

Revolutionizing pediatric radiotherapy reception: Implementing Kaizen for a child-friendly treatment journey

S. Khalfi^{1,2,3*}, FZ. Abdelli², El M. Sadiki², Y. Aghlallou³, W. Hassani^{1,2,3}, FZ. Farhane^{1,2,3}, Z. Alami^{1,2,3}, T. Bouhafa^{1,2,3}

¹Department of Medicine and Pharmacy of Fez, Boite Postale 1893 - KM 2.200 Route Sidi Harazem Fès, 30070, Morocco

²Department of Radiotherapy, Hassan II University Hospital Center, Fez, Avenue Hassan II, Fez 30050, Morocco

³Cancer Research Institute (IRC), 224Q+8V, Fes, Morocco

ABSTRACT Creating a child-friendly radiotherapy environment is essential to reducing anxiety and improving patient cooperation during treatment. This prospective study, conducted in two phases, evaluated the impact of an optimized reception strategy using the Kaizen method on pediatric patient anxiety and parental satisfaction. In Phase 1, anxiety levels were assessed in 50 children before starting radiotherapy, without any specific reception intervention. In Phase 2, a structured reception strategy was implemented during and after treatment, incorporating preliminary visits, interactive communication, and various educational and playful materials to familiarize children with the procedure. Results showed a significant reduction in anxiety (measured by the RCMAS) and a notable improvement in parental satisfaction. These findings demonstrate that the Kaizen approach, based on continuous improvement, optimizes the experience of young radiotherapy patients.

Keywords: Kaizen method; Pediatric radiotherapy; Reception strategy; Anxiety reduction

INTRODUCTION

Children undergoing radiotherapy often face heightened levels of anxiety due to the fear of the unknown and the intimidating nature of the medical environment. The complexity of the treatment process can make it difficult for young patients to feel comfortable and cooperate during their sessions. A personalized and adapted reception process plays a crucial role in alleviating this stress and ensuring smoother treatment experiences [1]. Incorporating principles from lean management, particularly through the Kaizen method, offers a unique opportunity to improve the reception process continuously. Kaizen, a Japanese philosophy focused on continuous, incremental improvements, emphasizes the importance of regularly gathering feedback from both patients and their families. By applying this approach, healthcare providers can identify areas for improvement and make adjustments that promote a more child-friendly and supportive environment [2,3].

This study aims to evaluate the impact of a Kaizen-based reception strategy on children's anxiety levels and parental satisfaction. The focus is on assessing the effectiveness of the interventions—such as educational and playful tools—designed to familiarize children with the radiotherapy process and reduce their fears. Additionally, this study will measure the quality of communication and the overall reception experience from the perspective of the parents.

Objectives

- Assess the impact of a Kaizen-based reception strategy on anxiety levels in children undergoing radiotherapy.
- Measure parental satisfaction with the quality of reception and communication.
- Evaluate the effectiveness of the implemented interventions, particularly playful educational materials, in helping children become familiar with the treatment process.

MATERIALS AND METHODS

This prospective study, conducted from January to December 2024 at the Radiotherapy Department of Hassan II University Hospital in Fès, aimed to assess the impact of a reception strategy based on Kaizen principles on the anxiety levels of children and the satisfaction of their parents.

Phase 1: Baseline assessment without a structured reception strategy (before treatment)

The first phase of the study involved assessing the anxiety levels of children before the implementation of any reception strategy. The sample consisted of 50 children aged 6 to 15 years who were about to begin radiotherapy. Demographic and clinical data were collected to ensure a relevant analysis of the results. Anxiety levels

Address for correspondence:

Khalfi Samia
Department of Medicine and Pharmacy of Fez,
Boite Postale 1893 - KM 2.200 Route Sidi Harazem Fès, 30070, Morocco
E-mail: samia.khalfi@gmail.com

Word count: 2344 Tables: 02 Figures: 02 References: 11

Received: 27 March, 2025, Manuscript No. OAR-25-163270;

Editor assigned: 31 March, 2025, PreQC No. OAR-25-163270 (PQ);

Reviewed: 14 April, 2025, QC No. OAR-25-163270;

Revised: 01 May, 2025, Manuscript No. OAR-25-163270 (R);

Published: 28 May, 2025, Invoice No. J-163270

were measured using the Revised Children's Manifest Anxiety Scale (RCMAS). This baseline assessment, conducted in the first half of 2024, allowed for the determination of the children's anxiety levels before any changes in the patient reception process were introduced.

