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Summary

Editorial	155
Marcio Nascimento de Oliveira	
Article	158
COVID-19 pandemic and the trends in healthcare design: insights from the “Decalogue for Resilient Hospitals”	
Stefano Capolongo, Andrea Brambilla and Marco Gola	
Article	176
Healthcare closer to people: A qualitative study of a Swedish reform on healthcare delivery	
Erika Eriksson, Göranb Lindahl, Patrik Alexandersson, Sofia Park and Henrike Almgren	
Article	196
Spatial flexibility and extensibility in hospitals designed by João Filgueiras Lima	
Haroldo Pinheiro Villar de Queiroz	
Article	212
Design Insights from a Research Initiative on Ambulatory Surgery Operating Rooms in the U.S.	
David Allison, Herminia Machry and Anjali Joseph	
Article	230
A study on the development of the concept growth and change on hospital architecture in Japan	
Kazuhiko Okamoto	
Article	262
A study on hospital infection control through architecture in 1980: Chapecó Regional Hospital case study	
Chayane Galvão and Jonathas Magalhaes Pereira da Silva	
Article	279
Natural ventilation for hospitalization environments: historical aspects	
Kátia Maria Macedo Sabino Fugazza	
Book Review	295
Hospital architecture and its propositions for beginners and experts	
Elza Costeira	

Editorial

It was with great pleasure that I accepted IPH's invitation to help organize the new issue of their magazine, a publication known for the quality of its contribution to the technical and scientific knowledge concerning healthcare facilities. One of the late Jarbas Karman's main legacies, the IPH Magazine offers a priceless space for reflection and exchange of experiences among professionals, scholars, and researchers, serving as a true "platform engaged in disseminating ideas, research projects, innovations, projects and plans", as Karman himself described in his editorial for the first issue, published in February 2001.

Celebrating the twentieth anniversary of this successful journey, this 17th issue includes seven previously unpublished articles, with contributions from renowned professionals and invited researchers from Brazil, Japan, Sweden, Italy, and the United States, as well as papers submitted to the magazine's editorial team. This edition also includes the collaboration of Prof. Elza Costeira, who reviewed the recent edition of "*Feitos para Curar – A arquitetura e o processo projetual no Brasil*", a book written by architect Luiz Carlos Toledo, a must-read for everyone interested in hospital architecture.

From Toyo University, professor Kazuhiko Okamoto presents a study about the development of the concept *Growth and Change*, proposed by British architect John Weeks, in hospital architecture in Japan. In his study, Prof. Okamoto demonstrates how Weeks' theoretical approach related with and resonated among the existing practices in Japan from the end of the 60's and its influence in several Japanese hospital designs.

In another article, a group of researchers from Chalmers University of Technology presents a qualitative study concerning the outcomes of a reform carried out in the Swedish health system, which tried to achieve, through a strategy based on decentralization making “healthcare closer to people”. The study presents an overview on the repercussions and tensions arising from the implementation of local hospitals and, more generally, other decentralized public services in the management of the healthcare network.

From Italy, researchers from the Polytechnic Institute of Milan discuss how the COVID-19 pandemic has affected the tendencies in designing healthcare facilities, using as background the Decalogue for Resilient Hospitals, a study whose purpose was to indicate the main strategies to be considered when designing new hospitals and remodeling existing ones. By listing several strategies that can be used by designers, during both the hospital design and operations, researchers Stefano Capolongo, Marco Gola and Andrea Brambilla emphasize that the current pandemic has led to an extreme change in how healthcare services work, accelerating innovation and transformation processes.

For his contribution, architect and professor Haroldo Pinheiro presents a reflection on how the concepts of spatial flexibility and extensibility were applied on hospitals planned by João Filgueiras Lima, aka Lelé. From his experience gathered during the development of several projects when he teamed up with Lelé, Haroldo highlights the building elements and solutions from iconic designs for the Sarah Group, especially the units built in Brasília and Salvador (Brazil), enriching his text with historical details and valuable drawings and photographs from his personal collection.

From Clemson University (USA), researchers David Allison, Herminia Machry and Anjali Joseph present the outcomes of a study concerning the design of ambulatory operating rooms. Initially, they seek to map, through case studies and visits, potential flow disruptions and other interferences that may be a hazard for the numerous activities involved in the daily routine of such settings. The researchers then present the design process of an ambulatory OR prototype, a study centered on evidence-based design recommendations, computer-based simulations and lessons learned with a post-occupancy evaluation of existing facilities. The prototype development included high-fidelity mock-ups in an iterative process that started with designing, continued with production and, finally, to a phase of redesigning. The study findings include several recommendations on the dimension and layout of ambulatory ORs.

Researchers Chayane Galvão and Jonathas Silva, from PUC Campinas, present a discussion concerning the architectural evolutions of healthcare settings regarding social, technological, and legislative influences,

highlighting the design solutions aimed at the control of hospital infections. By reviewing Chapecó Regional Hospital design, designed by architect Irineu Breitman, the authors identified design elements adopted by the architect with the purpose of decreasing the dissemination of hospital-acquired infections.

Finally, the architect and researcher Katia Fugazza presents a historical overview of design solutions concerning natural ventilation within healthcare settings. Her study, which is a consequence from her master's dissertation, shows the timeline of natural ventilation solutions in hospital design throughout history, stressing its importance and illustrating with several examples of renowned designs.

We hope the variety and richness of topics presented in this issue of the IPH Magazine serve as more than just a source of research, but also as inspiration and encouragement for everyone currently or willing to work with technical-scientific production related to healthcare settings. This area's complexity and ever-growing technological evolution require constant new investigations and research and, after two decades of existence, the IPH Magazine reaffirms its commitment to keep its doors always open for imparting high-quality information.

Enjoy your reading!

Prof. Architect Marcio Nascimento de Oliveira

COVID-19 pandemic and the trends in healthcare design: insights from the “Decalogue for Resilient Hospitals”

Authors

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Abstract

The COVID-19 pandemic has stressed the healthcare systems at global scale with specific regards to hospital organizations and facilities. The surge in infections and the huge number of critically ill patients has tested the flexibility of architectures for health forcing organizations to quickly adapt and exploit ad-hoc emergency solutions.

The paper proposes insights from the “Decalogue for Resilient Hospitals” which includes a series of design strategies and considerations applicable both to new hospitals and to the refurbishment of existing hospitals. The proposed strategies involve: 1) Strategic Site Location; 2) Typology Configuration; 3) Flexibility; 4) Functional program; 5) User-centeredness; 6) Healthcare network on the territory; 7) Patient safety; 8) HVAC and indoor air quality; 9) Innovative finishing materials and furniture; 10) Healthcare digital innovation. The COVID-19 pandemic disrupted healthcare operations and accelerated the processes of innovation and transformation. The incorporation of future-proofing design and operational strategies into new or refurbishment projects can enable the achievement of resilient hospital facilities.

Key words

COVID-19; Hospital; flexibility; resilience; digital innovation; patient safety.

COVID-19 impact on healthcare systems

The COVID-19 virus is creating unexpected stresses on architectures for health and critical care systems. The rate of infections and critically ill hospitalized patients reached unprecedented levels.

Hospitals play a crucial role within the healthcare system in providing essential medical care to all the community, particularly during an emergency. In general, they are complex and vulnerable institutions, dependent on critical external support and supply lines which operate at a very high rate and capacity.

Even a modest rise in admission volume during a relatively short period of time can overwhelm a hospital beyond its functional reserve. The COVID-19 pandemic has stressed critical support service clusters and interrupted supply chains along with medical staff shortages and communications challenges (WHO, 2020). Healthcare facilities struggled to adequately respond to an unprecedented demand for emergency care and Intensive Care Units (ICUs) for infectious diseases. The need of COVID-19 beds in acute care departments globally surged, forcing healing settings to adopt contingency capacity strategies such as adaptations to medical care spaces, staffing constraints, and supply shortages in order to increase their overall capacity.

The emergency underlined all the existing structural, technological and organizational challenges of worn-out and obsolete hospitals. In fact, they were seen to undermine resiliency and efficiency in tackling rapid epidemiological, economic and social changes that was necessary for addressing the COVID-19 surge. In addition, starting in the short term, healthcare systems will face two collateral issues: the growing delay of ordinary healthcare procedures (i.e. delay in cancer procedures, operations, etc.) and the physical and mental stress caused by the critical situation to healthcare workforce (VV.AA., 2020; Barach *et al.*, 2020).

In order to overcome the worldwide saturation of spaces within existing hospitals, two main strategies have been exploited:

- Starting from the example of Wuhan in China, that built an emergency hospital in 10 days, the whole world has taken the challenge to build several temporary structures to help support the great demand for beds for COVID-19 patients. Facilities designed to support the care of many patients, on a 25.000 square meters of prefabricated blocks were undertaken as the symbol of how innovation in construction field can impact on healthcare processes. Countless temporary solutions such as containers, inflatable systems, tent structures, modules, partition panels, ships have been proposed by designers around the world, such as the CURA

(Connected Units for Respiratory Ailments), the open source project by Carlo Ratti Associates (Italy) or the 68 beds and 10 ICU beds at the East Meadow in Central Park in New York City (USA);

- Another strategy regarded the transformation of non-sanitary building typologies, unused during the pandemic, such as re-tooled trade centers, airports, schools, etc. Several studies developed by designers resulted in conceptual works to convert schools or hotels into temporary healthcare spaces in 14 days or less. In addition, a taskforce set up by the American Institute of Architects (AIA, 2020) provided a planning tool to quickly identify suitable buildings for patient care. Examples can be found in the transformation of the Exhibition Center “Fiera Milano” in Milan (Italy) and ExCel Center in London (UK) and where also important transformations on HVAC systems were done; in any case, these examples have several limitations such as a limited capacity for surgery or high level diagnostics, lack of specialized support services and being distant from the core hospital.

The challenge of healthcare facilities

While outside the hospital temporary structures emerged, within the existing facilities the healthcare organizations had to deal with two emerging issues:

- Treating patients with severe symptoms while reducing the spread of the virus among users and medical staff. In order to deal with the first aspect, there was a rapid conversion of different facilities such as hotels, trade centers, airports, etc. into new hospital spaces, revealing a series of operational and safety difficulties that can be summarized in the structural impossibility to separate a critical care component (such as ICUs) from the rest of the hospital. Therefore, a large part of the COVID-19 areas have been designed in proximity with ad-hoc and extremely varied solutions according to the needs of the hospital, department or ward. The lack of a common comprehensive strategy is not only linked to the complexity of the emergency, but especially to the high complexity and highly variable hospital infrastructures. In fact, in terms of dimensions, number of users and volume of activities, the hospital is more similar to a city within a city characterized by stratifications of service networks distributed in indoor and outdoor. The general state of obsolescence and rigidity of healthcare has greatly contributed to the management and organizational challenges of this particular pandemic in several countries. Hospitals were forced to adopt several cross-cutting strategies including the creation of:

- Creating dedicated spaces for donning and doffing of personal protective equipment (PPE) decontamination areas for healthcare workers; new spaces with prefabricated technologies;
- Buffer areas between wards, the division between contaminated and non-contaminated areas, the transformation of acute care spaces (i.e. already equipped with advanced systems such suction, oxygen, negative pressure, etc.) starting from operating theatres;
- Core and shell empty environments at disposal (so-called “lung” spaces) to be equipped for emergencies or also unused area, gyms, car parks or congress centers;
- The other challenge faced by hospitals is the virus containment. The lack of validated data and evidence-based protocols forced each hospital to develop ad hoc solutions sometimes based on models of prior epidemics caused by viruses such as SARS in 2003 and Ebola in 2012, or bacterial epidemics such as Tuberculosis. Coping with these highly contagious episodes required applying strict infection control protocols in the distribution areas, at key thresholds such as entrances to better manage the flows of medical staff who can infect themselves, and as a consequence other workers and users.

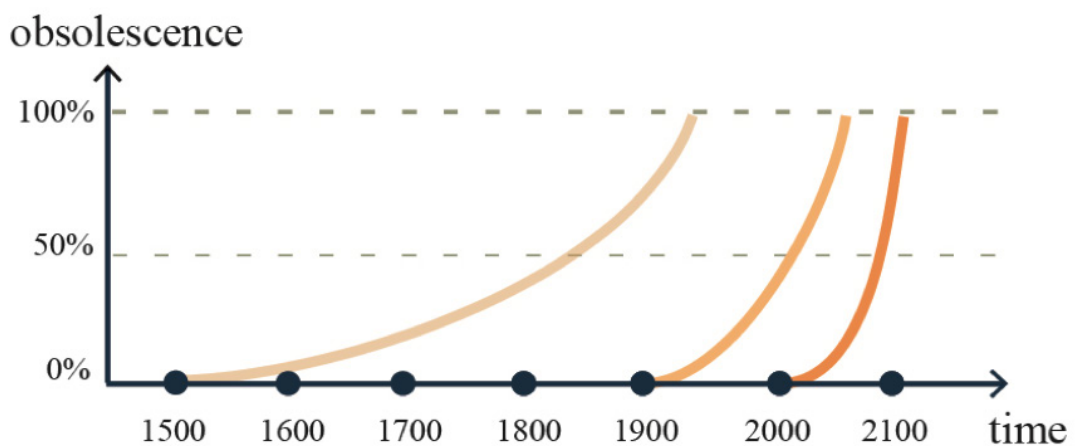


Figure 1. Hospitals obsolescence during the centuries.

