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Research Article

Cost of Care Related to Radiation Treatment in Locally Advanced Rectal Cancer: Short Course Radiation Therapy vs Long Course Chemoradiation

Parisa Shamsesfandabadi[1]*, Oralia G. Dominic[2], Matthew Fickie[2], Dennis Hareras[2], Stephen Abel[1], Paul B Renz[1], James McCormick[3], Alexander Kirichenko[1], Sushil Beriwal[1] and Rodney E Wegner[1]

[1]*Allegheny Health Network Cancer Institute, Department of Radiation Oncology, Pittsburgh PA, USA*

[2]*Highmark Inc., Pittsburgh PA, USA*

[3]*Allegheny Health Network, Division of Colorectal Surgery, Pittsburgh PA, USA*

***Corresponding author:** Parisa Shamsesfandabadi MD, Allegheny Health Network, Division of Radiation Oncology, 320 E North Ave, Pittsburgh, PA 15215, USA

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Abstract

Purpose/Objectives: The economic implications of radiation therapy techniques in colorectal cancer management investigated by using claims-based data from a health insurance provider in Pennsylvania (PA), Delaware (DE), West Virginia (WV), and New York (NY).

Methods: This is a retrospective analysis of 556 patients with an ICD-10 code of C20 from 2016 to 2021, exploring the costs associated with varying treatment factors. Patients, categorized by age, sex, and region, received radiation and chemotherapy. We divided the cohort based on number of radiation treatments- short course radiation therapy (SCRT) and long course radiation therapy (LCRT) also radiation techniques- 3D conformal radiotherapy (3D CRT) and intensity modulated radiation therapy (IMRT).

Results: The total cost of care was $10,226,361 with total number of claims of 5,406 resulting in a cost per claim of $1,892. In our data, 10.5% and 89.5% patients were treated with SCRT and LCRT, respectively. The number of patients treated with SCRT increased over time with a percentage change of 245% from 2016 to 2021. Total costs for SCRT and LCRT were $206,976 and $10,019,385, respectively; Median SCRT costs were $1,698 with IMRT and $1,106 with 3D CRT, while for LCRT was $2,258 with IMRT and $1,451 with 3D CRT. The use of IMRT increased to 64.5% in both SCRT and LCRT by 2021. In 2021, IMRT claims peaked at 682 (median 637, range: 490-682) with median costs of $2,692, compared to $1,497 for 3DCRT. Costs per claim varied across states, with PA at $1,707, DE at $5,699, WV at $1,817, and NY at $1,449.

Conclusions: SCRT is increasing in use and provides overall cost savings compared to LCRT. Similarly, IMRT use has increased in this patient population, which has a higher cost when compared to 3D CRT.

Keywords: Cost of Care; Rectal Cancer; Short Course Radiation; Long Course Chemoradiation; Radiation

