

### 3D Modeling of Hospital Environments: Case Study to Improve Patient Safety

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**Hospital environments require reconciling structuring with the National Health Surveillance Agency (ANVISA) standards. In this context, 3D modeling emerges as a tool for modernization and improvement. This article aims to describe its application in a children's physiotherapy room, seeking the best scenario for care and compliance with medical legislation. This case study was conducted in a mother and child complex between February and March 2024. 3D modeling at the studied location demonstrates that the changes made are by standards and promote everyone's satisfaction, efficiency, and well-being, that are inserted.**

**Keywords:** 3D Modeling. Children's Physiotherapy Room. ANVISA.

Hospital institutions have particularities in their architecture that require specific responsibilities to comply with rules and standards established by the National Health Surveillance Agency (ANVISA), seeking to avoid significant problems such as infections and accidents. Thus ensuring the safety and well-being of patients and staff at the site. Therefore, hospital environments still have a gap in structuring qualified patient care and an adequate environment for providing good care from professionals.

3D modeling is crucial in modernizing and improving hospital environments [1]. By offering the ability to visualize and design spaces in a three-dimensional way, this technology not only facilitates compliance with ANVISA's strict standards but also optimizes the arrangement of equipment and the functionality of spaces [2]. In a context where operational efficiency and patient safety are priorities, 3D modeling allows us to anticipate challenges and adjust projects before physical implementation, significantly saving time and resources.

Therefore, the justification for this study is the importance and relevance of using technologies such as three-dimensional modeling to structure

health units. The development of this technology saves time and money when simulating projects, anticipating potential errors to avoid rework and additional expenses [3], being an innovative tool for architects and engineers in the design of hospital facilities, and promoting a more functional and adaptable environment to demands dynamics of modern healthcare.

The study's objective is to apply 3D modeling in a children's physiotherapy room to simulate an environment that promotes satisfaction, efficiency, and well-being for those involved, following the regulations established by ANVISA.

#### Anvisa Resolutions in Hospital Settings

In Brazil, ANVISA establishes strict guidelines for the choice, acquisition, storage, and use of medical technologies, ensuring that devices meet the highest standards of safety and effectiveness [4]. The resolutions described below were used for the children's physiotherapy room studied.

**RDC N° 50/2002:** Provides technical regulations for planning, programming, elaboration, and evaluation of physical projects for healthcare establishments [5].

**RDC N° 63/2011:** This resolution establishes the requirements of good practices for operating health services, aiming to guarantee patient safety and quality of care [6].

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**RDC N° 307/2002:** Provides minimum requirements for the operation of health services, including infrastructure and operation criteria to guarantee the quality and safety of the services provided [7].

**RDCN°36/2013:** Institutes actions for patients safety in health services and provides other measures, emphasizing risk prevention and control [8].

**Materials and Methods**

This work was based on a case study, a methodology that makes it possible to study a place, a human being, or something specific in-depth [9]. The study was carried out between February and March 2024, and the research location was a child physiotherapy room in a maternal and child complex at the obstetric hospital in Feira de Santana. For this purpose, study hypotheses were raised, such as:

- What changes are generated from 3D modeling?

- Have ANVISA resolutions made the changes?
- Do the improvements impact patient safety and quality?

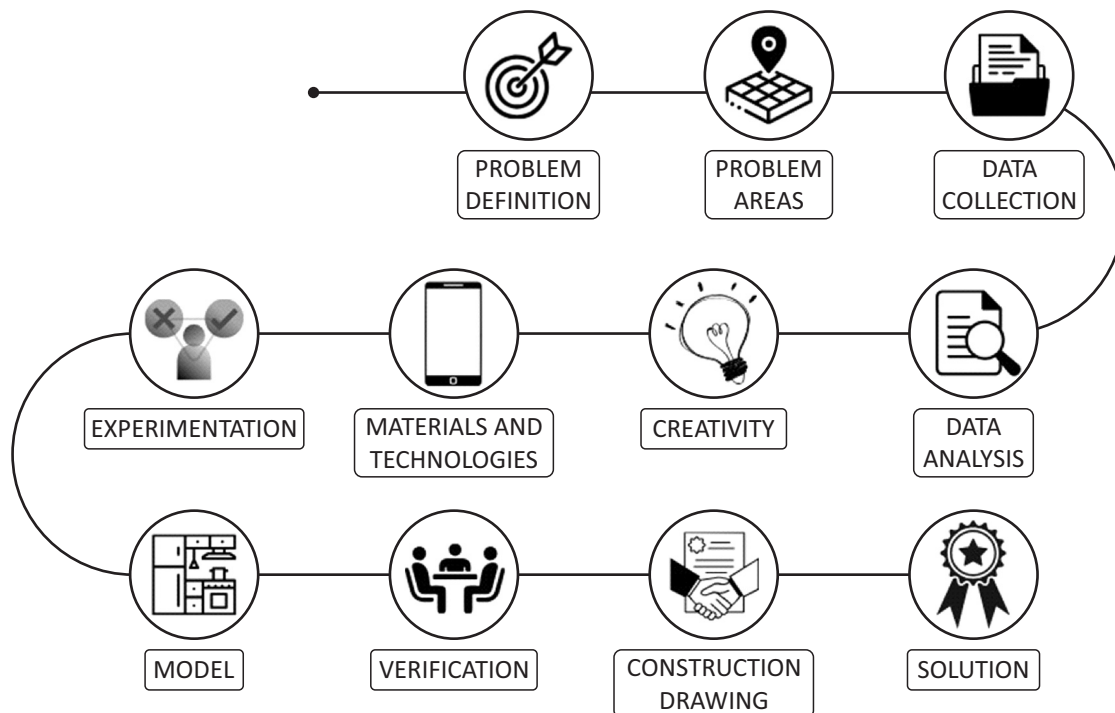
To create the three-dimensional model, a method was used based on 11 steps adapted from Munari [10], which will be presented and detailed below (Figure 1):

**Problem Definition:** The study focused on actions to physically adapt the children's physiotherapy room to ANVISA standards, aiming to meet the needs identified in audits and achieve the health unit's goals.

