

Radiotherapy Information System in Cancer Treatment Improvement: A Case Study at the Brazilian National Cancer Institute

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Abstract. Radiotherapy is one of the main means of treating cancer patients. Its application has grown worldwide. Around 50% of all cancer patients should receive radiation. Brazil faces a shortage of radiotherapy treatment because of a lack of enough treatment units, equipment availability, well-trained staff, and fair reimbursement. The Radiotherapy Information System (RIS) implementation to manage information about patient scheduling is vital to improve the efficiency of care and reduce the waiting time to start cancer treatment. The information system deployed can be indicated as a disruptive innovation in the Brazilian public health system, considering the radical improvement in the cancer treatment process at the Brazilian National Cancer Institute.

Keywords. Radiotherapy Information System, RIS, Cancer Treatment

1. Introduction

Cancer treatment involves a complex and multifaceted decision-making process. Brazilian citizens have faced long waiting times to start oncology treatment. Lengthy waiting periods increase the risk of cancer recurrence and decrease patients' survival rates [1].

Radiotherapy is one of the main means of treating cancer patients. Its application has grown worldwide. Around 50% of all cancer patients should receive radiation. Nowadays, the Brazilian public health system cannot attend to the radiotherapy demand, and many patients requiring radiotherapy are not to access this treatment. Brazil faces a

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shortage of radiotherapy treatment because of insufficient treatment units, equipment availability, well-trained staff, and fair reimbursement [2].

Growing demand for radiotherapy enforces healthcare service managers to face the challenge of delivering in-time radiation therapy to cancer patients for the lowest possible costs. Long waiting times can raise patients' anxiety and tumor growth, negatively impacting clinical outcomes. The high costs are related to Linear Accelerators. Therefore, the focus is on scheduling many patients on a low number of available machines [3].

The availability of accurate information critically influences the quality of cancer care and its efficient management. Radiotherapy Information System (RIS) plays a vital role in cancer treatment by ensuring proper and safe delivery of radiation therapy. Efficient patient scheduling within oncology clinics ensures the delivery of adequate treatment at the exact time. The main objective is to provide the effective use of scarce medical resources [4,5].

The implementation of the RIS to manage information about patient scheduling is essential to improve the efficiency of care and reduce the waiting time to start cancer treatment. Scheduling rules are defined to determine when treatment can be made. The objective is to ensure the effective use of the medical resources and deliver the proper treatment to the patient at the right time.

2. Methods

The Brazilian National Cancer Institute (INCA) has five hospital units that share the same information systems based on an integrated patient database. The focus on interoperability makes the most of patient data accessible across devices and platforms.

The RIS infrastructure was developed using INCA's intranet network that provides safe access to applications designed to improve cancer care. This information architecture consists of a collaborative environment between physicians and technicians, simplifying the physician work and empowering technicians involved in the decision-making processes. The legacy systems feed the radiotherapy data repository, which is the basis to build the decision support system, as shown in Figure 1.

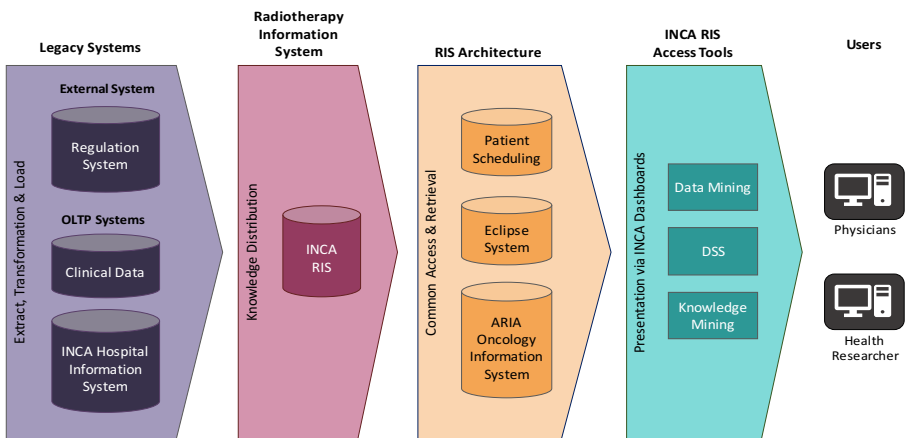


Figure 1. The INCA Radiotherapy Information Architecture

Radiotherapy is a time-consuming process requiring a significant volume and variety of data. Developing a web-based information system is intended to provide a tool that allows the exchange of therapeutic knowledge and patients' clinical data between INCA physicians. Treatment plans and best practices need to be shared to be made accessible to the whole team of clinicians.

Scheduling radiotherapy treatment appointments is a complex problem due to various medical procedures and scheduling constraints, such as machine availability, patient category, physicians' rota, waiting time targets, number of machines, and significant demand for patients.

