The impacts of visual comfort on pediatric oncology intensive care units

Os impactos do conforto visual em UTIs oncológicas pediátricas

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Abstract

Patient's discomfort in hospital Intensive Care Units (ICUs) regarding infrastructure, the lack of natural light and complementary artificial light, as well as colours found in these environments are important humanization concerns directly affecting the physical and emotional well-being of patients, caregivers and the multidisciplinary team, especially in paediatric oncology ICUS, which are stressful environments. This paper sought to answer relevant questions about visual comfort and traces of stress experienced by caregivers and a multidisciplinary team in a paediatric oncology ICU. For this purpose, a Visual Comfort Questionnaire and a Lipp's Stress Symptoms Inventory were applied to obtain participants´ feedback at a [hospital] in Brazil. The results showed that caregivers and employees pointed out the need to have more windows in the environment, addressing the importance of natural light for physical and emotional well-being. Based on this, a significant number of employees and companions associate stress to the everyday life in the ICU, which occurred mainly in the intermediate (resistance) or final (exhaustion) phases, according to the Lipp scale. These results showed the importance of a broader approach to hospital humanization.

Keywords: Pos-occupancy evaluation. Visual comfort. ICU. Oncology paediatrics. Windows.

Resumo

O desconforto do paciente em UTIs hospitalares quanto à infraestrutura e ausência de luz natural e luz artificial complementar, bem como as cores presentes nestes ambientes são importantes preocupações de humanização que afetam diretamente o bem-estar físico e emocional dos pacientes, cuidadores e equipe multidisciplinar, principalmente nas UTIs pediátricas oncológicas que são ambientes estressantes. Este trabalho buscou responder questões relevantes sobre conforto visual e traços de estresse em cuidadores e equipe multidisciplinar em uma UTI oncológica pediátrica. Para tanto, foram aplicados o Questionário de Conforto Visual e o Inventário de Stress Lipp para obter o feedback dos participantes de um [hospital] no Brasil. Os resultados mostraram que cuidadores e funcionários apontaram a necessidade de mais janelas no ambiente, abordando a importância da luz natural para o bem-estar físico e emocional. Parte significativa dos funcionários e acompanhantes nivelam o estresse com o cotidiano na UTI, fato que ocorreu principalmente nas fases intermediária (resistência) ou final (exaustão) segundo a escala de Lipp. Os resultados mostraram a importância de uma abordagem mais ampla da humanização hospitalar.

***Palavras-chave**: Avaliação Pós-Ocupação. Conforto visual. UTI. Pediatria oncológica. Janelas.*

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Introduction

Natural light has always played an important role in the history of architecture. Sunlight follows the cycle of the day and is characterized by constant variation, whether in terms of weather or seasons. The cyclic changes of light and dark that occur with a period of 24 hours as a consequence of the Earth's rotation around the sun is an important external environmental factor, as all living beings have developed an internal timing system aligned with this period, which allows the organism to anticipate the next environmental changes. This timing system is called the circadian cycle: from the Latin circa (about) and diem (day) and is performed by the central clock in the suprachiasmatic nucleus (SCN) of the hypothalamus. A number of physiological, biochemical and behavioural life processes, including body temperature, eating behaviour, hormone secretion and glucose homeostasis, are influenced by circadian rhythms in humans (CHAN *et al*., 2012). Environmental factors such as the light/dark cycle, temperature changes and food availability act as zeitgebers (timekeepers), which synchronize the endogenous circadian clock with the external environment. Therefore, the circadian rhythm is the result of an endogenous timing system that is influenced by external stimuli, where light is the main zeitgeber.

Light is perceived through the retina, which allows for the entrainment of the circadian rhythm to the exogenous light/dark cycle, by controlling the timing of feeding and the activity cycle, as well as regulating the rhythmic release of endocrine hormones (CARDONE *et al*., 2005). In addition to being closely related to the sleep/wake cycle, circadian rhythms are involved not only in inflammatory responses, but also in modulating therapeutic efficiency. How the immune system responds to disease or injury is often dependent on the interaction of the disease or injury with the circadian machinery. Circadian rhythms are often disrupted in ICU patients and there are a number of factors that are likely to contribute to this disruption (JOBANPUTRA *et al*., 2020).

In this context, these variations affect the perception of architectural space, such as variations in shapes, textures, colours, among others. The correct use of lighting intensifies the emotional impact on the space. Henry Plummer (1997) states that we are endowed with a psychic side greater than the intellectual one and the constant variations in luminosity can produce varied reactions and sensations, affecting all human activity (PLUMMER, 1997). Environmental construction takes into account several factors especially location, form, function, lighting, temperature, materials, colours and acoustics to provide well-being of those who will experience it there. When we enter an environment, we realize that the place can arouse feelings in addition to fulfilling the basic function of sheltering. The stimulus generated by forms and materials added to the cultural experience may or may not be pleasing, emitting sensations that go beyond physical control (KHIDMAT *et al.*, 2021).

The development of artificial light contributed to improving the spatial aspects and sensations of the environments, as well as heightening individuals´ emotional states. Light is perceived through the retina. Any discomfort can alter individuals´ sensations, as well as the work production. In his work on lighting, Hopkinson (1963) highlighted the importance of natural light in long-term environments. However, in wards, he proposes a complementary artificial light system to alleviate the visual and thermal discomfort of these environments, which in turn were endowed with large openings to the outside and darkness in the central areas, as in the 1960s, wards consisted of huge halls with a large number of beds (HOPKINSON, 1963).

Regarding artificial light, it could be a mistake to only consider lighting after choosing colours and materials. The luminance factor in architectural design should appear early on in the building conception. Nowadays, hospital architecture aims to qualify environments for the physical and emotional patients' well-being to reduce sensations of discomfort arising from the environment and contribute to the humanization of these environments.

Considering the construction of a medical facility, it is important to pay attention to integrating patients into the environment (such as ventilation, light, texture, colours and shapes) as the latter serves as a stimulus and provokes reactions in the human body. Some hospitals have already been investing in humanizing their spaces in favour of patient well-being, with characteristics such as lighter colours and large windows to obtain natural light and even using natural environments that bring patients closer to nature (BATES, 2018; PASCUCI *et al.*, 2017).

