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Strengths, weaknesses, opportunities and threats with the new system of radiotherapy remuneration in Brazil: a critical appraisal

Pontos fortes, fracos, oportunidades e ameaças com o novo sistema de remuneração em radioterapia no Brasil: uma avaliação crítica

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ABSTRACT

Objectives: To evaluate the economic impact of the new form of radiotherapy remuneration published by the Ministry of Health. **Methods:** We design a simulated group of seventy patients from a database of a public institution. We compare the remuneration from SUS old payment methodology (SOPM), with the new form entitled of the diagnosis-related groups (DRG). A comparison between the DRG with the SOPM corrected by four economic indexes was also performed. We tested if hypofractionation replace or equilibrate the absence of readjustment according to the economic indexes. A p-value <0.05 significant. **Results:** The remuneration of sixty CIDs using the SOPM and the DRG were done to simulate the group of patients. Evaluating the sixty CIDs, the DRG had a mean readjustment of 33.2% (-29.5% to 258%). However, evaluating the readjustment in the group, the ten most frequent tumor sites responsible per 85% of the remuneration had a readjustment < 5% (0.4-4.5%). The total of remuneration by the DRG or by the old table had a difference of R$18.700,00 (p=0.821). The difference was influenced by the breast cancer readjustment, and when breast cancer was the second or third most frequent, SOPM remunerated better than DRG. All indexes had a significant difference for the remuneration by DRG (p<0.0001). The hypofractionation improved the remuneration per fraction (p=0.001). The number need to treat with a hypofractionated schedule to equilibrate the difference for the economic indexes would be 31.2, 32, 60, and 58, for IPCA, IGPM, Dollar and minimum wage. **Conclusion:** The remuneration by DRG produced a non-significant difference compared with SOPM; the correction was < 5% for the most frequent tumors. The hypofractionation improves the ticket per fraction, but it does not exclude the need of a readjustment.

Keywords: Radiotherapy; Remuneration; Unified Health System.

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RESUMO

Objetivos: Avaliar o impacto econômico da nova forma de remuneração em radioterapia publicada pelo Ministério da Saúde. **Métodos:** Nós planejamos um grupo simulado de setenta pacientes a partir de um banco de dados de uma instituição pública. Comparamos a remuneração da metodologia de pagamento antigo do SUS (SOPM), com o novo formulário intitulado dos grupos relacionados ao diagnóstico (DRG). Também foi realizada uma comparação entre o DRG e o SOPM corrigido por quatro índices econômicos. Testamos se a hipofracionamento substitui ou equilibra a ausência de reajuste de acordo com os índices econômicos. A valor p<0,05 significativo. **Resultados:** A remuneração de sessenta CIDs utilizando o SOPM e o DRG foi realizada para simular o grupo de pacientes. Avaliando os sessenta CIDs, o DRG teve um reajuste médio de 33,2% (-29,5% a 258%). Entretanto, avaliando o reajuste no grupo, os dez locais de tumores mais frequentes, responsáveis por 85% da remuneração apresentaram reajuste < 5% (0,4-4,5%). O total de remuneração pelo DRG ou pela tabela antiga teve uma diferença de R$18.700,00 (p=0,821). A diferença foi influenciada pelo reajuste do câncer de mama e, quando o segundo ou o terceiro foi o mais frequente, o SOPM remunerou melhor que o DRG. Todos os índices tiveram uma diferença significativa para a remuneração por DRG (p<0,0001). O hipofracionamento melhorou a remuneração por fração (p=0,001). O número necessário para tratar com um cronograma hipofracionado para equilibrar a diferença dos índices econômicos seria 31,2, 32, 60 e 58, para IPCA, IGPM, dólar e salário mínimo. **Conclusão:** A remuneração do DRG produziu uma diferença não significativa em relação ao SOPM, a correção foi < 5% para os tumores mais frequentes. O hipofracionamento melhora o ticket por fração, mas não exclui a necessidade de um reajuste.

Descritores: Radioterapia; Remuneração; Sistema Unificado de Saúde.

INTRODUCTION

Radiotherapy (RT) is an essential component of multimodality treatment of oncological patients. It is estimated that about 60% of oncological patients will need radiation treatment during the natural history of their disease.[1] In the last decades, RT has passed through a tremendous technological improvement.[2,3] The advances seen have produced the opportunity of treating patients delivering more dose to the tumor and reduced doses on the organs around the tumor.[4-6] All these developments have been promptly implemented in developed countries on a full scale. Traditional two-dimensional radiotherapy (2DRT) has been substituted by three- dimensional conformal radiotherapy (3DRT), intensity-modulated radiotherapy (IMRT) and image-guided radiotherapy (IGRT).[3] Consequently, patients from developed countries treated by high-quality radiotherapy services have obtained a significant improvement in the reduction of severe collateral effects, better quality of life and in some cases improved survival.