Phase 2: Implementation of the Kaizen reception strategy (during and after treatment)

After the initial assessment, the reception strategy based on Kaizen principles was implemented with the goal of reducing children's anxiety and enhancing the experience for parents during treatment. This strategy, developed in collaboration with the medical team at the Radiotherapy Department, relies on a continuous improvement process, with adjustments made based on feedback from patients and healthcare staff. The aim was to create a more welcoming and less stressful environment for children while strengthening communication with their parents.

The strategy included several key interventions. First, children were given preliminary visits to familiarize themselves with the radiotherapy center before their first treatment. These visits allowed children to explore the space and mentally prepare for the treatment process. Educational and playful tools were also provided, such as coloring books illustrating the steps of the treatment, educational videos, and puppet demonstrations to explain the treatment process in a reassuring and engaging way. In addition, medical staff received training in using simple, reassuring language, and regular debriefing sessions were held to ensure clear and consistent communication with both parents and children. The Kaizen approach allowed for ongoing evaluation of these interventions. Feedback was collected after each treatment session and analyzed

in weekly meetings. This facilitated real-time adjustments to refine the reception strategy and address the specific needs of patients and their families.

Measurement of anxiety and parental satisfaction

Children's anxiety levels were reassessed using the RCMAS scale during and after treatment to evaluate the effectiveness of the Kaizen strategy in reducing stress and anxiety. At the same time, parental satisfaction was measured using questionnaires to assess the quality of communication, clarity of the information received, and emotional support provided to both the child and the family.

Statistical analysis

Data were analyzed using statistical tests such as paired t-tests and ANOVA to compare significant differences in anxiety levels and parental satisfaction before and after the implementation of the strategy. Quantitative analysis allowed for the measurement of the reduction in anxiety scores and the improvement of parental satisfaction scores, while qualitative feedback, particularly related to educational tools, was analyzed to better understand the impacts of these interventions.

RESULTS

Demographic characteristics of participants

The study involved 50 children aged 6 to 15 years, with an average age of 9.8 years and a balanced gender distribution (52% boys, 48% girls). The majority of patients were treated for brain tumors (30%), lymphomas (14%), and sarcomas (10%), with a minority diagnosed with other types of pediatric cancers (10%). The demographic data are summarized in Table 1.

Tab. 1. Demographic characteristics (n=50).		Variable	N (%)
	Age group	6-8 years	10 (20%)
		9-12 years	35 (70%)
		13-15 years	5 (10%)
	Gender	Male	26 (52%)
		Female	25 (48%)
	Tumor localization	Brain Tumors	10 (30%)
	Variable	Nephroblastoma	7 (14%)
		Sarcoma	5 (10%)
		Lymphomas	12 (24%)
		Rhinopharynx	6 (12%)
		Other	5 (10%)
	Disease stage	Localized	30 (60%)
		Advanced	20 (40%)
	Family structure	Lives with both parents	40 (80%)
		Lives with one parent	9 (18%)
		Orphaned	1 (2%)
	Number of siblings	No siblings	10 (20%)
		1-2 siblings	30 (60%)
		3 or more siblings	10 (20%)
	Education level	Primary School	20 (40%)
		Middle School	20 (40%)
		High School	10 (20%)
	Socioeconomic level	Low	15 (30%)
		Middle	25 (50%)
		High	10 (20%)

Evaluation of children's anxiety before the implementation of a welcoming strategy

Before the implementation of the new welcoming strategy, anxiety was a major limiting factor, leading to difficulties in cooperation and an increased use of sedation. An initial evaluation of anxiety levels using the RCMAS (Revised Children's Manifest Anxiety Scale) revealed that 68% of children had moderate to severe anxiety, while only 32% displayed mild or no anxiety. This situation complicated patient positioning, prolonged session preparation times, and increased the emotional burden for families and medical staff.

Implementation of the Kaizen-based reception strategy

The integration of the Kaizen methodology into the welcoming

process for children led to a significant improvement in the care pathway, with a progressive reduction in anxiety levels and better patient cooperation. After the implementation of the new measures, the proportion of children with moderate to severe anxiety decreased from 68% to 24%, while the percentage of patients with mild or no anxiety increased to 76%. This improvement was particularly marked in children under 8 years old, where severe anxiety dropped from 35% to 10% (Figure 1). The interventions implemented included preliminary visits before treatment began, improved interactive communication between healthcare providers, children, and their parents, as well as the introduction of tailored educational materials (explanatory videos, demonstrations with dolls, illustrated booklets). These actions helped reduce treatment-related fears and established a climate of trust from the very first consultation.

