Creation of an architectural space in oncological rehabilitation centers

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Abstract. In the modern world, individual space features in architectural design are becoming a priority. A crucial task is the creation of clinical rehabilitation centers (CRCR), capable of providing high value care to oncological diseased (OD) children in remission [1]. According to the Ministry of Health of the Russian Federation for the last period, the disease incidence of children and adolescents with oncology diseases is 15 cases per 100,000 children. Over the past decade, the number of OD children, registered annually, has increased by 12 %. According to the State Statistics Committee data, published in 2019 in the Russian Federation, about 4,000 new cases of malignant neoplasms in children are registered. The study found the emergence of qualitatively new structural units in medical institutions, the activities of which are aimed at the partial rehabilitation of oncological diseased children [2, 3]. The absence of a complex approach in the rehabilitation of oncological diseased children is also noted.

Keywords: Architecture of medicine, Hospital, Planning structure, Rehabilitation center.

1 Introduction
The International Classification of Functioning, Disability, and Health (ICF), approved by WHO in 2001 as an addition to ICD-10 is of paramount importance for the development of the rehabilitation services agency, allows to evaluate the “components” of human health and combines 2 opposite approaches (medical and social aspects) to understanding the limitations of vital activity and functioning. And if the medical model considers the limitation of vital activity as a problem, caused directly by a disease, injury or other change in health, which requires individual medical care, then the social approach involves collective responsibility for limiting vital activity, i.e. it becomes a human rights issue, acquires a political meaning [4].

The analyzed sources on the formation of the environment for OD children consider the objective-spatial environment as a complex, which is understood as the totality of the structural elements and spatial filling of the CRCR environment [5, 6].

CRCR includes the following departments: clinical, administrative, receiving and consulting, department of psychological aid, pedagogical and hospital ones [7, 8, 9].
The formation of the rehabilitation environment is affected by a number of factors that we studied: anthropometry of the OD child, ergonomic indicators, psycho-emotional state, type of given treatment and disease state [10].

2 Materials and Methods
2.1 Analysis of design principles of Architectural Space in Oncological Rehabilitation Centers

The principles of complex rehabilitation, which include the medical, physical, social and psychological spheres of recovery of children with oncological diseases in long-term remission, have not been practically developed until the present.

Based on the conducted study, four basic principles of the formation of the CRCR were formed:
1) the principle of unity of the accommodation processes;
2) the principle of space accessibility for an oncological diseased child;
3) the principle of variability, the principle of organizing recovery and rehabilitation space;
4) the principle of adaptivity of the rehabilitation space.
The principle of the unity of the accommodation processes is expressed in the adaptation of the recovering organism to the external conditions of a different space during the course of treatment [11, 12].

The accessibility principle of space for an oncological diseased child [13] is due to the specifics of the anthropometric features of a diseased child, the degree of his/her psycho-emotional state and the features of the rehabilitation process [14].

Figure 1 considers a single ward for a child in rehab. In this case, child care should be carried out with the help of an adult or medical staff. The constructed ovals characterize the space, occupied by the child in a static position at the moment. Lines indicate the motion patterns of the OD child. The places and zones of the ward, actively used by patients and requiring an increase, are marked in red.

**Figure 1.** An example of the formation of a special single ward for the lying OD child.

The variability principle assumes the emergence of many scenarios in architectural and planning decisions. The principle implies two levels: planning and technological. Both entail a change in the shape and volume of the premises. With the introduction of new technological equipment and a change in the scenario of the rehabilitation process, the environment should be variable, which is achieved by the transformability and mobility of the elements of space (Figures 4a, b). These levels dictate the space-planning decision, optimal for the rehabilitation environment.