In Brazil, the radiation oncology community has suffered to incorporate these developments to treat their patients.[7] The main reason to difficult the incorporation of high technology in patients from the Unified Health System (SUS, in the Portuguese acronym) has been the form that radiation therapy is reimbursed for the federal government.[8,9]

The system of remuneration during more than two decades has been based on tables with fixed values and a limited amount of treatment fields without any credit to use or incorporate technology.[7] To note, the charge of radiotherapy remuneration it is freezing for almost ten years.

Recently, the Brazilian Health Ministry has changed the way in which this remuneration will be done. The radiotherapy society has called this changed as payment for the DRG. Now the payment is linked to the tumor site with a fixed value independently of the number of radiation fields, treatment technique, accessories, and radiotherapy fractionation used. Theoretically, the payment for tumor DRG brings several advantages such as simplicity for evaluating the radiotherapy numbers, transparency to control the payment process, liberty for the radiation oncologist to choose the treatment technique and fractionation for their patients. However, even with some argued advantages, it was expected that the alteration of the form of payment came with a correction on the monetary value for the radiation procedures.

Since the publication of the payment for the DRG by the Brazilian Ministry Health, an intense debate around the impact of this new system over the radiotherapy services has been developed.

Therefore, in front of this scenario, we developed a simulated a group of 70 patients treated in a public radiotherapy service to evaluate the impact of the remuneration changing, the necessity of monetary corrections based on economic indexes, and if the

incorporation of hypofractionation schedules is helpful to get over the economic deficit.

METHODS

This study was an observational study using the benchmark of our institution during the period from 2012-2016 to simulate the composition of patients in a linear accelerator (LINAC).

We estimate a treatment machine was working 14 hours with three work shifts of radiotherapists treating one patient every 12 minutes giving seventy patients per day.

To calculate the remuneration, we used the new table published by the Health Ministry called of remuneration by the DRG. The proportion of seventy patients came from the benchmark study. We compared the reimbursement by the DRG with the old system. To estimate the necessity of readjustment on the radiotherapy procedures we used four economic indexes. The following indexes were chosen: the inflation rate accumulated between 2010-2018 (IPCA), the general price rate of market accumulated between 2010-2018(IGPM), the accumulated dollar variation between 2010-2018 and the accumulated minimum wage variation between 2010-2018. In the period, the mean accumulated IPCA, IGPM, Dollar and the minimum wage were 62.6%, 61.5%, 115.5% and 87%, respectively. Before to calculate the total costs, we performed an analysis of the difference between the DRG and the SOPM for the sixty CIDs more frequently treated in our database.

After the estimation of the tumors most frequent on the database, we built a group of 70 patients, and we calculated the total cost of all patients using the values given by the old table and by the DRG from SUS. After the calculation using the SOPM, we calculated the readjustment necessary for all seventy patients. For that, we applied the accumulated indexes during the period on the old table, and after that, we compared it with the remuneration by the DRG.

To test the hypothesis if the implementation of hypofractionation schedules is helpful to equilibrate the absence of readjusting, we calculated the number need to treat with a hypofractionation scheme to achieve the economic equilibrium using the difference between the corrected values calculated with the economic indexes as reference. To do this, we supposed that patients with prostate cancer and breast cancer would be treated with hypofractionation schedule. We choose only these two tumor sites due to the existence of level 1 of evidence to support the hypofractionated schedule in the clinical practice.

The CHIPP and START trial scheme were used as a reference for prostate cancer and breast cancer, respectively.[4,5] Hypofractionation for bone metastases was excluded from the model because currently, many radiotherapy services treat that condition with a single radiotherapy fraction.

Therefore, for prostate and breast cancer the number of the fraction for hypofractionated schedule was 20 and 16 fractions. The number of the fraction for the conventional fractionation radiotherapy was the most used in the clinical practice.

The following variables were calculated: total cost of radiotherapy by the old table, by the DRG, by IPCA, by IGPM, and by the minimum wage. The mean ticket per patient and fraction were calculated for each total cost.

Statistical analysis

The continuous variables were treated as mean and standard deviations. The total cost of radiotherapy remuneration by the SOPM, by the DRG, and by the economic indexes was compared with *T*-student for the independent sample. Linear regression with the correlation of Pearson was used to test with the difference accumulated during the period without readjusting was crescent and linear.

The difference between each table and the economic indexes were used to estimate the number of hypofractionated patients would be necessary to achieve the economic equilibrium. A p-value < 0.05 was considered significant.