The effectiveness of holistic care is achieved by interdisciplinary assistance that offers a range of interventions aimed at alleviating, supporting and helping to discover internal and external resources for better coping and acceptance of the treatment, cure or terminality process. In addition, for this care to take place in its global dimension, a factor that precedes and prepares the way for the act of care is essential, which consists of

constructing and harmonizing a space that can offer patients and families relief from stress and psychological distress and promote emotional well-being, despite the adversities of the treatment, its side effects, fear of death or loss of a loved one. Moreover, providing with a space beyond pain that can transport them, even if only for a few moments, to situations of comfort and pleasure. This will allow everyone to care with zeal and diligence, ethics and responsibility, acceptance and containment, empathy and compassion (BOFF, 1999). Within this conception, the principles that guide integrated care must prioritize special attention to the physical space, which, by itself, should enable measures to relieve physical and emotional suffering.

Within this context, the concern with the patient's well-being in hospitals and Intensive Care Units (ICUs) has provided a change in the physical space of these places (ROBERTSON, 2015; VASCONCELOS, 2004). This is mainly due to the often negative perception of patients and families regarding the infrastructure of these facilities (ROBERTSON, 2015). As they were not initially designed to be pleasant environments, the search for an increase in the quality of these environments and escape from a hostile and unwelcoming environment has been predominant in these constructions (PELLITTER; BELVEDERE, 2010). In this context, the so-called humanization has been modifying hospital architecture and is focused on bringing human values closer to the physical space, which positively affects the psychological health of those who care and those who receive care (MOHAMMAD MORADI; HOSSEINI; SHAMLOO, 2018; PELLITTER; BELVEDERE, 2010). In Brazil, the lack of funding is still a factor to be considered to improve hospital facilities (RIBEIRO; GOMES; THOFEHRN, 2014). Nevertheless, the patient's vision in an ICU often ends up being limited to the ceiling and artificial light, with total absence of the window dimensions, depriving them of the ability to perceive the day and night cycle and receive natural light (VELASCO BUENO; LA CALLE, 2020).

Colours also have indirect effects by affecting the thermal comfort of environments, even if the temperature remains constant, it is possible that people feel colder in environments with cool colours and heat in environments with warm colours, which can be a balancing factor when used correctly in certain environments (GARCÍA-SALIDO; LA CALLE; GONZÁLEZ, 2019).

It is known that the physical space of hospitals has a direct impact on the quality of life, well-being and work of the patient, their family, and thus also the multidisciplinary team that works in these environments. Likewise, ICUs are very sensitive and highly stressful places, contributing to vulnerability. Therefore, an in-depth study of this theme makes sense considering its various aspects (SHEPLEY *et al.*, 2012).

Analysing the context above, a Visual Comfort Questionnaire and a Lipp's Stress Symptoms Inventory were applied to obtain participants' feedback at a [hospital] in Brazil. After both questionnaires were applied, 30 responses were obtained from users and 11 from the multiprofessional team.

The results have shown that both caregivers and employees pointed out the need to have more windows in the environment, addressing the importance of natural light for physical and emotional well-being. Based on this, a significant number of employees and companions associate stress with the everyday life in the ICU, which occurred mainly in the intermediate (resistance) or final (exhaustion) phases, according to the Lipp scale. Based on that, a significant part of employees and companions' level stress with the everyday life in ICU occurred mainly in the intermediate (resistance) or final phases (exhaustion) according to Lipp scale. These results also showed the importance of a hospital humanization and the concern with the environment dedicated to those who care and those who receive care.

Theoretical reference

Post-occupancy evaluation in health environments

Hospitals are great examples of contemporary complex buildings. Moreover, it is known that they have to meet users´ increasing needs. The paediatric oncology sector was chosen as the object of this study because it serves a considerable number of users, allowing for a greater number of respondents, as the spaces significantly influence child well-being and because the oncology sector is an environment that needs adequate stimuli, as patients and families are vulnerable and in a stressful environment.

The objective of this study, applied in a paediatric oncology ICU, was to answer questions relevant to the impact of sunlight and artificial light, as well as the colours found in hospital environments on caregivers and the multidisciplinary team and the role of stress in the intensive care environment. To understand whether or not a building meets these needs, we can use the Post-occupancy Evaluation (POE), which is a set of activities and processes that systematically evaluate the performance of buildings after they have been built and occupied for some time (PREISER, 1988). The methodology can adopt different methods, be qualitative and/or quantitative instruments, and its importance lies on the combination of analyses carried out by

evaluators or designers and the feedback from its users (PREISER, 2002). Many users point to defects and deficiencies of a building when occupied, such as: accessibility, distribution and configuration of spaces, thermal performance, light comfort, natural and artificial conditions, use of colours, safety and protection issues. Knowing the built environment can lead to continuous improvement processes, save time and money on maintenance processes, as well as provide safety and well-being to its users (PREISER, 1995; VISCHER, 2008). Complex environments such as hospitals, which serve different categories of users, require constant maintenance and adaptation to the expectations of its users, showing that the POE has an interdisciplinary character (ZEISEL, 2007).

A building performance can be evaluated by different approaches: first, an evaluation of internal environmental quality: verification of the user's level of satisfaction or comfort that can be obtained by using qualitative research instruments and quantitative measurement instruments; second, a performance verification: evaluating the building through predictive models, such as compliance with energy efficiency standards; and third, a holistic evaluation: also known as Facility Performance Evaluation (FPE) or POE, which aims to describe the complex heterogeneities of systems, correlating their functioning with behavioural psychology through large databases. The FPE/POE techniques are questionnaires, interviews, field observations, walkthroughs, workshop sessions, photographic surveys, time use records and looking at physical evidence of use (MACALLISTER; ZIMRING; RYHERD, 2016).