**Figure 2.** An example of the transformable partitions usage.

The variability principle is considered as an example of the formation of the treatment section group (Figures 3a, b), changing the size of the premises achieved by moving the transformable partitions [15, 16]. This transformation makes it possible to divide spaces of the triple ward into single wards, for children, who need special conditions of care and rehabilitation.
Figure 3. Space-planning schemes, a - triple wards for OD children; b - single and triple wards after the transfer of transformable partitions. Symbols: 1 - table, 2 - cabinet, 3 - bed, 4 - wardrobe, 5 - chair, 6 - wheelchair, 7 - bath, 7 - toilet, 9 - sink, 10 - wardrobe.

The principle of organizing recovery and rehabilitation space is based on the socio-environmental expansion of the OD child's compensation abilities. Any element of the environment can positively or negatively affect the child and can be neutral [17]. Correction of the environment, with the possibility of active and independent use, is carried out:
- the formation of an area of proximal development (a stock of potential opportunities, that the child is currently not able to realize independently or actively uses them with the direct assistance of an adult (Figure 4 indicates an example of the interaction of an adult and a child at the time of a possible fall of the child.).
Figure 4. An example of a spatial model of interaction between an adult and the OD child.

- by the stimulation of the possibilities of the OD child creating a correspondence of the objective world, that can be recreated in a special sensory room (Figure 5).

Figure 5. Rehab medical (Great Britain) sensory room for children rehabilitation (Great Britain). 1 - star ceiling, 2,3 - fiber optic fiber, 4 - hanging chair, 5 - music waterbed, 6 - soft panels, 7 - projector, 8 - flickering aquarium, 9 - vibration floor-platform, 10 - odor generator.

Each full-featured, complex equipped sensory room has complex technological packing. The constitution of the sensory room may vary depending on the purpose of the rehabilitation of the relaxation room, or sensory stimulation, for individual or group sessions. Elements of the sensory room are: air bubble panels and tubes, soft platforms and acrylic mirror panels, safe fiber optic fiber, “Starry Sky” hanging ceiling, projectors, a flickering pool with transparent balls, a musical water bed, a vibration floor platform, special-designed furniture (ottomans, armchairs, seats, supporting pillows and rollers), a generator of odors and sets of aromatic oils.

These principles and studies reflect the specifics of designing a rehabilitation environment for children after oncological disease [16].
They made it possible to develop an architectural and spatial model of the organization of the CRCR (Figure 6), with the help of which the established tasks for the rehabilitation of children should be solved.

2.2 The method of volumetric modeling

As a result, the anthropometric features necessary for determining functional parameters in the formation of the spatial environment were identified. Schemes of movement of the sick child are made. To identify the ergonomics of space, three-dimensional mannequins of a child and an adult were constructed. Mannequins determine the possible scenario of independent movement of the child (swinging, falling, and moving with the help of a support) and when interacting with an adult.

A comparative analysis of the dimensions of spaces required to a sick child and the dimensions required to a healthy child was performed [19, 20].

As a result, the dimensions of spaces are determined on the example of medical and social, social and pedagogical departments and departments of psychoemotional rehabilitation, which are necessary for a sick child to move independently and interact with an adult.

![Figure 6: Spatial model of the CRCR for OD children.](image-url)
3 Results and Discussion
The study formed a spatial scheme of the relationship between the functional zones of the rehabilitation center used by a sick child. Also, the study formed the relationship schemes of functional zones used by the child together with adult on the example of the ward, medical and social departments and the Department of psychoemotional rehabilitation. As a result, the child's attendance zones were established, as well as schemes for independent movement and with the help of an adult. The study identified functional spaces where the child requires psychoemotional comfort that compensates for the emotional tension of the child.

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4 Conclusions
As a result of the study, we developed recommendations for the development of a space-planning decision of the CRCR. These decisions include:

- increase in the space of the treatment section premisses;
- the expansion of passages, openings, and communications, taking into account the motions of the child, or the simultaneous passage of the OD child and an adult;
- the arrangement of devices, equipment taking into account the safety of the OD child in remission;
- the arrangement of navigation systems that will make it possible for the OD child to navigate in the rehabilitation environment;
- the creation of spatial, color, sound and tactile references;
- the optimum color and light modes in a rehabilitation environment;
- the creation of a sparing sound mode.

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