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Journal of Community Medicine and Public Health Reports ISSN: 2692-9899

Research Article Volume 5 Issue 09

Impact Of COVID-19 Distancing Measures On Radiation Oncology Treatments

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Received date: 06 April 2024; **Accepted date:** 21 May 2024; **Published date:** 25 May 2024

Citation: Perry EL, Lewis FD (2024) Impact Of COVID-19 Distancing Measures On Radiation Oncology Treatments. J Comm Med and Pub Health Rep 5(09): https://doi.org/10.38207/JCMPHR/2024/MAY05090170

Abstract

Background and objectives: In response to the COVID–19 pandemic, hospitals and clinics worldwide were forced to postpone or cancel patient visits and treatments. The purpose of this research was to examine whether lockdown measures during the pandemic were associated with significant reductions in radiation oncology treatments given across three treatment centers.

Methods: A retrospective chart review encompassing data from 2017 to 2020 was conducted on medical billing records for three radiation oncology practices in a medium-sized metropolitan area in the United States. Quantitative data was collected on the volume of treatments given at the centers in each of the four years of the study. Only treatments and visits that involved direct patient interaction were utilized in the statistical analysis. Qualitative data was collected via interviews with Radiation Oncologists who provided treatments for the study population.

Results: A Repeated Measures Analysis of Variance (RM ANOVA) with a Greenhouse-Geisser Correction was used to determine if the volume of radiation treatments differed in the first six months of the years spanning 2017 to 2020. An RM ANOVA revealed a significant main effect of year, [$F(2.3, 11.59) = 6.7$, $p < 0.01$]. Significant differences in treatment volume were observed between the year 2020 and each of the previous three years ($p < 0.05$). No other comparisons between years reached or approached statistical significance. Results from qualitative interviews suggest that the statistically significant decrease in radiation oncology treatments was likely due to diagnostic delays resulting from the lockdown.

Conclusion: In 2020, fewer persons were screened for cancer, resulting in fewer cancer diagnoses. Physicians interviewed believed that this resulted in fewer persons with cancer receiving needed radiation treatments. Research has shown that delays in diagnosis and treatment lead to increases in late-stage cancer diagnosis and mortality. It is essential for public health policymakers to ensure that the cure is not worse than the disease.

Keywords: Covid-19, cancer, radiation oncology, public health.

Introduction

In response to the Covid-19 pandemic, the United States government, both federal and state, implemented restrictive measures, including social distancing guidelines, mandatory two-week quarantine, and shutdown of restaurants, bars, and other "non-essential businesses" to slow the spread of the virus. Hospitals and clinics also implemented steps to slow the spread. These measures included but were not limited to, the postponement of elective surgeries, cancellation and shutdown of optional screenings such as colonoscopies and mammograms, and the prioritization of patients based on their risk. In its annual Cancer Disparities progress report, The American Association for Cancer Research found that of 190 hospitals surveyed across 23 states, breast, colorectal, and cervical cancer screenings were down 85% **[1]**. According to Howington (a board-certified radiation oncologist):"There were no protocols in place for Covid-19. The protocol had to be developed and adjusted on the spot. Many protocols from national organizations were in direct conflict, furthering the confusion. As a result, my practice decided to make our protocol. It was entirely based on patient safety and minimizing exposure as much as possible since the deadliness of the virus was not known at the time" (Personal Communication). Howington summarized the decision process as follows, "The calculation of risk for patients is done by analyzing their risk of mortality due to their cancer and their risk of mortality due to contraction of Covid-19. If the Cancer risk outweighs the COVID-19 +risk, the patient is treated; if the COVID risk is higher than the cancer risk, the patient is not treated" (Personal Communication).

The majority of cancer patients are immunocompromised in some way. The three most common types of treatment for malignant, cancerous tumors are surgery, chemotherapy, and radiation therapy. Radiation and chemotherapy are known to weaken the immune system for months after treatment, making patients vulnerable to illness and infection. According to the National Institute of Health's

2018 patient education publication, "Chemotherapy and You," patients undergoing treatment with chemotherapy can have significantly lower white blood cell counts **[2]**. This means they are at a higher risk of infection and complications due to an illness. In this patient guide, the National Institute of Health states that although chemotherapy attacks cancerous cells, it also attacks a person's healthy cells, which is why patients may experience a lower white blood cell count **[2]**. Similarly, radiation therapy can also weaken a patient's immune system. According to Howington, "When given in small amounts to most regions of the body, radiation therapy normally does not affect the patient's immune system. However, when larger amounts are given, especially to areas located on or near larger bones, it can alter a patient's white blood cell levels" (Personal Communication).

