RESEARCH PAPER

Impact of COVID-19 on public's interest in radiotherapy and other cancer treatments: a cross-sectional Google Trends analysis

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ABSTRACT

Background: COVID-19 has significantly impacted cancer care. While previous studies have emphasized treatment modification and prioritized the delivery of cancer care, few have examined this issue from the public perspective.

Materials and methods: In the following study, we examine how public interest in various forms of cancer treatment has evolved during the pandemic using Google Trends. One-way ANOVA and linear regression tests were used to compare the mean search volume indices of three periods: pre-lockdown, lockdown, and reopening.

Results/Conclusions: Our findings suggest that public interest in cancer treatments decreased during lockdown and returned after reopening but, in general, is still lower than pre-lockdown levels. Despite that, healthcare professionals should strive to provide timely cancer care, assuage patients' fears of healthcare settings, and encourage patients to continue proper cancer screenings.

Key words: COVID-19; radiation therapy; public interest; Google Trends; chemotherapy, surgical oncology

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Introduction

COVID-19 has changed the landscape of cancer care, resulting in forgone screening, delayed diagnosis, and postponed treatment [1]. Healthcare professions were quick to adopt measures such as expedited treatment regimens, telemedicine, and PPE adherence to ensure high-quality cancer treatment [2]. However, there has been no study that has examined the interest in cancer care from patients' perspectives. The objective of this study is to use Google Trends, a publicly-available search engine analytics tool, to assess how the public's interest in cancer care, specifically radiotherapy, has evolved during the pandemic.

Materials and methods

Google Trends (Google LLC, Mountain View, CA) is a search engine analytics tool that analyzes the popularity of search queries, presented as "search volume index" (SVI): the search frequency of the queried term normalized to the highest frequency over specified time period and geographical location (scale of 0–100). The population included in Google Trends is a sample of all Google searches which is sufficient to be representative of the whole Google searches [3]. We queried Google Trends using the terms "IMRT", "proton therapy", "brachytherapy", "SBRT", "gamma knife", "chemotherapy", "cancer surgery", and "radiother-

apy", within the United States during the period 1/5/2020–10/10/2020. Each term and its synonyms were queried and the one with the highest search volume was selected to represent said category. "Top search terms" and "Rising search terms" for each term were verified to confirm that there were no other confounding meanings.

Three time periods were established: pre-lockdown (1/5/20–3/14/20), lockdown (3/15/20–5/30/20), and reopening (5/31/20–10/10/20), representative of an 'average/median' lockdown time of each state [4]. Descriptive statistics (mean ± SD) were used to describe SVI. One-way ANOVA was used to compare mean values of the three periods. Linear regression (regression coefficient β) was used to examine SVI changes over time. Statistical analyses

were performed using SPSS 25 (IBM Corp., Armonk, NY); significance was considered at $p < 0.05$.