RESULTS

Before to create the group of seventy patients from our benchmark, we calculated the remuneration of sixty CIDs using the SOPM and the DRG. In general, the table with DRG had a mean readjustment of 33.2% (-29.5% to 258%). However, the remuneration by DRG had 4 tumor sites (bladder, pituitary gland, meduloblastoma and sarcoma of Kaposi) with a negative difference indicating a deflected factor against the DRG. The mean difference for these four tumor sites was -15.4% (-1.87 to -29.55%). A positive value was found in 51 tumor sites and 5 had no correction. Twenty-one of these tumor sites with positive readjustment in the DRG had < 5%, and four, two, seven, sixteen tumor sites with a readjustment between 5-10%, 10-25%, 25-50% and >50%, respectively. During the period in our benchmark, 5272 patients were treated.

The Figure 1 describes the proportion of the tumor sites treated in a public radiotherapy service. Based on the finding proportion, seventy patients were used to simulate the total of remuneration using each table and economy indexes. Table 1 shows the proportion of patients used and the values calculated.

The top ten of the most frequent tumors (breast cancer, prostate cancer, head and neck cancer, rectal cancer, esophageal cancer, glioblastoma multiforme, cervix cancer, lung cancer, brain metastases and bone metastases), which correspond to 85% had a mean of readjustment of 15.8% and excluding breast cancer nine tumor sites had < 5% of readjustment (Figure 2).

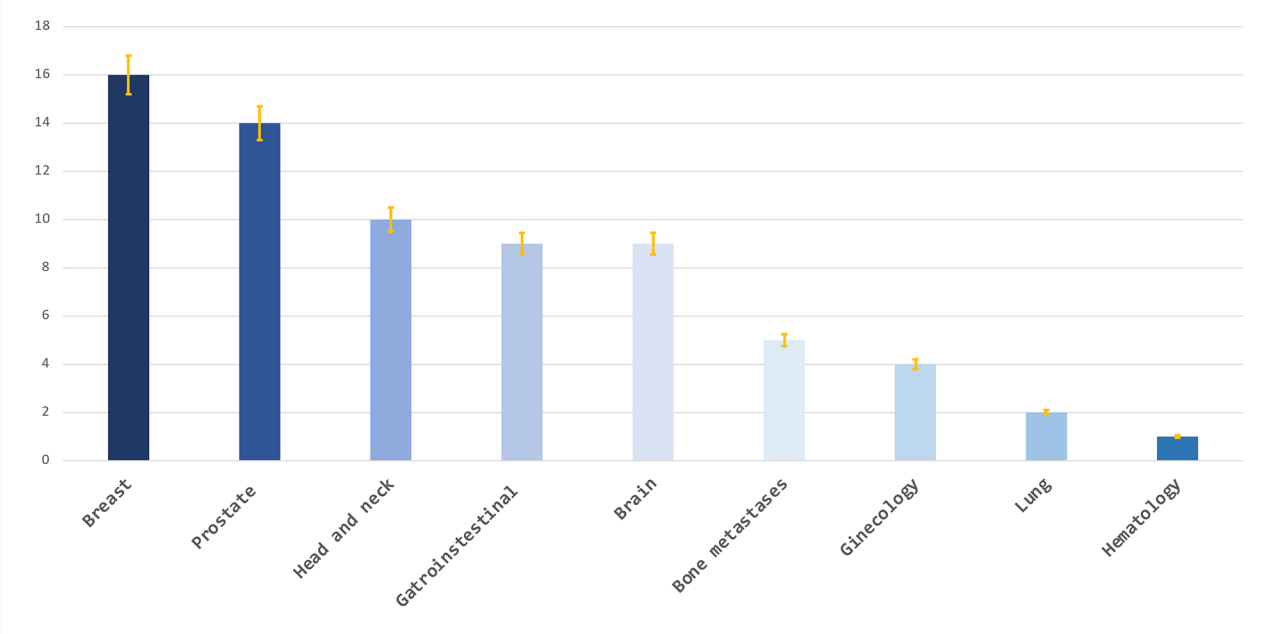

Figure 1. Distribution of tumor sites in the group of seventy patients designed.

