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Summary

Editorial

It is with a high note, with the publication of this new edition of IPH Magazine, that we end a very important year for the technical-scientific community that is interested in research applied to the healthcare settings and infrastructure.

In 2022 we have observed a gradual return to a more normal situation, both regarding institutional partnerships and collaborations, as well as in field research initiatives, which were impaired or even disabled due to the Covid-19 pandemic and other challenges related to the production of scientific knowledge in Brazil. This was also a year of many debates and reflections on architecture and healthcare engineering, and we have observed a growing interest in both the production and dissemination of research in various formats and subjects.

This edition of the IPH Magazine includes an article that deals with a very current theme, that has aroused scientific and professional interest, which is the appropriation, by architects and designers of health settings, of concepts based on Neuroscience, the branch of biology that studies the nervous system. In her article, the architect and researcher Patrícia Paiva shows how neuroscience applied to the architecture can contribute to the health and well-being of users of healthcare settings, including patients, companions, and workers. According to the author's words "the stimulation of the senses, via access to our nervous system, through vision, smell, hearing, taste and touch" can create a positive or negative impact on people's quality of life. From this finding, the author proposes a series of reflections on how the built environment affects people and

exemplifies the application of environmental strategies that stimulate the senses, such as biophilic design, natural lighting and acoustic comfort.

In an opinion piece, the architect and professor Luciano Monza brings a reflection about the paradigms involved in the conception and the operation of health buildings. According to Monza, who works with health projects in Argentina, the transformations that occurred in the models and the process of the disease/care, in technological development and in the alteration of the epidemiological profiles, among others, caused the appearance and development of new constructive typologies, where the traditional concept of hospital architecture was abandoned. Monza points out that the general hospital is no longer the paradigmatic building of health, as it was historically until the second or late twentieth century, and that it continues to occupy an important place, but no longer exclusive, as an object of study. According to the author, other constructive typologies have appeared and, most likely, will grow even more in quantity and variety in the future.

In another article, the researchers Regiane Lamim and Isabel Céspedes present a historical overview of health buildings in the city of São Paulo, seeking to draw a parallel between the evolution of medical sciences and architecture. According to the authors, the development of medical sciences led to the adoption of the "pavilion" typology in hospital buildings in the 19th century, moving to the "monobloc" typology in the 20th century, when the hospital came to be considered as a "healing machine", also arguing that knowing this historical evolution is fundamental to predict the parameters for the future of hospitals.

Finally, professor and researcher Erick Vicente presents a text about the experience of the late Architect Jarbas Karman, founder of IPH, during his stint at the Special Public Health Service (SESP), highlighting the importance of this experience as a public servant for the trajectory of Karman and other architects who worked on that public body and who later made important contributions to the development of hospital architecture in Brazil. The author exemplifies the production of this period with a brief analysis of two projects developed by Karman for SESP in the state of Pará.

The IPH Magazine remains available for free to the whole community of professionals, researchers and others interested in topics related to healthcare settings and infrastructure, seeking to recognize the value of the diversity of themes and approaches, and opening an opportunity for all interested parties in sharing their studies and experiences, with a renewed invitation to submit your contributions to the next editions.

Good reading!

Prof. Arch. Marcio Nascimento de Oliveira

Editor of IPH Magazine

Article

Evolution of hospital building, its alignment with medical sciences and patient care in the city of São Paulo

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Abstract

Throughout the history of the city of São Paulo, hospital buildings revealed that the cultural factor was decisive in their design. In the colonial period, medical care was offered by the church with a philanthropic character. The development of medical sciences, especially in Europe, during the 19th century, promoted the adoption of the pavilion typology in hospital buildings. With population growth and the advancement of technology, hospital buildings in the 20th century adopted the monoblock typology, and the hospital became a healing machine. This article aims to discuss the evolution of hospital buildings and their alignment with the science and culture of patient care, which took place in São Paulo. This historical background allows for a better understanding for the establishment of future parameters to be adopted in the current and future hospital designs.

Keywords:

hospital architecture, architectural typology, patient care.

1. Introduction

The largest city in Brazil, São Paulo, has undergone scientific, cultural, political, and administrative movements in the past decades, which had significantly impacted its urban network, its society, and also its hospital buildings, as shown in Illustration 1.

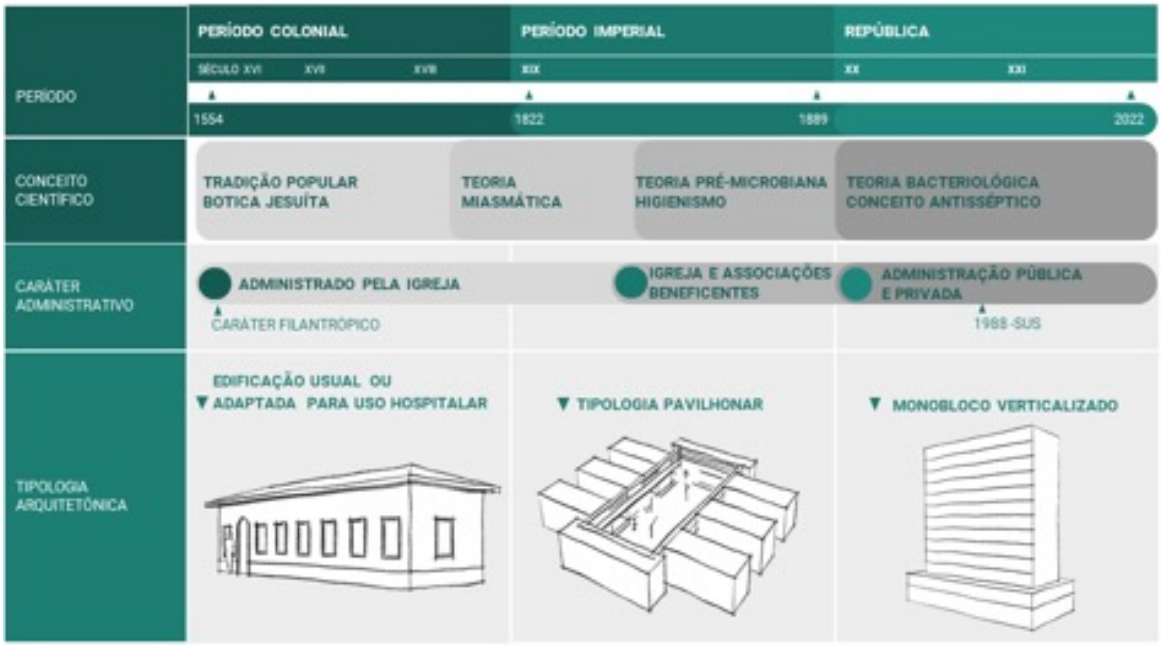

Illustration 1. Diagram with a summary of the evolution of architectural typology according to different historical periods, administrative systems, and scientific concepts.

2. Colonial period and health-dedicated buildings

At the beginning of the colonial period, medical practices were handled by the Jesuits, who possessed the knowledge of European apothecary and indigenous shamans. Subsequently, in a precarious way, a limited number of health professionals appeared in São Paulo (Lomonaco, 2004). The concept "medical-scientific" was surrounded by superstitions. Since the sick were treated at home, the wards had an improvised and temporary character, aiming to segregate the sick compulsorily and spatially. The medical concept and the building were based on philanthropy; and care was offered by the church in order to provide places for reconciliation with God and death (Campagnol, 2014).

The late 18th century presented a gradual diffusion of miasmatic theory, which endorsed that the physical environment was a source of transmission or cause of disease. Health policies consisted of preventive measures to fight diseases, delimiting the places where equipment considered as sources of miasmas should be installed. This concept has had impacts on architectural constructions and urban space. By analyzing

The Imperial City of São Paulo Plan – 1841, we can observe a concentration of equipment, considered as big polluters, in the north and south part of the city (Costa, 2011).

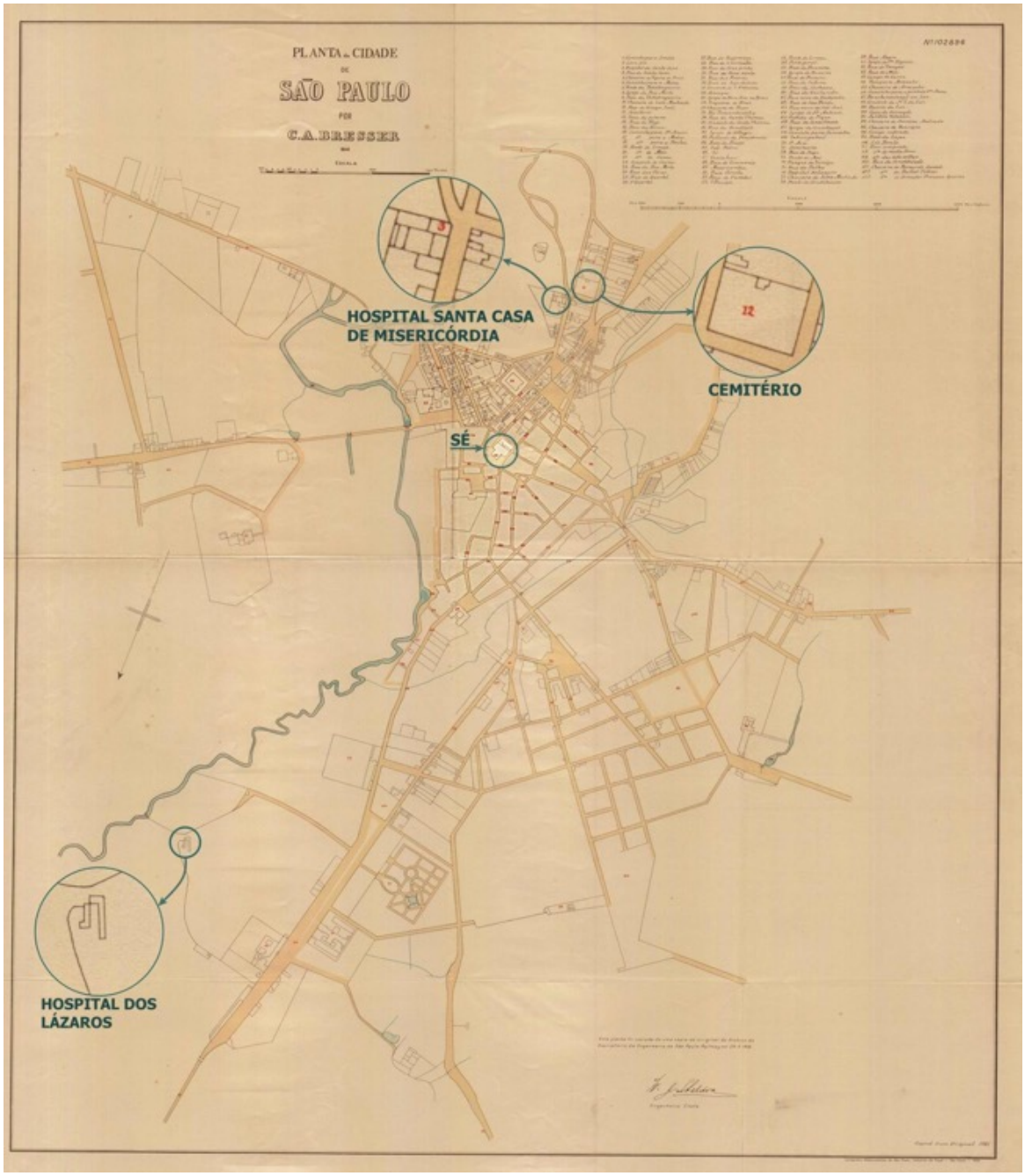

Illustration 2. Plan of the city of São Paulo in 1941, with the identification of Santa Casa de Misericórdia Hospital, across Aflitos Cemetery, in the south, and Lázaros' Hospital, in the north of the city. Source: BRESSER, C. A. **Planta da Cidade de São Paulo**. In: Comissão do IV Centenário de São Paulo. São Paulo Antigo: Plantas da Cidade. São Paulo, SP. 1954, p. 4. Available at http://www.arquiamigos.org.br/info/info20/i-1841b.htm. Modified.

The Santa Casa de Misericórdia Hospital was installed in 1825, in Chácara dos Ingleses area, in the southern region of the city. This location was strategic, due to its proximity to the Aflitos Cemetery, built in the 18th century. However, since it did not have the appropriate building features to accommodate a functioning hospital, a new project was elaborated for the Santa Casa in 1832, by a military engineer named Marechal de Campo Daniel Pedro Muller. The new building was inaugurated in 1840, occupying an area within the grounds of Chácara dos Ingleses. At the other end of the city, there was a another health institution, the Lázaros' Hospital, built and managed by the Santa Casa de Misericórdia's Fraternity. This building was intended for people infected with Hansen's Disease that were living around the city – even though it had very precarious settings and not enough capacity for the number of patients that needed it (Campos, 2011).

3. Hospitals during the Portuguese Empire

In the final decades of the 19th century, the strengthening of coffee culture led the city of São Paulo to undergo significant social and economic changes. The construction of the Santos-Jundiaí railway, between 1860 and 1867, provided a better flow for the coffee production. The railway enabled the growth of neighborhoods to the east of the city. Therefore, public health issues and improved hospital care conditions became a theme of interest on the part of governors and owners of coffee-growing farms. The main reason for this interest was to intensify the immigration process, thus ensuring the labor force for the crops (Mota, 2007).

The project for the Sociedade Portuguesa de Beneficência Hospital, conducted from 1873 to 1876, by Manuel Gonçalves da Silva Cantarino, brought the introduction of hygienist concepts in hospital buildings. Such concepts were also evident in the project of Variolosos Hospital, designed by engineer Inácio Wallace da Gama Cochrane, from 1878 to 1880. The building was idealized and composed of a linear system, with two lateral wards joined by a central body (Campos, 2011).

However, the building that represented a milestone in hospital architecture of this time was the new headquarters of the Santa Casa de Misericórdia Hospital, built between 1881 and 1884. Engineer Luiz Pucci's project was chosen after a competition. His project adopted the pavilion concept, with wards as independent buildings, connected through open corridors, which formed the boundaries of a central courtyard. The pavilions were provided with wide openings facing the East-West direction and were separated by gardens, favoring the lighting and air circulation. This concept was aligned with the system that had been adopted in Europe since the 18th century (Campagnol, 2014; Silveira, 2019).

Hospital buildings, at that time, began to be seen as instruments that could promote urban development. The analysis of the *Map of the Capital City of*

the State of São Paulo, from 1890, points to the urban growth around the Sociedade Portuguesa de Beneficência Hospital, located in the central region, and the Santa Casa Hospital, that was built in the western part of the city.

Illustration 3. *Planta da Capital do Estado de São Paulo*, 1890. The growth of the city occurred mainly on the east-west axis. On this map, three hospital establishments are identified, already inserted in the urban network. The Variolosos Hospital, built outside the western limit of the city, is not represented on this map. Source: MARTIN, Jules. **Planta da Capital do Estado de São Paulo e seus arrabaldes**. In: Comissão do IV Centenário de São Paulo. São Paulo Antigo: Plantas da Cidade. São Paulo, SP. 1954, p. 10. Available at: http://www.arquiamigos.org.br/info/info20/i-1890.htm, Accessed on September 10, 2022. Modified by the author.

4. The health system from the First Republic to the present day

The end of the monarchical regime and the beginning of the Republic changed the health policy, enabling the construction of new hospital units. The architect and engineer Francisco de Paula Ramos de Azevedo conceived important hospital buildings. His hospitals adopted the pavilion strategy, both for the Military Hospital, located in Luz neighborhood (1898 to 1899), and for the Juqueri Hospice (1895 to 1898). The wards were implanted in independent pavilions, separated by gardens, and interconnected through galleries to facilitate flow of people (Costa, 2011).