Results

Comparing pre-lockdown with lockdown periods, statistically significant decreases in search volume were observed in all modalities (Fig. 1, Tab. 1). Comparing lockdown with reopening, statistically significant increases were observed except for stereotactic body radiation therapy (SBRT) and chemotherapy; these modalities demonstrated modest increases that were not statistically significant. Comparing pre-lockdown with reopening, statistically significant decreases were seen in all except intensity-modulated radiation therapy (IMRT) (65.45 *vs.* 56.74, p = 0.204),
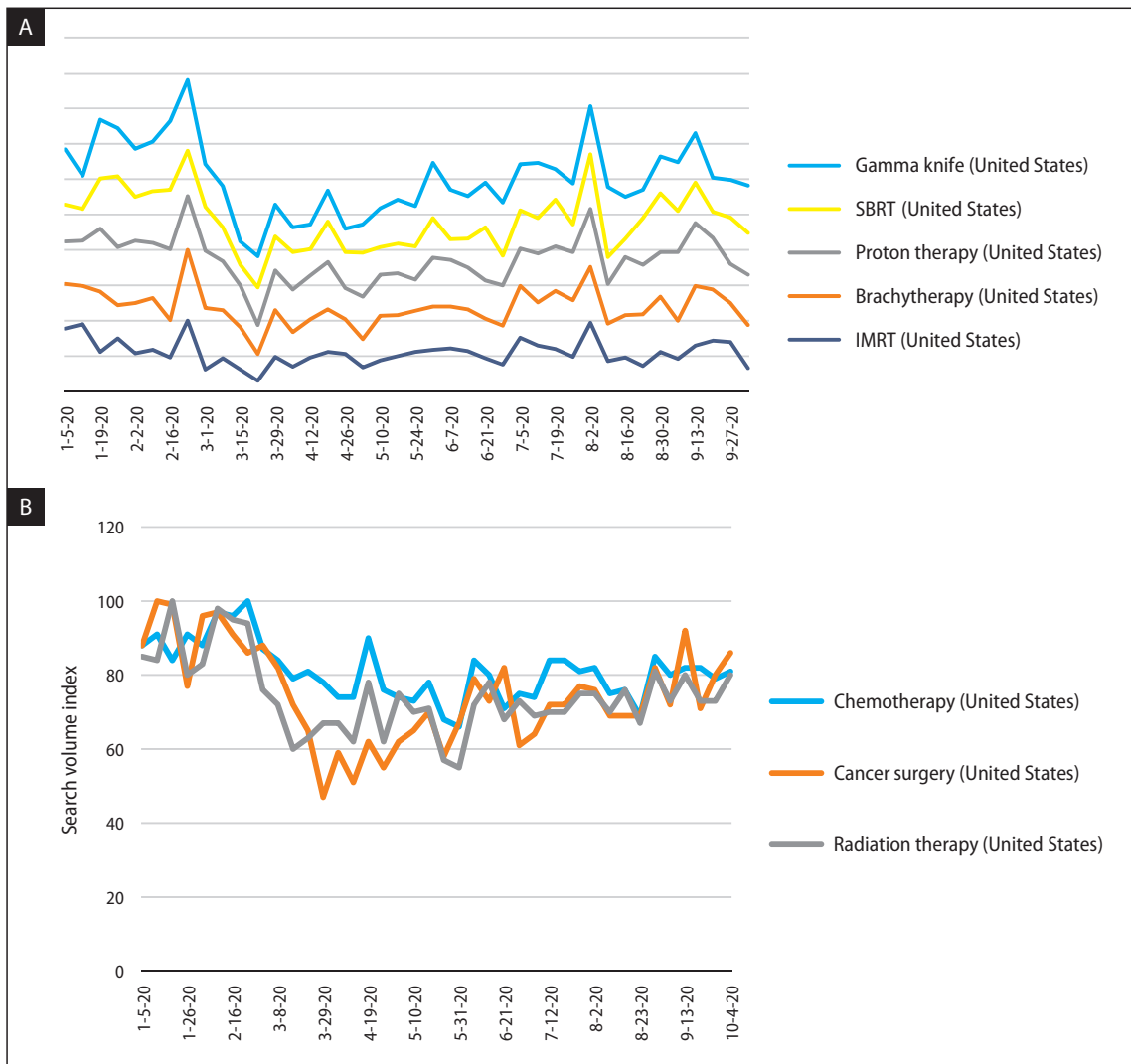

Figure 1. Line graph of search volume index changes over time by 5 different radiotherapy modalities (**A**) and 3 different oncological treatments (**B**) IMRT — intensity-modulated radiation therapy; SBRT — stereotactic body radiation therapy

Table 1. Comparison of mean SVI of 5 different radiotherapy modalities and 3 different oncological treatments across three key time periods during the COVID-19 pandemic

	Pre-lockdown	Pre-lockdown v.s. lockdown	Lockdown	Lockdown v.s. reopening	Reopening	Pre-lockdown v.s. reopening
	Mean (SD[a])	p value[b]	Mean (SD)	p value	Mean (SD)	p value
IMRT	65.40 (23.109)	0.005	42.82 (12.734)	0.039	56.74 (15.726)	0.20
Proton therapy	78.70 (12.157)	< 0.001	55.45 (8.490)	0.005	68.21 (12.255)	0.02
Brachytherapy	70.10 (16.835)	0.005	54.09 (9.115)	0.013	66.05 (10.768)	0.40
SBRT	66.10 (16.835)	0.006	47.09 (9.628)	0.256	54.95 (16.201)	0.04
Gamma knife	69.10 (15.308)	< 0.001	39.36 (12.909)	0.004	57.53 (17.138)	0.11
Chemotherapy	90.60 (5.502)	< 0.001	76.82 (5.619)	0.449	78.42 (5.480)	< 0.001
Cancer Surgery	90.40 (7.619)	< 0.001	60.55 (7.607)	0.000	74.37 (7.755)	< 0.001
Radiotherapy	86.70 (9.581)	< 0.001	66.55 (6.502)	0.033	72.53 (5.910)	< 0.001