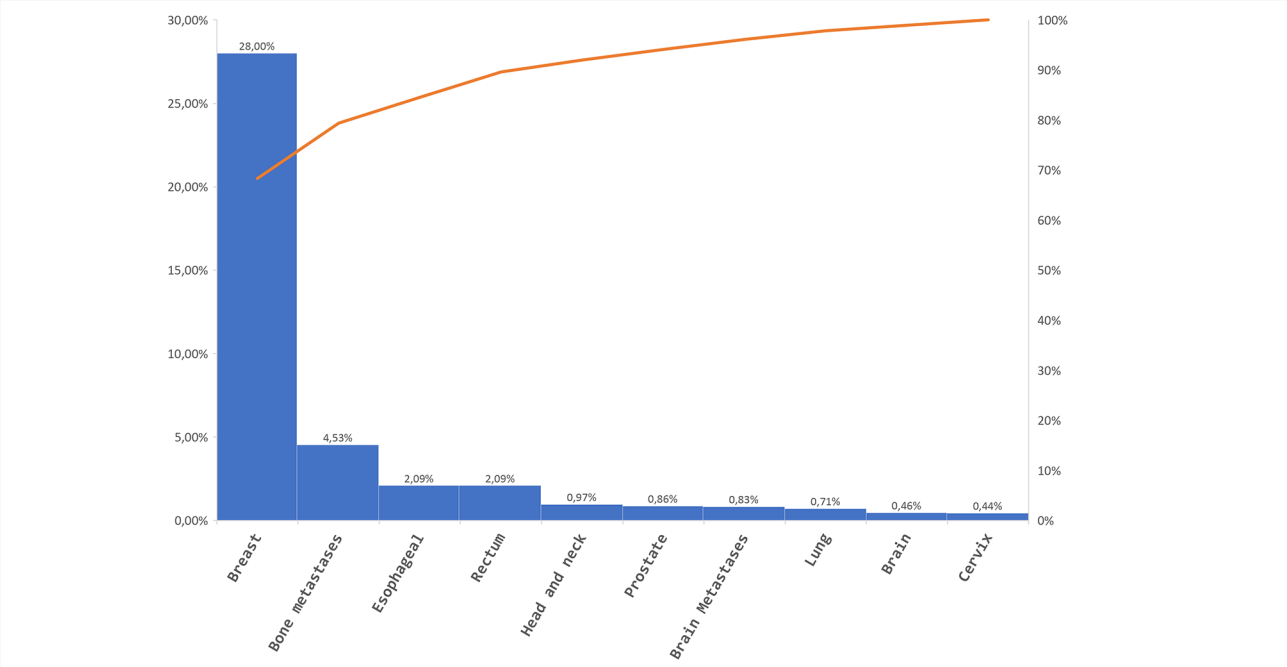

Figure 2. Percentage of readjustment of the ten most frequent tumors of the group.

The total of remuneration for 70 patients from this group by DRG or by the old table had a difference of R$18.700,00 with no significant statistical difference (p=0.821) (Figure 3). Comparing the remuneration by the DRG and with the readjustment by economic indexes a significant difference (p<0.001) was found in all indexes (Figure 3). The lower and higher difference was found for IPCA and dollar (Figure 3).

A linear difference was identified among the remuneration by DRG or any readjustment by economic index (p<0.0001), as described in Figure 3. The difference between the SOPM and DRG was influenced by the breast cancer readjustment, when breast is the second or third most frequent the SOPM remunerated better than DRG (Figure 4).

The mean ticket per patient was R$4333 with old table, DRG R$4601, IPCA R$6963, IGPM R$6999, dollar R$9305 and minimum wage R$8784 (Table 1).

The hypofractionated schedule improved the mean ticket per fraction (p=0.001), independently of table used (Figure 5). The number need to treat with a hypofractionated schedule to achieve the economic