Furthermore, since 2004, the Quality of Place and Landscape (ProLUGAR) research group in the Graduate Program in Architecture at FAU/UFRJ has been applying the activism approach of the cognitive sciences (VARELA; THOMPSON; ROSCH, 2003) aiming to expand the understanding of the inseparability between man and environment, as well as the reasons that justify user behaviour in a given built environment (RHEINGANTZ, 2004). Maturana *et al.* (2001[1] *apud* RHEINGANTZ *et al.*, 2008) justifies that this stance implies admitting that human behaviour is not limited to the production of an action or set of actions; that all human action takes place in some emotional domain, which necessarily includes unconscious, psychological and cognitive mechanisms. Another point of the ProLUGAR group is that every researcher is an observer: sensations, senses and emotions resulting from the stimuli provided by the environment during their experience of observing can be incorporated into their narrative, as well as seeking to absorb and incorporate their experience and that of other users. In their analysis of the actor-network in post-occupancy evaluation, Rheingantz, Pedro and Carvalho (2013) points out that objects, as well as humans, may be able to act in the collective, and that together they can transform their components. Thus, in FPE/POE, the interference of more than one agent needs to be recognised and that the questions resulting from the evaluating observer are sets of relationships bringing together human and non-human actors whose quality is configured as a relationship under construction.

However, Leaman and Bordass (2019) for the influential journal Productivity: *The Killer Variables Twenty Years On* point out that, although many points can be considered in the performance of a building, priority should be given to valuing the local context, as there is the issue of building a good place, as the peculiarities of its users (LEAMAN; BORDASS, 1999).

Therefore, an ICU unit that is an environment of great spatial complexity and that has relevant importance in promoting the health and well-being of patients and their team of workers must be constantly evaluated. There is a spatial preconception that patients treated in the ICU are not aware of their bed spaces or the spatiality of their surroundings according to Roxberg *et al.* (2020). However, today, with new treatment protocols, patients now usually receive mild sedation (EGEROD *et al.*, 2015; HOLM; DREYER, 2018). Thus, patients are aware of and perceive the space around them, which has not yet been fully considered in the design and construction of rooms in healthcare environments. Another point to be considered is the well-being of the patients' companions, which is sometimes overlooked as the ICU is a closed environment, hidden from the view of other people, in order to protect patient integrity (ROXBERG *et al.*, 2020).

According to Bestetti (2014), studying the ambience is extremely important, as an improvement in the conditions of the space can influence social relations, as well as recognizing that certain compositional elements of the space can significantly provide greater subjective well-being in users who participate in any spaces, public or private, of activity or conviviality and that can contribute to the humanization of the environment (BESTETTI, 2014).

A detailed study of the ambience in Intensive Care Units is of paramount importance as they can receive patients of any age group in a serious condition, requiring intensive and constant monitoring, as well as more

[1]MATURANA, H. R. *et al*. **Cognição, ciência e vida cotidiana**. Belo Horioznte: Ed. UFMG, 2001.

complex care (BOLELA; JERICÓ, 2006). In this context, the remarkable importance of the study is verified, taking into account the qualification of the place through a post-occupancy evaluation.

Ribeiro, Gomes and Thofehrn (2014) state that the consolidation of humanization requires a commitment to the environment. According to the authors, p. 7: "A children's hospital cannot be characterized as a place that serves 'youngsters', but rather as an institution that addresses the needs of a period of development called childhood […]" (RIBEIRO; GOMES; THOFEHRN, 2014). In a scoping review of studies evaluating ICU design features, Saha *et al.* (2022) found that the effect of lighting and windows was unclear in the studies, showing the need for further research (SAHA *et al.*, 2022).

Humanization is a broad concept and includes multidisciplinary aspects, and it is not only intended for patients (GARCÍA-SALIDO; LA CALLE; GONZÁLEZ, 2019; VELASCO BUENO; LA CALLE, 2020), therefore the concern for family members and health professionals is also a matter of humanization. Pio *et al*. (2017) also discuss the importance of caring for caregivers and family members as an improvement of the quality of life and humanization (PIO *et al*., 2017). Moreover, Fachini, Scrigni and Lima (2017) point out that physical stress can limit the freedom and autonomy of health workers (FACHINI; SCRIGNI; LIMA, 2017).

Methodology

The research was carried out in the paediatric oncology ICU of a hospital in Brazil throughout one year. During this period, the researchers visited the hospital almost weekly. On days when there were no complications in the ICU, 2 companions (out of the 4 or 5 occupied beds) who had not been previously interviewed and practically all the employees were interviewed. Thus, it is believed that at least 50% of the companions and 80% of the employees were interviewed.

The study was characterized by a cognitive behavioural approach, where the researcher assumes a posture of participant observer together with the users of the place. Thus, for the systematization of information, qualitative and quantitative methods were used. The qualitative study took place with a walkthrough analysis, observing the ICU environment and an analysis of its architectural plan, which enabled us to verify the existence or not of windows, the measurement of their dimensions and the descriptive observation of the colours used throughout the environment compared with current legislation.

Afterwards, for the quantitative analysis, a questionnaire was applied to assess the perception of companions and employees regarding the visual comfort provided by the existence or not of windows in the paediatric oncology ICU adapted from Santos (2017), Visual Comfort Questionnaire, as well as the I.S.S. Stress Symptom Inventory – Lipp (2000), Lipp Stress Inventory. The first questionnaire contained some specific sociodemographic questions for each of the groups evaluated (companions and employees), as well as the possibility of making observations/impressions about the visual comfort of the ICU.

The interviewees were the caregivers responsible for hospitalized children and young people, of different age groups, and the multidisciplinary team comprised physicians, nurses, nursing technicians, physiotherapists and a resident physician who had been working in the ICU for more than three months. Forty-one people were interviewed, 30 companions and 11 employees, corresponding to all the companions and professionals who were present and accepted to participate in the survey.

The impact of the effect of sunlight and artificial light present in the hospital environment and the role of stress in the intensive care environment on caregivers and the multidisciplinary team were carried out through descriptive and inferential analysis (Fisher's Exact Test, Independent- Samples Mann-Whitney U Test) (SANTOS, 2017).

The study was approved by the Research Ethics Committee at the University where the research was carried out and the Research Ethics Committee of the [hospital] and it can be found in the Supplementary Material.