Source. Capolongo (2012)

A Decalogue for resilient hospitals

Starting from these general considerations, the paper provide insights for the future healthcare architecture in terms of a Decalogue of strategies for new perspectives in healthcare design. This work was promoted by the Department of Architecture, Built environment and Construction engineering of Politecnico di Milano (Italy) as an observatory on the best practices for resilient healthcare facilities.

This approach will support in responding to the needs for critical care capacity applicable both to new hospitals and to the refurbishment of existing hospitals to provide a clearer and more coordinated response for future healthcare emergencies (Capolongo ., 2020).

The architectures for health of the future should be more and more resilient to changes and capable of protecting different users' health and tackling the transforming social, environmental, economic, and epidemiological needs of the context in which they are located. In the previous months, a comparative matrix has been structured in order to merge the strategies derived from the data and case studies collection. Two areas of improvement have been investigated:

- 1) strategies 1, 2, 3, 4 and 5 that can be implemented during the design phase;
- 2) strategies 6, 7, 8, 9 and 10 that can instead be achieved during the operation phase.

COVID-19 and Healthcare Facilities: a Decalogue of Design Strategies for Resilient Hospitals

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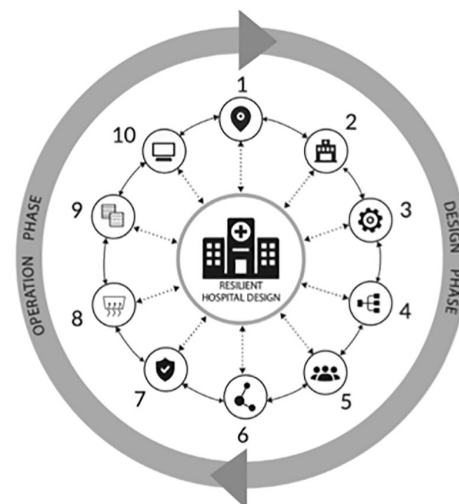
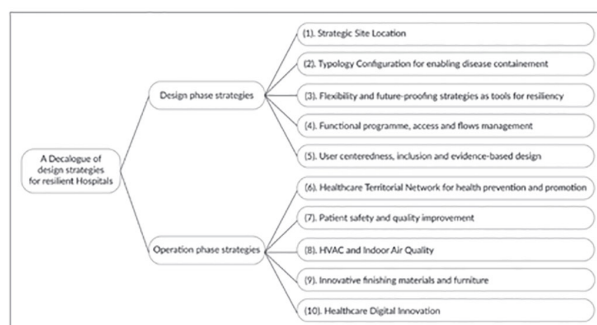


Figure 2. Outcomes of the "Decalogue for Resilient Hospitals".

Source. Capolongo et al. (2020).

1. Strategic Site Location

In the urban context, the hospital has a strategic role for different factors, such as the accommodation of a wide and diverse amount of users and visitors, the relevant building dimension and the economic supply chain. For this reason, hospitals' site selection is a crucial topic in planning decision processes that affects the social, environmental, and economic sustainability of healthcare structures and the efficiency of the service (Dell'Ovo *et al.*, 2018).

In recent years, hospital trends have highlighted the importance of localization in urban areas, however past and ongoing experiences, especially in relation to an infectious epidemic, are challenging this trend. In fact, the capability of changing functional areas or spreading them outside, has been often limited due to the lack of flexibility expansion related to the hospitals' location in dense city center. Learning from the management of previous pandemics, the localization of the post-COVID-19 hospitals to the city boundaries can guarantee both the limitation of flows outside urban areas, containing possible risks of contagion in high-density urban centers and the accessibility.

At the same time, a correct strategic location represents an opportunity for spreading in areas close to the healthcare facility. On the other hand, central areas should preferably host territorial facilities able to provide: health services at the first level, prevention and health promotion at the neighborhood scale (Miedema *et al.*, 2019).

2. Typology Configuration for Enabling Disease Containment

Nowadays, trends on hospital's typology are mainly characterized by horizontal configurations. In emergency state, this setting ensures the possibility to organize areas without constraining the entire distribution systems (Capolongo *et al.*, 2019). In order to provide an effective emergency management, treatment areas for contaminated and infected patients to be isolated through a clear separation of flows, cross-contaminations should be avoided through the appropriate usage of dedicated vertical and horizontal connections for diverse areas. Therefore, a hybrid typological configuration, characterized by a main structure connected to support pavilions, might represent a strategic solution, with dedicated accesses for emergency and logistics vehicles.

In case of infectious emergency, the independence of the buildings or the availability of autonomous internal units, allows to separate different functional areas from the rest of the system, without ordinary activities interruption. Providing outdoor spaces around the hospital is also suitable for hosting additional temporary structures such as tents, tensile structures or other modular solutions, which guarantee the connection to the hospital and the relationship to driveways for ambulances and logistics vehicles.

3. Flexibility and Resiliency

Resilience is one of the main challenges that healthcare facilities must tackle today. In order to ensure effective emergency management, the concepts of flexibility and future-proofing represent fundamental aspects

to consider in the hospital design process, from the overall building system to the single functional and environmental units.

For example, the Rush University Medical Center in Chicago represents a case study during COVID-19 pandemic. In fact, the hospital can expand both the emergency department capacity and the number of isolation rooms when needed. During ordinary operations, this hospital has around 40 negative pressure rooms that can prevent the spread of potentially infectious diseases in the air. Each environmental unit has a negative pressure with respect to the external corridor, in order to let the air-flow from the corridor into the room, leaving the hospital through the introduction of HEPA filters.

In general, all the interventions that can guarantee a fast reconfiguration are strategic in emergencies, such as:

- The presence of available spaces, empty and support areas among different lots and departments to accommodate expansions, reconfigurations or isolation areas;
- Non-sanitary areas easily transformable and to be equipped with low investments. For instance, the underground parking of several hospital in Israel can be converted into a hospital with many beds in wartime or flexible sports facilities can be reconfigured. Therefore, these areas must be supported by direct internal connections with the rest of the hospital as well as outside for ambulances;
- Functional areas that can be easily reconverted, such as common hospital ward that are provided of the proper amount of technical installations.

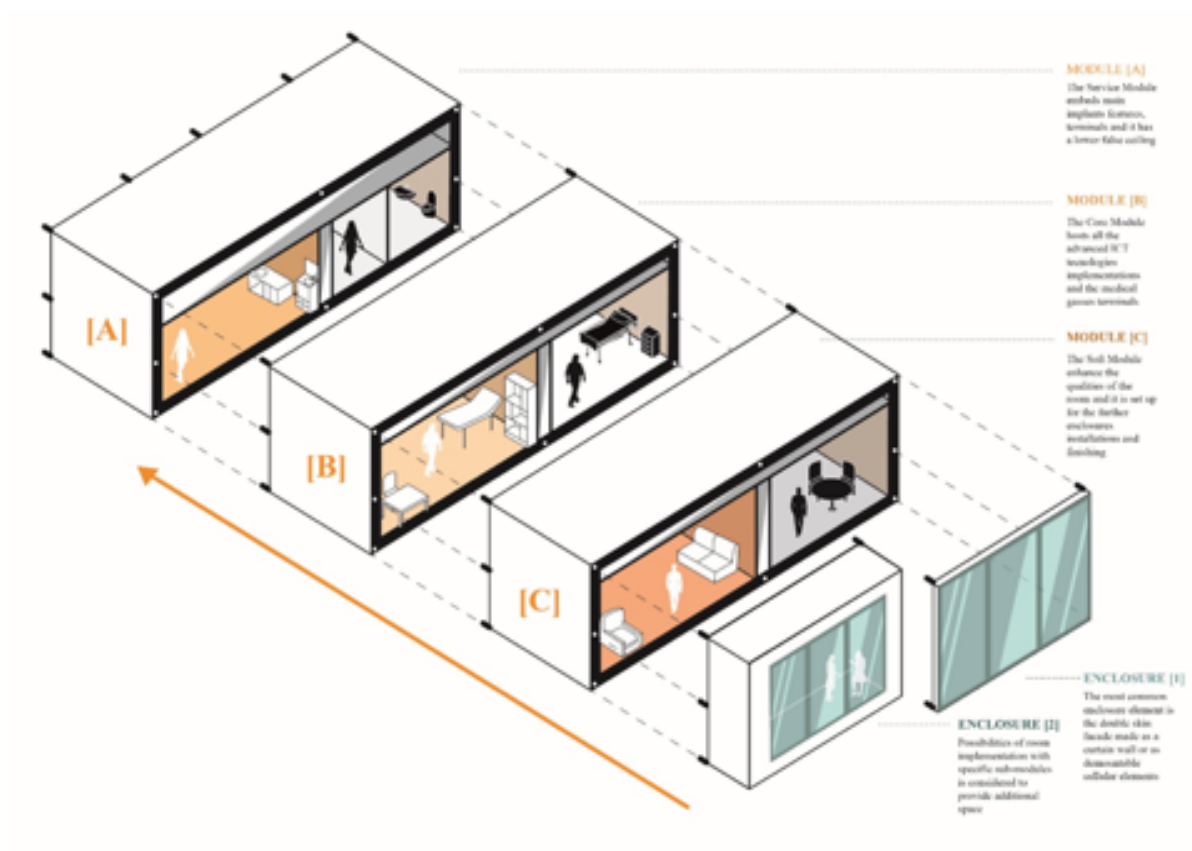


Figure 3. Open Room project developed by Alta Scuola Politecnica, broken down into its three sub-modules.

Source. Figure designed by Andrea Brambilla.

4. Functional design and Distribution system

Functional program is fundamental in such complex facilities. In case of emergency, the layout should consider some transversal issues:

- Distribution is one of the main aspects to consider within the functional design in relation to emergencies. The access for medical staff must be unique, as well as that one for visitors who are not directed to the emergency department. In case of an infectious emergency, flows that are normally differentiated (public and medical ones), must be able to be further separated, in order to divide the flows of patients with suspected or known infection by other users. In this regard, recognizable signage must effectively indicate temporary changes in hospital routes;
- The strong relation between the emergency department and infectious wards requires a fast connection for the movement of patients and hospital staff. These spaces should be localized at the same level for short and horizontal connections;

- The presence of storage areas is also required, which in case of infective emergency can host the wide amount of sanitary material, PPE and contaminated waste. There is a need of solutions for the extraordinary placement of corpses in low temperature environments, in close communication with the outdoor driveways for their transport;
- In order to decrease the risk of nosocomial infection's diffusion, all ordinary inpatient wards must maximize the number of single rooms. This can be guaranteed with a set of bed head beams and engineering plant equipment that allow to transform rooms into double rooms in case of hyper flow of patients.

In addition, a resilient hospital design must consider some organizational aspects of both high and low care areas mostly interested by the infectious emergency, such as:

- The results of ICUs as the one of the most affected, so additional filter areas are needed for the dressing/undressing of medical staff. Separated working areas from the main care area are suggested, in order to reduce the workers' exposure and the use of mobile diagnostic equipment;
- The emergency department must at the same time host patients with suspected infection and continue to manage all non-infectious cases, separating them from their entrance. Therefore, two separate entrances are recommended to distinguish sick people through dedicated triage, with separate paths and waiting and treatment spaces. External multiple decontamination areas for ambulances and areas for the preparation of pre-triage tents must be provided;
- The inpatient hotel, which usually welcomes outpatients, relatives or visitors, in emergency conditions must have a flexible configuration that allows to accommodate ordinary and additional medical staff, reducing the infectious risk for their families and ensuring them an effective rest in situations of high work stress. Similarly, it could be transformed to accommodate infectious patients of lower gravity or patient who needs of rehabilitation.

5. User Centeredness

Studies on User-Centered Design highlighted that during all the different phases of the design process, attention must be focused to the physical, psychological and social needs of all users to avoid future disabling situations generated due to COVID-19 or similar overwhelming conditions, as Mosca *et al.* (2019) stated. This is especially true in hospital environments, where aspects as accessibility, wayfinding and comfort,

directly impact on different users during emergencies; in particular, staff shows symptoms of anxiety, depression, insomnia and stress higher than normal within hospital facilities.

In this regard, during the pandemic, some designers developed recharge rooms for hospitals characterized by natural design elements that support medical workers recover from a physically and mentally taxing shift. These spaces were designed to be customized according to the users' needs, such as sounds, sights, and smells. The rooms use bringing the outdoors into built environments - to create spaces with nature out of underused hospital spaces near Intensive Care departments.