At the pandemic's beginning, little was known about whether Covid-19 posed more risk than other infectious diseases to cancer patients **[3,4]**. At the onset of the pandemic, a study from the Department of Infectious Diseases at the Zhongnan Hospital of Wuhan University observed four cancer patients who had contracted the virus. Doctors at the hospital concluded that due to their immunosuppressed state, cancer patients are both more likely to contract COVID-19 as well as develop complications from the disease, making it harder to treat **[5]**. Of the four patients observed, three under the age of 55 were able to recover, and a female aged 78 died of complications due to her cancer and the virus **[5]**. In a more extensive study conducted in China, Liang et al. found that 18 out of 1590 (1.13%) Covid-19 cases had a history of cancer, a rate four times higher than found in the Chinese population **[6]**. This supports the idea that people who are undergoing or have undergone cancer treatment are more susceptible to contracting Covid-19 **[6,7]**.

In the most comprehensive study to date, Chakraborty and Pandey conducted a meta-analysis and found that patients with cancer were twice as likely to contract Covid-19 **[8]**. They also found that the risk of death from Covid-19 was increased by a factor of four due to their immunosuppressed state **[8]**. However, of even more significant consequence, the researchers concluded that the measures being taken to prevent patients from contracting COVID-19, such as cancellation of elective surgeries, stopping of chemotherapy, or hypofractionation of radiation therapy, likely caused a twenty percent increase in death from cancer. Ultimately, their data showed no increase in mortality or morbidity due to COVID-19 in the carefully selected cohort of patients still receiving regular, routine treatment during the pandemic. Hence, these researchers concluded that oncologists are responsible for taking calculated risks and choosing between what they call "The Devil and the Deep Sea" **[8]**.

Although patients undergoing cancer treatments are more susceptible to COVID-19, withholding treatment may have even more deleterious effects. **[9.10,11,12,13]**. A study undertaken at King's College London in the summer of 2020 attempted to model the impact of diagnostic delays on cancer deaths **[9]**. The study used linked English National Health Service (NHS) cancer registration data and hospital administrative datasets. Of the 32,583 patients, the four types of cancers represented were Breast, Lung, Colorectal, and Esophageal. The researchers used a routes-to-diagnosis model to predict the impact of diagnostic and screening delays over twelve months. This study assumed that patients, as a result of COVID-19 physical distancing measures, would be primarily diagnosed via emergency screenings and patient referral pathways and, as a result, have higher rates of mortality than patients receiving traditional diagnostic approaches. In patients with breast cancer, they predict a 7.9 to 9.6 percent increase in deaths over five years. For colorectal cancer, they predict a 15.3 to 16.6 percent increase in additional deaths. For lung cancer, they predict a 4.8 to 5.3 percent increase in additional deaths. Finally, in esophageal cancer, a 5.8 to 6.0 percent increase in additional deaths **[9]**.

Cancer staging is another factor in assessing the cost/benefit of withholding or delaying treatment during the pandemic **[14,15,16,17,18]**. Amin states, "The extent or stage of cancer at the time of diagnosis is a key factor that defines prognosis and is a critical element in determining appropriate treatment based on the experience and outcomes of groups of previous patients with similar stage" **[10]**. For most cancers, early identification has a significant impact on survival rates. Thus, delaying staging diagnostics poses increased risks to patients. Underscoring the importance of proper staging, Fu-Zong et al. (2019) found in a study of 1651 lung cancer patients that the mortality rate for unscreened patients, therefore unstaged, was 7.5 times greater (73.8% total mortality rate) than those patients who were screened (9.9 total mortality rate) **[11]**.

Covid-19 lockdown measures altered best practice standards of care for cancer patients, including those receiving radiotherapy **[19]**. In 2020, the American Society for Radiation Oncology surveyed 252 radiation oncology clinics **[19]**. Respondents reported a 32% drop in patient encounters during the pandemic. Ninety-two percent of the clinics postponed treatments for lower-risk patients. All the clinics adapted care practices. Long-term studies were initiated to assess the impact of modified treatment protocols. Similarly, a study by Teckie and his colleagues in 2021 found that 42% of 412 patients experienced altered radiation treatment, either delayed, shortened, or canceled **[20]**. A multi-centered retrospective study in India led by Chauhan reviewed radiation treatments for 1412 cancer patients **[21]**. This study revealed a significant decline in the number of patients receiving radiotherapy during the pandemic compared to the period before the pandemic. During the pandemic, they found a sharp increase in single-fraction radiation treatment and the number of patients receiving palliative care. The impact of altered care was most significant among women **[21]**.

