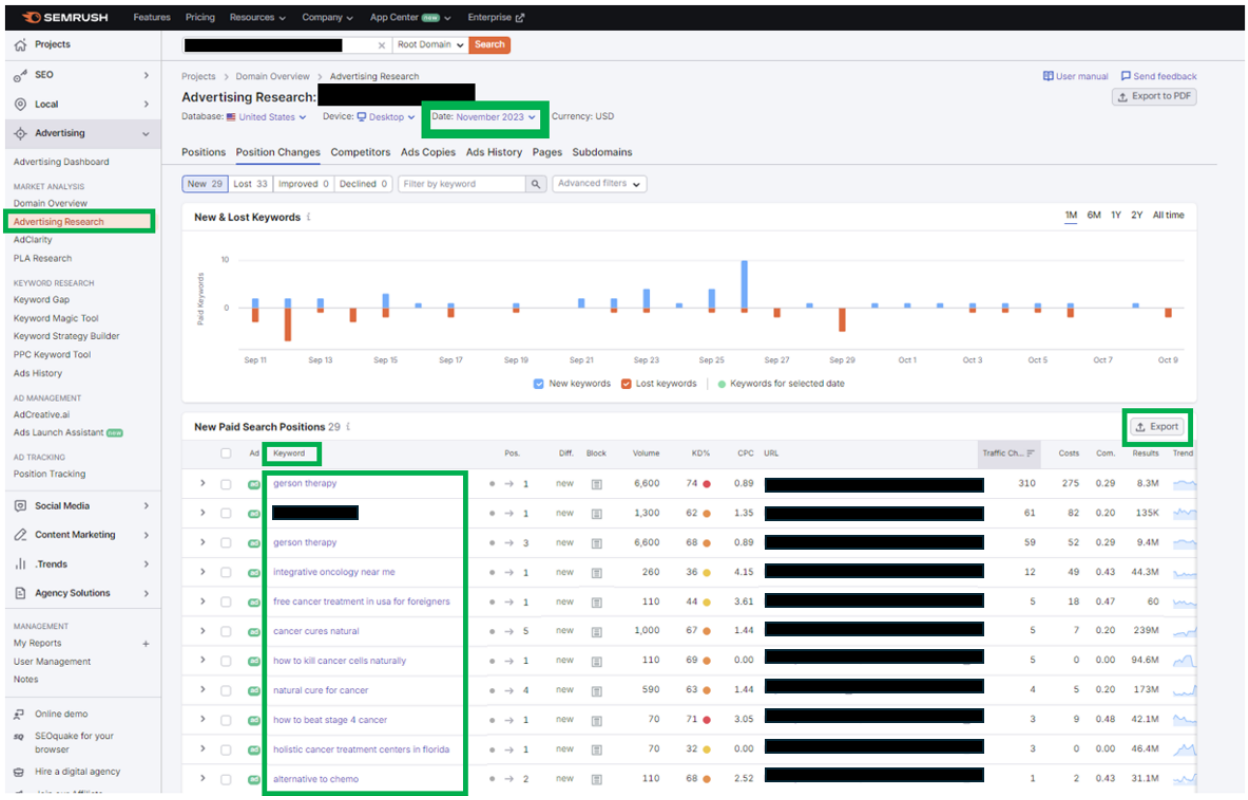

Figure A2. Collection of alternative cancer clinic paid Google search ad keywords.

Analysis

MZ independently reviewed half of the keywords to develop an inductive coding frame. Each keyword was considered a unique unit for coding. MZ found, iteratively reworked, refined, and defined themes. MZ repeated this process until no other themes were found or characterized within existing themes. Throughout this process, MZ coded 15,000 of the keywords and stopped upon reaching saturation of themes. AM completed two audits of a generalizable random sample of the keyword data (n = 400) of the code frame to verify saturation of the thematic categories and to test the defining characteristics of each. The first audit led to minor changes brought about through discussions between MZ and AM. The second audit tested the changes anew to confirm the presence of new categories, and to verify the completeness of defining characteristics. The second audit led to the identification of no new themes across the keywords.

Limitations

The limitation of the study is its data source. Semrush uses several methods to build its metrics but does not have access to the specific Google accounts of alternative cancer clinics. Therefore, while the data can provide useful insights, there are limitations to its accuracy. Semrush data collection is informed by partnerships between the company and clickstream data providers and uses its neural network algorithm to estimate traffic based on statistical sampling. Ads data are retrieved from databases tracking Google ads and estimating spend and reach. The data source and methods employed in the study are the most appropriate to answer our research questions. At present, there are few options to study how paid Google ads are targeted to cancer patients. Google provides in its Transparency Center a partial repository of ads which provide no information on ad targeting besides country and no engagement or spend metrics.