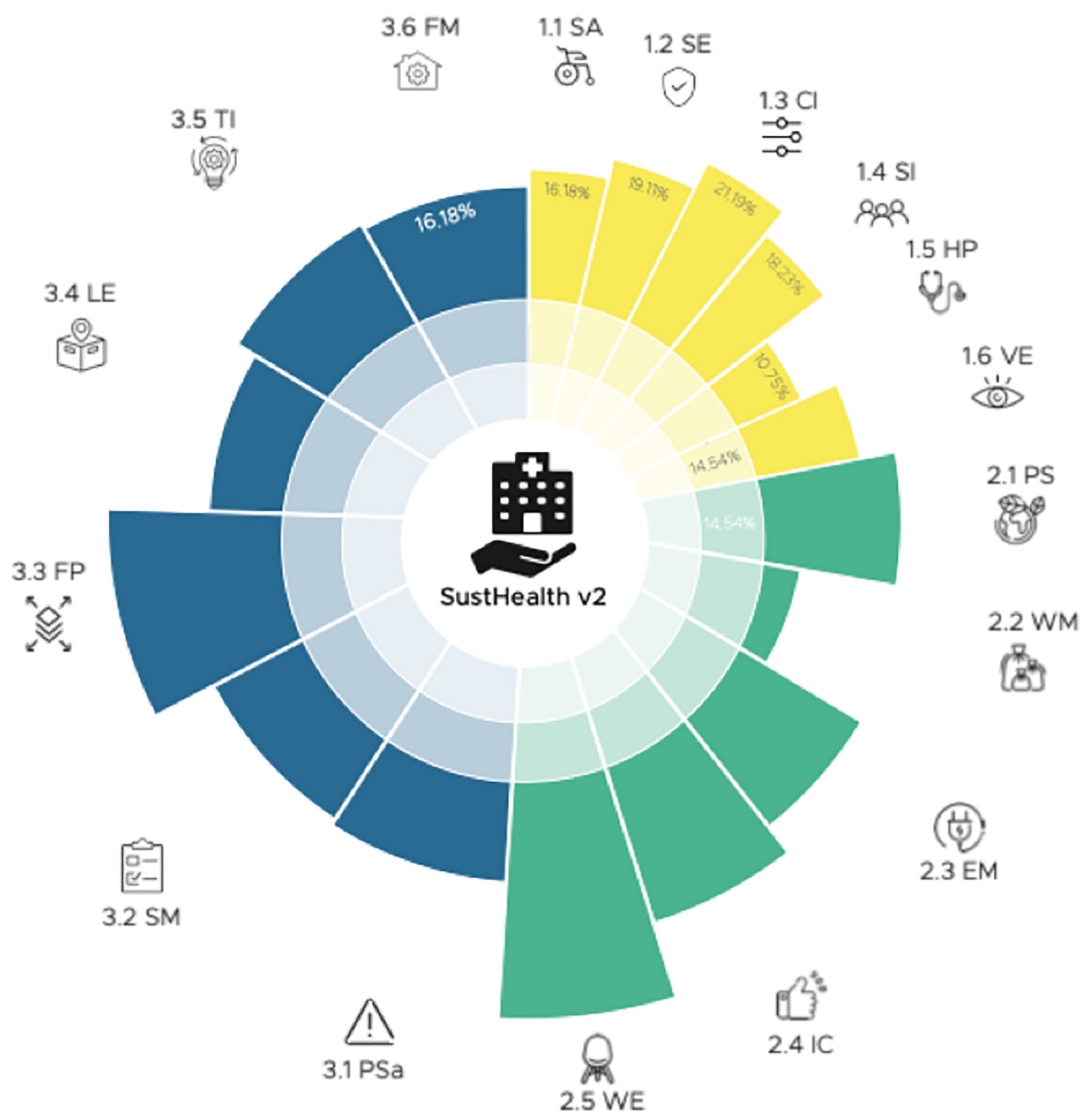


Figure 4. SUSThealth tool developed by Politecnico di Milano.

Researches, in fact, have demonstrated that looking at nature can improve recovery patient time and reduce nursing stress levels (Ulrich *et al.*, 2008; Elf *et al.*, 2020).

In addition, Evidence Based Design (EBD) studies demonstrate that the presence of spaces for the physical and psychological well-being is strategic for all users and it also positively influence the work performance of the healthcare staff. Such spaces, in fact, in case of emergency, could guarantee users environments to relax from psychological stress and daily pressures. They can be both areas inside the structure - close to the functional areas - or green areas of the hospital (i.e. garden and terraces), preferably with a variety of spaces, different seats and isolation points to ensure user's privacy.

6. Healthcare Territorial Network for Health Prevention and Promotion

The synergy between territorial services and healthcare organizations plays a crucial role for health promotion. In particular, the adoption of Hub & Spoke model could turn out particularly efficient in cases of high emergencies,

avoiding the overflow of users in the hospital thanks to health home care management or low and medium-care facilities (Mauri, 2015).

The community health centers in the territory along with the primary care services and triage activities could ensure a better management of low and medium-care services, as well as to favor the use of smart diagnostics and to support the outpatients management on the territory.

This capillary model encourages access to care for the population, reducing the patients' transfer, decreasing the overcrowding of the emergency departments, and minimizing hospital-based cross-contamination among users and healthcare staff. These healthcare facilities should be configured as integrated hub between healthcare professionals and health and social services. In addition, the use and application of healthcare devices for the smart hospital, as well as telemedicine programs, can easily support and strengthen the health network and the monitoring of the users' health status, even in the presence of healthcare emergencies.

7. Patient Safety and Quality Improvement

It is well-known that healthcare organizations regularly give rise to protocols for risk control and patient safety in hospital settings. In particular, the healthcare leadership needs to reorganize the users' behaviors and healthcare protocols in line with the best practices

for the COVID-19 control. Hospital design should give rise to physical environments that support providers to act in a professional, trustful and respectful manner for all the community.

Facility design affects how people work, and what processes, systems and technologies they will require to support the functioning of a learning work environment. It is necessary to take into consideration design strategies aimed at responding to possible emergencies and medical needs for guaranteeing patient safety. For example, among them, several healthcare facilities have included visual cues for visitors and users for highlighting the proximity of risk functional areas and infectious inpatient wards. Others have adopted protocols for bringing healthcare devices and materials, as well as the medical waste, through dedicated elevators in an attempt to minimize cross-contamination.

Moreover, for guaranteeing regular disinfection activities, some hospitals adopted spaces called “pods” for low-acuity patients. They were designed to reduce possible risk of infection by separating the patient from the equipment to be cleaned, thus reducing the possibility of contaminating them (Marsilio and Prenestini, 2020).

Many hospitals adopted strategies, such as adhesive tape on the floor, signage and signs boards on door used for annotations with special markers, intentionally positioned. Stations for accessing the PPE were provided in strategic positions, which in turn influenced the way and the place in which the hospital staff used the equipment.

Clear and immediate visual devices, wayfinding strategies and design-nudges can help to mitigate the transmission of infections by clearly defining risky areas, creating mental anchors for specific activities (Jamshidi and Pati, 2020) and consequently reducing mental fatigue and helping to align the behavior with the protocols to be followed.

8. HVAC and Indoor Air Quality

It is well-known that indoor air quality (IAQ) plays a direct or indirect leading role in prevention, especially in environments with vulnerable users. The quality of the air depends not only on the outdoor air but also on the presence of indoor sources that emit pollutants that can affect its composition (Gola *et al.*, 2019). It is therefore necessary to ensure adequate air exchanges in all the hospital settings through mechanical and, where possible, mixed ventilation.

To ensure efficient management in case of emergency, such as infectious epidemics the ventilation systems have a strategic role, but its functioning must be able to respond to different healthcare needs, in all the

conditions and especially in emergencies where air could be a possible means of infection diffusions (Correia *et al.*, 2020; Li *et al.*, 2007). The heating, ventilation, and air conditioning (HVAC) must be flexible and their operation must be able to be modified in terms of the air used, from recirculation to all-air systems, and pressure, from positive to negative. In addition, their regular and constant maintenance, cleaning and disinfection also become strategic through the use of innovative materials. As a consequence, new generation systems must be designed with solutions that guarantee easy inspection, and the possibility of intervention (Joppolo and Romano, 2017).

9. Finishing Materials and Furniture

Healthcare Acquired Infections (HAIs) have a relevant role in the light of the management of the COVID pandemic. In synergy with monitoring and risk management activities, it is necessary to use high-performance, long-lasting and easy to clean materials in relation to the medical needs. In particular, innovative materials must be introduced to reduce the bacterial (and viral) load on the finishing surfaces (van Doremalen *et al.*, 2020) among which also eco-active ones and photocatalytic paints, as well as characterized by high performances and flexibility-in-use. It is necessary to investigate and take into consideration, also, solutions used in emergency contexts such as, for example, washable textile materials. Their application could be extended in many healthcare areas for social distancing, and which in case of need can be easily clean and replaced, and/or removed for guaranteeing the adaptability and resilience of the spaces (Zanelli *et al.*, 2020).

Together with the application of best practices of ventilation, the cleaning products must be defined

in relation to the furnishings and finishing materials considering each surface characteristics (Kampf *et al.*, 2020). In addition, several detergents have chemical compositions that kill the bacterial and antiviral load but, at the same time, they can present volatile organic compounds (VOCs) toxic to humans, and require paying attention to environmental sustainability.

10. Healthcare Digital Innovation

The new digital technologies can support the patients' treatment and care processes both in the hospital and on the territorial healthcare network, also in case of emergency. In fact, the continuous control of the health status and vital parameters through IT systems, such as smartphone or wearable devices, can guarantee a better management of hospitalization, and consequently an efficient organization of hospital settings.

Moreover, the modular planning and forecasting of the occupation of ICUs and ordinary beds, both in the same hospital and within the territorial hospital network, can support the possible directing of the ambulances to the more appropriate healthcare facility. In addition, the constant monitoring and technological advancement allows the use of some electro-medical equipment remotely, decreasing the contacts between (infected) patients and hospital staff, and guaranteeing an overall control and a more efficient use of the resources.

As well as the use of sensors and devices through the Internet of Things allows the hospital to guarantee an experience for each user, monitoring the degree of comfort and satisfaction.

In the close future all medical procedures that can be treated without physical presence, will be carried out through digital systems and healthcare organizations will also be able to better manage patients' clinical information and therefore users at risk will be more protected through tailored medical paths. Nowadays more than ever, digital system should be integrated with structural innovations that would enable access to health services worldwide and in different condition guaranteeing safety and security to patients and health workers.

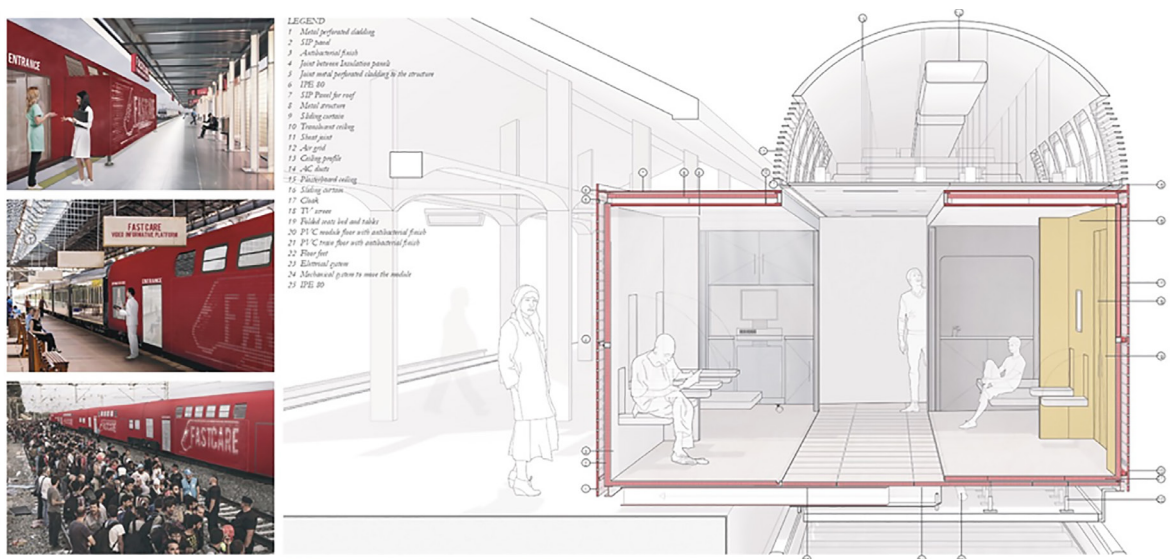


Figure 5. Fast care, designed by Politecnico di Milano.

Future perspectives

COVID-19 pandemic has accelerated all those processes of innovation already activated. In the same way, the hospital, which in the face of this gradual process of dematerialization and relocation of 'softer' clinical diagnostic activities, reaffirms itself as a center of the highest specialty for the treatment and care of acute patients, for high-level clinical and experimental research, for diagnostics and more complex operations.

For example, antimicrobial resistance has been recently highlighted by several institutions due to the mis-use and/or overuse of antibiotics in human medicine, specific facilities for infectious diseases treatment and containments emerged (Lanbeck *et al.*, 2016). The pandemic highlighted that a post-antibiotic era can be very difficult to tackle and the role of built environment is of increasing importance. Indeed, due to the high diffusion and infectious rates of COVID and in the waiting time to reliable drugs or specific vaccinations, the pandemic containment has been mainly performed through physical and social tool such as the confinement practices and hand washing prescriptions. Indeed, the hospital will have to increasingly reflect on its role of health promotion and protection, especially towards the most fragile users.

Considering all those issues, it is essential to promote multidisciplinary actions and monitoring programs for quality improvement through evidence-based evaluation tools in order to develop a new design for the hospital of the near future. Further multidisciplinary researches is encouraged to validate the presented strategies in case studies and in empirical settings.

The Decalogue of strategies aims to briefly indicate the key strategies to be considered in the design of new resilient hospitals and in the re-functionalization of existing structures.