Results and discussion

The study environment

The object of study, the paediatric oncology ICU, is located in the hospital area of a Health Centre, in Brazil, which includes Hospital, Radiotherapy, Nuclear Medicine and Imaging building, Rehabilitation Centre, Institute of Paediatrics, Fundraising Centre, Volunteer Centre, Waiting Station and Cellular and the Molecular Engineering Institute. The Centre is declared of Municipal, State and Federal Public Utility and has a highly qualified specialized and multidisciplinary medical team dedicated to assistance, teaching and research in the

areas of paediatric oncology and haematology. Its location is intra-urban in a residential area, but it is close to other hospitals, universities and major research centres, as well as being close to an ecological park (Figure 1), which contributes to the well-being of the users of the Centre.

The ICU is located in the former bone marrow transplant (BMT) sector of the hospital. With an area of 388 m², in a hexagonal shape, it has 6 rooms with beds and an area for their respective companions, in addition to private bathrooms, a central nursing station, in addition to areas for doctors and other infrastructure necessary for its operation (Figure 2).

The ICU is located in the hospital's former bone marrow transplant (BMT) sector. With an area of 388 m², in a hexagonal format, it has 8 rooms with beds and an area for their respective companions, as well as private bathrooms, a central nursing station, as well as areas for doctors and other infrastructure necessary for its operation. This spatial organization, where the rooms are located around the nursing centre, contributes to having a view of all environments, resulting in a positive effect on patients, such as stress reduction because proximity to nurses causes a sense of security and well-being (GAPPEL, 1995). Moreover, employees´ stress can be alleviated by enabling the control and reduction of patient care time (HOREVICZ; DE CUNTO, 2018). Added to this, the individual rooms favour the privacy of patients and the doors and partitions have glazed areas that contribute to improving olfactory and auditory control. In all rooms, the companion's chair is located next to the patient's bed (Figure 3).

Figure 1 - **Map of the studied hospital area**

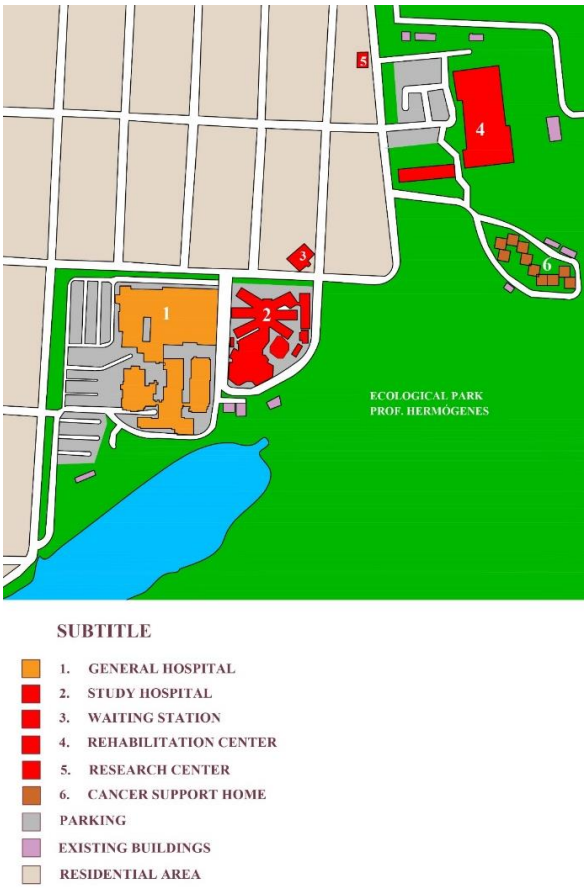


Figure 2 – **ICU plan view**

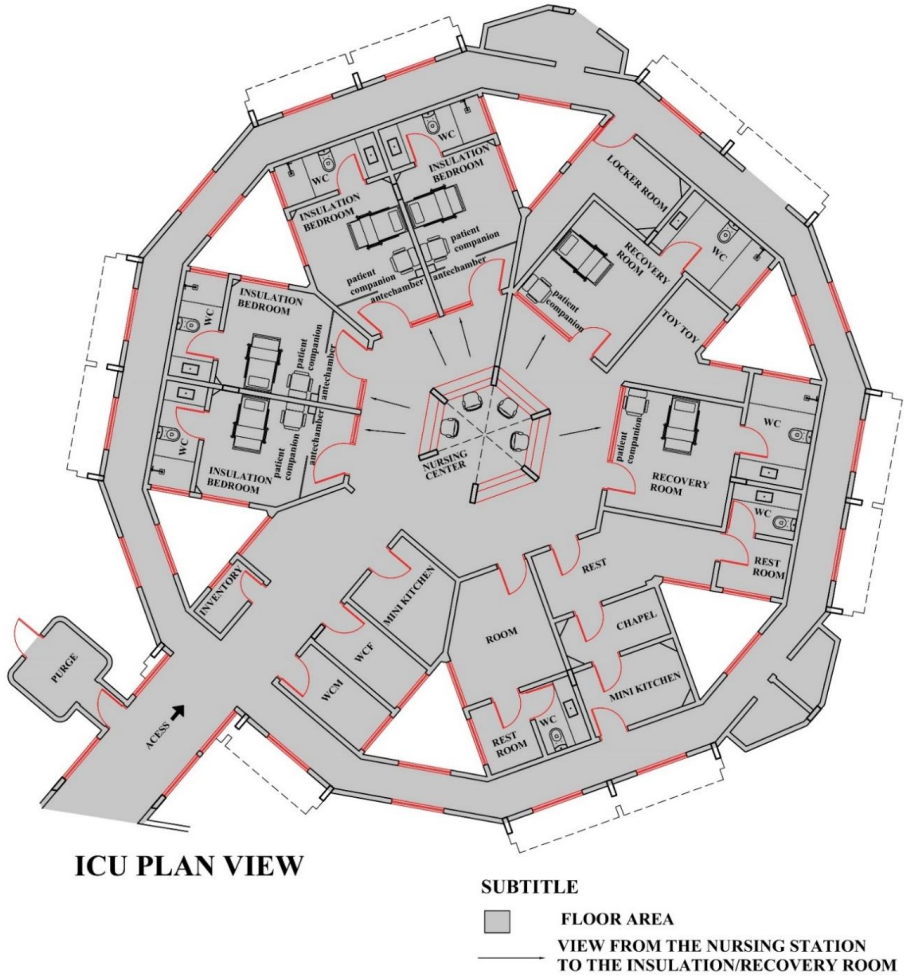
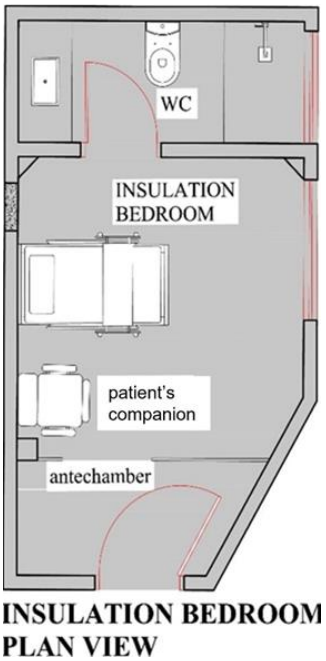