ANXIETY BEFORE AND AFTER IMPLEMENTATION OF RECEPTION STRATEGY

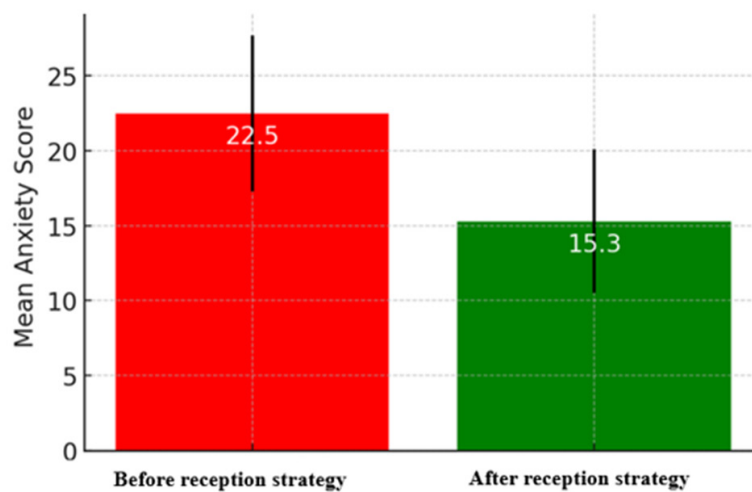


Fig. 1. Patient's anxiety before and after implementation of reception strategy.

One of the most notable effects of this new approach was observed in the management of sedation. Initially, 30% of the children required anesthesia to tolerate the first radiotherapy sessions. Thanks to the improvement of the welcoming protocol, the majority of them were able to continue their treatment without the need for sedation after the initial sessions.

Experience of families: Evolution of parental satisfaction

Parental satisfaction also saw a significant improvement. Before

the implementation of the Kaizen method (Figure 2), 47% of parents expressed major concerns regarding the emotional care of their child, and only 53% reported being satisfied with the support provided. After the adoption of the new practices, the parental satisfaction rate rose to 92%, with a significant reduction in concerns related to information and psychological support. Among the most appreciated aspects were the ability to accompany their child during the preparatory sessions (94% satisfaction), the clarity of the information provided (91%), and the availability of the healthcare staff (89%) (Table 2).

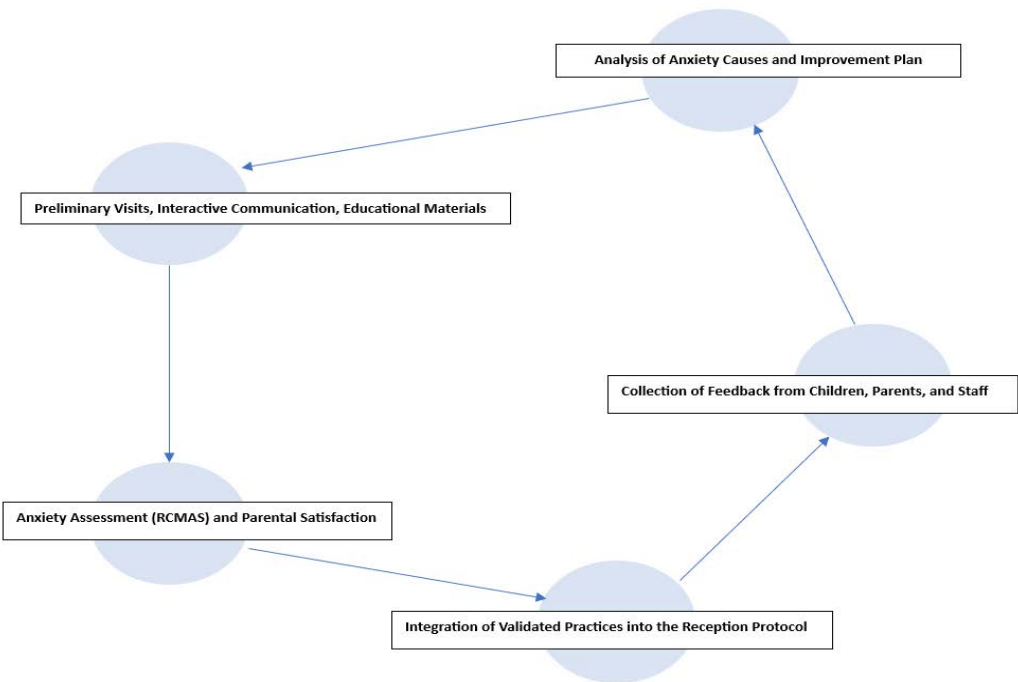


Fig. 2. Kaizen cycle applied to the reception of children in radiotherapy.