Different functionalities had to be implemented, including reducing machines idle time, reducing the usage of overtime slots, and reducing the number of patients who do not meet their waiting time targets. The Radiotherapy Information System was developed to schedule cancer patients and solve severe scheduling problems.

The developed system runs on a web application with a modular and layered architecture searching for usability, interoperability, and ease of maintenance. Generally, communication and collaboration with other physicians are necessary. The web-based information system was implemented to improve patient scheduling for radiotherapy treatment, as shown in Figure 2.

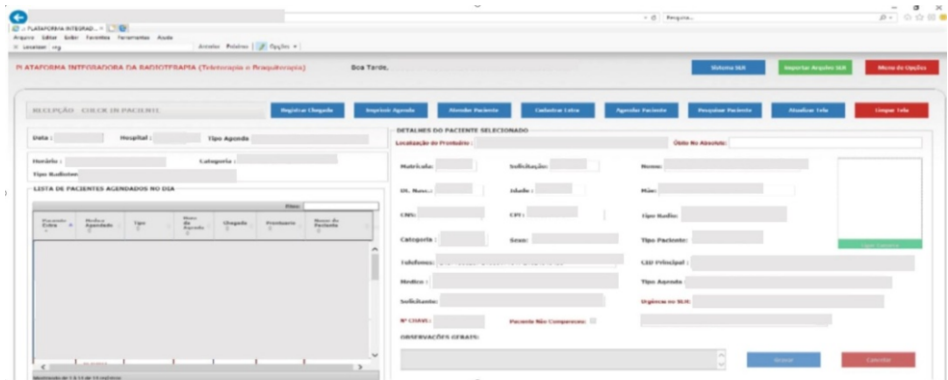


Figure 2. INCA Radiotherapy Information System (RIS)

3. Radiotherapy Information System (RIS)

The information architecture described in this paper has allowed the implementation of an Internet-based information system for radiotherapy. The system was deployed for patient scheduling, treatment decision-making, investigation, and results analysis.

The study describes the implementation of a Radiotherapy Information System (RIS) at INCA hospital units. The information architecture contains clinical data and therapeutic information accessible to INCA physicians. All these components can interact together.

The RIS is integrated with other information systems that support the radiotherapy decision-making process by supplying therapeutic information and sample plans, which can be improved to specific patient cases. Since treatment planning is a critical optimization process, complex plans are created not by a single specialist but by a nuclear medicine team, as shown in Figure 3.

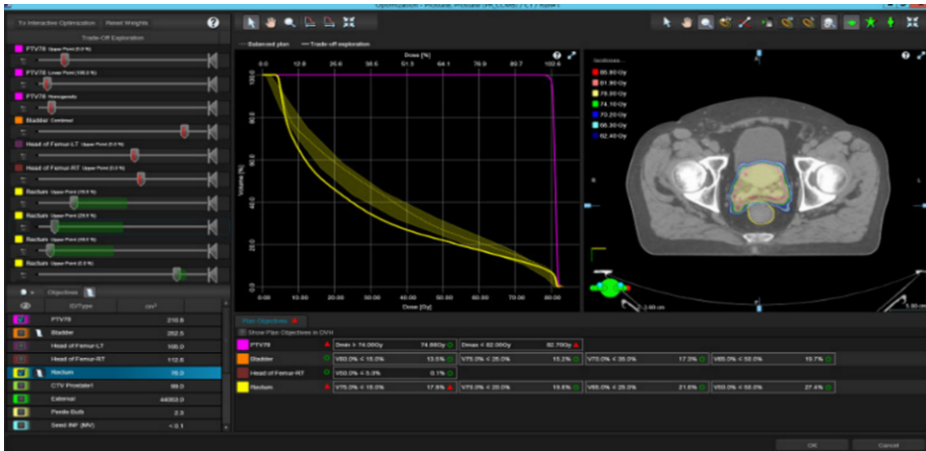


Figure 3. Eclipse System

4. Conclusions

The efficient radiotherapy patient scheduling within INCA clinics plays a crucial role in ensuring the delivery of the proper treatment at the right time. In this scenario, generating a high-quality solution is a challenging task since different goals such as reducing patient waiting time to start cancer treatment could be achieved, and a set of constraints, as the number of available machines, should be considered.

An integrated Radiotherapy Information System is a critical success factor in cancer treatment. The traditional decision-making process cannot deal with the vast amount of data that must be processed for modern medicine. Web-based information systems need to be developed to support complex radiation therapy treatments. This technology connects radiotherapy best practices, specialists, and patient information.

There were many challenges involved in organizing and communicating data in INCA radiation therapy treatment processes. The focus on interoperability has integrated the most patient data across devices and platforms that simplified to share patients' information between cancer hospital units. The system deployed can be indicated as a disruptive innovation in the Brazilian public health system, considering the radical improvement in the cancer treatment process at INCA.

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