Introduction

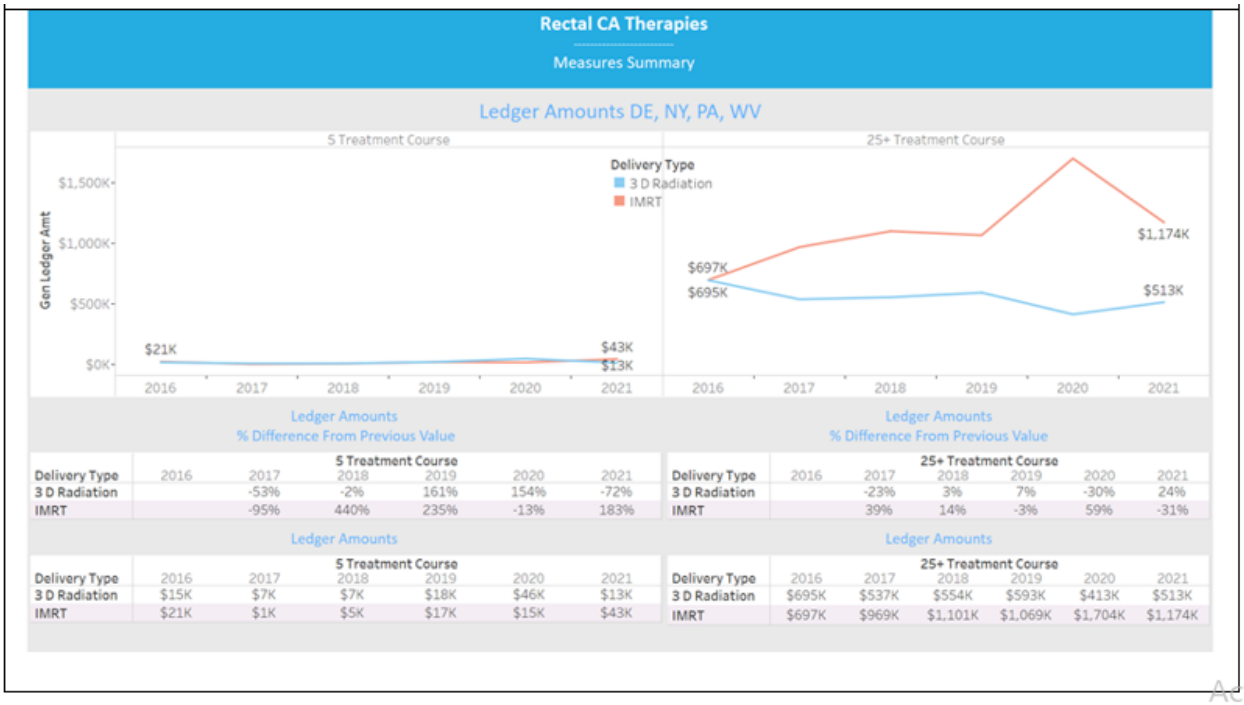
Colorectal cancer is the second most common cause of cancer-related death in the United States [1], and radiation therapy remains a key component in the management of rectal cancer. However, the cost of care for radiation therapy can vary significantly based on several factors such as the number of radiation treatments and the technique used. The purpose of this study is to use claims-based data from a health insurance provider in Pennsylvania (PA), Delaware (DE), West Virginia (WV), and New York (NY) to better assess the impact of these factors on the total cost of care in this patient population. The number of radiation treatments and the technique used can significantly affect the cost of care. Short Course Radiation Therapy (SCRT) is typically defined as 5 or fewer fractions, while Long Course Chemoradiation (LCRT) is defined as 25 fractions or greater. Intensity-Modulated Radiation Therapy (IMRT) and 3D Conformal Radiotherapy (3DCRT) are the two main techniques used in radiation therapy for rectal cancer. IMRT is more advanced as it allows for more precise targeting of the radiation, which has the potential to reduce toxicity and improve outcomes [2,17]. The cost of treating metastatic colorectal cancer places a significant economic burden on individuals, populations, and health care. However, IMRT is also typically more expensive than 3DCRT [3]. The cost of care for cancer treatment has become a significant concern for patients and their families [4,5], with many struggling to afford necessary care. This study aims to provide valuable insights into the cost of care associated with radiation therapy for rectal cancer, and can aid healthcare providers, payers, and policymakers in making more informed decisions when it comes to the management of rectal cancer, ultimately resulting in more cost-effective care for patients.