In the Isolamento Hospital, a typology known as tent systems was adopted, similar to military-type field hospitals. The pavilions were comprised of service blocks and administrative sector, which were separated by large gardens, taking a part of the same location of the Variolosos Hospital (1880). The pavilions, designed by engineer Teodoro Fernandes Sampaio, resembled aligned *challets*, fitted with balconies, and were built between 1878 and 1894. Other buildings were added in the following decades, such as the Institute of Hygiene in 1917, the Faculty of Medicine and Surgery in 1931, and the Hospital das Clínicas de São Paulo, in 1944, the largest of them, which meant that the place became the most important for the public health sector, a status that is currently maintained (Silveira, 2019).

At the beginning of the 20th century, a new scientific understanding about the spread of diseases, made possible by a deeper understanding of bacteriology, favored the adoption of a new hospital typology, which became a more compact, vertical block, with several floors. Some aspects, such as gardens and landscaping, were then discontinued, beginning the replacement of natural ventilation and lighting by technological systems (Costa, 2011; Toledo, 2020).

In 1930, during the government of Getúlio Vargas, the Ministry of Education and Public Health Affairs was established. In 1941, the Brazilian Hospital Organization Division organized a set of guidelines for the healthcare sector, thus seeking to create a systematization, standardization and specialization of hospitals, aiming at their economy (Ribeiro, 2020). The building of the Ministry became an icon of modern architecture, being the result of the work of a group of architects coordinated by Lúcio Costa and composed of Affonso Eduardo Reidy, Carlos Leão, Jorge Moreira, Ernani Vasconcellos, and Oscar Niemeyer, all advised by the French/Swiss Architect Le Corbusier (Benevolo, 2014).

Eventually, hospital buildings became so complex that IAB-SP (São Paulo's branch of the Institute of Architects of Brazil) felt the need of a course on hospital planning, which was then coordinated by architects Rino Levi,

Amador Cintra do Prado and Jarbas Karman in the 1950s (Costa, 2011).

Architect Rino Levi and his partner, the architect and engineer Roberto Cerqueira César, also made a notable contribution to the modern architecture of São Paulo. Among their projects, there is the Hospital das Clínicas Maternity, a project that, although unbuilt, won several architecture awards, and stood out in several publications worldwide. They were also commissioned in 1954 to develop the project of the Antônio Cândido Camargo Hospital, currently known as the Cancer Institute, and also the now famous Albert Einstein Hospital, in 1958. In these projects, it was clear their concern regarding how to organize the flow of users, the cluster of functions with division into interconnected blocks and the flexibility of spaces to support future modifications (Belleza, 2003; Spider, 2008; Costa, 2011).

The gradual expansion of health programs to serve the population, such as the National Institute of Social Security (INPS), in 1966; the National Institute of Social Security Medical Assistance (INAMPS), in 1977; and, finally, the Unified Health System (SUS), in 1988; led to a significant growth of demand for new hospital units. As a result, the Ministry of Health intensified its efforts towards the standardization of hospital buildings. Between 1965 and 1974, the Ministry of Health published minimum standards and guidelines for the construction of hospitals, which were later replaced by the Ordinance #400, from 1977, and Ordinance #1884, from 1994, which were in force until the publication of RDC #50, in March 20, 2002, by the National Health Surveillance Agency (ANVISA), which is still enforced nowadays. These regulatory legislations defined aspects such as the dimensioning of settings, the scope of the project and the its phases (Toledo, 2020).

After analyzing the digital map of the City of São Paulo, available through GeoSampa portal, we identify 217 hospital units, 463 Basic Health Units – UBS and 55 emergency care facilities in the municipality. However, these institutions are not homogeneously distributed. It was verified that hospitals are concentrated in central regions, which, on the other hand, had fewer UBS. However, further from the central region, there is an inversion: less hospital buildings and more UBS (PMSP, 2022).

The districts with the most hospitals were Bela Vista, with 19 units, and Vila Mariana, with 22 units. According to the São Paulo Social Vulnerability Index (IPVS), also available from GeoSampa, these districts are classified as group 1, i.e., of very low vulnerability, demonstrating the tendency of valuing the urban network that such equipments enable. More distant districts, characterized as group 5, of high vulnerability, and as group 6, of very high vulnerability, could count only with a smaller number of hospital buildings, as occurred in Campo Limpo, Cidade Ademar and Perus

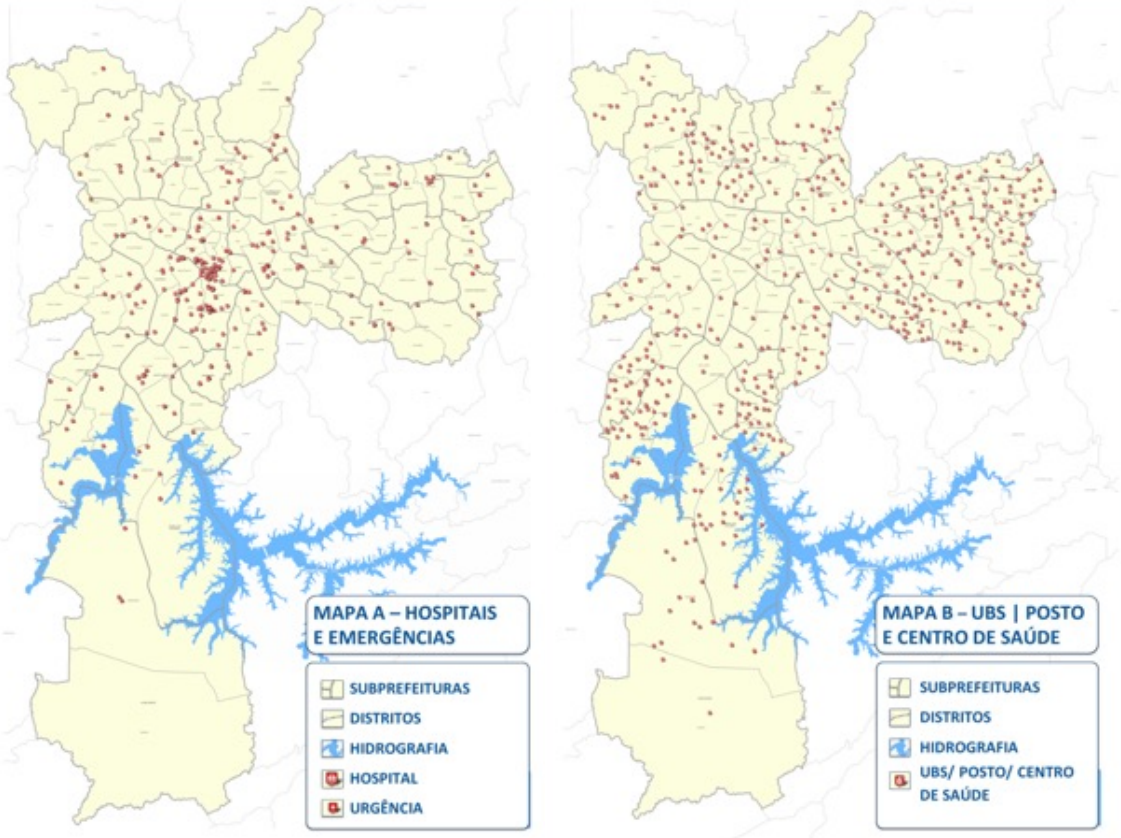

Illustration 4. GeoSampa Map. On map A, hospital and emergency equipment is identified with greater concentration in central regions. Map B identifies UBSs (Basic Health Units), and Health Centers, located more expressively in peripheral regions. Source: São Paulo City Hall. GeoSampa Map. Available at http://geosampa.prefeitura.sp.gov.br/PaginasPublicas/_SBC.aspx. Access on September 10, 2022. Modified.

neighborhoods (PMSP, 2022).

The result of these policies led not only to bad distribution, but also to a shortage of public hospitals, that were characterized also for being arid and strictly functional. The architectural language also did not consider the latest scientific research, developed in recent decades, such as evidence-based design, in which the building becomes part of the treatment of the patient, and also improves the effectiveness of the staff (Guelli, 2005). The deficiencies observed in the public health network allowed for private hospitals to develop, which were regulated by a specific law #9656 /1998, that included the definition of rules for the performance of private health care plans (Toledo, 2020).

More recently, the health crisis caused by the the Covid-19 pandemic brought about new issues concerning the current hospital structure, exposing the need to more easily adapt such buildings, to accommodate ever changing demands. The debate about the "hospital of the future",

whose focus, mainly, was the introduction of the latest technological resources, was then expanded. Fostering this discussion, the Office for Metropolitan Architecture – OMA and its partner, architect Reinier de Graaf, produced a visual manifesto, in the form of the film *The Hospital of the Future*. Exhibited at the 17th Venice Architecture Biennale of 2021, the short film exposed the problems of the current health model, as well as the need for self-sufficient and technological buildings, contextualized into the urban network. The discussion raised in the manifesto were expanded into the development of *Al Daayan Health District Master Plan*, also prepared by the *Office for Metropolitan Architecture*. The project proposed modular units, that could be reconfigured in different ways, using 3D printing, system automation and solar energy, while also ensuring an autonomous functioning, thus impacting clinical practice and patient care model.

5. Final considerations

The hospitals of the city of São Paulo included several typologies which were based on changing administrative models. During the colonial period, these institutions were usually of philanthropic nature, managed by religious entities, and their scientific knowledge was heavily influenced by popular beliefs. Subsequently, with the evolution of economy and the need to guarantee a healthy and productive workforce, health buildings became a healthcare issue, under the responsibility of government institutions (Campos, 2011). The Miasmatic theory was a very widespread concept and directly influenced hospital constructions, symbolized by the pavilion typology. In this model, the physical setting started to be considered a part of the treatment process. The development of new construction technologies and the introduction of the bacteriological concept also favored the adoption of new typologies, such as the vertical compact block (Costa, 2011), whose basic concept is still widely used today. However, with the expansion of the provision of services and the adoption of new regulations and systematizations, aimed at improving the economic performance, hospital buildings became arid and strictly functional, causing higher levels of stress and anxiety experienced by the patient (Toledo, 2020). Current scientific research, within the concept of evidence-based design, proves the influence the built environment has on patient recovery and on the well-being of the staff. The debate on the adaptability and flexibility of the new buildings, in the face of the use of latest technology, gained a new momentum after the Covid-19 pandemic (Graaf, 2021). The "hospital of the future" should, therefore, be based on evidence, and reinforce the importance of the physical setting in maintaining life and promoting the well-being of all of the occupants, including patients, families and technical staff.

Bibliographic references

ARANHA, M. B. C. **A obra de Rino Levi e a trajetória da arquitetura moderna no Brasil**. Tese Doutorado, Orientador Professor Dr. Lucio Gomes Machado, Faculdade de Arquitetura e Urbanismo da Universidade de São Paulo, 2008. Available at: https://teses.usp.br/teses/disponiveis/16/16133/tde-29032010-153615/pt-br.php#:~:text=O%20objetivo%20desta%20tese%20%C3%A9,marcos%20arquitet%C3%B4nicos%20ou%20arquitetos%20inaugurais. Access on August 12, 2022.

BELLEZA, G. **Roberto Cerqueira César (1917–2003)**. Arquitextos, São Paulo, ano 04, n. 038.07, Vitruvius, jul. 2003 (ISSN 1809-6298). Available at https://vitruvius.com.br/revistas/read/arquitextos/04.038/671. Access on August 12, 2022.

BENEVOLO, L. **História da Arquitetura Moderna**. São Paulo, SP, Ed. Perspectiva, 2016 – 2. Reimpressão 5ª edição, 2014.

BRESSER. C. A. **Planta da Cidade de São Paulo**. In: Comissão do IV Centenário de São Paulo. São Paulo Antigo: Plantas da Cidade. São Paulo, SP. 1954, p. 4. Available at: http://www.arquiamigos.org.br/info/info20/i-1841b.htm. Access on September 10, 2022.

CAMPAGNOL G., SHEPLEY M.M. **Positive distraction and the rehabilitation hospitals of João Filgueiras Lima**. HERD. 2014 Fall; 8(1):199-227. Doi: 10.1177/193758671400800113. PMID: 25816190.

CAMPOS, E. **Hospitais paulistanos: do século XVI ao XIX**. Informativo Arquivo Histórico de São Paulo, 6 (29): Apr/Jun 2011. Available at http://www.arquiamigos.org.br/info/info29/i-estudos.htm#VOLTA021. Access on August 12, 2022.

COSTA, R. G. R. **Arquitetura Hospitalar em São Paulo**. In: MOTT, M. L.; SANGLARD, G./organizadoras. (2011). **História da saúde em São Paulo: instituições e patrimônio arquitetônico (1808 – 1958)**. Barueri, SP: Minha Editora, 2011, p: 25-61.

GRAAF, R.; OMA. **The hospital of the future**. 2021. Available at https://www.oma.com/projects/the-hospital-of-the-future. Access on August 12, 2022.

GRAAF, R.; OMA; SQUINT. **Al Daayan Health District Masterplan**. 2022. Disponível em: https://www.oma.com/projects/al-daayan-health-district-masterplan. Access on August 12, 2022.

GUELLI, A. e ZUCCHI, P. **A influência do espaço físico na recuperação do paciente e os sistemas e instrumentos de avaliação**. Revista de

Administração em Saúde, Brasília, Brasil – vol. 7: (27), Apr-Jun, 2005.

LOMONACO, M. A. T. **Práticas médicas indígenas e jesuíticas em Piratininga**. In: NATALINI, G. e AMARAL, J. L. G./organizadores. **450 anos de história da medicina paulistana**. São Paulo: Imprensa Oficial do Estado de São Paulo, 2004, p: 4-30.

MARTIN, Jules. **Planta da Capital do Estado de São Paulo e seus Arrabaldes**. In: Comissão do IV Centenário de São Paulo. São Paulo Antigo: Plantas da Cidade. São Paulo, SP. 1954. p. 10. Available at http://www.arquiamigos.org.br/info/info20/i-1890.htm. Access on September 10, 2022.

MOTA, P. B. **A cidade de São Paulo de 1870 a 1930 – Café, Imigrantes, Ferrovia, Indústria**. Dissertação para Mestre em Urbanismo pela PUC Campinas, 2007. Available at http://repositorio.sis.puc-campinas.edu.br/xmlui/handle/123456789/16193. Access on August 12, 2022.

PREFEITURA MUNICIPAL DE SÃO PAULO. **GeoSampa Mapa**. Available at http://geosampa.prefeitura.sp.gov.br/PaginasPublicas/_SBC.aspx. Access on September 10, 2022.

RIBEIRO, C. **O projeto do hospital moderno no Brasil**. Arquitextos, São Paulo, ano 20, n. 237.06, Vitruvius, fev. 2020. (ISSN 1809-6298). Available at arquitextos 237.06 arquitetura hospitalar: O projeto do hospital moderno no Brasil | vitruvius. Access on August 12, 2022.

SILVEIRA, P. F. **Hospital de isolamento de São Paulo: investigações históricas de sua formação e de suas edificações remanescentes a partir de um projeto de restauro**. Campinas: PUC-Campinas 2019, Dissertação de Mestrado em Urbanismo. Available at http://repositorio.sis.puc-campinas.edu.br/xmlui/handle/123456789/16251. Access on August 12, 2022.

TOLEDO, L. C. **Feitos para Curar**. Rio de Janeiro: Rio Books, 2020 – 1ª edição.

Article

Jarbas Karman's experience during his SESP years

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Abstract

This article aims to approximate the architectural production of Jarbas Karman during the period he worked for SESP – Special Public Health Service.

SESP was created in 1942 with the aim of sanitizing territories that produced raw material, in addition to training professionals through exchange programs.

Karman worked at the institution between 1949 and 1951, where he was responsible, among other roles, for the project of Maternidade Escola de Belém (1949) and Marabá's hospital on stilts (1950).