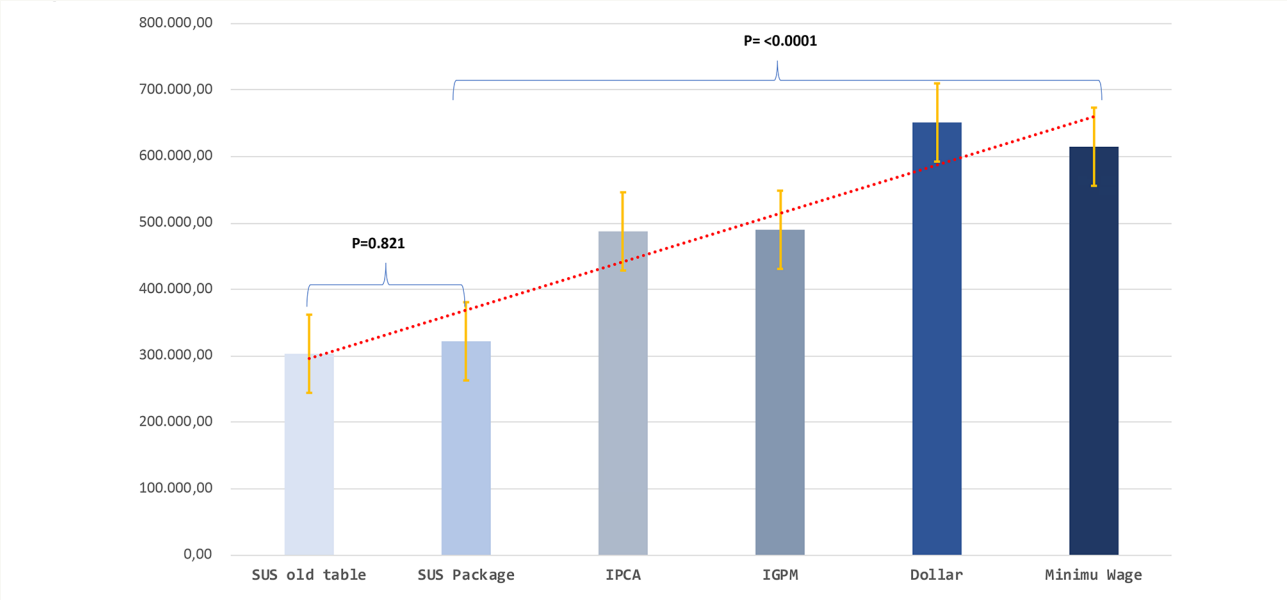

Figure 3. Total of remuneration according to the old table, the DRG and the old table corrected by indexes.

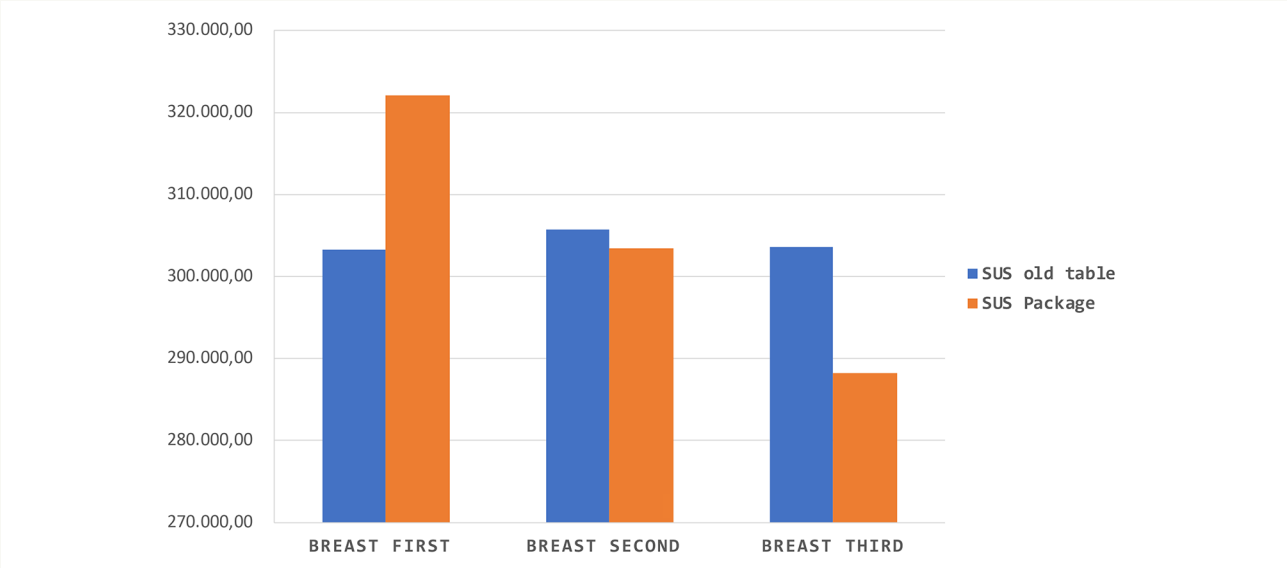

Figure 4. Difference of remuneration between the old table and the DRG according to the frequency of breast cancer in the group.

equilibrium between the DRG and economic indexes was 31.2, 32, 60, and 53, for IPCA, IGPM, Dollar and minimum wage, as described in Figure 6.

DISCUSSION

The purpose of the present study was to simulate the treatment of oncological patients in a radiotherapy service using the benchmark from a public institution. This strategy was chosen to give a more realistic overview of the real impact of the new system of remuneration on the public network of radiotherapy services. The new form of remuneration has strengths, weakness, potential threats and opportunities. The Figure 7 describes an analysis utilizing the S (strength), W (weakness), O (opportunity) and T (threats) technique.

The strength of the remuneration by DRG resides in better control and understanding of the real costs of radiotherapy in the country by the government, besides its simplicity and transparency. However, the way that it has been implemented can be disastrous and exacerbate the economic situation of the radiotherapy network in the country severely.