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References

AIA. **AIA's COVID-19 Task Force Creates Design Guide to Retrofit Buildings for Alternative Care.** ArchDaily, 2020. Available from: <https://www.archdaily.com/937331/aias-covid-19-task-force-creates-design-guide-to-retrofit-buildingsfor-alternative-care> [Accessed: 21st June 2020]

BARACH, P., FISHER, S.D., ADAMS, M.J., *et al.* **Disruption of healthcare: Will the COVID pandemic worsen non-COVID outcomes and disease outbreaks?** Progress in Pediatric Cardiology. 2020; 101254. doi:10.1016/j.ppedcard.2020.101254

CAPOLONGO, S., COCINA, G., PERETTI, G., POLLO, R., GOLA, M. **Horizontality and verticality in architectures for health.** TECHNE - Journal of Technology for Architecture and Environment. 2019;17: 152–160. Available from: doi:10.13128/Techne-24028

CAPOLONGO, S., GOLA, M., BRAMBILLA, A., MORGANTI, A., MOSCA, E.I., BARACH, P. **COVID-19 and healthcare facilities: A decalogue of design strategies for resilient hospitals.** Acta Biomedica 2020; 91:50-60. Doi:10.23750/abm.v91i9-S.10117

Capolongo Stefano. *Architecture for Flexibility in Healthcare*. Milan, Franco Angeli, 2012.

CORREIA, G., RODRIGUES, L., GAMEIRO DA SILVA, M., GONÇALVES, T. **Airborne route and bad use of ventilation systems as nonnegligible factors in SARS-CoV-2 transmission.** Medical Hypotheses. 2020;141: 109781. doi:10.1016/j.mehy.2020.109781

DELL'OVO, M., CAPOLONGO, S., OPPIO, A. **Combining spatial analysis with MCDA for the siting of healthcare facilities.** Land Use Policy. 2018;76: 634–644. Available from: doi:10.1016/j.landusepol.2018.02.044

ELF, M., ANÅKER, A., MARCHESCHI, E., SIGURJÓNSSON, Á., ULRICH, R.S. **The built environment and its impact on health outcomes and experiences of patients, significant others and staff—A protocol for a systematic review.** Nursing Open. 2020; doi:10.1002/nop2.452

GOLA, M., SETTIMO, G., CAPOLONGO, S. **Indoor Air Quality in Inpatient Environments: A Systematic Review on Factors that Influence Chemical Pollution in Inpatient Wards.** Journal of Healthcare Engineering. 2019;2019: 1–20. doi:10.1155/2019/8358306

JAMSHIDI, S., PATI, D. **A Narrative Review of Theories of Wayfinding Within the Interior Environment.** HERD: Health Environments Research & Design Journal. 2020; 193758672093227. doi:10.1177/1937586720932276

JOPPOLO, C.M., ROMANO, F. **HVAC System Design in Healthcare Facilities and Control of Aerosol Contaminants: Issues, Tools, and Experiments.** In: Capolongo S, Settimo G, Gola M (eds.) *Indoor Air Quality in Healthcare Facilities*. Cham: Springer International Publishing; 2017. p. 83–94. doi:10.1007/978-3-319-49160-8_8

KAMPF, G., TODT, D., PFAENDER, S., STEINMANN, E. **Persistence of coronaviruses on inanimate surfaces and their inactivation with biocidal agents.** Journal of Hospital Infection. 2020;104(3): 246–251. doi:10.1016/j.jhin.2020.01.022

LANBECK, P., RAGNARSON TENNVALL, G., RESMAN, F. **A cost analysis of introducing an infectious disease specialist-guided antimicrobial stewardship in an area with relatively low prevalence of antimicrobial resistance.** BMC Health Services Research. 2016;16(1): 311. doi:10.1186/s12913-016-1565-5

LI, Y., LEUNG, G.M., TANG, J.W., *et al.* **Role of ventilation in airborne transmission of infectious agents in the built environment? A multidisciplinary systematic review.** Indoor Air. 2007;17(1): 2–18. doi:10.1111/j.1600-0668.2006.00445.x

MARSILIO, M., PRENESTINI, A. **Making it happen: Challenges and transformations in health care processes, people management, and decision-making.** Health Services Management Research. 2020;33(2): 53–54. doi:10.1177/0951484820906314

MAURI, M. **The future of the hospital and the structures of the NHS.** TECHNE - Journal of Technology for Architecture and Environment. 2015; 27–34. doi:10.13128/Techne-16100

MIEDEMA, E., LINDAHL, G., ELF, M. **Conceptualizing Health Promotion in Relation to Outpatient Healthcare Building proposed in the commentary Design: A Scoping Review.** HERD: Health Environments Research & Design Journal. 2019; 12(1): 69–86. Available from: doi:10.1177/1937586718796651

MOSCA, E.I., HERSENS, J., REBECCHI, A., CAPOLONGO, S. **Inspiring architects in the application of design for all: knowledge transfer methods and tools.** Journal of Accessibility and Design for All. 2019;9(1). doi:10.17411/jacces.v9i1.147

ULRICH, R.S., ZIMRING, C., ZHU, X., *et al.* **A Review of the Research Literature on Evidence-Based Healthcare Design.** HERD: Health Environments Research & Design Journal. 2008;1(3): 61–125. doi:10.1177/193758670800100306

VAN DOREMALEN, N., BUSHMAKER, T., MORRIS, D.H., *et al.* **Aerosol and Surface Stability of SARS-CoV-2 as Compared with SARS-CoV-1.** New England Journal of Medicine. 2020; 382(16): 1564–1567. doi:10.1056/NEJMc2004973

VV.AA. **Impact of the Covid-19 pandemic on healthcare systems?**
Deloitte France, 2020. Available from: <https://www2.deloitte.com/fr/fr/pages/covid-insights/articles/impact-covid19-healthcare-systems.html>
[Accessed: 18th June 2020]

WHO. **Hospital Readiness Checklist for COVID-19**. World Health Organization Regional Office, 2020. Available from: https://www.euro.who.int/__data/assets/pdf_file/0010/430210/Hospital-Readiness-Checklist.pdf

ZANELLI, A., CAMPIOLI, A., MONTICELLI, C., VISCUSO, S., GIABARDO, G.
Novel Textile-Based Solutions of Emergency Shelters: Case Studies and Field Tests of S(P)EEDKITS Project. In: Aste N, Della Torre S, Talamo C, Adhikari RS, Rossi C (eds.) Innovative Models for Sustainable Development in Emerging African Countries. Cham: Springer International Publishing; 2020. p. 111–122. doi:10.1007/978-3-030-33323-2_10

Healthcare closer to people: A qualitative study of a Swedish reform on healthcare delivery

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Abstract

The purpose of this paper is to explore the considerations and potential effects of moving healthcare closer to people by drawing from the planning process of a regional initiative to establish two local hospitals in Sweden. Three main dimensions were identified: (i) closeness; (ii) collaboration, (iii) citizen and patient involvement. The interconnectedness among the three main dimensions was found to be important for understanding the new landscape resulting of the Swedish reform of “healthcare closer to people.” An inductive approach was applied utilizing the Gioia methodology and member-validation, this guided the qualitative analysis of, mainly, focus group and individual interviews. The paper states that a multiplicity of perspectives needs to be taken into consideration for successful reforms within contemporary healthcare and hereby it also aim to contribute to the discussion on the reform.

Keywords

Public sector reforms, Healthcare, Patient engagement, Decentralization, Patient centeredness, Sweden,

Introduction

In the decentralized Swedish healthcare system, the national government is responsible to legislate and to establish principles and guidelines (SKR, 2018). Like in other countries (Ferrario and Zanardi, 2011), the national level may to certain extent equalize geographical differences. The 21 regions are responsible for providing healthcare, most commonly through primary care and specialized care at often large hospitals (SFS, 2017). Within the regional healthcare systems and hospitals, separate units have been increasingly decentralized, including also planning and accountability, over the last decades (Andersson and Liff, 2012). Since a reform in 1992, the 290 municipalities are responsible for providing care at home or at special accommodations with added service or support, not least for older patients (SOU, 2016). Despite relatively good clinical results (Coleman *et al.*, 2011; MacDorman *et al.*, 2014), lacking patient involvement is one of the challenges for the Swedish healthcare system (Vårdanalys, 2014) as is fragmentation (Eriksson *et al.*, 2020) and escalating costs (SOU, 2016). These challenges call for a transformation of the system, not least by moving healthcare closer to people.

The national inquiry *Efficient Healthcare* (SOU, 2016) problematizes the Swedish healthcare system's focus on large hospitals. As an extension, another inquiry (SOU, 2019a) was launched, putting focus on the need to move resources from large hospitals (often distant in the sparsely populated parts of Sweden) to the geographically closer primary care and care for which the municipalities are responsible, but also to increase accessibility by, for example, improve use of information technology. Digitalization is also argued to enable task-shifting from staff to patients (Nordgren, 2009; SKR, 2019a), which also is likely to move healthcare from large hospitals to local level, even to patients' homes (SKR, 2019b). The direction of future healthcare has also been suggested to increase focus on health promotion and disease prevention, rather than today's focus on curing (mainly acute, time-critical) diseases at large, and expensive, hospitals (SOU, 2016, 2019a).

The need to reform the Swedish healthcare system should be understood in light also of the aging population structure (Socialstyrelsen, 2013) entailing that more people are living with multiple and chronic diseases today which, in turn, has brought to surface severe coordination problems among the various care providers these patients are likely to have in a decentralized system (Eriksson *et al.*, 2020). At the same time, policy in the healthcare system, the caring, is changing towards person-centered care, entailing increased focus on patient integrity, individual control and safety as well as lowering barriers between the healthcare system and patients (Alharbi *et al.*, 2012; Morgan and Yoder, 2012). Naturally, such policy will have consequences for both healthcare processes and the

location and function of facilities used. All of the above reports, inquiries and trends are collectively supporting the current development of the Swedish reform of “healthcare closer to people.” It is an ongoing work with an aim to restructure the healthcare in Sweden with an emphasis on care responding quicker to peoples need on a local level and at the same time allow for centralized specialization concerning more complex treatments. It also involves integration of regional and municipal care, home care and addressing issues related to the demographic situation, i.e. an ageing population. This development is a both a condition and a backdrop to the present case of the paper.

In parallel to the above-mentioned reforms, there is a booming construction of new healthcare facilities in Sweden. Because of an ageing building stock, new technologies, and new environmental requirements, Sweden invests approximately 10 billion euros over the years 2010-2020 (SKR, 2020). With the regionalized responsibilities each region updates and refurbish their healthcare building stock, mostly independently of each other. In urban areas the hospital areas are also reconceptualized as a part of the urban grid rather than an enclosed area for staff and patients only. Added to this should also be all the future adaptations of homes and public buildings that will be the result of the work concerning close care

In the regional context, decentralization of resources from large hospitals to smaller hospitals, focusing on local context, is important in the current transformation as it is perceived to increase efficiency, accessibility, equality and patient-centeredness (VGR, 2017). In light of the previous paragraph, this and similar reforms need to be understood as embeddedness in social context characterized by a multiplicity of perspectives and overlapping discourses that reveal that achieving wanted outcomes by bringing healthcare closer to people is not a matter of course. The purpose of this paper is to contribute with knowledge that can be used to increase understanding of the process of establishing local hospitals, healthcare systems and, more generally, decentralized public services.

Literature review

Decentralization

The last decades, the development in many western countries has been towards decentralization of public healthcare resources and authority (Anton *et al.*, 2014; Magnussen *et al.*, 2007; Saltman, 2008). The objective being to achieve efficiency and connect to local contexts. Definition of decentralization is not a matter of course, not least because it may be differently defined within the overlapping fields of management studies,

organizational theory, public administration, and political science (Dubois and Fattore, 2009; Park, 2013; Pollitt, 2005). However, a commonality is that decentralization tends to focus on either spatial dimensions or organizational dimensions (Peckham *et al.*, 2008). Influences from private sector the last decades have reinforced decentralization by moving resources from central to regional/local governments, focusing on facilities' local contexts rather than large and centralized institutions (Alonso *et al.*, 2015; Pettersen, 2001) and by promoting decision-making and accountability at lower levels within public organizations (Mattei, 2006; Fransson and Quist, 2014). Some of the benefits of decentralization include increased democracy, accessibility, innovation, and efficiency (Madon *et al.*, 2010; Osborne and Gaebler, 1992; Peckham *et al.*, 2008; Saltman *et al.*, 2006). In a healthcare context it is argued that the alignment with the local community increases ease and flexibility in designing and improving services as well as being a prerequisite in addressing health promotion and disease prevention (Heaney *et al.*, 2006; Park *et al.*, 2013). The arguments against decentralization in healthcare include that volumes may be too small to develop knowledge and skills of certain illnesses which may lead to poor clinical quality (Learn and Bach, 2010; Wouters *et al.*, 2009), inefficiency, and costly services (Banzon and Mailfert, 2018). Contrary, centralization to, for instance, large hospitals would guarantee enough volumes to carry out complex procedures (Versteeg *et al.*, 2018), which in turn would justify investments in top-of-the-line technology and enable research to be conducted (Gatta *et al.*, 2017; Weitz *et al.*, 2004). Indeed, it is argued that re-centralization is occurring in some healthcare systems (Gauld, 2012; Mauro *et al.*, 2017), including those in the present paper's neighboring countries of Denmark (Christiansen and Vrangbæk, 2018) and Norway (Adam *et al.*, 2019).

Multiplicity of logics in healthcare

It is important to note that official reports (e.g. Socialstyrelsen, 2003) that have emphasized healthcare closer to people previously to the aforementioned, already noted that these were "not new at all but rather the same principles that had been suggested [...] in the early 1970s" (Anell *et al.*, 2019, p. 110). If this reform is not new, how come healthcare has still not established itself according to these principles or moved closer to people?