The experience at SESP was of great importance for Karman's professional training. It allowed him to have direct contact with deep Brazil's reality and understand hospital buildings needed more attention when planned and managed.

Keywords

jarbas karman, sESP, architecture, hospitalcenters.

1. Introduction

The architecture of hospitals has changed intensely throughout the 20th century in Brazil. Taking into account the writings of Lauro Miquelin (1992), Luiz Carlos Toledo (2006), Renato da Gama-Rosa Costa (2011), Ana Amora Albano (2014), Elza Costeira (2014) and Antônio Pedro Alves de Carvalho (2014), researchers dedicated to researching this topic, it can be said that the architecture of hospitals underwent three paradigmatic changes: first, the adoption of the 19th-century French pavilion model as the best design and construction solution (between the 1900s and 1930s); second, the verticalization of buildings, initially inspired by the American experiences at the turn of the century and, later, by European modernism, mainly in the architecture of Le Corbusier (between the 1930s and 1950s); third, the criticism and rupture with pre-established models, resuming some of the ideas of the 19th century, valuing the well-being of patients and incorporating the most advanced administrative and operational practices at the time.

This third paradigm shift had as one of its protagonists architect Jarbas Karman, who dedicated 59 years of his career to designing, researching and teaching in the area of architecture, engineering and administration of hospital institutions.

His trajectory begins at SESP – Special Public Health Service, an arm of the Brazilian government that had as one of its objectives carrying out equipment and infrastructure works in the health area. Karman worked for about a year at the institution, but this experience was fundamental for his professional training.

The purpose of this article is to carry out an analysis of some of the experiences of the architect Jarbas Karman during this period.

2. Jarbas Karman: an architect in search of knowledge

Born in the city of Campanha, in the state of Minas Gerais, Brazil, Jarbas Bela Karman became interested in hospital planning during his specialization as an architect. First, he graduated in Civil Engineering, in 1941, from the Polytechnic School of the University of São Paulo – Poli USP. During his graduation, he attended CPOR (Reserve Officers Training Center), becoming a second lieutenant in the Army reserve. With a double title – lieutenant and engineer – he served the Brazilian Army during the Second World War, in 1942, in northern Brazil, collaborating with the construction of fortifications.

In the early 1940s, in the state of São Paulo – where Karman lived most of his life – architecture schools were still part of engineering courses. The first one to become independent was School of Architecture of Mackenzie University, in 1947, and, a year later, the School of

Architecture and Urbanism of the University of São Paulo – FAU USP. Before that, architect training used to take place as an extension of the civil engineering course.

After serving the Army, Karman studied architecture, graduating in 1944, also from Poli USP. During his specialization, he became interested in the planning of hospitals, because, according to Karman himself, he could not get answers to the doubts that arose during the design workshop he took on the subject, which at the time was mandatory for the education of an architect[1].

In 1949, following his desire to work in the field of public health, he was admitted to the Special Public Health Service (SESP). The position consisted of developing and supervising construction projects, renovations and adaptations of health institutions for the riverside population in the Amazon Valley and in the São Francisco River Valley.

Karman worked at SESP for about a year. He moved with his wife to Belém do Pará and started to develop projects for hospitals and health centers in several Brazilian cities.

The testimonies and manuscripts from his collection indicate that the experience at SESP was fundamental for his education. By having contact with the riverside population and with villages that did not have basic sanitation and health education, in addition to scarce resources to build, renovate or update healthcare units, he understood architecture should, in order to achieve good results in the area of public health, team up with hospital management, besides, obviously, understanding local social, cultural, economic and geographic issues in order to apply resources in the best possible way.

SESP was created based on a partnership between Brazil and the USA (an issue that will be dealt with later). The partnership provided for the granting of scholarships and funding for the training of professionals abroad. Knowing this, Karman applied for a scholarship to pursue a Masters in Hospital Architecture at Yale University in New Haven, Connecticut. The fellowship was awarded, and he left for North America in 1951.

His experience abroad was quite extensive: he traveled across Canada and dozens of US cities. He attended courses on operating theaters and sterilization centers in Ontario, hospital planning in New York, and hospital safety in Boston.

After completing his master's degree, in 1952, he returned to Brazil and established his architecture office in the city of São Paulo and started a campaign to disseminate the knowledge he acquired during his experience at SESP and his studies in North America.

1 According to statements by the architect himself, transcribed by Monica Cytrynowicz in the book Instituto de Pesquisas Hospitalares Arquiteto Jarbas Karman – IPH: 60 anos de história.

Throughout his career, the architect collaborated with dozens of undergraduate and graduate courses; participated in conferences, congresses and seminars and gave classes and lectures in Brazil and abroad; published more than a hundred articles in national and international journals and wrote three books: "Iniciação à Arquitetura Hospitalar" (1972), "Manual de manutenção hospitalar" (1994) e "Manutenção e segurança hospitalar preditivas" (2011 – released posthumously) , in addition to participating as organizer and author of the publication "Planejamento de Hospitais" (1954). He was a member of several institutions dedicated to the hospital area, including abroad, among which the "Public Health Group of the International Union of Architects" (UIA-PHG) and "The American Public Health Association" stand out; he participated in several commissions for the elaboration of resolutions and technical standards of institutions such as ANVISA and ABNT. Under the command of his office, he developed more than 300 architectural projects for healthcare buildings, including new constructions, renovations, expansions and reformulations of different scales and programs.

He died in São Paulo, on June 2, 2008.

In an article written for IPH Magazine, in 2004, Karman states SESP had the merit of being his "preparatory Brazilian internship" for his training in North America and for the creation of IPH (Karman, 2004, p. 7). In order to contribute to research on the transformations of Brazilian hospitals and to document Jarbas Karman's work, it is necessary to better understand the actions of this service linked to the Brazilian government and the role of the architect as a collaborator.

3. Architects of SESP

Shortly before the end of World War II, with the intensification of relations with the Soviet Union, Americans created an international cooperation program between allied nations, with the aim of strengthening political and economic relations, which became known as Ponto IV. Brazil was one of the countries that received funds from this program, aimed at technical-scientific development in several areas, including the sanitary field.

One of the consequences of this cooperation was the creation of the Special Public Health Service – SESP. Configured as a bilateral agency, it was created by the Brazilian government with resources and under the guidelines of the US government after the Third Meeting of Consultation with the Ministries of Foreign Affairs of the American Republics, in 1942.

The main objectives of SESP were to promote basic sanitation in the regions responsible for the production of strategic raw materials for war, such as rubber, iron ore and mica (Adriano; Pessoa, 2017). It was

necessary to improve the health of workers in the Amazon regions and in Rio Doce Valley.

Researcher Lina Rodrigues Faria states that:

> "Since the 16th century, various diseases such as malaria, smallpox, measles, hookworm, dysentery and yellow fever affected a large part of the free and slave population in Brazil". (Faria, 2006).

Faria emphasizes in her text that malaria was the most significant case, given that in the Amazon region there were "vast areas endemic to the disease". The riverside populations of the São Francisco and Rio Doce valleys were two of those who suffered most from the devastating action of the disease.

To contribute to the basic sanitation of these regions, SESP hired architects to develop projects for the construction and renovation of health units. A fact of great importance in the country, considering that the participation of architects in the sector would only be intensified from the second half of the 20th century[2].

Professor and researcher Antônio Pedro Alves de Carvalho, in an article on Brazilian norms for the design and construction of hospitals, highlights the participation of SESP in this process:

> "SESP worked in several rural health and sanitation programs until its extinction in 1990. One of the great advances of this service, at the time, was the training of specialists in courses in the United States. This exchange of knowledge also encompassed architecture, with the creation of the hospital architecture section" (CARVALHO, 2017, p. 22).

One of the consequences of the work of architects at SESP was the creation of the Minimum Hospital Standards (BRASIL, 194?), a guide with technical guidelines for the design of small and medium-sized general hospitals. Written by architects Roberto Nadalutti and Oscar Valdetaro[3], the publication has texts, architectural plans and detailed lists of furniture and equipment. Carvalho points out that this guide "can be considered the basis of all legislation in the area of healthcare architecture in Brazil" (Carvalho, 2017, p.24).

As mentioned above, the exchange of professionals between Brazil and the United States is another important factor to understand SESP's contributions to the transformation of hospital buildings. Karman, Nadalutti and Valdetaro benefited from scholarships to study in North America. According to architect and professor Luiz Carlos Toledo, in addition to Karman's master's degree at Yale, the three architects took a specialization course offered by the Public Health Service, Division of hospitals Facilities, in 1952, in the USA (Toledo, 2020, p.38).

2 According to Renato da Gama-Rosa Costa, in chapter 2 – Arquitetura Hospitalar in São Paulo –, from the book "História da Saúde em São Paulo: institutions and architectural heritage".

3 Roberto Nadalutti and Oscar Valdetaro, after SESP, worked at the Ministry of Health, where they participated in other publications of a normative nature. The architects teamed up and developed several hospital projects throughout Brazil. This production is little known and needs further research.

The production of these architects in this period is still very little known.

There is no further information about his projects and accomplishments.

Considering the importance Karman himself attributes to SESP in his formation, it is important to know better his production prior to his master's degree in the USA.

4. Two hospitals designed by Karman for SESP

Jarbas Karman Collection, which is part of IPH Collection, shows that the architect developed at least ten projects for healthcare buildings while he worked for SESP, in cities located in the states of Pará, Paraíba, Pernambuco, Bahia and Minas Gerais.

There are not drawings of all the projects in the collection, which prevents deeper research into their production before their trip to North America. However, the architect managed to preserve drawings of two projects from that period, which will be presented below.

4.1. Maternidade Escola de Belém

The first hospital designed by Karman was Maternidade Escola de Belém do Pará, in 1949. Of considerable monumentality for the region, the building would occupy approximately one third of the block formed by José Bonifácio avenue, Gentil Bitencourt avenue, Deodoro de Mendonça street and Farias de Brito street.

The lot was reserved, at the time, for the construction of Belém City Arena. As you can see on the layout plan (illustration 1), the project consists of a six-story blade located on the northeast-southwest diagonal of the lot, connected by a walkway to a trapezoidal-shaped volume equivalent to four floors in height.

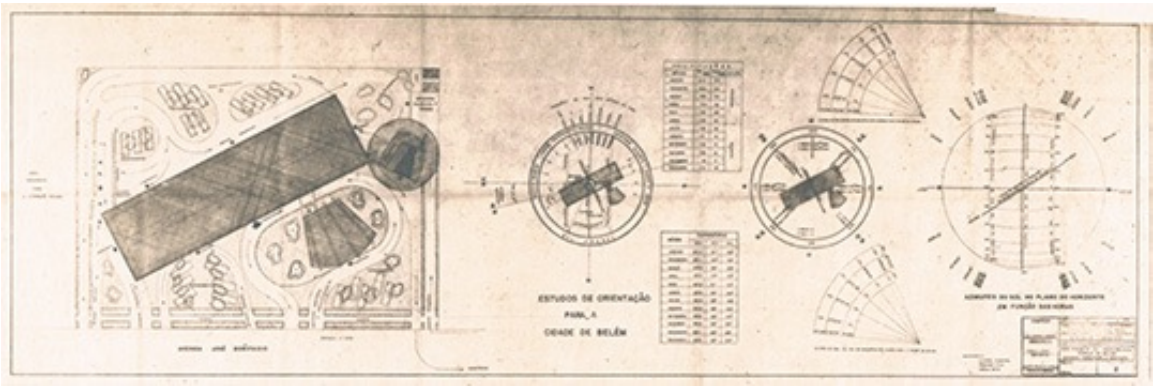

Illustration 1 . Implementation board of Maternidade Escola de Belém.
Source: IPH Collection/Jarbas Karman Collection.

On the second panel, which contains a perspective of the set, it is possible to observe that the blade has a wide eaves on the roof and generous overhangs on all floors on its four sides, which could be used as balconies or open corridors. The trapezoidal volume, which would house the auditorium, has a formal and structural concept similar to the proposals for the Palace of the Soviets, by Le Corbusier and Pierre Jeannereti (Moscow, 1931), for the Auditorium of the University of Brazil, by Lúcio Costa and team (Rio de Janeiro, 1936) and the Municipal Theater of Belo Horizonte, by Oscar Niemeyer (Minas Gerais, 1943), where the external pillars and roof beams, arranged in radial axes, support the main volume, with part of it suspended from the ground.

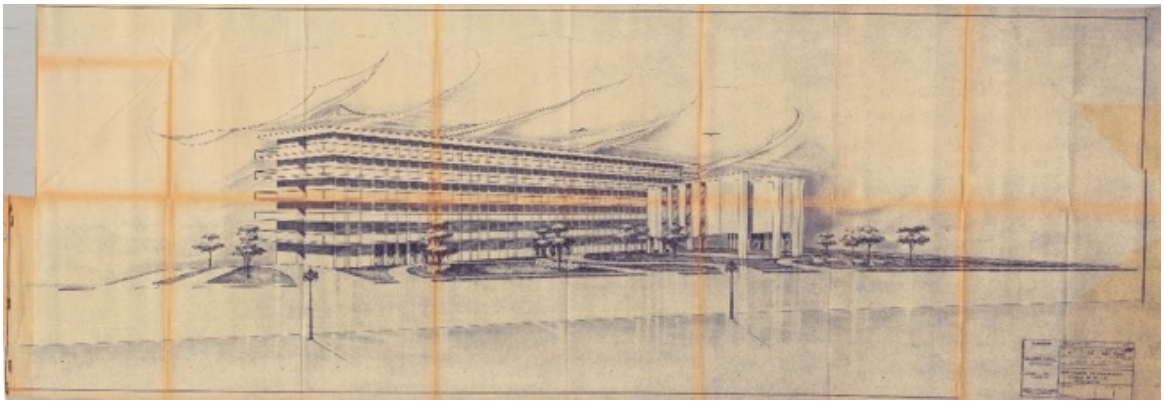

Illustration 2: perspective of Maternidade Escola de Belém.
Source: IPH Collection/Jarbas Karman Collection

Still on the implementation board, Karman presents the studies that guided the implementation of the set. The architect considered, for the disposition of the volumes, the best insolation, and the use of the prevailing winds.

The building was not carried out as proposed on Karman's ideas. In a recent survey, developed by Aristóteles Guilliod de Miranda, from the School of Architecture and Urbanism of the Federal University of Pará and published on the Virtual Laboratory website – FAU ITEC UFPA (2015), there were significant changes in the original project. The justification was that it was necessary to adapt the proposal to current legislation. Sometime later, it was destined to house Augusto Meira School, undergoing a drastic change of use. The built project retains few traces of the original. The implantation was adjusted to the north-south axis and other volumes were added. From Karman 's drawing, only the relationship between the blade and the trapezoidal volume of the auditorium[4] remains.

The project was the cover of issue IV, year III, of the Bulletin of the LBA (Legião Brasileira de Assistência) – State Commission of Pará – in June 1950.

4 Research published on the internet in two parts. First part: <https://fauufpa.org/2015/02/23/a-maternidade-escola-que-virou-colegio-em-belem/>; second part: <https://fauufpa.org/2015/02/28/a-maternidade-escola-que-virou-colegio-em-belem-2/>.

Illustration 3 . Cover of LBA Bulletin. Source: IPH Collection/Jarbas Karman Collection

4.2. Hospital in Marabá

Marabá hospital dates from 1950. The building was located 250 meters from the bank of Tocantins River, in a block made up of the current Antônio Maia avenue (former Antônio Maia street), Travessia do Hospital, Cinco de Abril street (former Duque de Caxias street) and Travessa Santa Teresinha.

There are two versions of the project. One dated from May 30, 1950, and one undated. Both versions have a single floor suspended from the ground by concrete pillars.