Our data shows that the remuneration for DRGs had a deflector in 4 tumor sites, no readjust in five and a mean readjust of 33.2% for 51 of 60 CIDs evaluated. However, this number is fictitious being influenced by higher readjustment given in rare conditions, which rarely needs of radiotherapy treatment having a minor effect on the remuneration to maintain a radiotherapy machine. The total value of radiotherapy costs simulated with a group of seventy

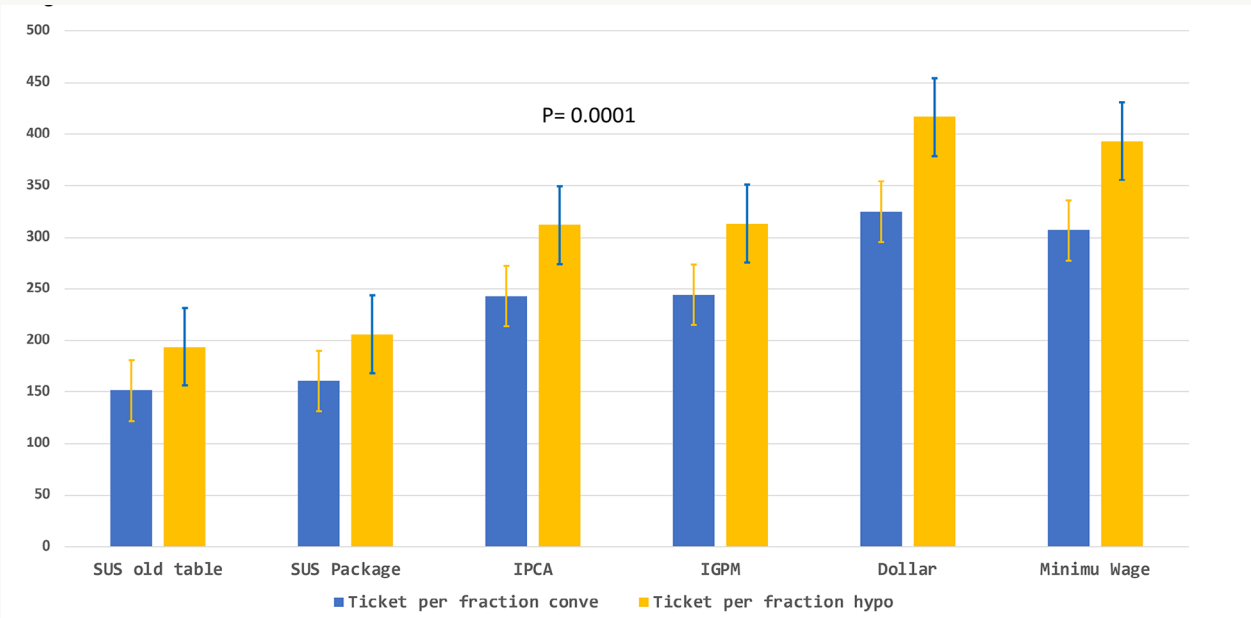

Figure 5. Improvement of remuneration per fraction (ticket) comparing conventional and hypofractionation.