One answer may be the complexity of healthcare organizations and systems (Batalden and Davidoff, 2007; Berwick, 2008). The presence of a multiplicity of professions housing a variety of knowledge interests from various disciplines (Bergman *et al.*, 2015) complicates matters. Mintzberg (2017) identified different perspectives in healthcare that need to be

united when changing healthcare organization: care and cure, referring to the nursing and medical professions; control, executed by managers; and community which is constituted by politicians and citizens. In a broader level of abstraction, the traditional discourse (Foucault, 1993) of medicine which regulates the role-casting between staff and patients (Gaventa and Cornwall, 2007) has been complemented by a managerial discourse emphasizing profitability and the active healthcare “customer” who is making choices (Nordgren, 2009; Malmlose, 2015). The overlap of these and other discourses – each regulating what can be said and done (and not) – and the multiplicity of professional perspectives (Mintzberg, 2017) impacts how contemporary healthcare is organized and managed as well as complicates healthcare improvements because the logics may be conflicting. To complicate things further, it is suggested that healthcare should not be understood in isolation, but rather as part of a broader welfare system which entails interconnectedness with other private, public and third sector actors – and additional logics (Fransson and Quist, 2014; Osborne, 2018).

Method

Setting

The present paper draws from a local single case (Ragin and Becker, 1992) of Swedish healthcare set in the Western Region of Sweden. This region is the second largest in Sweden and inhabits 1,7 of Sweden’s 10 million inhabitants (Statistics Sweden, 2019). In this paper, we studied how officials in a project group working with the establishment of two local hospitals and other healthcare professionals, managers and politicians directly concerned by healthcare closer to people perceived key aspects of the reform. The benefit of qualitatively study one case thoroughly is to potentially generate findings that contribute to develop theory as well as sharing knowledge that may open up for future research, in other contexts (Carmona and Ezzamel, 2005).

Data collection

Data was primarily collected through two semi-structured focus group interviews (Morgan, 1996) with project group participants and six semi-structured individual interviews with other stakeholders, done by either of the paper’s authors. Both groups were considered relevant due to their engagement, insight and knowledge of the project. Additional data was also collected from the project group, including observations and notes from meetings as well as reports and other documents related to the project, often these sources of data was a point of departure for interviews. Interview topics were also retrieved from key concepts and

themes in international journals and national inquiries that the participant was asked to define and elaborate on ('local hospital', 'health promotion', 'close healthcare', etc.). Data was collected during the first phase of the project (2016–2018). From May 2019 a broader approach has been applied in the project, for example concerning citizen involvement which is further elaborated beneath.

Data collection method	Number of participants	Sex	Stakeholder
Focus group 1	4	4 female	Project group officials
Focus group 2	7	4 female/3 male	Project group officials
Interview 1	1	Female	Primary care nurse and manager
Interview 2	1	Female	Primary care nurse and manager
Interview 3	1	Male	Primary care physician and manager
Interview 4	1	Male	Hospital physician and manager
Interview 5	1	Female	Primary care physician
Interview 6	1	Female	Regional politician
TOTAL	17	12 female/5 male	

Table I. Data collection methods and participants

Data analysis

Based on an inductive coding procedure entailing a description of how coding is derived from findings (Corley and Gioia, 2004; Gioia *et al.*, 2013), the collected data was sorted into first order concepts, second order themes and aggregate dimensions. In the analysis of the first order concepts we stayed as close as possible to the interviewees' answers, such as used vocabulary, expressions etc. Here, their interpretations of aspects central in healthcare close to people was at the heart. The second order themes were constructed by us and based on similarities between first order concepts. A deviation from the procedure was done by discussing tentative second order themes with the project group members at a workshop with the purpose of letting them validate interview findings and that we had understood the context accurately as well as deepening understanding of the constructed themes (Greenwood and Levin, 2007; Lincoln and Guba, 1985). We returned to the standard procedure for the final step of developing overarching aggregate dimensions. Figure 1 illustrates the coding structure.

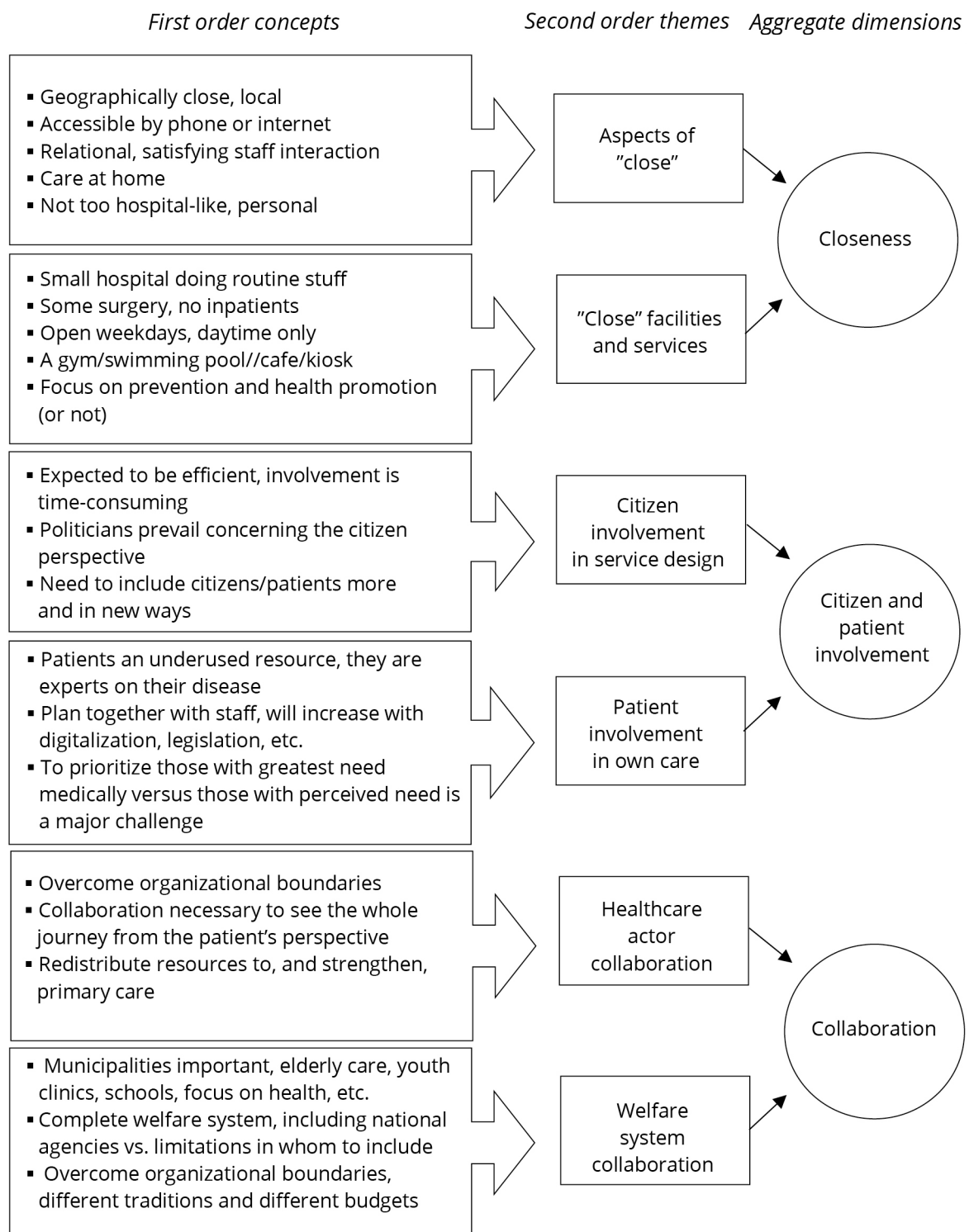


Figure 1. Coding structure

Empirical findings

In this section we will revisit the aggregate dimensions closeness, citizen and patient involvement and collaboration, presented in the previous section, as well as illustrated in figure I.

Closeness

This aggregate dimension includes aspects related to “close” as well as expectations of these “close” facilities and services.

In the former, aspects of close, geographically close services were mentioned to be important in the local community. However, one interviewee doubted the feasibility of this aspect of closeness in the present project: “If you build two local hospitals in this city, how many of the one million inhabitants will really feel that it is close?” However, others argued that geographical closeness was not exclusive to the location where one lived, but also to people’s jobs, leisure, and so forth. Despite a certain distance, “close” could be achieved through information technology in which the patient could be at home discussing issues with healthcare staff. Another aspect that also was mentioned as a notion of “close” was the relational aspect, and that closeness was experienced in the encounter with staff from the patient’s perspective. Continuity in contacts was noted as an important aspect in order to establish such relationships, e.g. to meet the same staff if possible.

For the aspect of closeness focusing on facilities and services, it was argued that such “close” facilities and services should address the care often needed by an individual or among the local population. The local hospital should be smaller but still capable of offering various specialist services and outpatient clinics, including outpatient surgery. The association embedded in the name “local hospital” related it to the notion of a full/complete “hospital” and brought with it an obligation to provide, for example, diabetes specialists, something that would also separate them from primary care. However, it would indeed be possible to do what was described as “simple stuff” at the local hospital, such as checking blood pressure.

Others thought the term “hospital” was misleading because people would expect an emergency department, something most of the interviewees would prefer not to have at local level. However, not to have inpatient clinics was something that many interviewees considered as relevant as opening hours would be restricted to weekdays and daytime. “Close facilities” would entail a natural meeting place in the local context that offered “a more holistic building in which other aspects [than healthcare] was integrated”, for example training and meditation for staff and patients,

daily activities for disabled and elderly, a gym or a café. Similarly, others suggested they would welcome a less “hospital-like” facility, a design with less of institutional character than common healthcare facilities.

As interviewees discussed what offerings the local care facility should have, many differing opinions about preventive care emerged. There were just as many of the interviewees that thought health promotion would be a particularly important issue to address for the local hospitals, as those rejecting the idea. Among the former, it was argued that healthcare needed to address the growing problems with obesity, smoking habits, and other life-style related problems. It was argued by the interviewees that this should be the local hospital's tasks not least because health and prevention was particularly important for already sick patients in order to prevent them from getting worse. The opponents commented that it was not the task for a hospital – large or small – but primary care and municipalities to inform citizens about health. Others argued that at the end of the day, this was the responsibility of citizens themselves, and that healthcare should mainly offer information for people to act upon. Moreover, there was no time to work with prevention and promotion since hospitals were not given any money for working with these issues: “You don't get any compensation for preventing disease.” One interviewee was critical of this logic of medicine in which “to save someone” was more important than to prevent disease. Consequently, it was argued, resources in healthcare are distributed in accordance with this medical logic.

Citizen and patient involvement

The discussion of this aggregate dimension concerns citizen involvement in designing healthcare services as well as patient involvement in their own care.

With regard to citizen involvement, there was frustration from some of the project members who wanted to involve citizens in the discussions of the new local hospitals, but who had been informed that the politicians wanted to do that themselves. This caused worry because the experience was that “they [the politicians] talk in terms of numbers and figures” and that citizens would not be allowed to participate in genuine decision-making. A politician confirmed this situation by stating that initially all politicians wanted to involve citizens. However, instead they had meetings with city district officials, and members of the project group of the new hospitals. Citizens were not represented at these meetings. Citizen involvement in this project was mainly a “paper product” one interviewee said. Despite the initial clear ambition from politicians – “They are elected by the people, so they argue that they represent people in a way” as mentioned by one interviewee – it was important to involve patients

because they, as sick citizens, could have important perspectives that the elected politicians did not have. However, because they were allowed to involve neither citizens nor patients, it was as if the politicians “insinuate that citizens and patients in some way would be a barrier or obstacle in our process [...] we’re supposed to be so darn efficient so there’s no time to involve them [citizens and patients]”. Others agreed, meaning it made it difficult to be innovative when not being allowed to involve citizens and patients and concluded “we are doing it totally wrong”. Some interviewees had prior experience of citizen dialogues when deliberating over new healthcare facilities and said that one must meet and talk to people to gain relevant information. There had been one process of citizen dialogue in the studied project, but the representativeness among the participants was questioned as well as whether the process had reached those in greatest need. A politician argued that overall, they should have done more outreach activities, focus groups and so forth with people, but it was difficult because “there is a lot of bureaucracy in this project now”.

It is also relevant to notice that the above description applies to the first phase of the project, 2016–2018. From May 2019 a broader approach to participation has been applied. However, at this stage the frame, concept and scope has been set. A situation that raises issues related to areas from local democracy to co-design not encompassed by this study.

The other aspect of involvement concerned patients in their own care and treatment. It was argued that patients were the only experts of their disease, and another interviewee said that “patients are an underused resource, easy to forget”. It was mentioned that the current trend to involve patients as part of the healthcare team for improved quality needed to be more structured and planned. Currently, it was up to each unit/staff to decide how to involve patients and a common way to do it – digital communication – was difficult because these issues were often too complex to explain in writing. In the end it took more time than it saved. Today’s information society, where patients are well-informed and have the ability to read up on diagnosis, treatments etc., the requirements, demands and expectations are different than before information and communication technologies became commonplace was a reflection from the interviewees. It was also argued that new legislation would increase patient involvement, for instance when patients were being discharged from hospital, staff from hospital care, primary care and municipality had to jointly plan follow up or continuing home treatment with the patient and their relatives. However, the patients themselves were also variously “good” at getting involved, and often the strong-voiced were prioritized, contributing to a situation described by one of the interviewees; “we often forego those that really are very sick for the benefit of persons that suffer from other reasons”.