The undated one, which will be called the first version from now forward, has two boards: one with the general plan of the hospital implanted in the lot, in scale 1:200; another with a schematic section, an elevation and constructive details, in varied scales.

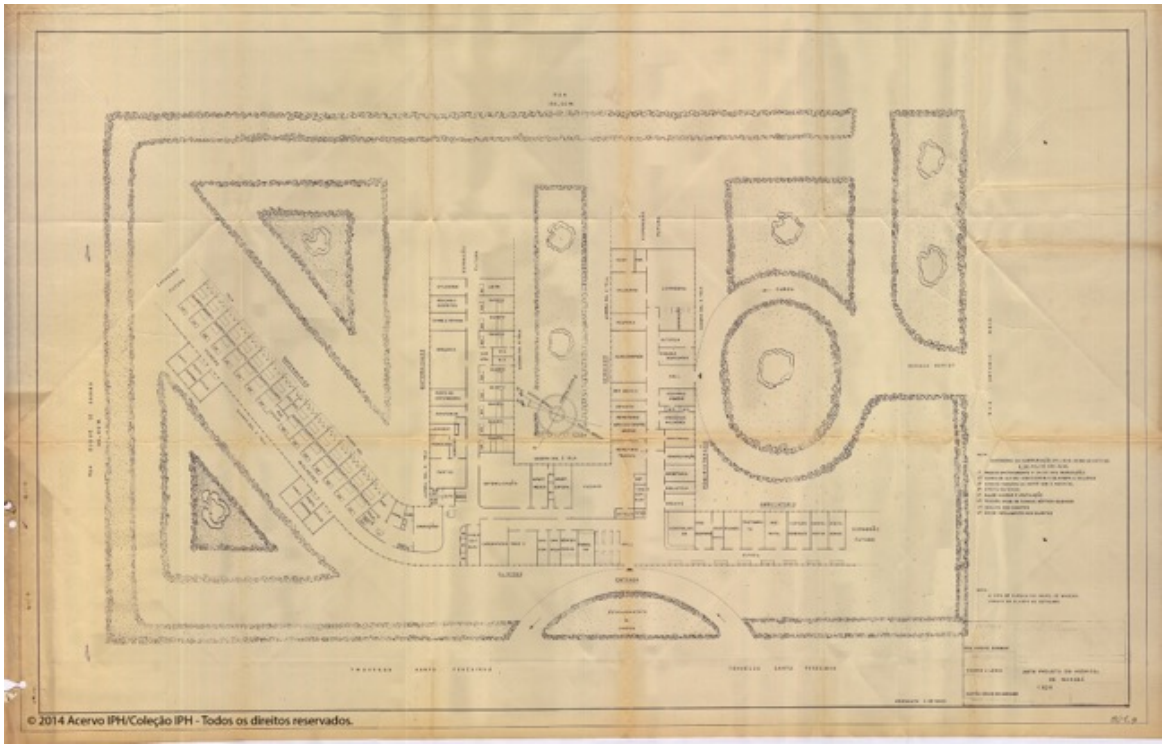

Illustration 4 . board with floor plan of the first version of Hospital Marabá.
Source: IPH Collection/Jarbas Karman Collection.

The first version, with capacity for 40 beds, has four pavilions of different sizes, connected to each other, one close and aligned to Travessa Santa Teresinha, two positioned more in the center of the lot, parallel to each other and aligned to Antônio Maia street, and a third positioned diagonally to the others, in the northeast-southwest direction. There are two accesses, one for patients, facing Travessa Santa Teresinha and the

other for employees and general services, facing Antônio Maia street. Both accesses are ramped, to allow users to enter at a level, since the entire hospital would be suspended from the ground. The program provided for outpatient care, x-ray exams, clinical analysis laboratory, maternity, obstetric center (with a delivery room), a surgical center (with an operating room), administrative support and technical-logistical support composed of a sterilization, kitchen, warehouse, laundry, mortuary, boilers, and generator room. It is interesting to note that, already in 1950, Karman proposed the separation of two beds per room and the decentralization of the nursing station (15 beds for each station in general hospitalization).

When observing the elevation, it is possible to notice that the project proposed an inclined floor, defined by him as "wing slope", that is, with a ramped floor in the entire extension of the pavilions, with height variation between 1.50 m (in the accesses) and 4.00 m (at the end of the pavilions) from the ground.

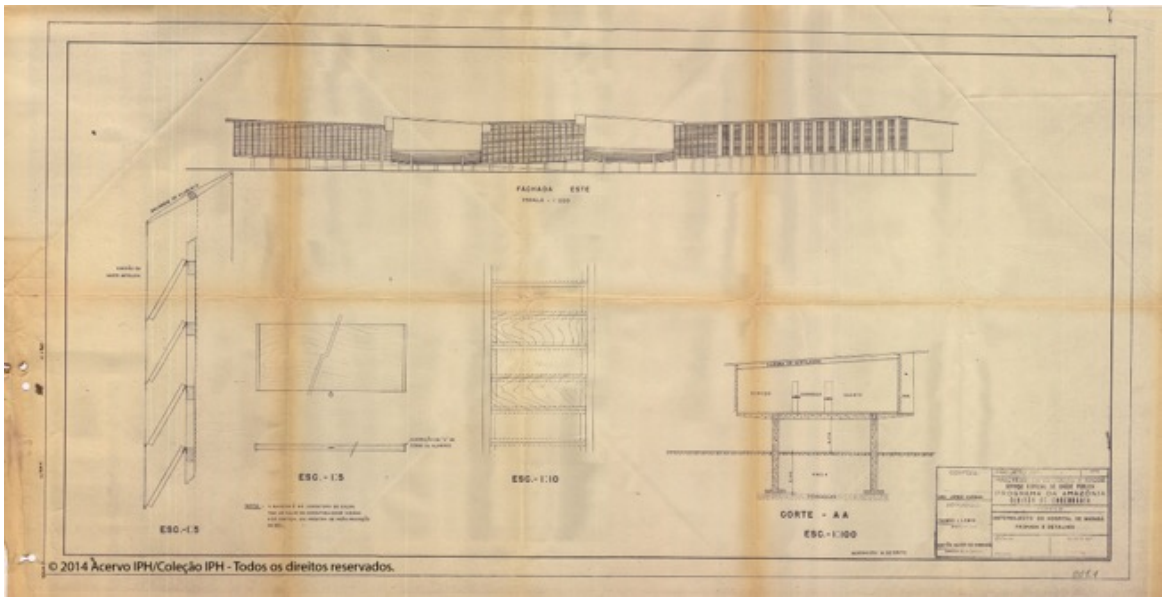

Imagem 5 . Prancha com elevação, corte e detalhes da primeira versão do Hospital de Marabá. Fonte: Acervo IPH/Coleção Jarbas Karman.

Karman gave 8 reasons why[5]:

"#1 Building effectively safe from flooding

#2 Gain in height with the economy of ramps and columns

#3 Use of the part under the hospital

#4 Aesthetic effect

5 The justifications are written on the board with the floor plan of the first version of the project for the Hospital de Belém.

#5 Greater hygiene and ventilation

#6 Possibility of raised septic tank

#7 Slopes leading to sewers

#8 Greater isolation of rooms" (Karman, 1950).

The schematic section and detail of brises show Karman 's concern for the local climate. The project proposes larger eaves for the faces with greater insolation, a ventilated space between the roof and the lining and louvers in aluminum and wood, a furniture that would allow patients to control the amount of natural light in the rooms.

The dated plank, which in this article is referred to as the second version, is also composed of four interconnected pavilions, three of which are orthogonal and one diagonally in relation to the streets. Also capable of holding 40 beds, it has a more elaborate program, with three accesses instead of two, one for employees and general services, one for emergencies (facing Travessa Santa Teresinha) and another for the outpatient clinic (facing to Antônio Maia Street). The accesses are ramped, which indicates that this proposal maintains the idea of raising the hospital from the ground.

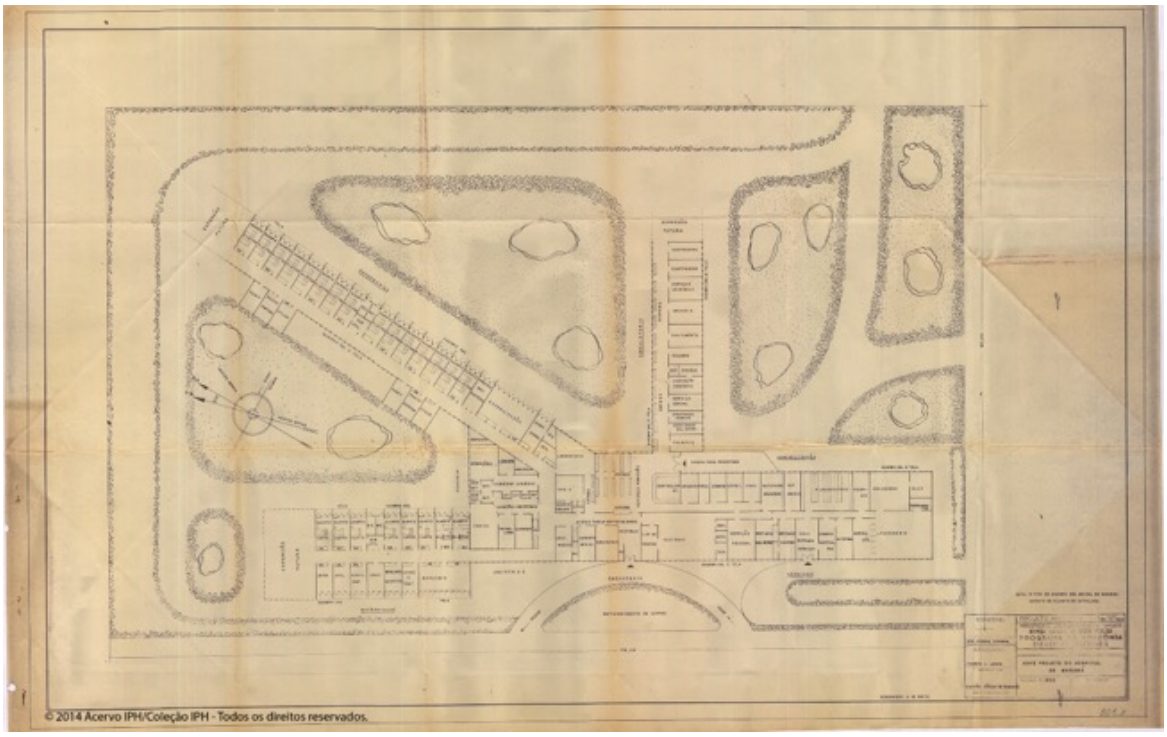

Illustration 6 . board with floor plan of the second version of Hospital de Marabá
Source: IPH Collection/Jarbas Karman Collection

The distribution of the program follows a similar logic: rooms with one or two beds, decentralized nursing stations and grouping of technical-logistical support. However, this version presents a different configuration of the operating room and the obstetrics center. The units are juxtaposed, almost forming a single unit, with independent access, close to the sterilization center and practically equidistant from the maternity and general hospitalization. The layout of these units, almost agglutinated, would be improved by Karman years later, as can be seen in the projects for the Hospital de Clínicas de Pelotas Dr. Francisco Simões, in Pelotas (1956), and for Hospital São Domingos, in Uberaba (1958).

It was not possible to verify whether the second version maintained the proposed slope of the ground floor slab, as was thought for the other version.

Considering the changes in the organization and positioning of the operating room and the obstetrics center, and that these changes would be improved in later projects, it is possible to say that the second version is the most recent, and the architect developed it to improve the project.

Currently there is a hospital built on the site, called Hospital Materno Infantil de Marabá. The implantation of the set does not correspond to either of the two versions developed by Karman, however the characteristics of the external closures (modulation of the frames), the use of apparent roofs and, mainly, the suspension of the ground floor in relation to the ground by pilotis suggest that the architect's ideas served as the basis for the construction of the hospital.

5. Final considerations

The two projects developed by Jarbas Karman during his journey through SESP make it clear that his concerns about better physical-functional sectorization, the separation of accesses by type of user, the approximation of functional units with operational affinities and care for physical comfort and psychological aspects of patients are some of the issues that were already present in the architect's professional practice, even before his period of study in the USA.

The formal boldness of the project for Belém and the lightness of the architectural complex suspended by stilts, added to the organizational issues of the second version of the project for Marabá, are indications that Karman no longer agreed with the common practices of the early 20th century and that he was already trying to the break with pre-established models, returning to valuing the well-being of patients and suggesting new architectural arrangements to make institutions more efficient and safe.

His experience at SESP was significant to the point that he was released from the obligation to develop a master's graduation work, whose theme was the design of a general hospital. Researcher Monica Cytrynowicz, writing about the origins of IPH, reveals that Karman 's advisor at Yale, prof. Bouis, allowed him, as he had already designed and built hospitals of considerable size, to dedicate himself only to research and theoretical studies on the subject (CYTRYNOWICZ, 2014, p.23).

Faced with these facts, not only in relation to Karman's projects, but also the publication of the first guide to the design and construction of hospitals by Nadalutti and Valdetaro, it is evident that the production of SESP architects has made a great contribution to the transformation of Brazilian healthcare buildings. Nonetheless, this subject needs further documentation and further research.

Bibliography and references

Newspapers and internet

ADRIANO, Tatiana.; PESSOA, Alexandre. **SESP: 75 ANOS DE LUTA PELA SAÚDE PÚBLICA**, 2017. Disponível em: <https://pnsr.desa.ufmg.br/sesp-75-anos-de-luta-pela-saude-publica/>. Acesso em: 22 de dezembro, 2022.

AMORA, Ana Albano. A moderna arquitetura de saúde e a cidade. **Revista IPH**, São Paulo, nº 11, páginas 30-43, 2014.

CAMPOS, Rodrigo Pires de. **POLÍTICAS INTERNACIONAIS DE SAÚDE NA ERA VARGAS: O SERVIÇO ESPECIAL DE SAÚDE PÚBLICA, 1942-1960**. Cadernos de Saúde Pública, Rio de Janeiro: Editora Fiocruz; 2006. 318 pp.

CARVALHO, Antonio Pedro Alves. Normas de Arquitetura de Estabelecimentos Assistenciais de Saúde no Brasil. **Revista IPH**, São Paulo, nº 14, páginas 21-38, 2017.

FARIA, Lina Rodrigues de. **Malária em dois tempos. História, Ciências, Saúde - Manguinhos, Rio de Janeiro: Casa de Oswaldo Cruz**; 2000. Disponível em: <https://www.scielo.br/j/hcsm/a/h8t9ZcrxGfJcf4JFqGjryGx/?lang=pt>. Acesso em: 22 de dezembro, 2022.

Karman, Jarbas B. IPH cinquentão – 1954-2004: história da sua fundação. **Revista IPH**, São Paulo, nº 5, ano 3, dezembro de 2004.

Books

AQUINO, Paulo Mauro Mayer de; COSTA, Ana Beatriz Bueno Ferraz; VICENTE, Erick Rodrigo da Silva. **O desenho de hospitais de Jarbas Karman: exposição realizada durante o VII Congresso Brasileiro para o Desenvolvimento do Edifício Hospitalar**. São Paulo: IPH, 2017.

CARVALHO, Antonio Pedro Alves. **Introdução à arquitetura hospitalar**. Salvador, BA: UFBA, FA, GEA-hosp, 2014.

COSTA, Renato Gama-Rosa. **Arquitetura hospitalar em São Paulo**. In: MOTT, Maria Lúcia; SANGLARD, Gisele (Org.). **História da saúde: São Paulo: instituições e patrimônio histórico e arquitetônico (1808-1958)**. Barueri, SP: Minha Editora, 2011. p. 25-61.