Figure 3 – **Insulation bedroom plan view**



The rooms have areas of 9.38 m² and 12.44 m² with a window that opens onto a lightwell. These areas meet the recommendation of the Works Code of Campinas (PREFEITURA…, 2003) that prescribe a minimum area of 8 m² for rooms and, when there is more than one room, they may have areas smaller than 8m². Compliance with the Works Code is recommended by RDC No. 50 of February 21, 2002, which pays attention to special environments of Health Assistance Entities recommending guidelines for the dimensioning of hospitalization areas and the dimensioning of lighting areas, in the sense that they need direct light from a natural source in the environment, as is the case of intensive care (PREFEITURA…, 2003). Compliance with this same RDC 50/2002 is also observed in relation to the presence of the companion chair next to the bed (AGÊNCIA…, 2002).

According to ANVISA's recommendations (AGÊNCIA…, 2014, p. 76) "[…] daylight can provide part or all of the lighting necessary for carrying out tasks in Health Care Establishments […]", and access to natural lighting must be achieved without depending on other environments (the user must not enter a room/bedroom to have access to natural light), such as windows at the ends of corridors, skylights in deep areas of the building with heavy traffic, sleepers and doors with side windows/glasses (page 82) (AGÊNCIA…., 2014). When carrying out new projects for Health Care Establishments, it is recommended to have access to natural lighting and a view of the natural landscape "whenever possible" (FACILITIES…, 2010).

Our observation in loco verified that the windows indicate whether it is day and night and that their dimensions 96 x 110 x 93 cm comply with the regulations of the Campinas Works Code in Section III: On the Dimensioning of Openings, art. 102, which provides for the openings of the rest area, which must have dimensions proportional to the area of the compartment at least 10% (ten percent) for insolation. The windows are always closed with no natural ventilation; the environments are ventilated by air conditioning due to regulatory issues of Health Establishments (AGÊNCIA…, 2002; PREFEITURA…, 2003; ABNT, 2021).

The most users want the presence of windows and consider that seeing the "out there" is important. This is because in general, people consider that a living space includes an environment with windows, which offers a wide view of the world we live in, and which allows the entry of natural light to bring clarity and well-being. If we consider the symbolism of the Sun, which has many representations, from the perspective of psychology, we can say that one of the most significant is the expression of the possibility of life for nature and humanity, as it warms, illuminates the paths, offers light that allows seeds to germinate, sprout, grow, bloom and bear fruit, thus preserving the human species and maintaining hope in the inner world of each one. In her study on "The Personal Interrelationships of Children with Cancer in the Phases of Disease Progression", Perina (1992) identified that the children who are in palliative care, in the final phase of life, manage to have a clear perception that life consists of two stages: life and death. Moreover, they show us this bipolarity through their drawings, where they project all this knowledge about the time of life where there is sun and green trees with strong roots and the time of death, where the trees wither and there is no more sunlight and no colour, black predominates (PERINA, 1992).

When a child has cancer, parents feel emotionally destroyed and helpless considering a life-threatening illness. The fear of losing the child, which is the center of so many projections, expectations and idealizations, takes over their fantasies and can trigger emotional reactions that oscillate between denial, sadness, anger, depression and ambivalent feelings of hope and hopelessness. When fear takes over, it can trigger panic reactions, and everything becomes much more difficult to work through and the process of accepting the child's death sometimes becomes impossible. This can happen when the child from the beginning of the treatment is seriously ill and goes to an ICU or when they have severe clinical complications and a high risk of death. Isolation, social withdrawal, the need to be alone or just with the family or in a religious space, such as the hospital chapel are natural in these moments. For this reason, many do not want contact with the outside world, which is, at this moment, very threatening and staying within the ICU space next to the child is all they want and that gives strength to continue believing in a cure or in the possibility of a miracle. To a certain extent, staying in that protective bubble protects both of them. When the threat passes, they begin to break out of this protective bubble and resume contact with the personal and social universe.

Moreover, we observed that the hospital design meets all engineering and architectural standards, however, not all users are satisfied. Although the design meets all objective criteria that guide the best environmental conditions in terms of luminosity, colours, natural light, windows with visibility to the outside world, and satisfactory relationships with professionals that allow the reception of total pain, that is, physical, psychological, social and spiritual, even so, not all users can feel satisfied because the most important thing is the recovery and cure of the disease. When healing becomes impossible, there is great difficulty in accepting the harsh reality of the loss of the child and it may be necessary to look for a culprit. The hospital, doctors and the multiprofessional team become the target of projections and attacks from parents and patients in this case.

What was good and idealized as the protector and saviour of the child's life, at this moment when they can no longer recover their health, becomes the culprit and a series of complaints and searches for medical and team errors begins.

Other times, even when the child is responding well to treatment, with a good chance of cure, parents may be dissatisfied with some person, things or external events. This could possibly be explained by the fact that they do not accept the emergence of the disease as part of life and they need to express their dissatisfaction, guilt and/or imperfections onto someone or some situation. According to Ornstein (1996), evaluations carried out in health care units demonstrated the strong association that their users maintain between "physical environment" and "social environment". They are often anxious, complaining about the lack of attention and care by their spouse, family members or staff, which can often lead to a compromise in their marital, family and professional relationships. For this reason, far beyond environmental conditions, the subjectivity of each person, personality characteristics, ways of coping, defence mechanisms, capacity for resilience in the face of the emergence of a life-threatening disease and ways of dealing with it must be taken into consideration, as well as mourning resulting from the many losses experienced in the hospital context. In the worst case, their child's own life.