**Problem Areas:** The study, after the initial stage, was divided into specific subproblems to meet the needs of the hospital, focusing the analysis on the children's physiotherapy room.

**Data Collection:** Data collection was carried out by identifying critical points. Analyzing ANVISA

**Figure 1.** Research method.



Source: adapted Munari [10].

resolutions was essential to defining the specific needs to be met. The standards consulted were RDC 50/2002, RDC 63/2011, RDC 307/2002, AND RDC 36/2013.

**Data Analysis:** A detailed analysis of the content of each resolution and standard was carried out, seeking to identify the specific requirements that applied to the hospital environment under study.

**Creativity:** The analysis revealed that 3D modeling was a promising tool for visualizing spaces. Using this technique, it was possible to create intuitive and dynamic representations of spaces, facilitating the understanding of the characteristics and needs of each location.

**Materials and Technology:** Looking for an economical, accessible, versatile, and easy-to-use solution, the choice fell on the Room Planner application. The application is free and available for mobile devices. It offers a wide range of products (equipment and materials), information about stores and prices, and fidelity to the actual measurements of the environment and products.

**Experimentation:** Experimenting with the Room Planner application began the construction of the 3D modeling, following a few steps: first, the existing materials and equipment in the location were added, with their actual measurements, for an accurate visualization of the space. After adjustment, the items were placed in the desired locations. Finally, the remaining necessary products were researched, added to the modeling, and organized in the desired way.

**Model:** After creating the initial model, three other models with different layouts were developed to find the best solution. Once the alternatives were finalized, the final model was selected.

**Verification:** After finalizing the 3D model, a crucial validation step was carried out with the study's target audience. This stage involved

presenting the model to the coordination of the Quality and Patient Safety Center and the hospital board. The objective was to obtain feedback on the model, identify areas for improvement, and seek final approval.

**Construction Drawing:** A construction document was prepared to complete the work. This detailed the situation in the modeled environments, with comprehensive records and descriptions of all relevant aspects. The document included images and detailed descriptions of the 3D modeling and a complete list of necessary materials and equipment, with their respective measurements and specifications.

**Solution:** The finalized and validated 3D model solved the study's initial problem. The next step will be implementing the proposed solutions in the modeled environments and adapting them to ANVISA standards to guarantee a safe and quality environment for patients and healthcare professionals.

## Results and Discussion

In this study, the effects of using technology on the experience of patients and employees in the children's physiotherapy room were analyzed, making it possible to simulate the scenarios and identify and correct existing inadequacies in the location. According to Souza [2], the project is seen as a whole in a three-dimensional creation, enabling a broad view of the study site. In this context, the modeling in the children's physiotherapy room demonstrates that the changes made are by the RDC mentioned above; the improvements made and their relationship with the standards established by ANVISA are described in Table 1.

From these improvements, the construction of the future state was made; in Figures 2 and 3, it is possible to visualize the transformation to a space with more excellent safety, comfort, and compliance with ANVISA legislation for

**Table 1.** Improvements and their resolutions.

DRC	Standard Compliance	Improvement
Nº 50/2002	This resolution helps ensure the children's physiotherapy room has adequate dimensions, ventilation, lighting, and appropriate materials.	Exchange of old equipment for more modern ones; solutions for ceiling infiltration; space optimization and removal of equipment that does not belong on site
Nº 63/2011	This RDC considers implementing a quality policy to manage services according to rules and focusing on quality management, patient safety, organizational conditions, the physiotherapist's health protection, and the site's infrastructure management.	Improved workflow; positioning sockets close to the places and equipment required; removing cardboard boxes and photo walls; creating a hygiene policy.
Nº 307/2002	Ensures that the children's physiotherapy room provides a safe and efficient service.	Removing cracks in the ceiling.
Nº 36/2013	Contributes to children's safety during physiotherapy, preventing falls and accidents	Swings with ideal and fixed supports

**Figure 2.** Current status of the children's physiotherapy room.



**Figure 3.** 3D modeling of the children's physiotherapy room.



hospital environments. Providing more excellent quality of care for employees and patients through outstanding organization, efficiency, use of unused available materials, and acquisition of essential resources to provide greater satisfaction.

According to Lozado [11], public or private hospitals must adapt to established quality standards, thus aiming to improve performance and the provision of services offered to patients. Investment in infrastructure, equipment, and materials combined with policies and standards are essential to ensure patient safety [12]. Therefore, institutions that do not prioritize these investments contribute to risks and incidents related to patient care.

## Conclusion

Based on the above, 3D modeling is an indispensable tool in planning and optimizing hospital environments. Using architectural software, it is possible to create three-dimensional representations, allowing a complete visualization and better analysis of these spaces. Thus, adopting this proves to be an efficient tool, but it is essential to guaranteeing well-designed, functional, and adapted hospital settings to the needs of healthcare professionals and patients. It is concluded that the initial objective of the work

was achieved, and the application of 3D modeling in the planning of a children's physiotherapy room proved to be an effective tool to ensure compliance with ANVISA regulations and to create an environment that promotes satisfaction, efficiency, and well-being. The tool allows detailed visualization and adjustment of different aspects of the environment, resulting in a functional, safe, and welcoming space for children.

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