Collaboration

This dimension is divided into collaboration between traditional healthcare actors and collaboration among actors in the broader welfare system.

It was commonly assumed that it was a “healthcare-closer-to-people-system” that was supposed to be built. “Today we work as isolated islands”, as one interviewee said. A reason to create a system based on the concept “close” was to avoid that patients would travel long distances to seek care at large specialized hospitals. Such a system would enable different competences and functions to be “close” to people. It was argued that geographically, such services could be distributed, but that it needed to be well-established and have smooth ways of working so that the patient “nevertheless perceives some type of closeness”. Overcoming organizational boundaries was crucial but a major challenge “because it is different budgets and different traditions and different with everything”. Another interviewee added that maybe there was a need to merge the budgets into one and re-organize in order to enable true collaboration.

In the interviews it was argued that better coordination and collaboration were needed and that it would benefit the patient’s coherent journey. The different systems for patient records was found to be a barrier, but also the difficulty to just being able call someone at another unit to discuss was a challenge. It was noted in the interviews that it was particularly important to strengthen the existing first-line provider, the primary care to address these issues. More care than today should be provided at primary care level rather than at specialized hospitals, and resources had to be moved from hospitals to primary care, even though this would most likely create a lot of fuss it was noted. Interviewees representing primary care agreed, they also noted that they must be financially compensated more reasonably than today. A comment that implies a challenge to, and questioning of, the internal funding system and principles in the region’s healthcare structures.

It was also argued that the future system needed to be bigger than including only the actors from the regional healthcare system. Particularly the municipalities and their care should be included. This was important because municipalities were responsible for care of elderly at home but also health information at schools. Such an expanded system was referred to as a “safety system” or “coherent system”. Others argued it was important to delimit the system because they could see no end to such a system to include almost anything, for example national insurance agency and public employment service. Others agreed saying that “systems have a tendency to swell and become very large” and that, besides “pure”

healthcare services provided by municipalities and regions, other actors could act as satellites because of their impact on the system and patients' well-being. However, it was argued that these (insurance and employment agencies, for example) could be located at the local healthcare provider once or week. The same would be the case for patient associations. Providing such surfaces for interaction between actors would be important for the new local hospitals.

Discussion

Interconnected dimensions for healthcare closer to people

In this subsection we theorize about the interconnectedness among the three constructed aggregate dimensions and its consequences for providing healthcare closer to people.

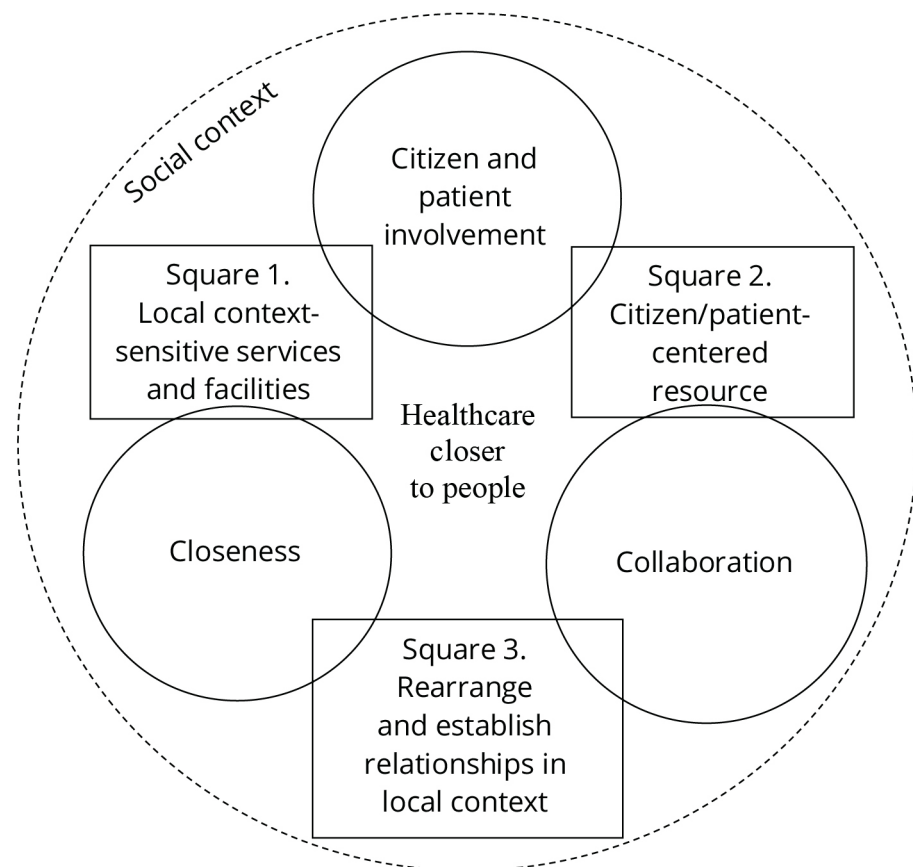


Figure II. The dimensions interconnectedness and embeddedness in social context

Square 1 shows that based on geographical closeness, citizen-focused services could be designed that are relevant for the population in the local context. For example, adapting services and information based on the needs of the population in a specific area – preferably by involving those in developing services and facilities (Jacquez *et al.*, 2013; Olsson *et al.*, 2014). Moreover, citizen-centered closeness could also be provided through digital eHealth services by enabling people to reach particular services despite long distances (Melchiorre, 2018), for example while being on vacation, etc. Closeness and patient-centeredness could also be reached by creating continuity in that patients meet the same staff as often as possible, which in turn would enable relationship-building (Morgan and Yoder, 2012). To sum up, citizen and patient involvement is a prerequisite to create an experience of closeness that also enable knowledge of collectives to be included in designing services (physical or digital), but also on an individual level for the physician or nurse to know how to encounter and interact with a specific patient.

Square 2 addresses the intra-organizational focus of Swedish healthcare, at the expense of issues between organizations (Andersson and Liff, 2012; Fransson and Quist, 2014). This is alarming, not least because many problems are not isolated healthcare, but societal matters of concern (Mintzberg, 2017). For example, the older population require healthcare providers to increase collaborations with other actors than is the case today, for example care provided by the municipalities. By reconfiguring how societal resources are integrated and put together based on the needs of people, new collaborations are likely to emerge, for instance, to provide not separate services, but a joint service through collaboration (Fransson and Quist, 2014; Eriksson *et al.*, 2020). As such, the patient is less likely to fall to the cracks between organizations and their different regulations, borders, budgets, and so forth. Taking a citizen or patient perspective is also a prerequisite for proper collaboration and the only way to visualize the patient's *whole* journey, rather than the fragments that the separate providers often see and address connected to their delivery (Fransson and Quist, 2014; Morgan and Yoder, 2012).

In square 3, collaboration is sensitive of the local context, for instance through established relationships between staff of regional and municipal care providers that may contribute to a sense of closeness for the patient facing a coherent local system (Fransson and Quist, 2014; Eriksson *et al.*, 2020). Indeed, also specialists from hospitals could visit local providers to keep the local and close attachment. Services do not need to be provided locally but could indeed be provided at other places – but this would require arrangements to be adequately arranged to retain a sense of closeness. With the introduction of a new way to provide care – as the new local hospitals in the present project – knowledge of how primary

care, local hospitals, specialized care at large hospitals and municipalities can collaborate must be brought to surface, including patient pathways and facilities needed, logistics/transportation of supplies, usability of the healthcare physical environment, workspaces and patient spaces and intangible resources such as staff's knowledge and skills. The new local hospitals can be a platform for collaboration between the local community and the health needs of the local population – and as such a contributor to social sustainability and accessibility to equal care (Jacquez *et al.*, 2013; Olsson *et al.*, 2014).

Embeddedness in social context

As indicated by the dotted circle in figure II, the reform of moving healthcare closer to people should be understood to be embedded in social context. Something that may help to understand why moving healthcare closer to people is easier said than done.

In the empirical material it is clear that there were tensions between different healthcare actors' perspectives (Mintzberg, 2017) or discourses (Foucault, 1993). It may be argued that due to ways of organizing the public in recent decades (Andersson and Liff, 2012; Fransson and Quist, 2014), management has gained power whereas a depoliticization has occurred in which politicians have lost some of its power (Mattei, 2006) – yet the latter sees themselves as representatives of the people which is manifested in the empirical material as if they either are spokespersons for the people or would like to carry out citizen involvement themselves. A study (Solli, 2017) set in the same regional context as the present case, concluded that interfaces between regional politicians and citizens existed, but that few citizens knew about these gatherings or had little interested in participating in these dialogues at all. Citizen and patient perspective have also been enhanced through the increased importance of deliberative elements of healthcare delivery and design (Culyer and Lomas, 2006), including popular concepts such as person-centeredness (Alharbi *et al.*, 2012; Morgan and Yoder, 2012) as well as underpinned by management discourse in which customer focus from private sector has spilled over on public sector (Andersson and Liff, 2012; Fransson and Quist, 2014). The healthcare professionals impact has been toned down during the management discourse (Doolin, 2002; Malmlose, 2015), but has lately gained increased attention, not least in contemporary Swedish public sector (SOU, 2019b) in which trust in professionals knowledge and skills is highlighted as important (and consequently, a desire to downplay managerial influences) – maybe this is particularly important in healthcare structures in which the medical professions have traditionally have had a strong position. Naturally, other tensions could be brought to surface, for example patient wishes (underpinned by management ideas) versus

medical professions' knowledge (Dent, 2006), the digitally enabled patient will also have a better starting point, or negotiating skill, at the same time, calling for research on professional roles – as well as the risk to empower patients as a means to cut costs (Nordgren, 2009).

Conclusion

The current establishment of two local hospitals in a Swedish healthcare context offers a possibility to study aspects of decentralization, more specifically, how healthcare services can be provided closer to people. Three overriding and interconnected dimensions have been highlighted as important to this transformation: closeness, entailing a geographical, accessible, and relational closeness from the citizen's/patient's point of view; citizen/patient involvement, entailing a need to base the starting point from the lived experience of citizens in the local context or patients living with a particular disease in designing "close" services and facilities; and collaboration, entailing that healthcare providers and other actors need to work together to provide citizen-/patient-centered care and a sense of closeness. Moreover, the paper has theorized the importance to recognize the social context in which these dimensions are embedded. Thus, reorientations of healthcare system like this and similar reforms will inevitably bring tensions between logics and discourses to surface. The interconnectedness among the dimensions and the embeddedness in social context are the present paper's theoretical contribution. The contribution to policy is to recognize the multiplicity of actors to increase the likelihood of succeeding with moving healthcare closer to people as well as in managing similar healthcare transformations. Only time will tell whether the Swedish decentralization initiatives are "more rhetorical than real", as questioned in a UK context by Peckham *et al.* (2008, p. 560). For now, the development around close care and integration between actors is lived experience in a social context. To be experienced and discussed.

The aspect of decentralization this paper focus is the concept "closeness", citizen/patient involvement as well as collaboration. It is possible that a quantitative or mixed-methods approach would have had highlighted other aspects of decentralization (such as capacity, competence and so forth).

References

Adam, A., Lindahl, G. and Leiringer, R. (2019), "The dynamic capabilities of public construction clients in the healthcare sector", *International Journal of Managing Projects in Business*, Vol. 13 No. 1, pp. 153–171.

- Alharbi, T., Ekman, I., Olsson, L., Dudas, K. and Carlström, E. (2012). "Organizational culture and the implementation of person centered care: results from a change process in Swedish hospital care", *Health Policy*, Vol. 108 No. 2–3, pp. 294–301.
- Alonso, J., Clifton, J. and Díaz-Fuentes, D. (2015), "The impact of new public management on efficiency: an analysis of Madrid's hospitals", *Health Policy*, Vol. 119 No. 3, pp. 333–340.
- Andersson, T. and Liff, R. (2012), "Multiprofessional cooperation and accountability pressures: consequences of a post-new public management concept in a new public management context", *Public Management Review*, Vol. 14 No. 6, pp. 835–855.
- Anell, A., Glenngård, A. and Merkur, S. (2012), *Health systems in transition: Sweden. Health System Review 2012*. European Observatory on Health Systems and Policies, Copenhagen.
- Anton, J, Munoz de Bustillo, R., Fernandez Macias, E. and Rivera, J. (2014), "Effects of health care decentralization in Spain from a citizens' perspective", *The European Journal of Health Economics*, Vol. 15 No. 4, pp. 411–431.
- Banzon, E. and Mailfert, M. (2018), "Overcoming public sector inefficiencies toward universal health coverage: the case for national health insurance systems in Asia and the Pacific", *Asian Development Bank*.
- Batalden, P. and Davidoff, F. (2007), "What is 'quality improvement' and how can it transform healthcare?", *Quality and Safety in Health Care*, Vol. 16 No. 1, pp. 2–3.
- Bergman, B., Hellström, A., Lifvergren, S. and Gustavsson, S. (2015), "An emerging science of improvement in health care", *Quality Engineering*, Vol. 27 No. 1, pp. 17–34.
- Berwick, D. (2008), "The science of improvement", *Journal of the American Medical Association*, Vol. 299 No. 10, pp. 1182–1184.
- Carmona, S. and Ezzamel, M. (2005), "Making a case for case study research", *The Art of Science*, Copenhagen Business Press, Copenhagen, pp. 137–152.
- Christiansen, T. and Vrangbæk, K. (2018), "Hospital centralization and performance in Denmark – ten years on", *Health Policy*, Vol. 122 No. 4, pp. 321–328.
- Coleman, M., Forman, D. and Bryant, H. (2011), "Cancer survival in Australia, Canada, Denmark, Norway, Sweden, and the UK, 1995–2007: an analysis of population-based cancer registry data", *The Lancet*, Vol. 377 No. 9760, pp. 127–138.