The ICU has light colours, with predominantly yellow light walls, which convey calmness, serenity and the feeling of being a cosy environment; neutral colours collaborate to increasing the ability to concentrate on what is being done, which is important in an environment, such as an ICU (Figure 4).

In general, the colours in the ICU are soft and exclude the use of strong or stimulating colours, which would not be appropriate for patients in this environment (MALKIN, 1992). However, the absence of colour can lead to monotony and apathy. Malkin (1992) suggests placing small, coloured details or a strip next to the ceiling. We observed that in the analysed ICU, the colours are present in the frames, which are blue, on the workers' uniforms and in the bed linen, which is green (MALKIN, 1992).

Yellow can be associated with the sun and life. It stimulates perception, intellectual activity and suggests animation. However, light yellow can have the opposite effect, when the incidence of sunlight is less. Walker (1990) and Varley (1982) suggest combining this colour with dark blue: when the walls are light yellow, the frames can be painted in a dark blue colour. This is the case of the studied ICU (LACY, 1996; WALKER, 1990; VARLEY, 1982).

Blue is indicated for hospital environments, as it contributes to reducing stress and tension, but as it is the coldest colour of the colours, it can cause a feeling of cold, induce sleep and depression (WALKER, 1990), and therefore cannot be used alone.

Figure 4 – **ICU**

Source: Unicamp Faculty of Medical Sciences - Oncology League, 2010.

Blue helps to balance breathing; slow down the pulse and heart; calm the central and peripheral nervous system; it brings relief from childhood illnesses such as whooping cough, jaundice, asthma, tonsillitis and diarrhoea; it helps to rehabilitate bones, connective tissues, veins, arteries, marrow and lubricate joints; it is an anticancer colour (VARLEY, 1982). These actions are triggered by the formation, in the brain, of eleven neurotransmitter hormones that have a tranquilizing action, which calms the whole body (WALKER, 1990). Moreover, navy blue works favourably in feverish and inflammatory states, exerting a calming and refreshing effect.

Using green in workers' uniforms and bed linen also provides a calming action for patients: green acts on the sympathetic nervous system, in addition to relieving blood vessel tension and lowering blood pressure; it helps in the formation of bones, muscles and cells of various tissues; and combats insomnia and nervous states (VARLEY, 1982). As green is a cool colour, it has the same requirements as blue: it should be combined with other colours so as not to become exhaustive and have negative effects.

Calle, Martin and Nin (2017) state that organizational and architectural characteristics can make an environment hostile for patients and caregivers/family members. We verified a hospital that complies with the norms and is concerned with criteria for the humanization of the space for patients, but there is still a doubt as to whether it is also suitable for caregivers and health professionals (CALLE; MARTIN; NIN, 2017). García-Salido, La Calle and González (2019) provide a broader approach to humanization, where caregivers and even health professionals would also be subjects of this humanization (GARCÍA-SALIDO; LA CALLE; GONZÁLEZ, 2019).

The research addressed visual comfort in the paediatric oncology ICU and Stress Symptoms in companions and employees. The study of the environment through the architectural plan, the analysis of the ICU and the observation in loco of the hospital, as is the case of the windows that indicate day and night, meet the norms of the City Code of Works and the norms current hospital regulations, in addition to the colours used on the walls, paintings, bed linen and workers' uniforms aimed at reducing stress and tension.

Both groups, companions and collaborators, highlighted the importance of windows and that they could have more windows overlooking the sky and gardens, which collaborates with other studies on the importance of natural light in the well-being of individuals and in performing the circadian cycle for the recovery of patients.

Regarding the construction of new ICUs, it is strongly recommended to create an environment richer in colours and with windows.

Most employees and companions are stressed, predominantly in the resistance and durability phases. Both groups pointed out that the ICU colours, although appropriate, are monotonous, that a possible application of drawings or brighter colours could help to improve the visual comfort of the ICU.

Despite the adequacy of the environment found in the study, the work showed the importance of evaluating the visual impacts in ICU environments, as other improvements can bring even greater visual comfort to employees, companions and patients. Although the stress of both groups cannot be credited only to the environment, the literature shows that the environment can bring a significant improvement in this aspect, contributing even more to more humanized environments in ICUs.

According to Dr Roderic Bunn, building performance analyst and consultant in Soft Landings, England, a fundamental and rather inconvenient truth should be recognized: that the innate human capacity to adapt, cope and tolerate a wide range of conditions comfort will always confound attempts to show that one condition is statistically better than another (CARTWRIGHT, 1981).

It is suggested that other works should be done taking into account a broader approach to humanization, in addition to the evaluation of hospital environmental certifications where the subjects are patients, caregivers/family members and even health professionals, meeting the premises of the POE in evaluate complex environments, such as hospitals, which require constant transformations.

The work innovates by evaluating the comfort and environmental stress from the point of view of the companions and employees, in addition to the technical evaluation of the environmental comfort. Jobs tend to evaluate environmental comfort and stress from the point of view of the patient or the staff, and companions are often neglected, left in the background. Furthermore, a joint assessment of companions and staff associated with verifying a technical point of view is practically non-existent in the national literature.

Visual comfort questionnaire

In this context, Table 1 shows some information about companions, patients and employees.

It was observed that 93.3% (28) of the companions were relatives of the patients, 55.2% (16) had a paid job, 58.6% were the main providers of their livelihood and 70% had a profession with flexible hours or were housekeepers, 53.3% (16) of the companions had never been to an ICU before, the companions spent 1 to 23 hours in the ICU (mean = 8.2, Std. Deviation = 6.3). Regarding employees, 54.5% (6) were nurses and the remaining nursing technicians, 54.5% (6) had worked for more than three years in the ICU and worked 6 hours a day (Table 1).

Table 2 presents some significant variables related to the visual comfort of the companions and and employees.

It can be observed that companions tend to consider the environment more comfortable than employees, in addition to being less bothered by the lack of windows and noise in the environment. The results seem to indicate that companions are less sensitive to the visual and acoustic comfort of the environment than employees (Table 2). Studies by Beauchemin and Hays (1996) revealed that bright light is effective for treating depression, and patients with bright, sunny rooms had a shorter hospital stay (BEAUCHEMIN; HAYS, 1996).