COSTEIRA, Elza. **Reflexões sobre a edificação hospitalar: um olhar sobre a moderna arquitetura de saúde no Brasil**. In: Bitencourt, Fábio; Costeira, Elza (org). **Arquitetura e engenharia hospitalar**. Rio de Janeiro: Rio Books, 2014. p. 101-140.

CYTRYNOWICZ, Monica Musatti. **Instituto de pesquisas hospitalares arquiteto Jarbas Karman – IPH: 60 anos de história**. São Paulo: Narrativa Um, 2014.

KARMAN, Jarbas B.; LEVI, Rino; PRADO, Amador Cintra do. **Planejamento de Hospitais**. São Paulo: IAB-SP, 1954.

MIQUELIN, Lauro Carlos. **Anatomia dos edifícios hospitalares.** São Paulo: Cedas, 1992.

TOLEDO, Luiz Carlos. **Feitos para curar: arquitetura hospitalar e processo projetual no Brasil**. Rio de Janeiro: ABDEH, 2006.

Article

Design for health environments: how neuroscience applied to architecture can contribute to the health and well-being of its users

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Abstract

We spend most of our time in the built environment and are often unaware of how it can positively or negatively impact our quality of life, physical and mental health. There are many studies in the field of neuroscience that provide evidence of the impact of architecture on our brain through our senses. The stimuli caused by the environment are captured by our receptor cells that lead to our nervous system causing the sensations, emotions, feelings that shape our behavior. This work aims to describe aspects of neuroscience with a focus on health environments through bibliographic research and application in architectural projects. These aspects are applied environmental strategies such as biophilia, lighting and acoustic comfort considering the five senses as the main access route to our brain. Through the studies of neuroarchitecture it is possible to design environments that can improve the performance, wellness, social relationships, and recovery of its users.

Keywords

neuroscience, neuro architecture, brain, biophilia, senses, behavior

1. Introduction

> Architecture, since its beginning, brought to humanity the notion of solidity and security desired by the human species already at the time when man lived in caves, under all sorts of bad weather. Through their deeds, empires were projected and left their marks; traits of a group of people began to be defined and to be recognized as characteristic of a particular culture; art and beauty acquired other proportions. One of the only certainties maintained in the design of all its historical evolution was that architecture lends its attention and offers its services to the human being (CRIZEL, 2020, p. 34).

"Taking architecture seriously, therefore, imposes some unique and exhaustive demands on us. It requires us to be open to the idea that the environment in which we live affects us" (BOTTON, 2006, p.25).

Villarouco (2021:9) brings reflections on the spaces we inhabit and the number of environmental stimuli we receive and guide our emotions, thoughts, and behaviors. Elements such as light, color, sound, nature, texture, and smell can affect our well-being, often unconsciously.

According to neuroscientist Tieppo, (2019, p.1), the brain controls every aspect of human life, and it becomes increasingly clearer that everything we see, hear, smell, digest, talk, feel and think depends on how the brain reacts. Including how we act and behave, our beliefs, memories and desires, our motivation and even our own identity.

By this logic, architecture can influence how the brain reacts to stimuli provoked in the built environment. According to Eberhard (2009, p.753), most neuroscientists believe architecture is a profession concerned with beauty and aesthetics, which we perceive by the visual system of harmony, symmetry, and proportions. However, architecture is more than aesthetic, it needs to meet the functional needs of users, have elements such as lighting and natural ventilation. He suggests that classrooms should provide cognitive activities, inpatient rooms should assist in patient recovery, and that work environments should be more productive.

Nanda (2005, p.164) describes that a good sensory environment is not one that awakens all the senses intensely, but that provides harmony among them, that is, it is not about aesthetics and appearance, but rather the aesthetics of the experience.

Our nervous system is responsible for processing the stimuli received at all times, such as: the sound of the wind, the busy street, birds, conversations of co-workers, cars passing along the street, the smell of coffee or someone smoking, the sweet taste of recently baked apple pie cake, colors, the cold or the heat.

Often, we cannot perceive these stimuli consciously. Levitin (2015, p.37) describes how the human brain has evolved to hide from us certain things we don't pay attention to. We have a cognitive blind spot, where the brain completely ignores what is not a priority at that moment, even if it is in front of our eyes. According to him, cognitive psychologists call this blind spot blinding by negligence.

In this sense, knowing and applying neuroscience to architecture, commonly called neuroarchitecture, helps us build more efficient and purposeful environments, promoting well-being to its users.

2. Methodology

This work is characterized as descriptive and bibliographic research on neuroscience and its applicability to architectural projects in health environments. The methodology used was the research of scientific articles on the internet, on specialized websites, such as academic *Google*, *Scielo,* among others, on technical standards, and published books related to the topic. Data collection was based on title identification, theoretical reference, application, and results.

Therefore, the goal was to understand how our nervous system works and how we can, through neuroscience studies, design spaces intend to contribute to the well-being and quality of life of people in health environments, such as hospitals. The result of the research aims to awaken new perspectives towards design, focusing on user's experience, whether it is a patient, companion, or employee. The research focused on knowing our nervous system and applying environmental strategies, such as: biophilia, lighting and acoustic comfort, considering the five senses. Ultimately this work wishes to establish a multidisciplinary approach to the fields of medicine, biology, architecture, among others.

3. Understanding the nervous system

In the 1990s, we had a great advance in the knowledge of the functioning of human nervous system. According to Tieppo (2019, p.28), this was the brain decade, because neuroimages obtained by magnetic resonance imaging, tomography and other equipment helped deepen knowledge about the brain.

According to Preuss (2014, p.1), humans have very different cognitive abilities in comparison to other creatures, thanks to a few unusual characteristics of our brain, such as the fact that it weighs, on average, 1.3 kg, which is very large for our body. Most of this difference in brain size is due to the evolutionary expansion of the cortex, a region that performs sophisticated cognitive functions, such as language, consciousness, and

problem solving. The size of the cortex is part of what makes man different from other animals.

According to BrainFacts.org (2012, p.1), the nervous system is divided into two parts: central nervous system and peripheral nervous system. Both works together so the body can properly share the sensations and their needs. The central nervous system is formed by the brain and spinal cord. The brain is inside the skull, and the spinal cord is protected by the spine. The peripheral nervous system consists of nerves that run through the entire body. The brain sends its messages through the spinal cord to the peripheral nerves of the whole body, in addition to control the muscles and internal organs. The peripheral nervous system is subdivided into somatic and visceral. The somatic is composed of neurons that connect the central nervous system to parts of the body that interact with the outside environment. The visceral is composed of neurons that connect the central nervous system to the internal organs.

The peripheral nervous system is also subdivided into two parts: sympathetic and parasympathetic. The sympathetic system applies energy and resources for moments of stress and excitement; while the parasympathetic saves energy and resources during the state of relaxation, such as sleep.

> The nervous system is an information processing system. There is information continuously coming and going, like cars running at great speed on highways. Through the nervous system, we receive information about the external environment – through vision, hearing, touch, smell, taste – and the internal environment, our interior – such as pain, body position, thoughts, emotions, memories, information of the viscera. Thus, we select, process, and combine the information, producing answers from it. That is, the nervous system receives signals from the environment, from all parts of our body and responds to the stimuli received, producing an action, a movement, a behavior (TIEPPO, 2019, p. 111).

Regarding the conscious perception of the built environment undergone by our brain through sensory stimuli, Paiva (2019, p. 565) points out that to process information consciously, we use less than 1% of our unconscious processing capacity, according to Eagleman. Therefore, most stimuli will affect individuals on a subconscious level. Although people may be affected by stimuli, they are not necessarily aware of the effect.

> Individuals are in constant active interaction with many environments around them. A warm room can cause people to sweat, feel uncomfortable and unable to concentrate. A dark room can make people feel scared, alert, and unable to relax. A bright classroom with natural light can help students be attentive to the class. The environment always affects its occupants on some level. This interaction can be called architecture and individual relationship. Spaces can change people (architecture and individual),

> and people can change spaces (individual architecture). Therefore, this relationship is a two-way street (PAIVA et al, 2019, p. 565).

Based on the knowledge of neuroscience and application to architecture, the term neuroarchitecture has been studied in more depth. It is believed that the beginning of neuroscience applied to architecture, according to Carbone (2021, p.13), occurred with the studies of Fred Gage, a neuroscientist who, in 1998, discovered that the brain continued to produce hormones in adulthood, which led him to be interested in how the environment influences the structure and functioning of our brain. Alongside John Eberhard and other professionals, Gage founded ANFA (Academy of Neuroscience for Architecture). For him, the design of spaces in the 21st century needs to improve our well-being, improve our performance, and reduce stress and fatigue in cities.

Subsequently, it will be presented environmental strategies based on the study of neuroscience, which architects and designers can use as a design tool to enrich environments, minimize short- and long-term negative effects and enhance positive effects. Strategies to stimulate the senses (vision, smell, taste, touch, hearing) will be presented in correlation to topics such as biophilia, lighting, acoustic comfort and how they can be applied to health environments in a practical way. In addition, the strategies will be depicted through some illustrations of projects under study and of environments already built.

4. Stimulating the senses

> You don't see the world as it is, you see it how you've learned to. Perception is then this process of placing information within what memory allows to recognize, united in order to identify situations of danger, spatial positioning, recognition of forms. However, part of this recognition involves filling gaps and re-leveraging more recurrent patterns, nullifying certain elements of information variability in this process. This functioning characteristic is what favors the existence of cognitive phenomena such as perceptual constancy and perceptual illusions (VILLAROUCO et al, 2021, p. 50).

The information received from the environments varies, but the perception is the same. Natural light, for example, throughout the day, suffers variations in temperature and color. But what we perceive around us does not change.

One of the functions of built environments is to promote emotion. "We are, above all, beings moved by emotion [...] The emotion is like a roller coaster, it leaves us ungoverned at certain times, but it also boosts us. We are emotional beings." (TIEPPO, 2019, p.167).

> Neuroarchitecture, as a study that also seeks to understand the spatial understanding of its users, so that they can get a better experience in relation to the projected environments, nourishes the awakening of mental triggers linked to sensations, emotions, and behaviors in their search for results. Knowing how to naturally access this challenging and rich system of human integrations, aiming to give users positive experiences in the face of living with environments, makes design practices efficient in their most symbolic purpose: to promote an empathic experience to those who are inserted in these specialties (CRIZEL, 2020, p.42).

The part of the brain that produces emotion is the limbic system – Tieppo (2019, p.167) defines it as the emotional system –, which is present in various parts of the brain, processes stimuli and responds automatically to them. It provides quick responses to environmental demands. The limbic system was developed throughout the evolutionary process to be able to anticipate situations that require rapid responses, such as escape, attack, and survival. The situations of greatest emotion are strongly recorded in the memory, so our nervous system recognizes them and anticipates the reactions.

Tieppo (2019, p.116) explains that to feel some information, consciously or unconsciously, sensory receptors must be activated. This set of receptors is called somesthetic or somatosensory system. Somesthesis includes the five senses of our body, such as temperature when touching a surface, pain, pressure, and proprioception.

Such quotes show that the nervous system is influenced by the environment, causing emotions, and shaping human behavior. These emotions are produced by the limbic system, which receives and processes information by the senses: vision, hearing, smell, taste, and touch. Next, we will contextualize how senses are impacted by the built environment.

4.1. Vision

"Vision is the most used sense to understand the space in which one is. It can influence how the information captured by the other senses will be interpreted [...] we do not see the world only with our eyes, but with our brains" (VILLAROUCO, 2021, p.101).

The visual system, as Silva describes (2013, p.1), is composed of the eyes and its structures, such as eyelids, eyebrows, muscles, lacrimal apparatus, and nerves. Vision works through the processing of data received by the brain, through light-activated sensory receptors. This information is also stored in the brain.

According to Tieppo (2019, p.132), vision relies on receptors that respond to light, energy, and electromagnetic energy. Such receptors are called photoreceptors and are in the retina, divided into cones and rods. Cones are sensitive to three light spectra (green, red, and blue). Rods are sensitive to black and white tones and help you see when there is less light.

The electrical stimulus is taken to some places of the brain, according to Villarouco (2021, p.106), having as first destination the hypothalamus, responsible for regulating the body metabolism and the synchronization of the biological clock, that is, day and night cycle. It is at this point that cones and rods, as mentioned above, begin to act. In the dark, rods are triggered, and in low light the body tends to feel drowsiness and lack of concentration, guided by the biological clock.

> Natural and artificial light are great examples of the direct impact of the physical environment on metabolic regulation [...] without the conscious perception of the individual. Through light, the brain synchronizes much of its operation with the external world (circadian rhythm) to cover the 24-hour period in which biological cycle activities take place. Light also regulates physiological and psychological rhythms, directly affecting wakefulness and sleep, hormonal secretion, cellular function, and genetic expression (CRIZEL, 2020, p.274).

Sunlight is the example of lighting that respects the biological rhythm of the human body: by day it emits a more bluish light and, as nightfall, a more yellowish light.

However, modern society lives excessively within built environments, under the influence of artificial lighting, computer, and cellular screens, causing important behavioral changes. In environments where individuals cannot have a sense of day or night, their biological clock loses control of the system for which it is responsible, according to Filho (2018, p. 30).

> Red light helps maintain or increase the level of mental activity without suppressing the production of melatonin, a hormone that regulates sleep, unlike blue light. Other studies had shown that bluish lights can reduce the production of melatonin, released by the pineal gland, located at the base of the brain. Melatonin helps regulate circadian rhythm, varying phenomena such as heart rate and sleep that fluctuates in periods of approximately 24 hours. More blue light and less melatonin could leave the body more vulnerable to developing tumors, in addition to deregulating sleep. Those who must stay awake to work at night may feel a little more sleep under red light, but the body is likely to suffer less damage (FIORAVANTI, 2009, p.1).

In a study carried out at Brigham and Women's Hospital, in Boston, USA, by Rahman et al (2014, p.1), volunteers were tested with exposure to two

types of light: bluish and greenish. They all had normal physical and psychological examinations, besides having tested negative for color blindness testing. They were monitored for seven days before the test, with a sleep period of eight hours a day, and could not consume any type of medication, supplement, caffeine, alcohol, or nicotine. During the test, they performed their daily work activities for six and a half hours with a blue light on. It was observed that, during this time, they had higher level of concentration, more keen attention and brain waves that suggested they were in a state of alertness. On the other, the greenish light did not result in any significant difference. The research also concluded that the exposure to blue light at night increases alertness, but suppresses the production of melatonin, a hormone produced by our body and whose main function is to regulate the circadian cycle.

Applying this result to health environments, such as hospitals, which operate 24 hours a day, blue light during the day helps the clinical staff to perform their activities in a state of alertness, focus and concentration. At night, this light can be used to keep professionals focused, however, carefully, so as not to interfere in the circadian cycle. For the patient, reducing the amount of light in the hallway minimizes light interference within inpatient rooms or ICU bed, avoiding interruption of patient's melatonin production during sleep.

In places destined for hospitalization, where user can stay for many hours or days, good conditions of artificial lighting and a view of the external environment can bring comfort, in addition to the important perception or orientation of time in the face of the circadian cycle. For emergency environments, operating rooms, intensive care units and other critical areas, excessive lighting over the visual impact can result in relevant emotional discomfort, producing irritation and stress, emotions that reduce the quality of care (ANVISA, 2014).

Therefore, it is very important to have natural lighting, both for the patient and for health professionals. Artificial lighting must follow parameters according to standards and be sized for the type of environment and activity to be developed. Also, when possible, it should have dimerization to control light intensity.

According to the ANVISA standard (2002), for environments such as inpatient rooms and ICU beds, in addition to direct artificial lighting and natural lighting, it is mandatory to have emergency lights on the wall, for patient's spatial orientation at night on the way to the bathroom. Such light can neither influence sleep, nor melatonin production. Therefore, it cannot present blue light spectrum, according to the above-mentioned study. In illustration 1, you can see a lighting installed on a footer, which is lit at night and allows spatial identification of the room,

providing safety for the patient when getting up. In the ceiling, the lighting is dimerizable, being lit at the highest intensity only during the medical or nursing procedure. The patient and his/her companion are free to regulate the intensity of light according to their needs.