Methods

This study was a retrospective secondary analysis of medical claims among insured members in Pennsylvania (PA), Delaware (DE), West Virginia (WV), and New York (NY) with an ICD-10 code of C20 and history of radiation and chemotherapy billed under that code from 1/1/2016 to 12/31/2021. The ICD-10 code C20 corresponds to malignant neoplasm of the rectum. The data was obtained from a large national insurance provider and was de-identified and aggregated to protect patient privacy. Patients were grouped by age, sex, and geographical region. The number of claims and total cost of care were tabulated by year. We also divided the cohort based on number of radiation treatments-defining short course radiation therapy (SCRT) as 5 or fewer fractions and long course radiation therapy (LCRT) as 25 fractions or greater. In addition, we were able to deduce which patients were treated with 3D conformal radiotherapy (3DCRT) and intensity modulated radiation therapy (IMRT) based on the appropriate CPT codes. All patients received chemotherapy with various combinations of Capecitabine, Fluorouracil, Irinotecan, Oxaliplatin and Leucovorin. Statistical analysis was performed using SAS software (version 9.4). Descriptive statistics were used to summarize the data. Continuous variables were expressed as median (range) and categorical variables were expressed as percentages. The chi-square test was used to compare categorical variables between the two groups.

Results

Table 1: The number of patients treated and cost with short course radiation treatment (SCRT) increased over time, 2016–2021.



We identified 556 patients treated with radiation for diagnosis code C20 between 2016 and 2021. The majority of patients (61.8%) were male and the median age was 62 (15-100). The vast majority of patients (75.7%) resided in Pennsylvania. The total cost of care across the cohort related to ICD-10 C20 was $10,226,361. The total number of claims for the included years was 5,406 resulting in a cost per claim of $1,892. Based on our data, 59 (10.5%) patients were treated with SCRT and 499 (89.5%) patients treated with LCRT. As shown in Table 1, the number of patients treated with SCRT increased over time. The total cost of claims was $206,976 and $10,019,385 for treating with SCRT and LCRT, respectively; in summary, the median cost for SCRT was $1,698 with IMRT and $1,106 with 3D CRT, while the median claim cost for LCRT was $2,258 with IMRT and $1,451 with 3D CRT. In general, the use of IMRT increased over time in both SCRT and LCRT from 48.2% in 2016 to 64.5% in 2021. The highest number of claims for IMRT was in 2021 (682 claims) (median 637, range: 490-682). The median claim cost was $2,692 for IMRT and $1,497 for 3D CRT. There was a difference in costs per claim by state as follows: $1,707 for PA, $5,699 for DE, $1,817 for WV and $1,449 for NY.

Additionally, we found that the cost of care also varied based on the type of chemotherapy used in conjunction with radiation therapy. The median cost of care for patients receiving Capecitabine, Fluorouracil, Irinotecan, Oxaliplatin and Leucovorin in combination was $2,500, while the median cost for patients receiving Capecitabine and Fluorouracil was $1,800. We also found that the cost of care was higher for older patients, with the median cost for patients over the age of 75 being $2,700, compared to $1,800 for patients under the age of 75. Similarly, the cost of care was higher for male patients, with a median cost of $2,600 for males compared to $1,700 for females. In terms of geographical region, we found that the cost of care was highest in Delaware, with a median cost of $5,700, while the median cost in Pennsylvania, West Virginia, and New York was $1,700, $1,800, and $1,450 respectively.

Discussion

The results of this study show that the use of Short Course Radiation Therapy (SCRT) is increasing, but is still only used in a small subset of patients with locally advanced rectal cancer. As expected, SCRT is associated with lower costs when compared to Long Course Chemoradiation (LCRT). This is in line with previous studies, such as the one conducted by [15]and [20] which have also shown that SCRT is associated with lower costs of care when compared to LCRT. However, it is important to note that the cost of care for SCRT may not be as low as the findings in this study suggest, as the study only includes data from four states and the results may not be generalizable to other regions of the country. The study also found higher costs of care for IMRT compared to 3D CRT, regardless of length of treatment course.