The position of the windows allows light to enter, however, as they are directed towards external lightwells, the views from the windows are impaired.

When asked about the positive and negative points of the ICU, some caregivers reported that they have visibility of the external environment, that the environment could have more windows and also the lack of a winter garden, which highlights the importance of the presence of windows and solar light. One respondent stated that "[...] he would like to be outside, seeing the sky with the windows would be a distraction, a greater combination of colours and drawings to distract the children and not look like a hospital. The view from the beds of the other children is a little uncomfortable […]".

Employees were unanimous about the importance of having windows in the ICU environment. One of them reported that "[...] the bad lighting does not favour the environment, the colour of the walls makes the environment unwelcoming, as well as the lack of landscaping and natural light, not all rooms have windows, and many do not favour light input […]". It is known that the type of lighting adopted can physiologically influence the perception of colours.

Authors such as Bender and Petry (2019) reinforce the importance of architecture to provide greater well-being to children and caregivers, facilitating the work of health professionals and contributing to the humanization of institutions (BENDER; PETRY, 2019).

Table 1 - **Distribution - sociodemographic information**

Variable	Companion		Patient[1]		Employee	
	n	%	n	%	n	%
Sex						
Female	17	56.7%	-	-	7	63.6%
Male	13	43.3%	-	-	4	36.4%
Education						
Elementary School	13	43.3%	-	-	0	0.0%
High school	9	30.0%	-	-	5	45.5%
University education	7	23.3%	-	-	2	18.2%
Postgraduate studies	1	3.3%	-	-	4	36.4%
Age						
Mean	41.1		9.2		38.1	
Median	39.0		8.0		37.0	
Std. Deviation	14.0		7.8		3.8	
Interquartile Range	23.0		13.4		7.0	
Range (minimum-maximum)	69.0 - 48.0		29.0 - 0.2		44.0 - 11.0	
Total	**30**	**100.0%**	**-**		**11**	**100.0%**

Note: [1]information given by the companion.

Table 2 – **Distribution of some significant variables of the questionnaire (Fisher's exact test), according to the type of informant**

Variable	Companion		Employee		Total		p-value
	n	%	n	%	n	%	
Do you think the environment is							
nice and comfortable	25	83.3%	6	54.5%	31	75.6%	0.033**
indifferent	1	3.3%	4	36.4%	5	12.2%	
neither nice nor comfortable	4	13.3%	1	9.1%	5	12.2%	
Do you find the environment bright							
yes	28	93.3%	2	18.2%	30	73.2%	0.000***
more or less	1	3.3%	8	72.7%	9	22.0%	
no	1	3.3%	1	9.1%	2	4.9%	
Windows are important in the environment							
yes	19	63.3%	11	100.0%	30	73.2%	0.075*
more or less	5	16.7%	0	0.0%	5	12.2%	
no	6	20.0%	0	0.0%	6	14.6%	
Does any reflection disturbs you							
yes	2	6.7%	4	36.4%	6	14.6%	0.035**
no	28	93.3%	7	63.6%	35	85.4%	
Total	**30**	**100.0%**	**11**	**100.0%**	**41**	**100.0%**	

Note: *significant 10%; **significant 5%; and ***significant 1%.

Stress lipp inventory

The care and reception of the clinical staff are the most praised points, translated as “love, attention and warmth” and that the light colours, temperature, space dimensions and environmental conditions are adequate.

Companions who mentioned that the light in the ICU bothered them or that the temperature was low, making the environment cold, were caregivers who were identified in a highly stressful situation. Living with pain, loneliness and fear of losing a loved one changes the perception of the environment.

In this context, we have to consider the differences in the type of bond that professionals establish with children and adolescents in contrast with their parents, who have an affective relationship and emotional level of an order unequalled by any other personal relationship.

No matter how much the emotional involvement of health professionals with the patient, whether by identifying, transferential aspects or motivated by empathy and compassion, it constitutes a professional relationship for which they are qualified to provide better quality care according to the specificity of their professional training, within a given hospital space and according to their workload. For a good health professional-parent-patient relationship, a bond of trust needs to be established and a relationship that offers security and continuity to the needs of patients and families. If the health team is aware that the best available treatment is being offered, they understand that they are giving their best care, effective assistance in procedures and care for children, adolescents and family members, and are able to recognize their possibilities and limitations in the treatment process, cure or no cure. They may suffer a great deal when the patient gets worse or there is no chance of a cure, but the feeling of having offered the best care to everyone will bring a sense of accomplishment and enable people to mourn over the loss of the patient.

Offering humanized care, in a welcoming space, with adequate lighting, colours, the continuous presence of family members next to the child, constant welcoming and meeting physical, psychosocial and spiritual needs by the health team helps to preserve hope and faith in the recovery of life in its fullness, or in the process of elaborating anticipatory mourning, when life fades away each day and the farewell ritual begins.

Some professionals may experience intense psychological distress with the loss of their patients and identifying with the child's parents and the grieving process may be more difficult, triggering further stress or burnout, but in the subjects of this research we did not find altered levels of stress. We believe that the studied environment, where these professionals develop their activities, is able to offer peace of mind at work, security and support among the team itself through discussions based on the model proposed by Roberts (2012), and physical attributes such as the presence of windows, which allow the notion of day and night, the armchair next to the patient, using colours on the walls, paintings, bed linen and workers' uniforms are designed to

reduce the stress and tension that provides exchanges of experiences and anguish considering certain crisis situations in the hospital context. The groups provide opportunities to identify transference and countertransference aspects in the relationship between the health team, parents and patients.

It can be observed in Table 3 that companions are more stressed than employees in the alert and exhaustion phases, whereas in the resistance phase the proportion of workers in stress is slightly higher than that of companions. However, these proportions were not significant.

Table 4 shows that LIPP scale scores are significantly different for psychological symptoms in both the resistance and exhaustion phases, as well as for the total.

The underlying assumption of the model is that the psychological demands of a job and the ability to exercise control/decision can be used to predict work-related stress. A work environment characterized by high demands and high control results in challenging and stimulating work (ZBOROWSKY *et al*., 2010).