[a]SD — standard deviation; IMRT — intensity-modulated radiation therapy; SBRT — stereotactic body radiation therapy; [b]p value obtained from one-way ANOVA with post-hoc LSD test

Table 2. Linear regression analysis of SVI of 5 different radiotherapy modalities and 3 different oncological treatments during the reopening period

	From pre-lockdown to nadir[a]			From nadir to after reopening		
	β	R square	p-value	β	R square	p-value
IMRT	−5.406	0.527	0.008	0.636	0.118	0.07
Proton therapy	−1.564	0.386	0.003	0.866	0.335	0.001
Brachytherapy	−1.213	0.152	0.11	0.724	0.272	0.004
SBRT	-1.274	0.270	0.01	0.483	0.087	0.11
Gamma knife	-2.877	0.442	0.004	0.856	0.225	0.008
Chemotherapy	−1.130	0.604	< 0.001	0.311	0.102	0.18
Cancer surgery	−2.973	0.573	0.003	0.967	0.576	< 0.001
Radiotherapy	−1.536	0.549	< 0.001	0.554	0.279	0.02

IMRT — intensity-modulated radiation therapy; SBRT — stereotactic body radiation therapy; [a]nadir is defined as each search term's respective lowest search volume

brachytherapy (70.10 *vs.* 66.05, p = 0.400), and gamma knife (69.10 *vs.* 57.53, p = 0.106).

Linear regression analysis (Tab. 2) showed that brachytherapy (β = −1.213, p = 0.110) and chemotherapy (β = −1.130, p = 0.000) were least impacted by lockdown. During reopening, interest in proton therapy had the fastest and most robust return (β = 0.866, p = 0.001), followed by gamma knife, brachytherapy, IMRT and SBRT. Among the three branches of cancer treatment, surgery had the most robust return (β = 0.967, p = 0.000), followed by radiotherapy (β = 0.554, p = 0.020) and chemotherapy (β = 0.311, p = 0.183).

Discussion

Our findings suggest that public interest in cancer treatments decreased during lockdown and re-turned after reopening but, in general, is still lower than pre-lockdown levels. We postulate that public interest and response have largely been shaped by guidelines established by organizations.

SBRT has had statistically insignificant increases from lockdown low points after reopening. Slowed return in interest may reflect reduced number of diagnoses and delayed cancer treatment. Since SBRT plays an important role in treating early-stage non-small cell lung cancer [5], we postulate that the lower interest in SBRT may indicate decreased lung cancer screening and detection of early-stage disease, which is supported by what Kaufman et al. discovered using Quest diagnostics data [6].

Interest in brachytherapy had a change between pre-lockdown and reopening, was among the least affected by the lockdown, and showed a quick return to baseline after reopening. Amer-

ican Brachytherapy Society recommended minimizing delays for gynecologic brachytherapy [7]. Guidelines for brachytherapy during COVID-19 were also published, emphasizing the importance of timely brachytherapy for patients with gynecologic, breast, and prostate malignancies [8]. The observed trend was also supported by a retrospective cohort study by an individual U.S. institution, noting only minor treatment delays and interruptions for patients needing brachytherapy [9].

Gamma knife had a change when comparing pre-lockdown with reopening and the second-fastest rebound after reopening. Stereotactic surgeries (SRS) are frequently used for treating intracranial malignancies, benign tumor, and vascular malformations. Many of these can be treated electively, except primary or secondary intracranial malignancies and symptomatic lesions which should be treated on a semi-urgent basis [10]. Given its non-invasiveness, shorter course of treatment and no need for intensive care, SRS has been purported by many as an alternative for open surgery during the COVID-19 pandemic [10–12].

The fastest return after reopening was observed in proton therapy. This is in alignment with the goals stated in the guidelines published by multiple proton centers. The New York Proton Center and the MD Anderson Proton Therapy Center have respectively published their institutional COVID-19 guidelines regarding patient prioritization [13, 14]. Many of the conditions being treated (e.g., head and neck cancers, pediatric malignancies) cannot afford treatment delays. Moreover, many of the patients on proton therapy are on clinical trials; any delays in treatment risk violating the protocols.