Belkacemi **[22]** described proactive measures implemented in French radiation oncology clinics to minimize the risk of COVID-19

infection while continuing to provide effective treatment to patients. Protocol changes designed to reduce patient contact included hormone therapy during delays to receive radiotherapy and hypofractionation. In-person patient encounters were decreased by 50%. At the time of publication, they reported no adverse effects to their patients. While the research shows a decline in radiation treatments during the pandemic, others argue that radiotherapy is a safer modality with less compromise to the immune system than chemotherapy or surgery **[23]**. They contend that radiation treatment should have been given more significant consideration as an alternative form of care for patients with late-stage cancer **[23]**.

The present study aimed to evaluate further the impact of COVID-19 lockdown measures on radiation oncology treatments. Unique to this study, comparisons were made with each of the three years before the pandemic to better assess the impact of natural trends in treatment. Specifically, differences in the frequency of radiation treatments given in each of the three years before the pandemic were compared to the number provided during the pandemic.

Methods

The study was a retrospective multicenter chart review of patients undergoing radiation treatment for cancer. Data was obtained from the medical billing service MCBS. No human subjects were manipulated or impacted by this research. The data collected included only the number of radiation treatments administered and in-person patient interactions. No demographic or personal data that could potentially identify patients was collected.

Data was collected for patients receiving treatment in three different radiation oncology centers in the midsize metropolitan region in the southern United States. The data included the monthly treatment volume at each center, focusing on the number of possible radiation treatments (based on the prescribed treatment protocol for patients) administered each year. To control for seasonal variation, data on treatment volume was collected from January 1st to June 31st each year.

Data on the number of treatments given in each test period was entered into Excel spreadsheets and uploaded to SPSS version 29 for analysis. To analyze differences in treatment volume across each of the four years of the study, a repeated measures analysis of variance (RM ANOVA) with follow-up pairwise comparisons was performed. In addition to chart reviews, qualitative data was collected in semi-structured interviews with two radiation oncologists treating patients during the study's time frame. Both physicians were asked the following questions:

1. Did you observe any difference in the number of patients you saw in the first six months of 2020?
2. If so, what do you attribute this difference to?
3. Do you believe that the COVID-19 pandemic has made people more likely to seek cancer treatment or less likely to seek cancer treatment?
4. Do you have any other comments about the impact of the Covid-19 pandemic on your practice?

Results

A Repeated Measures Analysis of Variance (RM ANOVA) with a Greenhouse-Geisser Correction was used to determine if the volume of radiation treatments differed in the first six months of the years spanning 2017 to 2020. This analysis revealed a significant main effect of year, [$F(2.3, 11.59) = 6.7$, $p < 0.01$]. The results of post hoc LSD pairwise comparisons are presented in **(Table 1)**.

Table 1: LSD pairwise comparisons mean differences in radiation treatments by year.

Treatment Year	2017	2018	2019	2020
2017	-	109.5 (70.4)	22.5 (79.0)	197.5 (61.1) *
2018	109.5 (70.4)	-	132.0 (70.8)	307 (80.7) *
2019	22.5 (79.0)	132.0 (70.8)	-	175.0 (48.3) *
2020	197.5 (61.1) *	307 (80.7) *	175.0 (48.3) *	-

*p< 0.05; standard error in parentheses.

Significant differences in treatment volume were observed between the year 2020 and each of the previous three years ($p < 0.05$). No other comparisons reached or approached statistical significance. As illustrated in table two, fewer treatments were provided in the first six months of 2020, which marked the beginning of lockdowns, than in the first six months of the three preceding years.

Table 2: Radiation treatments given in first six months: 2017 through 2020.

Month	2017	2018	2019	2020
January	1,644	1,790	1,851	1,531
February	1,695	1,681	1,784	1,635
March	2,047	1,953	1,793	1,773
April	1,612	2,021	1,747	1,498
May	1,828	1,912	1,608	1,362
June	1,727	1,853	1,635	1,574
Total	10,553	11,210	10,418	9,373

Table two shows the largest absolute difference in treatments between 2018 and 2020. There were 1837 more treatments in 2018 than in 2020. Again, although there was variation in treatment volume between 2017 through 2019, differences were not statistically significant. There was no significant upward or downward linear pattern in the treatment frequency from 2017 through 2019, suggesting the decline in treatments observed in 2020 was likely due to COVID-19 lockdown measures.

Discussion

Several studies have reported a significant decrease in the number of people being treated for serious illnesses during the Covid-19 lockdown **[14]**. Supporting these findings, the present study found a significant reduction in oncological radiation treatments during the first six months of the COVID-19 lockdown compared to treatments given in the same time frame in each of the preceding three years.