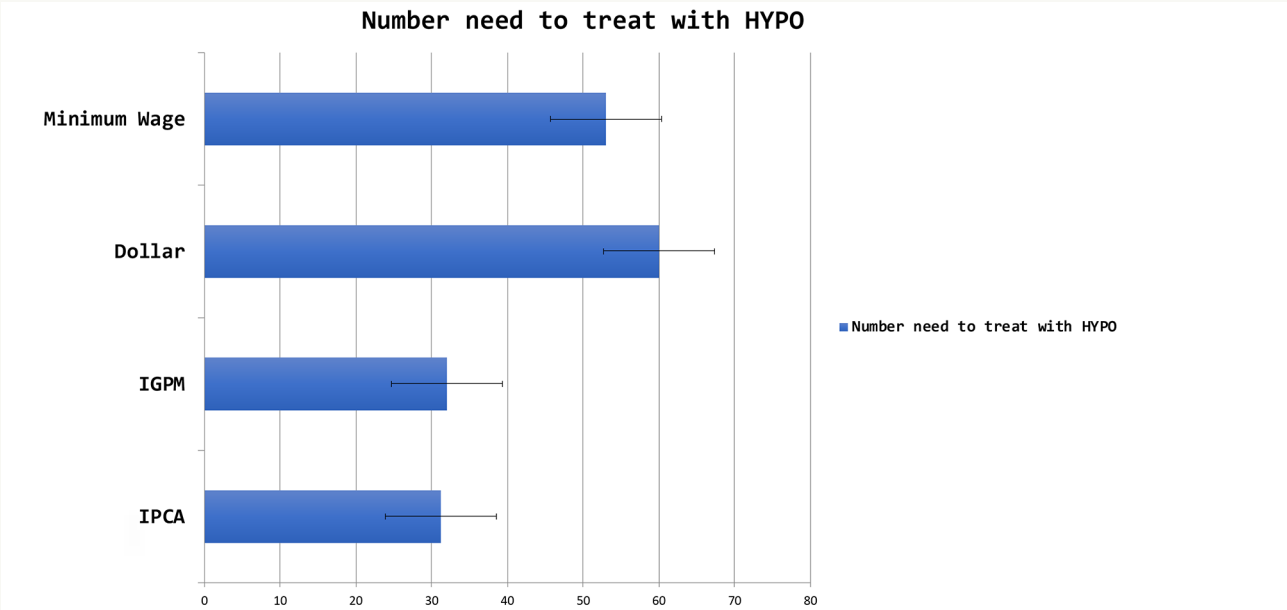

Figure 6. The number need to treat with hypofractionation to equilibrate the lack of readjustment.

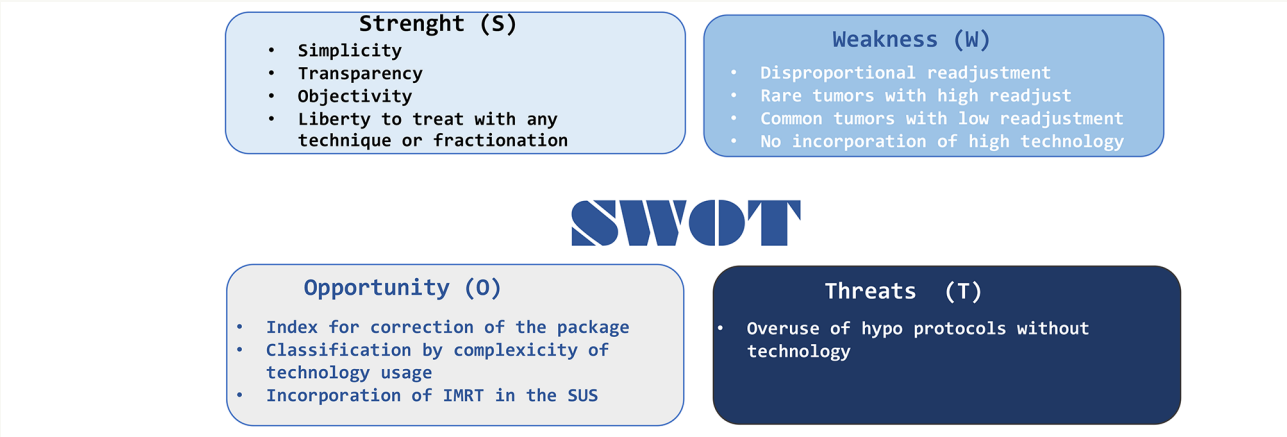

Figure 7. The SWOT analysis of current situation.

patients only had a higher cost to be reimbursed by the DRG, when breast cancer was the first tumor in the group. However, even in that situation, the difference was not statistically significant. When breast cancer was the second or third in the rank of the patients' group, the total value was lower than the old table (Figure 4). This result reveals a dangerous weakness and a potential threat to the public radiotherapy network and could affect several services with these characteristics.

Furthermore, excluding breast from the top ten, nine tumor sites had a readjust <5% (0.4-4.5%). The government gave higher rates of readjusting for rare tumors and lower rates for common tumors. For instance, the top ten tumor sites rank in frequency from the group or our database (5712 patients) is equivalent to 85% of treated patients in a public radiotherapy service in Brazil had only 15.8% of readjusting. The accumulated rate of four economic indexes ranging from 62 to 115% demonstrates the size of the difference between the readjustment necessary and the radiotherapy problem in Brazil.

The fact of the radiotherapy table of remuneration has been frozen for almost ten years is disturbing, and the new way of remuneration can force the system broken the chain of production.[7] The model of payment should generate value for all the chain, i.e., patients, physicians, health managers, and government. The remuneration by the DRG with a low rate of readjusting as the only action of the government after many years with nothing, does not resolve the economic deficit of the public radiotherapy network. It is clear by the difference between the DRG and the old table corrected by economic indexes.