Illustration 1. Quarto de internação. Inpatient room. Source: Illustration produced by the author (2021).

If some hospital environments do not receive natural lighting, it is possible to install plates that mimic the sky, so that one can get the notion of day, as shown in illustration 2. At night, when turned off, the lighting in the environment changes the color temperature: from blue to yellow, enabling melatonin production.

Illustration 2. Nursing station. Source: Illustration produced by the author (2021).

Another important point to be addressed is the view towards nature. Many studies have been conducted relating direct and indirect contact with nature to assist in patient recovery.

> The relations established between human beings and nature have fostered significant changes in the perception and representation of natural elements along their evolutionary path. Relationships, initially instigated by survival instincts, were transposed into domination and control with the advent of agriculture. However, the technological innovations resulting from this did not extinguish the need for the connection between biotic and abiotic elements conditioning the homeostasis of ecosystems, thus demanding, after a short period of withdrawal – corresponding to less than 5% of human existence – the gradual resumption of positive attitudes linked to nature (ZANATTA, 2019, p. 950).

Man's relationship with nature is called biophilia. This concept, coined and popularized by biologist Edward O. Wilson, in his book Biophilia, means humans' innate tendency (of any age, location and culture) to develop an emotional connection with life and living processes (FONSECA, 2009, p. 602).

> The results suggest that stressed individuals feel significantly better after exposure to nature scenes, rather than urban scenes without elements of nature. Compared to the influences of urban scenes, the salient effect of nature's exhibits was to increase Positive Affection - including feelings of affectionate friendship, playful and exaltation. The increase in positive

> affection produced by nature scenes is consistent with the discovery that nature's exposures have also significantly reduced the Awakening of Fear (ULRICH, 2007, p. 17).

According to Gressler (2013, p. 489), Roger Ulrich conducted a study at the Pennsylvania Hospital between 1972 and 1981, in which patients with the same clinical condition underwent the same surgery and were placed in hospital beds for recovery: half in rooms overlooking nature and half overlooking a brick wall of the neighboring building. Patients overlooking nature had shorter post-surgical hospitalization and used fewer analgesics. The results of this research suggest that only a glimpse of nature can enable the recovery of stress.

In illustration 3, the inpatient room has a large window and views of a green area. Therefore, it is very important to choose the faces of buildings that will allow inpatient rooms overlooking nature and, when not possible, mimic it with images such as paintings or wallpaper.

Illustration 3. Inpatient room window view. Source: Illustration produced by the author (2021).

Ulrich (2002, p.1) describes in his article research results on stress reduction when in contact with nature for five minutes. Patients exposed to nature for longer periods calm down and show clinical improvement, reducing analgesic intake and decreasing length of admission. He suggests that therapeutic gardens in hospitals bring, in addition to the benefits mentioned above, positive moments of escape from stressful

clinical environments. A place not only patients can enjoy, but also their relatives and health professionals

Illustration 4 shows the floor plan of the *pilotis* of a hospital, with commercial galleries, shops, restaurants and living areas, as well as a therapeutic garden. They are paths for mobility where the physical abilities of the patient are tested and improved, with points of contemplation, islands of vegetation to create a differentiated microclimate and shading points.

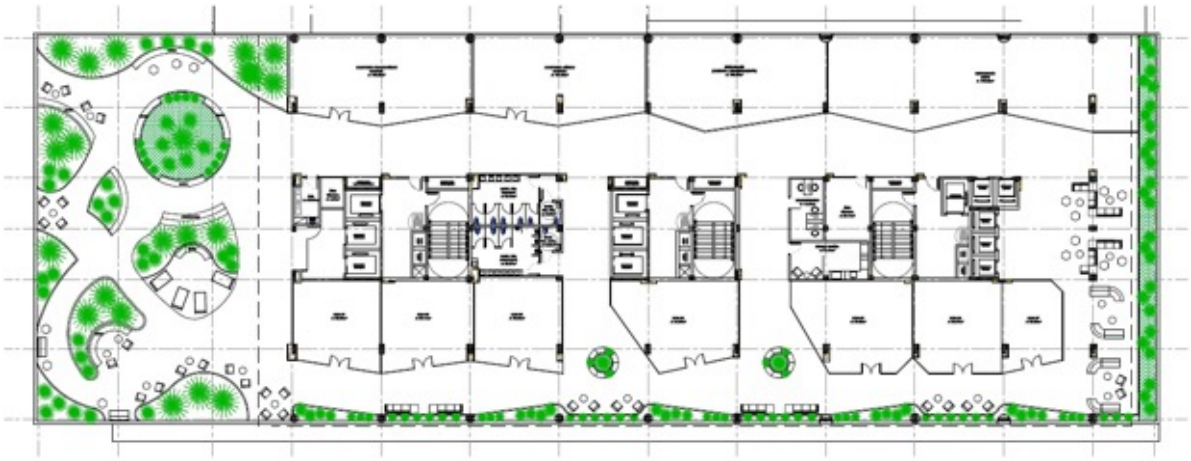

Illustration 4. Gallery and therapeutic garden of a hospital. Source: Illustration produced by the author (2021).

The hospital is a building with areas that need to be "clean", so it is not possible to use natural plants in most sectors. To include nature in these environments, considered critical and semi critical, such as inpatient units, operating room, ICUs, among others, the company *Skyfactory* helped a pioneering study in neuroarchitecture, led by the Department of Design and by Texas University School of Human Sciences. Debajyoti (2015, p.1) examined how the insertion of simulated nature, in the form of photographic compositions of the sky installed on the ceiling, influenced the results of patients. Previous studies had already shown that nature has a positive influence on patients, but its references were pictures with representations of nature, not realistic simulation. This experiment used ten rooms: in five of them ceiling lamps were installed, projecting a realistic image of a skylight; in the remaining five, there was no intervention. The study collected data from 181 patients, in 11 results. It was possible to conclude that, within the group with access to the images, environmental satisfaction was 12% higher, and the level of stress and anxiety reduced 53.4% and 34.79%, respectively. Below, in illustration 5, there is an example of how to apply such plates to the ceiling in the ICU room, since the patient is lying with his back to the window, with frontal

monitoring by the nursing, with the possibility to glimpse nature and have the day notion. At night, the plate is turned off, lights become more indirect and with a more yellow color temperature, without the blue light spectrum, contributing to patient's sleep and to the restoration of his health.

Illustration 5. ICU bed. Source: Illustration produced by the author (2021).

4.2. Hearing

"Sound perception involves brain structures such as prefrontal cortex, premotor cortex, motor cortex, somatosensory cortex, temporal lobes, parietal cortex, occipital cortex, cerebellum, limbic system, including amygdala and thalamus" (OVERY; MOLNAR-SZACKACS, 2009 apud ROCHA, 2013, p. 133).

For Tuan (1980, p.10), hearing is not very developed in humans and primates. The eyes get more detailed and accurate information about the environment than the ears, but generally we are more touched by what we hear than by what we see. For many, music is an emotional experience much stronger than the fine arts or sceneries. We are more vulnerable to sounds because we cannot close our ears as we can do with our eyes.

> The brain can work on many things at the same time, with overlap and parallelism. This is how our hearing system processes sound: it does not have to wait until it finds out the height of a sound to know where it comes from [...]. Our brain is constantly updating its opinions, especially when

> it comes to perceiving visual and auditory stimuli, hundreds of times per second, and we don't even know this (LEVITIN, 2021, p. 90).

In health environments, for example, sound can influence patient's recovery or interfere with the execution of the health professional's work.

NERBASS (2015, p. 108) presents a research on environmental factors that impair the sleep of ICU patients. Among such factors there is the noise caused by the devices connected to the patient, parallel conversations from staff or visitors and companions. Excessive noise has been considered the most sleep disturbing factor in the ICU, with harmful effects not only on the recovery of patients, but also on the health of professionals.

The predominant concept of ICU, for example, are beds arranged in a hall, separated by a curtain, for a better visualization of the patient. However, this model has been proved very inefficient in relation to acoustic comfort. A new concept that has been adopted are closed rooms with glass, allowing visualization of the patient and ensuring a more adequate noise level, as can be seen from illustration 6.

Illustration 6. ICU rooms. Source: Illustration produced by the author (2021).

Bittencourt (2021, p.14) describes alternatives to reduce noise within ICUs, such as: replacing acoustic alarms with visual ones, distinguishing alarms to prioritize life-threatening ones, periodically assessing the acoustic level, and showing the team studies on the subject, making them aware of the possible negative effects of excessive noise.

On the other hand, the presence of music in these environments has been shown, through scientific studies, to be beneficial for ICU patients, for example.

According to Junior research (2018, p.6), there is evidence of reduced symptoms of discomfort, increased positive sensations, facilitation of personal and interpersonal communication, greater sociability, reduction of physical and mental pain, beneficial changes in physiological patterns and body stimulation with the use of music therapy. Among the 35 studies analyzed by him, 14.5% indicate that music helps in the decrease of anxiety; 31,7% recommend the use of music as nursing intervention; 18.4% conclude that music acts in physiological responses; 12.4% refer to music as a viable alternative for sedative and anxiolytic use; and 17.9% conclude that music helps reduce pain. However, 3.2% report that there were no significant results for patients regarding the use of music.

From the end of the 20th century, the Ministry of Health established important comfort strategies in the National Policy for the Humanization of Care and Management in the Unified Health System – Humaniza SUS. Among the recommendations for humanized ambiences, the existence of noise was highlighted, hence the proposal for "the use of background music in some spaces, such as wards and waiting rooms. In another context, it is also important to consider acoustic protection that guarantees privacy and control of some noises" (BRASIL, 2010, p. 122).

> A measure of humanization for hospitalized patients refers to the use of music individually, using disposable headphones. Solution for patient comfort recommended by scientific studies and professionals dealing with the acoustic comfort component. This measure has presented results "that can regulate mood, reduce aggressiveness and depression" justified because the "musical hearing process positively affects the release of brain chemicals" (ARAÚJO, 2013:1319APUD BITTENCOURT, 2021, p. 13).

Finishing materials should also be considered as a strategy to reduce noise. There are guidelines regulating the level of noise within built environments. One of them is NBR 10.152, which regulates noise levels for acoustic comfort, whose limits depend on the type of environment and the activity performed.

Bittencourt (2021, p.20) mentions some design aspects for health buildings, in order to enhance noise reduction, such as: choosing the land properly; considering environmental aspects that may impact acoustic comfort; evaluating the impact of natural conditions, landform, topography and geological conditions in the implementation of the building; choosing and defining the shape of the building and its relationship with other buildings of the immediate surroundings; ordering and distributing internal spaces, considering flows and functional

relationships; establishing the spatial distribution and the adequacy of the internal design of the building; defining the use of construction solutions that reduce the noise leakage; defining and applying materials that reduce the reverberation and absorption of noise; using and applying constructive details that contribute to better acoustic quality.

4.3. Smell

According to BARBEITOS (2010, p.2), from the moment a person smells something, the odor is memorized in a learning process, being important in food selection and in emotional processes and experiences. Olfactory learning is directly related to individual and collective experiences and may alter affective states and relationships regarding social and sexual behavior. Thus, memories evoked through odors are distinct from others, due to their great emotional strength.

NANDA (2005, p.60) describes that the sense of smell registers variations in odor within a limited range. At distances of approximately one meter, it is possible to smell more intimate odors, such as the smell of hair, skin, clothing. Perfumes and other stronger odors can be perceived from two to three meters. Fetid smells, such as rotten fish, can be perceived at longer distances.

Such concepts bring upon reflections regarding the importance of triggering a good sense of smell within environments. In addition, how much it can interfere with the well-being of users, considering their affective memories, pleasant and unpleasant odors.

Hospital environments, according to WOSNY (2004, p.1), has its own odor. The "smell of hospital" is indicative of quality in health and, mainly, of conditions for hospital infection.

Smells such as medicine, "hospital food", disinfectant, are recurrent in the statements of those who remain in the hospital, either for an elective consultation or for longer hospitalization period.

> Every odor communicates something. Pleasant or unpleasant, odors send some message, obvious in various situations, in others, requiring decoding. They may mean some imminent danger present in the environment, cause or result of any damage or discomfort to the individual. The interpretation of these olfactory messages by nursing, depending on its response, can be decisive in the conduction and outcome of the act of care mediated by the relationship between olfactory perception/nursing action. It may be suggestive of physiological emanation resulting from the action of a given pathology ported by the client. Olfactory perception, sharper in one, less in others, responds to a variety of sensations. The greater aesthetic/

> philosophical and technical/scientific understanding of odorous fumes may favor nursing diagnosis and care planning, environmental and therapeutic quality surveillance (WOSNY, 2004, p. 1).

Some precaution should be taken when designing hospital environments, such as the choice of odorless finishing materials, place where products and medications are handled and location of the kitchen production away from patients, so as not to negatively impact the well-being of its users.

Using biophilia strategies, a topic mentioned in previous chapter, nature connects positively with man, reducing pain, stress, and anxiety. Therefore, smells of nature for hospital environments can help in the restoration of patients and the well-being of health professionals. This strategy can be carried out with an electric aroma diffuser with essential oils.

4.4. Taste

> Taste or taste is a chemical sense, that is, it depends on chemoreceptors (sensory receptors that transform chemical energy into electrical energy). We have these chemical receptors present in different parts of the tongue and which are sensitive to five specific types of substances: there are different receptors for sweet, bitter, acidic, salty and umami. The latter, despite the strange name, is stimulated by something we know well, the taste of monosodium glutamate, the so-called flavor enhancer. These umami receptors, when stimulated, give the food the feeling of tasty and pleasant. With these five receptors, we are able to identify the most varied flavors in food and delight ourselves with the most fantastic goodies (TIEPPO, 2019, p. 129).

In the hospital environment, different users receive food every day. Staff, students, companions, and patients eat daily inside the hospital. Patients receive up to five meals a day. How to make this a positive experience and enhance the recovery process?

> Access to a variety of safe and healthy foods is a fundamental human right. Adequate nutritional care, including food quality, has beneficial effects on patient recovery and quality of life. The presentation of the meal, the variety of products and the physical location are the primary factors that contribute to the negative perception of the user and attitudes towards the meals of institutions. Generally, the public sees hospitals as institutions, with the view that they are less favored in resources. The negative image of the hospital meal is generalized and, therefore, not necessarily related to food itself (GARCIA, 2010, p. 474).

For Hesse (2016, p.53), hospitals, in the last decade, have seen an opportunity to improve patient care, in addition to providing a competitive differential and as a way of reducing costs. In the hospital, nutrition works in an integrated manner and considers the limitations of each patient in

relation to their clinical status. For him, the meal should be presented in a pleasant way, to arouse the desire to eat. In the five articles studied by Hesse, the time of hospitalization and well-planned menus are mentioned as determinant in the acceptance of hospital meal.

Hospitalized patients, either in the ICU or regular bed, receive their food in bed, often at a high table, without much ergonomics, or on a meal bench. The environment where they spend the day does not satisfactorily stimulate the taste. That is why it is so important to improve this experience with a good presentation of the meal, stimulating more than one sense.

The hospital staff or even companions, who eat their meals in cafeterias, also need adequate spaces, with coatings that absorb the noises, with the presence of real or simulated nature, with colors and stimuli that make the experience pleasant, as we can see in illustration 7.

Illustration 7. Hospital cafeteria. Source: Illustration produced by the author (2022).

A good sensory environment is not one that strikes all the senses, but one that creates an engaging conversation among them. It is an initial step beyond the aesthetics of appearance towards the aesthetics of experience (NANDA, 2005, p.164).