While it is highly likely that the lockdowns contributed to the decrease in treatments, this study could not rule out other causal factors (e.g., fewer persons with cancer and increased early-stage diagnoses necessitating fewer radiation treatments). However, interviews conducted with the treating Radiation Oncologists lend support to the contribution of the lockdown to the decrease. One physician interviewed believed that "It was a combination of multiple things. The first is that our practice intentionally delayed the treatment of diagnosed individuals with cases of cancer that were not as life-threatening as others." A common theme in the interviews was the unprecedented nature of the Covid-19 pandemic. The pandemic caused doctors to alter standards of care which negatively affected patients wanting to receive proper treatment. According to Stewart, "In some cases, there were patients with relatively serious symptoms or serious cancer diagnosis, but who chose to stay home because they perceived the threat of COVID to be greater than the threat of cancer." Howington stated, "I don't think Covid has changed people's minds or outlooks as to whether or not to seek treatment for known cancer." Howington believed that, in many cases, decreases in health-seeking behavior originated in diagnostics, the initial phase of quality health care. Both physicians attributed the decrease to a lack of diagnosis and referrals from other practices. Both discussed the importance of human interaction with patients and the pandemic's toll on oncological treatments. Stewart stated, "There is much nonverbal communication in the faces of doctors and patients. I think mask-wearing has depersonalized the experience and made it harder for us as physicians to establish a rapport with our patients. Personal connection makes a big difference in the world of cancer, and some of that has been lost. I totally understand the need for masks, but I look forward to the day I can talk to a patient without one again". Similarly, Howington said that most of his consultations had been moved to 'Telemedicine' or virtual consultations. He stated, "Logically, one can conclude that with less thorough patient interaction directly and less thorough physical examination incidental findings may have been missed, which may ultimately lead to an alternate diagnosis or worst staging of the patient's current disease." Both doctors expressed severe concerns over the impact of the pandemic on their practice. They believe that care was compromised by restrictions on physicians' ability to see patients in person. They concluded that the climate of fear stemming from COVID restrictions resulted in poorer diagnostics and fewer oncological patients receiving necessary care. In 2021, Alkahout and his colleagues conducted a meta-analysis of 17 publications and concluded that "The anticipated outcomes (of the decline in cancer screenings) include delayed diagnosis and marked increases in the numbers of avoidable cancer deaths. Urgent policy interventions are needed to handle the backlog of routine diagnostic services and minimize the harmful effects of the COVID-19 pandemic on cancer patients" **[14]**. A recent paper from the National Academy of Medicine spells out lessons learned from the pandemic with specific guidelines for protecting public health should we encounter future outbreaks **[24]**. Included in their recommendations is "investment in public health infrastructure' for better community engagement and communication to mitigate fears and increase healthcare knowledge. Importantly, these recommendations are intended to inform the public better so that those in need are more likely to seek out healthcare professionals and ultimately receive necessary care.

Conclusion

As the results from our qualitative interviews suggest, the decrease in the radiation oncology treatments was likely due to diagnostic delays resulting from the lockdown. The CDC reported that during April of

2020, breast and cervical cancer screenings were down 87% and 84%, respectively. In 2020, fewer people were screened for cancer, fewer people were diagnosed with cancer, and fewer people were referred to the radiation oncology clinic, as our data shows. As Alawadhi and his colleagues concluded, cancer treatment is time-sensitive **[15]**. The survival of a patient is directly correlated with the stage of cancer at diagnosis. Diagnostic decreases and delays result in more people receiving initial treatments for late-stage rather than early-stage cancer. A decrease and delay in diagnosis means a decrease and delay in treatment **[9]**. Preventative measures instituted for a pandemic cannot be worse than the disease. **[25,26]**. This and prior studies suggest that education is essential to protecting public health. Especially in treating serious cancers, patients must have the information necessary to make sound judgments regarding their healthcare.

Limitations

Due to restrictions in data access, the current research could not determine the number of individual patients treated in each year of the study. Therefore, patients treated or scheduled for treatment during the study period could not be interviewed. Lastly, mortality data for those patients seen pre-Covid-19 and during Covid-19 was unavailable.

Acknowledgements:

We thank Dr. Jed Howington M.D (Radiation Oncology Associates, Augusta GA) for participating in the interview portion of our discussion and giving us insight into his practice, we thank Dr. John Stewart M.D (Radiation Oncology Associates, Augusta GA) for participating in the interview portion of our discussion and giving insight into his practice.

Funding: The author(s) received no external funding for this research.

Ethical Approval: Ethical approval was sought and granted from NeuroRestorative Research Institute IRB #IORG11535.

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