Our study is limited by the short time-frame; longer trends may be more apparent with longer time elapsed. Future research could correlate this data with the public's behavior when cancer screening/diagnosis/treatment data becomes available.

Conclusion

While it is promising to see an upward trend of interest in cancer treatment from lockdown levels, healthcare professionals should strive to provide timely cancer care, assuage patients' fears of health-care settings, and encourage patients to continue proper cancer screenings.

Conflict of interest

None declared.

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Author responsible for statistical analysis

Data sharing

Research data are available at https://trends.google.com/trends/?geo=US

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References

1. Balogun OD, Bea VJ, Phillips E. Disparities in Cancer Outcomes Due to COVID-19-A Tale of 2 Cities. JAMA Oncol. 2020; 6(10): 1531–1532, doi: 10.1001/jamaoncol.2020.3327, indexed in Pubmed: 32789508.
2. van de Haar J, Hoes LR, Coles CE, et al. Caring for patients with cancer in the COVID-19 era. Nat Med. 2020; 26(5): 665–671, doi: 10.1038/s41591-020-0874-8, indexed in Pubmed: 32405058.
3. FAQ about Google Trends data. https://support.google.com/trends/answer/4365533?hl=en.
4. U.S. state and local government responses to the COVID-19 pandemic. https://en.wikipedia.org/wiki/U.S._state_and_local_government_responses_to_the_COVID-19_pandemic.
5. Videtic GMM, Donington J, Giuliani M, et al. Stereotactic body radiation therapy for early-stage non-small cell lung cancer: Executive Summary of an ASTRO Evidence-Based Guideline. Pract Radiat Oncol. 2017; 7(5): 295–301, doi: 10.1016/j.prro.2017.04.014, indexed in Pubmed: 28596092.
6. Kaufman HW, Chen Z, Niles J, et al. Changes in the Number of US Patients With Newly Identified Cancer Before and During the Coronavirus Disease 2019 (COVID-19) Pandemic. JAMA Netw Open. 2020; 3(8): e2017267, doi: 10.1001/jamanetworkopen.2020.17267, indexed in Pubmed: 32749465.
7. ABS. ABS Statement on Coronavirus 2020. https://www.americanbrachytherapy.org/about-abs/abs-news/abs-statement-on-coronavirus/.

8. Williams VM, Kahn JM, Harkenrider MM, et al. COVID-19 impact on timing of brachytherapy treatment and strategies for risk mitigation. Brachytherapy. 2020; 19(4): 401–411, doi: 10.1016/j.brachy.2020.04.005, indexed in Pubmed: 32359937.

9. Hathout L, Ennis RD, Mattes MD, et al. The Impact of COVID-19 on Brachytherapy During the Pandemic: A Rutgers-Robert Wood Johnson Barnabas Health Multisite Experience. Adv Radiat Oncol. 2021; 6(1): 100600, doi: 10.1016/j.adro.2020.10.013, indexed in Pubmed: 33163697.

10. Liaw J, Patel VA, Bann DV, et al. Letter: COVID-19 Pandemic: Safety Precautions for Stereotactic Radiosurgery. Neurosurgery. 2020; 87(2): E201–E202, doi: 10.1093/neuros/nyaa163, indexed in Pubmed: 32335668.

11. Zacharia BE, Eichberg DG, Ivan ME, et al. Letter: Surgical Management of Brain Tumor Patients in the COVID-19 Era. Neurosurgery. 2020; 87(2): E197–E200, doi: 10.1093/neuros/nyaa162, indexed in Pubmed: 32347942.

12. Crisà FM, Leocata F, Arienti VM, et al. Gamma Knife Radiosurgery for Treatment of Brain Metastases during the COVID-19 Outbreak. Stereotact Funct Neurosurg. 2020; 98(5): 319–323, doi: 10.1159/000510271, indexed in Pubmed: 32726792.

13. McGovern SL, Wages C, Dimmitt A, et al. Proton Therapy in a Pandemic: An Operational Response to the COVID-19 Crisis. Int J Part Ther. 2020; 7(1): 54–57, doi: 10.14338/IJPT-20-00027, indexed in Pubmed: 33094136.

14. Chhabra AM, Choi JI, Hasan S, et al. Prioritization of Proton Patients in the COVID-19 Pandemic: Recommendations from The New York Proton Center. Int J Part Ther. 2020; 6(4): 38–44, doi: 10.14338/IJPT-20-00022.1, indexed in Pubmed: 32582818.