Tab. 2. Parental satisfaction scores.	Evaluation items	Phase 1 (Mean ± SD)	Phase 2 (Mean ± SD)	(p-value)
	General satisfaction	3.2 ± 0.8	4.5 ± 0.5	p<0.001
	Clarity of communication	3.4 ± 0.7	4.6 ± 0.6	p<0.001
	Impact of educational supports	3.1 ± 0.9	4.4 ± 0.5	p<0.001

The semi-structured interviews conducted with a sub-sample of 15 parents and 15 children revealed several key insights. Over 75% of the parents reported that the pre-visit and the explanations provided had significantly helped reduce their children's anxiety by addressing the fear of the unknown. The educational tools, particularly the playful ones, were seen as effective in making the process less intimidating for the children. Additionally, the interactive approach adopted by the staff was widely praised for its ability to clarify the treatment process and improve communication between the healthcare team, the children and their families.

The positive impact of this reorganization was also observed on the healthcare teams. Before the implementation of the new protocol, the average time required to position a child before the start of the session was 12 minutes. After optimizing the process, this time was reduced to 7 minutes, representing a 41% improvement. This reduction allowed for better session flow and a decrease in stress for the medical teams.

DISCUSSION

The implementation of a Kaizen-based reception strategy significantly improved the radiotherapy experience for pediatric patients and their parents. Our findings demonstrated a notable reduction in children's anxiety levels following the introduction of structured and engaging interventions, such as preliminary visits, educational tools, and enhanced communication techniques. The systematic integration of patient and family feedback allowed for continuous adjustments, ensuring a more child-friendly and reassuring treatment environment.

These results align with previous findings emphasizing the

importance of alleviating the psychological burden associated with pediatric radiotherapy. Research has shown that continuous psychological support and age-appropriate information are essential throughout the treatment process, helping both children and parents maintain a more optimistic outlook and improving their ability to cope with the challenges of therapy. In our study, the use of educational and playful tools, along with tailored communication strategies, contributed to this need for ongoing support [1].

In an interesting study by Sharmin et al., the authors highlighted the critical need for child-friendly immobilization devices in radiotherapy, particularly in economically disadvantaged countries such as Bangladesh. These devices are essential to ensuring that young patients remain still during treatment, which is vital for precise radiation targeting and minimizing the risks associated with movement.

The study emphasized that while treatment efficacy is crucial, the physical and psychological comfort of pediatric patients should not be overlooked. This aspect is even more important in resource-limited settings, where children are often already experiencing significant stress due to their medical conditions.

The design of these immobilization devices should incorporate child-specific features, such as the use of non-threatening materials and ergonomic adaptations that accommodate different anatomical structures. A well-thought-out design can enhance the overall experience for young patients, helping them feel more at ease during treatment.

The study's findings suggest that devices specifically designed for

children not only improve their comfort but also increase their cooperation and treatment precision. This indicates that investing in child-friendly designs could lead to better health outcomes for pediatric patients undergoing radiotherapy an approach that aligns with the findings of our own study [4].

Moreover, the literature highlights the value of a multidisciplinary approach, involving healthcare professionals, families, and social workers, to address the emotional and psychological distress linked to radiotherapy. By incorporating feedback loops through the Kaizen methodology, our study fostered active collaboration among medical teams, allowing real-time adjustments to improve patient-centered care. Similarly, maintaining consistent healthcare staff throughout the treatment was an essential factor in reducing patient anxiety, as continuity in care fosters trust and emotional security a principle supported by previous studies [5,6].

Our study demonstrated that the implementation of a child-friendly reception strategy helped reduce the need for anesthesia in some patients. In a study, it was observed that the median age at which children typically no longer require anesthesia during radiotherapy is 6 years [7]. However, the continued use of anesthesia at older ages was partly attributed to a lack of physician awareness regarding available strategies to alleviate anxiety. To address this issue, holt et al were introduced a new initiative, with 65% focusing on video-based distraction therapy and/or the use of augmented and virtual reality-innovative approaches aimed at reducing anxiety and, consequently, the reliance on anesthesia [8].

Effective communication strategies also play a critical role in reducing treatment-related stress. Prior research advocates for a structured exchange of information between all medical professionals involved in pediatric cancer care [9]. In our study, regular debriefing sessions and staff training in child-centered communication techniques enhanced the clarity and accessibility of information provided to both children and their parents, reinforcing their confidence in the treatment process.