Corley, K. and Gioia, D. (2004), "Identity ambiguity and change in the wake of a corporate spin-off", *Administrative Science Quarterly*, Vol. 49 No. 2, pp. 173–208.

Culyer, A. and Lomas, J. (2006), "Deliberative processes and evidence-informed decision making in healthcare: do they work and how might we know?" *Evidence & Policy: A Journal of Research, Debate and Practice*, Vol. 2 No. 3, pp. 357–371.

Dent, M. (2006), "Patient choice and medicine in health care: responsabilization, governance and proto-professionalization", *Public Management Review*, Vol. 8 No. 3, pp. 449–462.

Doolin, B. (2002), "Enterprise discourse, professional identity and the organizational control of hospital clinicians", *Organization Studies*, Vol. 23 No 3, pp. 369–390.

Dubois, H. and Fattore, G. (2009), "Definitions and typologies in public administration research: the case of decentralization", *International Journal of Public Administration*, Vol. 32 No. 8, pp. 704–727.

Eriksson, E., Andersson, T., Hellström, A., Gadolin, C. and Lifvergren, S. (2020), "Collaborative public management: coordinated value propositions among public service organizations", *Public Management Review*, Vol. 22 No. 6, pp. 791–812.

Ferrario, C. and Zanardi, A. (2011), "Fiscal decentralization in the Italian NHS: what happens to interregional redistribution", *Health Policy*, Vol. 100 No. 1, pp. 71–80.

Foucault, M. (1993), *Diskursens ordning [The order of discourse]*, Brutus Östlings Symposium, Stockholm.

Fransson, M. and Quist, J. (2014), *Tjänstelogik för offentlig förvaltning [Service logic for public administration]*, Liber, Stockholm.

Gatta, G., Capocaccia, R. and Botta, L. (2017), "Burden and centralised treatment in Europe of rare tumours: results of RARECAREnet—a population-based study", *The Lancet Oncology*, Vol. 18 No. 8, pp. 1022–1039.

Gauld R. New Zealand's post-2008 health system reforms: toward re-centralization of organizational arrangements. *Health Policy* 2012;106(2):110–3.

Gaventa, J. and Cornwall, A. (2007), "Power and knowledge", in Bradbury, H. and Reason, P. (Eds), *The Sage Handbook of Action Research: Participative Inquiry and Practice*, Sage, London, pp. 172–189.

Gioia, D., Corley, K. and Hamilton, A. (2013), "Seeking qualitative rigor in inductive research: notes on the Gioia methodology", *Organizational Research Methods*, Vol. 16 No. 1, pp. 15–31.

Greenwood, D. and Levin, M. (2007), *Introduction to Action Research: Social Research for Social Change*, Sage, Thousand Oaks.

Heaney, D., Black, C., O'Donnell, C., Stark, C. and Van Teijlingen, E. (2006), "Community hospitals – the place of local service provision in a modernising NHS: an integrative thematic literature review", *BMC Public Health*, Vol. 6 No. 1, pp. 309–320.

Jacquez, F., Vaughn, L. and Wagner, E. (2013), "Youth as partners, participants or passive recipients: a review of children and adolescents in community-based participatory research (CBPR)", *American Journal of Community Psychology*, Vol. 51 No. 1–2, pp. 176–189.

Learn, P. and Bach, P. (2010), "A decade of mortality reductions in major oncologic surgery: the impact of centralization and quality improvement", *Medical Care*, Vol. 48 No. 12, pp. 1041–1049.

Lincoln, Y. and Guba, E. (1985), *Naturalistic Inquiry*, Sage, Newbury Park.

MacDorman, M., Mathews, T., Mohangoo, A. and Zeitlin, J. (2014), "International comparisons of infant mortality and related factors: United States and Europe, 2010", *National Vital Statistics Reports*, Vol. 63 No. 5, pp. 1–7.

Madon, S., Krishna, S. and Michael, E. (2010), "Health information systems, decentralisation and democratic accountability", *Public Administration and Development*, Vol. 30 No. 4, pp. 247–260.

Magnussen, J., Hagen, T. and Kaarboe, O. (2007), "Centralized or decentralized? A case study of Norwegian hospital reform", *Social Science & Medicine*, Vol. 64 No. 10, pp. 2129–2137.

Malmrose, M. (2015), "Management accounting versus medical profession discourse: hegemony in a public health care debate – a case from Denmark", *Critical Perspectives on Accounting*, Vol. 27 No. 1, pp. 144–159.

Mattei, P. (2006), "The enterprise formula, new public management and the Italian health care system: remedy or contagion?", *Public Administration*, Vol. 84 No. 4, pp. 1007–1027.

Mauro, M., Maresso, A. and Guglielmo, A. (2017), "Health decentralization at a dead-end: towards new recovery plans for Italian hospitals", *Health Policy*, Vol. 121 No. 6, pp. 582–587.

Melchiorre, M., Papa, R., Rijken, M., van Ginneken, E., Hujala, A. and Barbabella, F. (2018), "E-health in integrated care programs for people with multimorbidity in Europe: insights from the ICARE4EU project", *Health Policy*, Vol. 122 No. 1, pp. 53–63.

Mintzberg, H. (2017), *Managing the Myths of Health Care: Bridging the Separations Between Care, Cure, Control, and Community*, Berrett-Koehler Publishers.

Morgan, D. (1996), "Focus groups", *Annual Review of Sociology*, Vol. 22 No. 1, pp. 129–152.

Morgan, S. and Yoder, L. (2012), "A concept analysis of person-centered care", *Journal of Holistic Nursing*, Vol. 30 No. 1, pp. 6–15.

Nordgren, L. (2009), "Value creation in health care services—developing service productivity: experiences from Sweden", *International Journal of Public Sector Management*, Vol. 22 No. 2, pp. 114–127.

Olsson, E., Lau, M., Lifvergren, S. and Chakhunashvili, A. (2014). "Community collaboration to increase foreign-born women's participation in a cervical cancer screening program in Sweden: a quality improvement project", *International Journal for Equity in Health*, Vol. 13 No. 1, pp. 62–72.

Osborne, D. and Gaebler, T. (1992), *Reinventing Government: How the Entrepreneurial Spirit is Transforming the Public Sector*. Addison-Wesley, Reading.

Osborne, S. (2018), "From public service-dominant logic to public service logic: are public service organizations capable of co-production and value co-creation?", *Public Management Review*, Vol. 20 No. 2, pp. 225–231.

Park, S., Lee, J., Ikai, H., Otsubo, T. and Imanaka, Y. (2013), "Decentralization and centralization of healthcare resources: investigating the associations of hospital competition and number of cardiologists per hospital with mortality and resource utilization in Japan", *Health Policy*, Vol. 113 No. 1, pp. 100–109.

Peckham, S., Exworthy, M., Powell, M. and Greener, I. (2008), "Decentralizing health services in the UK: a new conceptual framework", *Public Administration*, Vol. 86 No. 2, pp. 559–580.

Pettersen, I. (2001), "Hesitation and rapid action: the new public management reforms in the Norwegian hospital sector", *Scandinavian Journal of Management*, Vol. 17 No. 1, pp. 19–39.

Pollitt, C. (2005), "Decentralization: a central concept in contemporary public management", in Ferlie, E., Lynn, L. and C. Pollitt (Eds), *The Oxford Handbook of Public Management*, Oxford University Press, Oxford, pp. 371–397.

Ragin, C. and Becker, H. (1992), *What is a Case?: Exploring the Foundations of Social Inquiry*, Cambridge university press, Cambridge.

- Saltman, R. (2008), "Decentralization, re-centralization and future European health policy", *European Journal of Public Health*, Vol. 18 No. 2, pp. 104–106.
- Saltman, R., Busse, R. and Figueras, J. (2006), *Decentralization in Healthcare: Strategies and Outcomes*, McGraw-Hill Education, New York.
- SFS (2017), *Hälso- och sjukvårdslag*, Nordstedts, Stockholm.
- SKR (2018), *Svensk sjukvård i internationell jämförelse*, SKR, Stockholm.
- SKR (2019a), *Hälso- och sjukvården år 2035*.
- SKR (2019b), *Framtidens vårdbyggnader*.
- SKR (2020), *Presentation 2020-01-22*, Association of Swedish Municipalities and Regions, SKR, Annual assembly of the Network of real estate and asset managers.
- Socialstyrelsen (2003), *Kartläggning av närsjukvård 2003*, Socialstyrelsen, Stockholm.
- Socialstyrelsen (2013), *Tillståndet och utvecklingen inom hälso- och sjukvård och socialtjänst, lägesrapport 2013*, Socialstyrelsen, Stockholm.
- Solli, R. (2017), *Utvärdering av Västra Götalandsregionens politiska organisation*, 2017.
- Statistics Sweden (2019), *Befolkningens sammansättning*.
- SOU (2016), *Effektiv vård*, Elanders, Stockholm.
- SOU (2019a), *God och nära vård*, Elanders, Stockholm.
- SOU (2019b), *Med tillit följer bättre resultat*, Elanders, Stockholm.
- Vårdanalys (2014), *Vården ur patienternas perspektiv*, TMG, Stockholm.
- Versteeg, S., Ho, V., Siesling, S. and Varkevisser, M. (2018), "Centralisation of cancer surgery and the impact on patients' travel burden", *Health Policy*, Vol. 122 No. 9, pp. 1028–1034.
- VGR (2017), "Strategi för hälso- och sjukvårdens omställning i Västra Götalandsregionen 2017.
- Weitz, J., Koch, M., Friess, H. and Büchler, M. (2004), "Impact of volume and specialization for cancer surgery", *Digestive Surgery*, Vol. 21 No. 4, pp. 253–261.
- Wouters, M., Karim-Kos, H. and le Cessie, S. (2009), "Centralization of esophageal cancer surgery: does it improve clinical outcome?", *Annals of Surgical Oncology*, Vol. 16 No. 7, pp. 1789–1798.

Spatial flexibility and extensibility in hospitals designed by João Filgueiras Lima

Author

Haroldo Pinheiro Villar de Queiroz architect

Abstract

The detailed study of multiple elements constituting a building is a constant practice in the design process employed by architect João Filgueiras Lima, aka Lelé; and the logical interaction among these components is a purpose he cultivates with obstinacy. His work, especially in hospitals, reflects a high alignment of construction systems to favor building efficiency. In this article, I comment on some of these contributions from my own point of observation, since I had the opportunity to be a witness, a collaborator, and even an associate in most part of such production.

Key words

João Filgueiras Lima, Lelé, construction system, structure, technical installations.

Structure and infrastructure

Among Le Corbusier's five points defining the new architecture, the open plan was certainly the one that enabled the greatest gain for modern and contemporary healthcare facilities (HF).

In fact, by detaching the structure from partitioning and sealing walls the longevity and efficiency of hospital buildings increased - either because it is easier to relocate internal spaces to incorporate new technologies for diagnosis and treatment, or to adjust to new medical techniques, or even to expand the building in an orderly fashion without interrupting medical activities during construction.

However, for the buildings to acquire effective flexibility, it is desirable to plan technical facilities with the purpose of offering the same freedom provided by the independent structure.

In healthcare facilities design, we observe the strategy of architects who align or associate structure and facilities - like public facilities bordering the roads that structure the city and follow them from the planned urban expansion to secondary local roads that eventually are incorporated to the project. Or just as tree roots ensure progressive and proportional stability and nourishment to the growth of leafy branches.

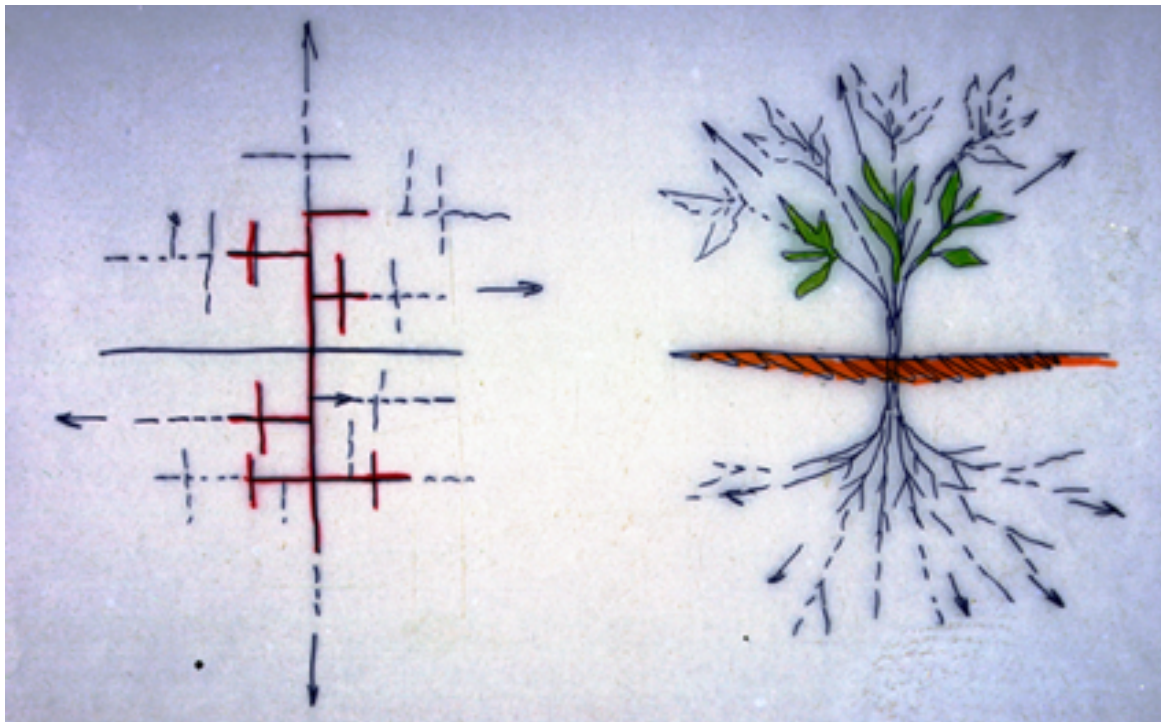


Illustration 1. Hospital expansion – structure and infrastructure; João Filgueiras Lima drawings.
Source. Author's personal archives.