We observed in Table 3 that companions are more stressed than employees in the alert and exhaustion phases, whereas in the resistance phase, the proportion of workers in stress is slightly higher than that of companions. However, these proportions were not significant.

Table 4 shows that LIPP scale scores are significantly different for psychological symptoms in both the resistance and exhaustion phases, as well as for the total.

Table 3 - **Distribution of stress symptoms, by phase, according to the type of informant**

Lipp - Stress[1]	**Companion**		**Employee**		**Total**	
	n	**%**	**n**	**%**	**n**	**%**
Stress - alert phase	7	23.3%	0	0.0%	7	17.1%
Stress - resistance phase	13	43.3%	5	45.5%	18	43.9%
Stress - exhaustion phase	7	23.3%	1	9.1%	8	19.5%

Note: [1]Fisher's Exact Tests, p-value=0,160; 0,100; 0,412.

Table 4 - **Distribution of stress symptoms scores (LIPP), by phase, according to the type of informant**

Stress Symptoms Inventory	**Tipo**	**Median**	**IR[1]**	**p-value**
Physicists - alert phase	Companion	3.0	4.0	0.215
	Employee	1.0	3.0	
Psychological - alert phase	Companion	1.0	2.0	0.193
	Employee	0.0	1.0	
Total - alert phase	Companion	**4.0**	**4.3**	**0.103**
	Employee	**2.0**	**4.0**	
Physical - resistance phase	Companion	2.0	2.3	0.896
	Employee	2.0	3.0	
Psychological - resistance phase	Companion	2.0	2.0	0.040**
	Employee	1.0	1.0	
Total - resistance phase	Companion	**3.0**	**4.0**	**0.359**
	Employee	**2.0**	**5.0**	
Physical - exhaustion phase	Companion	2.0	2.0	0.301
	Employee	1.0	1.0	
Psychological - exhaustion phase	Companion	3.5	3.5	0.007***
	Employee	1.0	3.0	
Total - exhaustion phase	Companion	**6.0**	**5.3**	**0.023****
	Employee	**2.0**	**5.0**	
TOTAL	Companion	**14.0**	**11.8**	**0.065***
	Employee	**6.0**	**13.0**	

Note: [1]interquartile range. *significant 10%; **significant 5%; and ***significant 1%.

Santana, Ferreira, Santana (2020) found a significant percentage of nurses with occupational stress in a university hospital in Minas Gerais, Pafaro and De Martino (2004) found a predominance of psychological stress in nurses working double shifts at a paediatric oncology hospital in Campinas. As in the research by Zanetti, Stumm, Ubessi (2013) addressing the stress of family members of patients hospitalized in an ICU of a hospital in the northwest region of Rio Grande do Sul, Brazil, stress occurred mainly in the intermediate (resistance) or final phases (exhaustion). It is interesting to note that the main component of stress is psychological and not physical, which indicates measures to improve the comfort of companions could alleviate this suffering.

It is known that the environmental conditions of an ICU directly influence the professionals who work in this space, who are generally in states of constant nervous tension and alertness, in addition to the required daily journeys. Moreover, for the companions, their journey in this environment is no less painful. However, it is observed that although the use of colours in the ICU of this hospital is adequate, the predominance of light yellow and the incidence of not such adequate lighting (mentioned by most employees) can collaborate to generate states of monotony, stress and fatigue added to the psychological states of its users.

Conclusions

The research addressed visual comfort in the paediatric oncology ICU and Stress Symptoms in companions and employees. The experience drawn on during hospitalization can affect the way companions see and feel the hospital environment. The fact of being a companion already brings with it the responsibility of caring and protecting the patient. Although stressful experiences can contribute to a negative evaluation of the place, the companions consider the environment more comfortable. On the other hand, employees, who have a greater burden of permanence, feel less stressed than companions, as they have an almost affective relationship with the place. A significant part of employees and companions is stressed, predominantly in the phases of resistance and durability.

Physical attributes such as the presence of windows, which allow the notion of day and night, the armchair next to the patient, using colours on the walls, paintings, bed linen and workers' uniforms are designed to reduce stress and tension. These elements in the environment were identified by analysing the architectural plan of the ICU and on-site observation of the hospital code. Both groups, companions and collaborators highlighted the importance of windows and that they could have more windows overlooking the sky and gardens. The lack of gardens outside the ICU is mentioned in the speech of the employees and the presence of gardens could be a mitigating factor of stress. Environments with natural lighting and gardens are restorative environments.

The proximity of the rooms to the employees' workstations, with easy visual access to the beds, is an important attribute of the environment in reducing stress as the companions feel safer and the employees can perform a service in a shorter time.

Taking these characteristics as a starting point, it was suggested that the [hospital] should invest in windows that are unobstructed by furniture, in the adequacy of spaces so that, whenever possible, windows are installed in individual ICU beds so that users can perceive the "world outside".

Despite the adequacy of the environment found in loco, the study showed that the predominance of light yellow and the inadequate incidence of lighting can be factors that impact the presence of stress of its users added to the emotional burden demanded by an ICU stay and a work that demands great attention and quick responses from its employees. The work showed the importance of evaluating the visual impacts in ICU environments, as other improvements can bring even greater visual comfort to employees, companions and patients. Although the stress of both groups cannot be credited only to the environment, the literature shows that the environment can bring a significant improvement in this aspect, contributing even more to more humanized environments in ICUs.

The work has some limitations, it was carried out in a single hospital and, although it shows that the groups studied are subject to different pressures inherent to the type of situation faced in an ICU environment, it is clear that the presence of natural light through the presence of windows contributes to the reduction of stress, especially among employees. Despite this, the improvement of visual comfort would collaborate to the reduction of the stress faced by the studied groups. Hospital designers should always pay attention to planning environments with restorative attributes.

It is suggested that professionals in this field of research can carry out other work taking into account a broader approach to humanization, in addition to evaluating hospital environmental certifications where the subjects are patients, caregivers/family members and even health professionals.

This study innovates by evaluating environmental comfort and stress from the point of view of companions and employees, in addition to the technical assessment of environmental comfort. Studies tend to assess environmental comfort and stress from the patient's point of view, that is, from the staff, companions are generally neglected, and left in the background. In addition, the joint assessment of companions and employees associated with verification from a technical point of view is practically non-existent in the national literature.

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