Furthermore, engaging interventions such as creative arts therapy and playful specialists have been identified as beneficial in familiarizing children with radiotherapy and reducing stress. Our study supports this finding, as the integration of child-friendly learning materials, interactive pre-treatment visits and storytelling elements helped normalize the treatment environment and mitigate fear. Additionally, maintaining a daily routine has been shown to be a key factor in the psychological well-being of both children and their families during cancer treatment [8-10]. While our study did

not directly assess routine maintenance, the structured reception process helped establish predictability, which may contribute to emotional stability.

Finally, the involvement of social workers has been recognized as crucial in helping families regain emotional balance and cope with the mental strain of childhood cancer [8-11]. Although our study did not specifically focus on social work interventions, the Kaizen-based reception model encouraged multidisciplinary collaboration, which could be further expanded to include social support services in future implementations.v

CONCLUSION

Our study demonstrates that a patient reception strategy based on the Kaizen method can significantly enhance the radiotherapy experience for pediatric patients and their families. By integrating structured and tailored interventions such as preliminary visits, educational tools and enhanced communication techniques we observed a notable reduction in anxiety levels among children, along with a decrease in the use of anesthesia.

The results obtained align with the existing literature, which emphasizes the importance of continuous psychological support and age-appropriate information throughout the treatment process. The adoption of immobilization devices tailored to children's needs, particularly in resource-limited settings, combined with the involvement of a multidisciplinary team comprising oncologists, engineers, psychologists and social workers, appears to be essential for improving both treatment comfort and precision.

Finally, the integration of continuous feedback loops through the Kaizen method allows for real-time adjustments, fostering a patient-centered approach and the continuous enhancement of care quality. These findings encourage the exploration of innovative and collaborative strategies to optimize the management of young patients undergoing radiotherapy, effectively combining therapeutic efficacy with psychological well-being.

FUNDING

This research is funded by cancer research institute of Morocco (IRC), www.irc.ma» (project n° 1317/AmP 2023).

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

REFERENCES

1. Skoutari A, Chounta E, Skenteris N, Tsoukalas N, Alexopoulou A, et al. Oncologic children undergoing radiotherapy: Ways to alleviate the psychological burden – A review. *Rev Recent Clin Trials*. 2021; 16:166-172.
2. Flug JA, Stellmaker JA, Sharpe RE, Jokerst CE, Tollefson CD, et al. Kaizen process improvement in radiology: Primer for creating a culture of continuous quality improvement. *RadioGraphics*. 2022; 42:210086.
3. Kapur A, Adair N, O'Brien M, Naparstek N, Cangelosi T, et al. Improving efficiency and safety in external beam radiation therapy treatment delivery using a Kaizen approach. *Pract Radiat Oncol*. 2016; 7.
4. Sharmin MN, Ray DS, Kaes MI. Child friendly mandatory immobilization devices for radiotherapy: Balancing comfort and clinical necessity from a medical physicist's perspective for Bangladesh. *J Cancer Prev Curr Res*. 2024; 15:97–101.
5. Boterberg T, Dunlea C, Harrabi S, Janssens GO, Laprie A, et al. Contemporary paediatric radiation oncology. *Arch Dis Child*. 2022; 108:332–337.
6. Hildenbrand AK, Clawson KJ, Alderfer MA, Marsac ML. Coping with pediatric cancer: Strategies employed by children and their parents to manage cancer-related stressors during treatment. *J Pediatr Oncol Nurs*. 2011; 28:344–354.
7. McFadyen JG, Pelly N, Orr RJ. Sedation and anesthesia for the pediatric patient undergoing radiation therapy. *Curr Opin Anaesthesiol*. 2011; 24:433–438.
8. Holt DE, Hiniker SM, Kalapurakal JA, Breneman JC, Shiao JC, et al. Improving the pediatric patient experience during radiation therapy – A Children's Oncology Group study. *Int J Radiat Oncol Biol Phys*. 2020; 109:505–514.
9. Gårdling J. When children undergo radiotherapy: Exploring care, developing and testing preparation procedures. Lund University. 2017. [Google Scholar]
10. Balazy KE, Gutkin PM, Skinner L, von Eyben R, Fowler T, et al. Impact of audiovisual-assisted therapeutic ambience in radiation therapy (AVATAR) on anesthesia use, payer charges and treatment time in pediatric patients. *Pract Radiat Oncol*. 2020; 10:e159-e165.
11. Angstrom-Brannstrom C, Engvall G, Mullaney T. Children undergoing radiotherapy: Swedish parents' experiences and suggestions for improvement. *PLoS One*. 2015; 10:e0141086.