The results of this study indicate that the use of SCRT is increasing in the treatment of locally advanced rectal cancer. This is consistent with previous studies, such as the one conducted by [6], which have shown that SCRT is a viable alternative to LCRT for selected patients with rectal cancer. The use of SCRT is associated with a reduction in toxicity, improved quality of life, and similar oncological outcomes when compared to LCRT [7-11]. Notably, in the phase 3 international multicenter trial Rectal Cancer and Preoperative Induction Therapy Followed by Dedicated Operation (RAPIDO), preoperative short-course radiotherapy followed by total neoadjuvant treatment (SCRT-TNT) led to an increased pathological compete response rate, decreased disease-related treatment failure, and decreased distant metastatic disease at 3 years compared with preoperative LCCRT with or without adjuvant chemotherapy [12,13]. However, SCRT-TNT was associated with an increased risk of locoregional recurrence (LRR) whereas the reduction in disease-related treatment failure and distant metastases remained after 5 years [15].

The use of IMRT has increased in this patient population as well, which is consistent with the trend of increased use of IMRT in the treatment of rectal cancer (16). IMRT is considered to be more advanced than 3DCRT, as it allows for more precise targeting of the radiation, which can reduce toxicity and improve outcomes [2-19]. However, IMRT is also typically more expensive than 3DCRT [3]. The cost of care also varied based on the type of chemotherapy used in conjunction with radiation therapy. The median cost of care for patients receiving Capecitabine, Fluorouracil, Irinotecan, Oxaliplatin and Leucovorin in combination was $2,500, while the median cost for patients receiving Capecitabine and Fluorouracil was $1,800. This suggests that the choice of chemotherapy can have a significant impact on the cost of care. Studies such as the one conducted by Chu et al. [21] and [22] have shown that the use of capecitabine-based regimens in rectal cancer is associated with lower costs compared to infusional fluorouracil-based regimens.

The cost of care was found to be higher for older patients and male patients in this study. This is consistent with previous studies, such as the one conducted by [23] which have also shown that the cost of care is higher for older patients and male patients. This highlights the importance of considering factors such as patient age and sex when evaluating the cost-effectiveness of different treatment options. Furthermore, our data did not include performance status or indicators of other co-morbidities, but based on these findings male gender and increased age may have been a surrogate for those factors; resulting in higher cost of care. The cost of care was found to be highest in Delaware, compared to Pennsylvania, West Virginia, and New York. This suggests that there may be regional differences in the cost of care for rectal cancer treatment. These differences could be due to a variety of factors, such as differences in healthcare costs and availability of resources. Studies such as the one conducted by [24] and [25] have found that the cost of cancer care varies significantly across states and regions in the US.

Our study has some limitations that should be acknowledged. Firstly, the study is based on claims data, which may not capture all aspects of the patient's care, including any additional costs incurred outside of the insurance coverage. Additionally, the study is limited to the states of Pennsylvania, Delaware, West Virginia, and New York, and the results may not be generalizable to other regions of

the country. Despite these limitations, the study provides valuable information on the cost of care related to radiation treatment in locally advanced rectal cancer. The results of this study can help inform healthcare decision-making and resource allocation in the treatment of rectal cancer. In conclusion, our study shows that SCRT is increasing in use and provides anoverall cost savings compared to LCRT. Similarly, IMRT use has increased in this patient population, which has a higher cost when compared to 3DCRT. These findings indicate that a more detailed cost-effectiveness analysis of short-course radiation therapy needs to be conducted to evaluate the cost-benefit ratio. The consideration of demographic and regional factors can also help to better understand the cost of care related to radiation treatment in locally advanced rectal cancer. Future studies should focus on evaluating the long-term cost-effectiveness of different treatment options for rectal cancer, including the potential impact on patient outcomes and quality of life. Additionally, it could be beneficial to evaluate the cost-effectiveness of different chemotherapy regimens in conjunction with radiation therapy. This would provide a more comprehensive understanding of the cost-benefit ratio of different radiation therapy techniques and help inform healthcare decision-making.

Conflicts of Interest

None.

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Author Contributions

PS, SA, PBR, OGD, MF, DH, JM, AK, SB, REW: Design, manuscript drafting, revision. PS, OGD, MF, DH, REW: Data analysis, manuscript drafting, revision, and final approval.

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