4.5. Touch

"The organ responsible for the sense of touch is the largest organ in the human body: the skin. The mechanisms responsible for the sense of touch are in the second layer of the skin, the dermis. Touch is the first sense to be developed in the human embryo" (Pacievitch, 2013, p. 1).

Tieppo (2019, p.117) brings the concept of touch followed by sensitivity. By touching something, we experience not only the touch, but also sensations such as tickling, pressure, vibration or movement, temperature, pain, and position of body parts.

The sense of touch is related to human development and adaptation. It is by touching things that the baby begins to identify the different shapes and textures of objects. He also begins to understand his own body and differentiate people. People with visual impairment use their fingertips to "read" embossed dots on a surface and orient themselves in space through touching and proprioception.

When designing hospital environments, it must be considered the touching experience to prioritize spatial reading using the Braille system, as well as use different finishing materials and furniture to make it possible to identify different places, and add other sensations to the somatosensory system, such as adequate temperature of the environment, through natural or artificial ventilation.

5. Conclusion

The study of neuroscience applied to architecture brings important aspects to the design process that go beyond aesthetics and prioritize the user experience. The main aspect studied in this article was the trigger of the senses, access path to our nervous system, through vision, smell, hearing, taste, and touch, as well as the positive or negative impact on people's quality of life. Our nervous system captures the stimuli of these environments and transmits them to our body through receptor cells, causing sensations, emotions and shaping our behavior. This work brought reflections on how the built environment can affect our brain and impact the lives of people, with a focus on health environments, and how to apply environmental strategies that stimulate the senses, such as: biophilia, lighting and acoustic comfort. Therefore, it was presented: how biophilia can be applied through the presence of living or simulated landscapes, textures and aromas, which can reduce the time of hospitalization of patients, the use of medications and the stress of health professionals; how lighting, natural or artificial, regulates the biological clock of the human being and, when applied adequately, helps melatonin production at night as well as focus and concentration during the day;

and how acoustic comfort contributes to a more effective recovery or a work with greater focus and concentration. Neuroarchitecture studies and future advances in neuroscience can contribute to improve the design of buildings, making them more attractive and improving the health and well-being of its users.

Bibliography

BARBEITOS, Carmo Ledna Pereira. **Percepção do olfato: folhas que não guardei**.2010. Disponívelem:<https://docplayer.com.br/24178589-Percepcao-do-olfato-folhas-que-nao guardei.html > Access on December 16, 2021.

BRASIL. ANVISA. Agência Nacional de Vigilância Sanitária. **Conforto Ambiental em Estabelecimentos Assistenciais de Saúde / Tecnologia em Serviços de Saúde**. Brasília: 1ª edição, Agência Nacional de Vigilância Sanitária, 2014.

BRASIL. ANVISA. Agência Nacional de Vigilância Sanitária. **Dispõe sobre o Regulamento Técnico para planejamento, programação, elaboração e avaliação de projetos físicos de estabelecimentos assistenciais de saúde**. Brasília: 1ª edição, Agência Nacional de Vigilância Sanitária, 2002.

BRASIL. Agência Nacional de Vigilância Sanitária. Núcleo Técnicoda Política Nacional de Humanização. **Acolhimento nas práticas de produção de saúde / Ministério da Saúde, Secretariade Atenção à Saúde, Núcleo Técnico da Política Nacional de Humanização**. – 2. ed. 5. reimp. – Brasília: Editora do Ministério da Saúde, 2010. 44 p. : il. color. – (Série B. Textos Básicos de Saúde).

BITTENCOURT, Fabio. **Conforto acústico em ambientes de saúde. Música, paisagismo e materiais de revestimentos como soluções humanizadoras**. E-book digital. Inbec Pós Graduação, 2021.

BOTTON, Alain de. **A arquitetura da felicidade**. Rio de Janeiro: Rocco, 2007.

BRAINFACTS. **Parts of the nervous system**, 2012. Available at:< https://www.brainfacts.org/brain-anatomy-and-function/anatomy/2012/parts-of-the-nervous-system> Access on December 12, 2021.

CARBONE, Jessica. **Guia prático. Neuroarquitetura no combate ao estresse e à ansiedade**, 2021.

CRIZEL, Lori. **Neuroarquitetura: neuroarquitetura, neurodesign e neuroiluminação**. 1ª ed. – Cascavel - PR: Lori Crizel, 2020.

DEBAJYOTI, Pati et al. **The Impact of Simulated Nature on PatientOutcomes: A Study of Photographic Sky Compositions**. 2015. Available at: <https://pubmed.ncbi.nlm.nih.gov/26199272/. 2016> Access on November 10, 2021.

EBERHAD, John P. **Applying Neuroscience to Architecture**. 2009. Available at: <https://www.sciencedirect.com/science/article/pii/S0896627309004310. 2009 >. Access on November 10, 2021.

FILHO, Ruy Barbosa Soares. **Resposta humana à luz: alterações não visuais e o projeto luminotécnico residencial com LEDs**. 2018. Available at: <https://teses.usp.br/teses/disponiveis/16/16132/tde-09102018-161925/pt-br.php. > Access on December 13, 2021.

FIORAVANTI,Carlos. **As cores da noite**. 2009. Available at: https://revistapesquisa.fapesp.br/as-cores-da-noite-4/ . Access on December 13, 2021.

FONSECA, Pedro Ricardo Gouveia. EDWARD O. WILSON, A CRIAÇÃO. UM APELO PARA SALVAR A VIDA NA TERRA. 2009. Available at: http://dx.doi.org/10.14195/0870-4112_7_29. Access on December 13, 2021.

GARCIA, Rosa Wanda Diez. **Alimentação hospitalar: proposições para a qualificação do serviço de alimentação e nutrição, avaliadas pela comunidade científica**. 2012. Available at: <https://www.scielo.br/j/csc/a/Z5T8Xh9z4V4p4grcSwjTJrL/?lang=pt. > Access on December 14, 2021.

GRESSLER, Sandra Christina. **Ambientes restauradores: Definição, histórico, abordagens e pesquisas**. 2013. Available at: https://www.scielo.br/j/epsic/a/h4t9nkcPW4Srq7WX7P8dQsf/?lang=pt> Access on December 14, 2021.

HESSE, Cezar Augusto. **A importância da gastronomia contemporânea na refeição hospitalar**. 2016. Available at: https://www.univates.br/editora-univates/publicacao/208 > Access on December 16, 2021

JUNIOR, Hermes de Andrade. **Eficácia terapêutica da música: um olhar transdisciplinar de saúde para equipes, pacientes e acompanhantes**. 2018. Available at: <https://www.epublicacoes.uerj.br/index.php/enfermagemuerj/article/view/29155> Access on December 16, 2021.

LEVITIN, Daniel J. **A mente organizada. Como pensar com clareza na era da sobrecarga de informação**. 1ª ed. – Rio de Janeiro: Editora Objetiva, 2015

LEVITIN, Daniel J. **A música no seu cérebro: a ciência de uma obsessão humana**. 1ª ed. – Rio de Janeiro: Editora Objetiva, 2021.

NANDA, Upali. **Sensthetics: a crossmodal approach to the perception, and conception, of our environments**. 2005. Available at: <https://oaktrust.library.tamu.edu/handle/1969.1/3215 > Access on November 7, 2021.

NERBASS, Flavia Baggio. **Distúrbio do sono em unidade de terapia intensiva**. 2015. Available at:< https://portal.secad.artmed.com.br/artigo/disturbios-do-sono-em-unidades-de-terapia-intensiva> Access on December 15, 2021.

PACIEVITCH,Tais. **Tato**. 2013. Available at: < https://www.infoescola.com/anatomia-humana/tato/ > Access on December 17, 2021.

PAIVA, Andrea de; JEDON, Richard. **Short- and long-term effects of architecture on the brain: Toward theoretical formalization**. 2019. Available at: https://www.sciencedirect.com/science/article/pii/S2095263519300585#bib29 > Access on November 8, 2021.

PREUSS, Todd. **How does the human brain differ from that of other primates**. 2014. Available at: https://www.brainfacts.org/ask-an-expert/how-does-the-human-brain-differ-from-that-of-other-primates> Access on December 10, 2021.

RAHMAN, Shadab A. **Diurnal Spectral Sensitivity of the Acute Alerting Effects of Light**. 2014. Available at: https://academic.oup.com/sleep/article/37/2/271/2558955. Access on December 13, 2021.

ROCHA, Viviane Cristina da. **A música por uma ótica neurocientífica**. 2013. Available at: <https://www.scielo.br/j/pm/a/4MYkTmWFfsG4P9jfRMdmh4G/?lang=pt> Access on December 15, 2021.

SILVA, Michelle Alves da. **Visão**. 2013. Available at: www.infoescola.com/anatomia-humana/visao/. Access on December 12, 2021.

TIEPPO, Carla. **Uma viagem pelo cérebro: a via rápida para entender a neurociência**. 1ª ed. – São Paulo: Editora Conectomus, 2019.

TUAN, Yi-Fu. **Topofilia: um estudo da percepção, atitudes e valores do meio ambiente**. Trad. Lívia de Oliveira, São Paulo: Difel, 1980.

ULRICH, Roger S. **Health Benefits of Gardens in Hospitals**. 2002. Available at: < https://greenplantsforgreenbuildings.org/news/health-benefits-of-gardens-in-hospitals/> Access on November 7, 2021.

VILLAROUCO, Vilma. **Neuroarquitetura. A Neurociência no ambiente construído**. Rio de Janeiro, 2021.

WOSNY, Antonio de Miranda. **Odores e infecções em ambiente hospitalar**. 2004. Available at: < https://www.scielo.br/j/tce/a/b3rb6psBKQkCBtYwxLZdd7g/?lang=pt > Access on December 16, 2021.

ZANATA, Amanda A. et al. **Biofilia: produção de vida ativa em cuidados paliativos**. 2019. Available at:<https://doi.org/10.1590/0103-1104201912223 > Access on November 10, 2021.

Opinion article

From Hospital Architecture to Architecture for Health

Author

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Globally, the hospital was for centuries the dominant, and virtually only, typology[1] of the health care building. Synonymous in the cultural and architectural imaginary, par excellence, of the sanitary building.

Although chronic hospitals have existed for centuries, and although the Dawson Report[2] in Great Britain in 1920 incorporates ambulatory care within its analysis of the supply of health services, as Ramón Carrillo defines in a resolution[3] of 1947 the characteristics of health center, health unit and health center, Only in an incipient way from the second half of the twentieth century, accelerating towards the end of the century and the first decades of this century, a series of transformations led to the appearance of new typologies, with increasing presence in the health system and in our cities, which has implied that the hospital is no longer the only health effector.

The transformations can be grouped into three broad categories: models of the health/disease/care process, technological developments, and epidemiological changes.

It should be clarified previously that the order that has been given to these changes in this text is random, one not being more important than the other and being, in addition, closely linked to each other, understanding them not as independent processes but as closely interrelated and feedback processes.

1 It is important to note that, in this work, when talking about *typology* I refer to the relationship between the program of needs (the use and/or the purpose) and the building. I'm not using the word *typology* as to the relationship between morphological characteristics and building, which is the most common definition of the word in architecture. By example Marine Waisman (1990) defines it as "*the network of typological relationships that result in a given spatial volumetric organization...*" . The same author affirms that, unlike the natural sciences that can establish laws, the sciences of culture establish concepts that characterize and order the particular within the general. From the affirmation that architectural typologies are a classification, which tends to the study of the similarities of architectural spaces, uses, functions, forms, construction methods, eras, etc. and that there are typologies that can be defined from function or use, but not from form, nor from

1. Changes in the health/disease/care/care model

These changes, which privilege health care over the treatment and care of the disease, have been driven by two simultaneous processes:

1.1. Implementation of the Primary Care Strategy

Although it is a very long process that could even be traced back to the thirteenth century (Rovere, M)[4], from certain experiences in some countries in the 60s and 70s and from the goal of "health for all by the year 2000" of the WHO in 1975, it is especially since the Alma Ata Conference[5] (1978) that the **Primary Care Strategy of Health**: "*essential health care based on practical, scientifically sound and socially acceptable methods and technologies, made available to all individuals and families in the community, through their full participation and at a cost that the community and the country can bear, at each and every stage of development, in a spirit of self-responsibility and self-determination*".[6]

As several authors [7] have pointed out, this strategy comprehensively conceives the health problems of individuals and society, through the integration of care, disease prevention, health promotion and rehabilitation. This perspective also proposes an organization of health services by different levels of care, which must have the participation of the community to solve problems through accessible, high quality and continuous and comprehensive services.PHC was born as a policy of expanding coverage to solve what at that time was called the crisis of accessibility of health systems. This crisis in developed countries was expressed through skyrocketing health care costs and rising population demand for services, in the face of unequal and incomplete coverage.

At the same time, in the Latin American region the population began to be mostly urban, in full demographic transition. Inequities in access to health services became increasingly visible, as they were organized with a centralist approach and failed to cover the entire population. Based on this approach, health systems have been pouring policies and resources to the levels of least complexity and closer to where people live. By virtue of the fact that they work on the maintenance of health trying to anticipate the onset of the disease and / or treating the disease at its initial levels, they are therefore more efficient and improve the quality of life of the population.

The policies developed within the PHC framework are largely responsible for relevant changes in some health indicators; of [8] significant increase in health personnel who work professionally outside hospitals; of a certain tendency in the medical-industrial complex to develop 'portable' technologies; of the multiplication of health centers and other

spatiality, nor from constructive systems (Moyo Peralta, 2016) , I use the concept of typology as the relationship between the function, use and / or program of needs and the building.

2 Dawson of Penn and Bond C (1964). Dawson Report (1920) on the Future of Services Medical and Related. WHO and PAHO Scientific Publication No. 93, Washington, United States.

3 Articles 1, 2 and 3 of Resolution 5078 of the Secretary of Public Health of the Nation Dr. Ramón Carrillo of November 20, 1947.

4 Rovere M. (2012). Primary Health Care under Debate. Magazine Health Debate Vol 36 N° 94, Rio de Janeiro, Brazil. ISSN 0103-1104.

5 The International Conference on Primary Health Care in Alma-Ata, organized by WHO and UNICEF, with the participation of the ministers of health of different countries and held in Kazakhstan, USSR, from September 6 to 12, 1978, was the most important international health policy event of the seventies.

6 WHO (World Health Organization) and UNICEF (United Nations Children's Fund) (1978). Declaration of Alma Ata.

7 Ministry of Health of the Nation, Argentina (2012). The Right to Health. 200 years of health policies in Argentina. Buenos Aires, Argentina. ISBN 978-950-38-0141-3.

8 Rovere M. (2012). Op. Cit.

decentralized facilities incorporating themselves as social equipment near the most vulnerable populations; among others.

In 2018, the Astana Declaration reaffirms[9] "*primary health care as the most inclusive, efficient and effective approach to improving people's physical and mental health as well as their social well-being, and that primary health care is the cornerstone of a sustainable health system for universal health coverage.*" It also emphasizes the importance of promotion, prevention, cure and rehabilitation services, and accessibility as a priority.

In addition, the Pan American Health Organization, through a high-level omission, prepared the document *Universal Health in the XXI Century: 40 years of Alma-Ata*, where among the 10 recommendations it proposes to promote networks with a first level of resolutive care (recommendation 2), implement initiatives to eliminate barriers to access to health services (recommendation 5), and promote the rational use and innovation of technological resources to serve the health needs of the population (recommendation 9).