It is true that the reimbursement by DRG brings liberty to the radiation oncologist treat more patients with fewer fractions. However, here is another problem; the public radiotherapy network is prepared to treat their patients with hypo protocols? It is also true and known that to deliver fewer radiotherapy fractions with more dose per fraction makes necessary high technology,[10] and due to long years without monetary correction in the remuneration, the public radiotherapy network is not prepared to implement this kind of treatment with safety to the patients.[7-9] However, due to the dramatic economic situation, many services can choose to treat their patients with the hypofractionated schedule to balance their budgets and continue to survive. Our data demonstrate that hypofractionated schemes are adequate to improve the mean ticket per patient and fraction. However, how many patients would need to treat to balance the economy deficit? Using the IPCA as a parameter, our number shows that it would be necessary to increase the number of patients treated to 100 per radiotherapy device to achieve the economic equilibrium with table corrected by IPCA.

In 2011, a report on care for cancer patients done in Brazil by a Federal Audit Court identified a lack of radiotherapy machines with a long waiting list, patients waiting on average three months for the beginning of radiotherapy, and many machines overload to attend the high demand.[9]

Consequently, the new system of remuneration put the Brazilian radiotherapy society in a paradoxical situation. From the one side it gives liberty to use any radiotherapy technique, but, on the other hand, it does not stimulate to incorporate high technology. Therefore, how to treat more patients with hypo schemes to compensate for the economic lost? The increasing of the number from 70 patients to 100 (42%) in the radiotherapy machine would need 20 hours of working, increasing the necessity of more radiation oncologists, physics and radiation therapists, consequently, increasing the costs.

Moreover, currently many machines in the country already treat between 90 and 100 patients daily. So, how to treat 30-40% more? It is possible to infer from this group simulation that the vicious cycle with a higher load of patients, deficit of radiotherapy devices and long waiting patients' lists will continue to exist even with the changing of the system of remuneration.

However, what would be the opportunities with the remuneration by DRG? The Figure 7 describes the SWOT after the analysis of the possible scenarios with this group simulation.

The Ministry of Health gave the first step creating the remuneration by the DRG. The second step would be the creation of a group from Brazilian Radiotherapy Society to work together with the Ministry of Health for the creation of a factor or classification on the DRG to incorporate high technology such as IMRT, VMAT, IGRT and SBRT. This step would be crucial as to stimulating as to warrant the maintenance of radiotherapy devices to use these techniques.

The third step would be the discussion by this group of an index of correction for the DRG applied each 5 or more years. Our analysis in Figure 2 shows that both IPCA and IGPM would be adequate indexes. It would be necessary once the maintenance of the machine and the purchase of spare parts are priced in US dollars, and the dollar exchange price has been valued more than 115 % since the freezing of the SOPM. All other expenses also increased by more than 60%, leading to the insolvency of all services covered by the SUS that do not receive supplementary funds.

All these steps make together could have power and a synergistic effect in bringing back the interest of new players, including players from the private sector, to treat patients from SUS.

After all, it is important recognizing the limitations of our analysis. First, it is a result of a simulated analysis based on a radiotherapy machine with 70 patient distribution of a single radiation department, thus, the estimated numbers and differences between the ways of remuneration can suffer influence of changes depending on each radiation department

disease distribution. Second, it was not our intention another limitation to evaluate the costs to deliver radiation treatments. We restricted our analysis only to compare the old SUS methodology and its total revenue, and a projected equivalent monetary value corrected by inflation indexes; and those inflation indexes may not truly capture the inflation rate in radiation oncology area, as they were built to refer to specific situations in Brazilian economy (such as food, leisure, family economic viability, or general companies in Brazil's economy).

CONCLUSION

The remuneration by DRG has several advantages over the SOPM, bringing several opportunities to be developed in the short term to improve the economic deficit of public radiotherapy network. Our analysis identified a tremendous disproportion in the readjustment given. The readjustment was higher in rare tumors, excluding breast cancer, and <5% for the tumors most frequent in clinical practice. A non-significant difference of R$18.700,00 between the old table and DRG was found using a simulated group of seventy patients from a benchmark of a public institution. However, the distortion created by the readjustment with the DRG can affect the remuneration of the radiotherapy services depending on the characteristics of patients' population putting in risk the system. The DRG incentives to use hypofractionated schedule, from one side, our data shows that hypo protocols significantly increase the ticket per patients, but it does not exclude the necessity of an adequate readjust of the radiotherapy procedures. On the other hand, services with high technology and free slots in the radiotherapy machine can improve significantly their remuneration utilizing hypo protocol.

As the federal budget for radiotherapy is low, our data shows that depending on the number of radiotherapy services willing to implement hypofractionation as the standard of treatment, and if the implementation is massive with many radiotherapy services on the market at the same time the budget of federal government directed to radiotherapy should be reviewed.

AUTHOR'S CONTRIBUTION

Gustavo Viani Arruda: Collection and assembly of data, Conception and design, Data analysis and interpretation, Final approval of manuscript, Manuscript writing, Provision of study materials or patient

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