1.2. Containment of costs and growing demand for health services

It is common to say that in health supply generates demand. As well as the demand for health services, and with them for resources, tends to a continuous and incessant increase. This persistent increase in costs is due to the increase in supply (through new treatments and new technologies), the increase in chronic diseases (which is causing more people to live with a disease that is not fatal but requires permanent care for a long time), the increase in life expectancy (which also increases the incidence of chronic diseases), the increase in consumption habits in a society where access to health is also understood as a good to be consumed, the empowerment of sectors of the population that demand more benefits, and the demand induced due to the asymmetry of information between the patient and the provider who often demands for it.

Based on this, decision-makers and administrators of health systems began to evaluate as economically more convenient the maintenance of health to the treatment of the disease, just as the treatment of a recent pathology requires fewer resources than that of an advanced one. The steadily rising costs of health services have become a permanent concern of both public and private service providers. A synthesis of these concerns is reflected by the WHO[10] in 2010, where they refer to the fact that between 20 and 40% of health resources are wasted and that hospital care absorbs more than half and, sometimes, up to two thirds, of total public health expenditure; being both hospital admission and length of hospitalization the two most important (often excessive) types of expenses. As a way to overcome these economic barriers, it points to

9 The Astana Conference, also organized by WHO and UNICEF, with the participation of the ministries of health of almost all countries of the world and held in independent Kazakhstan, on 25 and 26 October 2018, aimed to revise the definitions of Alma Ata 40 years after the Declaration.

10 WHO (World Health Organization) (2010). World Health Report: Financing Health Systems: The Road to Universal Coverage. WHO, Geneva, Switzerland. ISBN 978 92 4 068482 9 / ISSN 1020-6760.

investment in primary care, ensuring easy and cheap physical access to services and prevention and promotion interventions for all that can be cost-effective and can reduce the need for subsequent treatment.

In 2018, the Astana Declaration, mentioned above, also refers again to the need to take action on rising health care costs. However, it should be noted that in recent years some authors[11] have begun to pose a paradoxical situation: that prevention reduces costs in the short term (since in general it is cheaper to treat a disease at the beginning than when it worsens) but, in the long term, the prolongation of life, product precisely of the aforementioned policies, It makes the demand on health and social security systems, and with it costs, tend to increase.

2. Technological developments that modify the modalities of care

2.1. Pharmacology

Pharmacology has allowed the reduction of the duration and even the disappearance of a large number of pathologies, and the outpatient treatment of diseases that previously required hospitalizations (often prolonged). At the same time, it has allowed, or contributed to, pathologies that were fatal have ceased to be so but that are not completely cured and, as a result, a high number of individuals, increasing, live with a permanent disease that limits their abilities and require constant attention. In some cases without hospitalization, but also, in others, with long hospitalizations that do not require greater diagnostic and treatment services.

In addition, new perspectives are now opening up with biological therapies, nanotechnology, personalized pharmacotherapy (see point 3.3.4.), regenerative medicine with tissues and organs artificially made in laboratories (Mauri M. , 2015).[12] According to the WHO, medicines (drugs) represent between 20 and 30% of global health expenditure.[13]

2.2. Medical equipment

A large number of new and/or more modern diagnostic and treatment devices have been developed that have admitted methods of greater precision and information, less invasive, shorter duration of procedures and, often, outpatient use. New biomedical technologies have provided sophisticated tools such as computed tomography, magnetic resonance imaging and positron emission tomography that allow morphological and functional diagnostics for organs and molecules to be made without surgery. But also treatments such as minimally invasive surgery, surgery with robots, interventional radiology, new types of radiotherapies, and new laboratory methods (Mauri M. , 2015).[14]

11 Maceira D. (2014). Aging and challenges for the Argentine health system. The years do not come alone, edited by Gragnolati M., Rofman R., Apella I. and Troyano S., World Bank, Buenos Aires, Argentina. 88055.

12 Mauri M. (2015). The future of the hospital and the structures of the NHS. TECHNE Journal of Technology for Architecture and Environment (9), Pag. 27/34. https://doi.org/10.13128/Techne-16100

13 WHO (Organization World Cup Bless you) (2010). Op. Cit. Pag. 68

14 Mauri M. (2015). Op. Cit.

2.3. Information and Communication Technologies (ICTs)

These allow remote communication and real-time information, facilitating diagnoses and treatments. Biomedical sciences are being radically transformed by advances in monitoring, recording, storing, and integrating the information that characterizes human biology and health at scales ranging from single molecules to large populations of subjects.[15] The processing and use of this volume of information is affecting the modalities of care and, simultaneously, the characteristics of the physical resource in health.

The Pan American Health Organization[16] differentiates between Telemedicine (provision of remote health services in the components of promotion, prevention, diagnosis, treatment and rehabilitation, by health professionals using information and communication technologies) and Telehealth (set of activities related to health, services and methods, which are carried out remotely with the help of ICTs and include, inter alia, telemedicine and tele-education in health).

Since the covid 19 pandemic, the implementation of telemedicine and telehealth has greatly accelerated. A series of services that were supposed to be possible to be realized but that were not implemented or that were implemented on a small scale, have been carried out in a much more massive way in a few months. Although the return to the *new post-pandemic normality* again retracts the provision of part of these services to the face-to-face form, the leap that telehealth has taken in a short period of time will most likely have no turning back.

Is it possible and necessary to think that remote consultations, diagnoses and treatments will now require a specific physical place?

2.4. Gene Therapies

The description of the human genome is perhaps the greatest advance (Mauri M. , 2015)[17] of medical knowledge that could open a new era: predictive medicine that would allow to know in advance the predisposition to a disease and the possibilities of getting sick of each individual, allowing the focus of interventions on each person but opening, simultaneously, a large number of technical and ethical questions. In turn, the field of nanotechnology also opens up new therapeutic perspectives.

2.5. Artificial Intelligence

Artificial intelligence (AI) is defined as the ability of technologically coded algorithms to learn from data so that they can perform tasks automatically without each step having to be programmed specifically by the human

15 Kuzmar I. (2017). How create one Service Telemedicine, revision systematics and analysis for his implementation. Editions University Simon Bolivar, Barranquilla, Colombia. ISBN 978-958-8930-97-8.

16 PAHO (Pan American Health Organization) (2014). Conversations envelope eHealth Information management, dialogues and knowledge sharing to get closer universal access to health PAHO, Washington DC, United States. ISBN 978-92-75-31828-7.

17 Mauri M. (2015). Op. Cit.

being (WHO, 2021).[18] The World Health Organization recognizes that AI represents a great opportunity for the practice of public health and medicine, but, simultaneously, in order to reap the benefits of AI, challenges for health systems, professionals and beneficiaries must be identified.

AI can improve the delivery of health services, both in prevention, diagnosis and treatment, and is already changing the delivery of health services in developed countries. The possible fields for AI in health are the different technologies available, genetic information, digitized medical records, radiological images and clinical care. Also in clinical research and drug development, in planning and management of health systems and in epidemiological surveillance.

In the aforementioned document[19], the WHO defines 6 key ethical principles for the use of AI in public health and medicine:

- Protection of people's autonomy

- Promotion of human welfare and security and the public interest

- Ensure transparency, comprehensibility and intelligibility

- Promotion of responsibility and accountability

- Ensure inclusion and equity

- Promote responsible and sustainable AI

3. Changes in the epidemiological profiles of the population

Towards the beginning of the twentieth century in developed countries and towards the end of the same century in underdeveloped countries, with Argentina in an intermediate stage, all populations have made an epidemiological transition in the direction of the reduction or disappearance of infectious and contagious diseases and the increase in degenerative diseases. New pathologies have also been incorporated as a result of social and environmental conditions.

The increase in life expectancy during the twentieth century, and changes in living and feeding conditions are closely related to the epidemiological transition, being both engine and consequence. Likewise, the control of mortality from many diseases has increased the number of people living with some type of chronic disability that requires long treatments, but generally without hospitalization.

In January 2020, when the Covid 19 pandemic had not yet broken out, the United Nations (UN) identified in a document[20] the 13 challenges of global health for the decade that was beginning.

18 WHO (World Health Organization) (2021). Ethics and governance of artificial intelligence for health: WHO guidance. WHO, Geneva, Switzerland. ISBN 978-92-4-002920-0 (digital) / ISBN 978-92-4-002921-7 (printed).

19 WHO (World Health Organization) (2021). Op. Cit.

20 UN (United Nations) (2020). The 13 challenges of global health in this decade. UN, New York, United States. https://news.un.org/es/story/2020/01/1467872.

These are generic definitions, framework themes, such as "good intentions" and it is difficult to find in them elements that can directly influence architecture for health.

On September 2011, the United Nations General Assembly met to discuss the prevention and control of noncommunicable diseases worldwide. It was the second time in the history of the UN that the General Assembly convenes a summit to address a health issue (the first was AIDS), which accounts for the magnitude and repercussions that the advance of these pathologies is having worldwide. The approved document[21] defines the four main noncommunicable diseases as cardiovascular diseases, cancer, chronic lung diseases and diabetes, which according to the World Health Organization claim the lives of three out of five people worldwide and cause great socio-economic damage in all countries. in particular developing countries. It defines the four diseases as preventable and places the focus on health promotion and prevention, as well as changes towards healthier lifestyles and improved living conditions of populations as the main strategies to prevent them. It also identifies as having a significant incidence of mental and neurological disorders, and renal, oral, and ocular diseases. It also emphasizes the need to strengthen the capacities of health systems (mentioning laboratory and imaging services in particular), and to facilitate access to and coverage of them.

4. The conceptual displacement and expansion of the disciplinary field

Since the transformations mentioned above, the modalities of care have been modifiedand also, as a consequence, the characteristics of the buildings intended for the provision of health services. This includes hospitals, as well as the great development of two large groups of new building types:

4.1. Outpatient buildings

The main characteristic of these buildings is the absence of hospitalization as we know it in hospitals (more than 8 or 12 hours), although they may have hospitalizations called short stay (some hours).

These buildings for outpatient care can be low (health center, primary care center, rehabilitation, dental, outpatient, etc.) or medium complexity (diagnostic imaging, outpatient surgery, endoscopies, radiotherapy, cancer treatments, dialysis, emergency, assisted fertilization, laboratories, blood processing, etc.), as well as consultation, diagnosis or treatment, or having more than one of these particularities simultaneously. They are small or medium scale, are embedded in the habitat of the population and must have resolution capacity.

21 UN (United Nations) (2011). Political Declaration of the High-level Meeting of the General Assembly on the Prevention and Control of Noncommunicable Diseases. UN, New York, United States. 11-49780 (S) 150911 160911.

Ambulatory care buildings have a greater heterogeneity than hospitals in the sense that the latter are much more repetitive and regular in the services that compose them and in how they are organized.

A hospital requires a minimum number and type of services to be able to function as such, and the existence of certain services requires the presence of others. If we define that a health care building to be called a hospital must have hospitalization, it must also inevitably have diagnostic and treatment services complementary to hospitalization since it would lose meaning without them. That is why we always find, even in hospitals of less complexity, services such as laboratory, imaging, surgery, and most likely deliveries. These services in turn require the existence of others such as intensive care and neonatology. On the other hand, a series of supply and processing services (pharmacy, food, laundry, sterilization, warehouses, etc.) will be necessary for the previous ones to function and the hospital can remain in activity continuously and permanently: 24 hours a day, 365 days a year. To these may be added others, but even the smallest and least complex hospital, will have a minimum of ten or twelve services and a basic organization from them. In contrast, (only) ambulatory care buildings can have from one sunor service to more than ten. Mostof them do not require practically another to operate since the benefits that are made in them are commonly self-sufficient. This makes the variability of this type of buildings much greater, and that they are much less repetitive in their programming and organization than hospitals.

4.2. Buildings with hospitalization for specific diseases

The essential particularity of these buildings is that they become the habitat of people with chronic diseases (permanently) or semi-chronic diseases (for a prolonged period of time) that require long hospitalizations in spaces with specific physical characteristics according to the pathology.

This has involved the development of new types of buildings for certain diseases, whose main characteristic is to become the temporary or permanent habitat of populations with chronic diseases, such as buildings for complex rehabilitation, Alzheimer's disease or palliative care. Although the hospitalization of these buildings usually has characteristics that differ from the acute hospital, a certain continuity can be established with the old chronic hospitals such as mental health, leprosariums, etc.

Buildings with hospitalization for specific chronic diseases require particular spatial resolutions according to the pathology they attend (due to conditions of the pathology), require hospitalizations more similar to a home (specific places to sleep, specific places for activities of day life, places of recreation, etc.) than to that of an acute hospital hospitalization,

They have few or no diagnostic services, do not require urgent or emergency services, treatment services are specific and limited, therefore occupying high percentages of the building's surface in hospitalization.

4.3. The new (or not so much) disciplinary field

It is from the transformations mentioned in the models of the health/disease/care/care process, in technological developments and epidemiological changes, and from the emergence and development of new building typologies as a result of these transformations, that we can speak of a shift from the traditional concept of *hospital* architecture to *architecture* (of buildings) for (the care of) *health*.

It is not a new disciplinary field within architecture, but the expansion of an existing and studied disciplinary field, through the incorporationof new objects of study, within the paradigms and dimensions that it is possible, to a large extent, to find in hospital architecture.

The general hospital ceases to be the paradigmatic health building, as it has historically been until the second half or end of the twentieth century, occupying an important but no longer exclusive place as an objectof study. Other building typologies have been formed and, most likely, will expand in quantity and variety towards the future with more and more presence in health systemsand in our cities.

The definition of a broader field, such as *architecture for health*, allows a better understanding of a subject that is becoming more complex in the continuum.

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Next, there is the list of books incorporated into our library in 2022.

Pensando para a Saúde series

Launched by RioBooks, this series includes several titles:

Os espaços de saúde no amanhã, by João Carlos Bross

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A ambiência no cuidado ao recém-nascido hospitalizado, by Thalita Lellice

Por ambiências sensíveis nos lugares de nascer, by Cristiane Neves da Silva

Planejamento físico-funcional e hotelaria em saúde

Daniel Alexandre da Silva

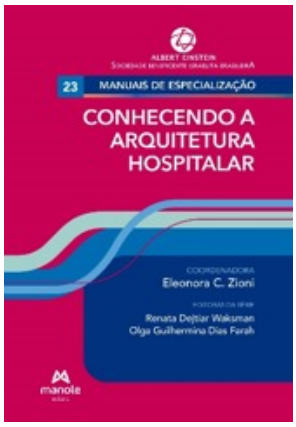
São Paulo: Senac, 2021

This title outlines an overview of architecture in health, analyzing the historical evolution of physical spaces from ancient times up to today. It discusses the basic concepts of architecture and hospitality, as well as the importance of humanization in environments and their services as a differential in the market, in addition to analyzing the health building from the perspective of sustainability and social and environmental responsibility.

Conhecendo a arquitetura hospitalar

Renata Dejtiar Waksman (Coordination); Renata Dejtiar Waksman and Olga Guilhermina Dias Farah (Editing)

Santana do Parnaíba [SP]: Manole, 2022 (Manuais de Especialização; 23)



Belongs to Manuais de Especialização series, published by Albert Einstein Israeli Institute of Teaching and Research. This title was developed in a multidisciplinary way, seeking to reinforce the importance of Hospital Architecture in present times. It addresses topics such as: master plan, design, design process, approval and development of a hospital project; organization of flows in the hospital; ambience and humanization; neuroscience applied to comfort architecture; hospital hospitality processes, among others.

The Patient Room: Planning, Design, Layout

Wolfgang Sunder, Julia Moellmann, Oliver Zeise and Lukas Adrian Jurk

Basel: Burkhäuser, 2020

This book addresses the current challenges in planning, designing, and conceiving the layout of patient rooms in the hospital context. Moreover, it examines the most appropriate measures under the aspects of hygiene to promote patient recovery and contain the spread of infections. The chapters address aspects such as nursing care, possibilities for patient room design and the research project Krankenhaus, Architektur, Mikrobiom and Infektion (KARMIN), in English, “Hospital, Architecture, Microbiome and Infection”.

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