Such a comment was to introduce architect João da Gama Filgueiras Lima – aka Lelé, one of the architects who most researched and carried out technical and construction solutions that ensured flexibility and expansibility to buildings serving several purposes, mainly healthcare facilities.

First professional steps, first healthcare facilities

Lelé graduated at the end of 1955 from University of Brazil National School of Architecture (now UFRJ); he perfected his design and construction skills with architect Aldary Toledo, in Rio de Janeiro, and with Oscar Niemeyer, during his experience in Brasília.

Between 1962 and 1965, he was part of the group that founded the Architecture course at the University of Brasília, initially as professor of Construction Technique, then as coordinator of the post-graduate course and executive secretary of the UnB Planning Center (CEPLAN). He developed and detailed Oscar Niemeyer's projects for the campus, such as CEPLAN and Arts Institute buildings, the Central Science Institute (ICC, or "Minhocão") and others of his own authorship, such as the Colina housing buildings and General Services blocks - always using prefabricated solutions, industrially or on site, both to Niemeyer's designs and his own.

In 1963 he traveled to Eastern Europe to study prefabrication, and in 1969 to Western Europe and the USA to perfect his hospital planning skills.

In 1968 he conceived his first hospital design: Taguatinga Regional Hospital (TRH) – prior to that he had only designed the project for the expansion of Brasília District Hospital, originally designed by Oscar Niemeyer.

For TRH, he successfully associated his prefabrication and hospital planning knowledge, combining structure and infrastructure solutions to ensure flexibility and expandability. As Lelé himself noted, "the level of industrialization established for the construction of this hospital was quite ambitious for the time" (LIMA, 2012).

The concrete "V-shaped" beams used in TRH are like those used in Disbrave automobile shops in Brasília (1965) - but here incorporating accessible ducts at the base of the beam for distribution of various wiring, instead of conduits.

The project also presents solutions for reducing energy consumption and the use of air conditioner, favoring natural alternatives for reducing the thermal load on the façades and for zenithal illumination and ventilation, as well as for landscaping integration in internal environments - solutions that have characterized his professional activity from the beginning and endured.

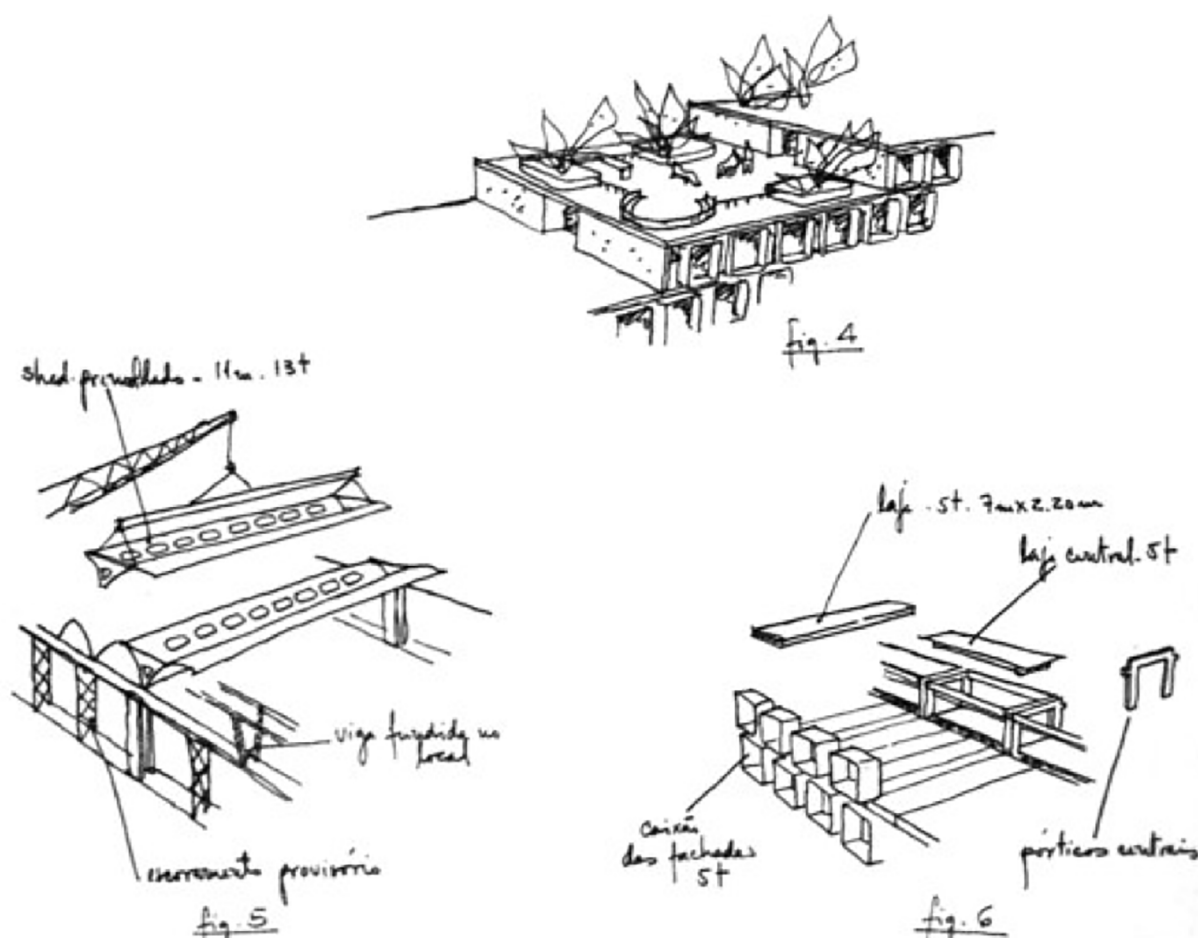


Illustration 2. A piece of the preliminary design for TRH; Illustration 4: Nurse station balconies, horizontal extensibility outlook; Illustration: Shed beams assembly, application of concrete on beams on site; Illustration 6: Vertical hospitalization block assembly – João Filgueiras Lima drawings.

Source. Author's personal archives.

Between 1969 and 1972, as a technical consultant for Distrito Federal Hospital Foundation, he coordinated the work on the TRH, excellently executed by the then young engineer Joaquim Ferreira Cambraia, and elaborated the preliminary project for Brasília Base Hospital (BBH) - a project not carried out by DF government, which chose to “promote” the District Hospital to Base Hospital (after extensions and renovations carried out by an office with no connection to the original author of the design).

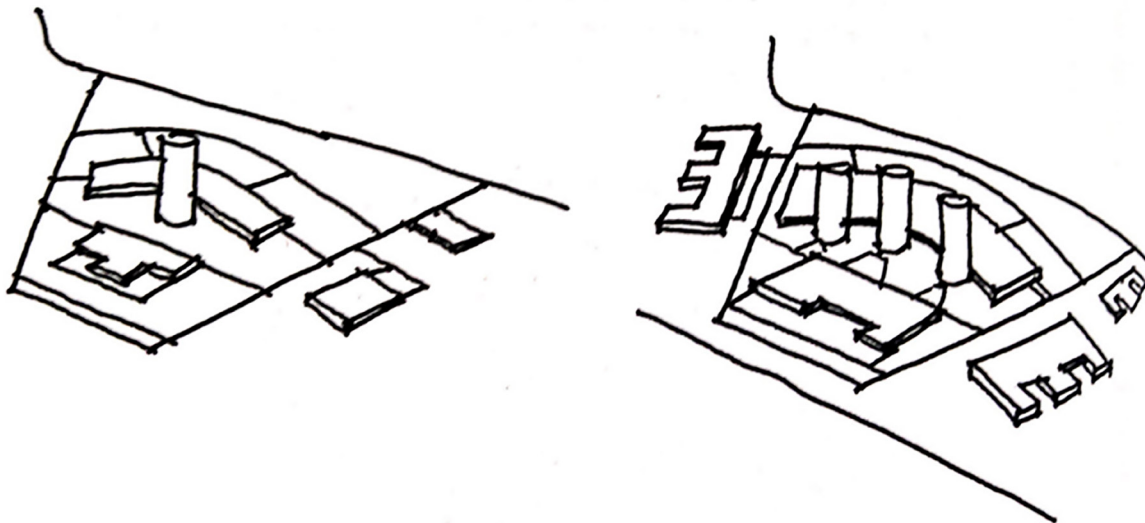


Illustration 3. A part of BBH preliminary design – on the left, 1st phase with foundation and a hospitalization tower for 600 beds; to the right, the final phase, with broaden foundation and three towers, adding up to 1,800 beds – João Filgueiras Lima drawings.

Source. Author's personal archives.

Sarah/DF

In the 1970s, Lima began a successful partnership with physician Aloysio Campos da Paz Jr., then director of Sarah Kubitschek Rehabilitation Center - initially to build the Musculoskeletal System Hospital (Sarah/DF).

At this stage, in addition to the control he always sought to exert over projects and their respective works, Lelé also oversaw the design of fixed and moving furniture for the hospital teamed up with designer Alex Chacon, from his UnB days.

Later on, during the expansion of Sarah Hospital Network, he would also carry out projects for several other components of the buildings, assuming wide and effective control over the new buildings: design, construction, settling, maintenance, post-use evaluation, updates and expansions.

After this contextualization, I shall resume my topic: if in the initial projects the structure design already incorporated the path of some technical installations, in Sarah/DF we observe a constructive system that didactically integrates structure and installations.

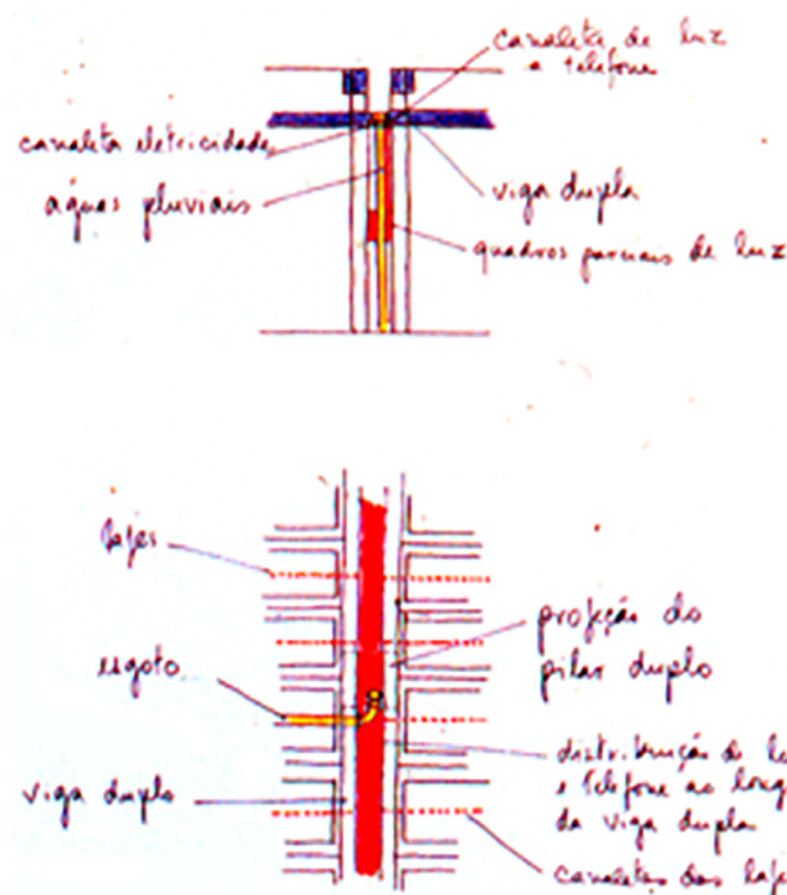


Illustration 4. Sarah/DF – basic structural system with installation traffic: on top, a cut through the double beam and double pillar view; below, ceiling plant – João Filgueiras Lima drawings.

Source. Author's personal archives.

In this hospital, prefabricated concrete slabs ribbed in a symmetrical “V” shape, connected to double orthogonal beams cast in situ and on double columns, form the structural system of the hospital's basement - this one scaled in three levels, for adaptation to the terrain: 0.00 m (from the main access); -3.65 m; and -7.30 m.

At the base of the “V” ribs, the incision is maintained for the inlay of metallic channels where the wiring runs and where light fixtures or sound and detection equipment is fixed (like the solution tested in Taguatinga Hospital).

The plumbing systems are installed in the upper bed of the ribbed slabs and double beams; and in the lower “caves” of the ribs the air conditioning ducts are fitted (where necessary).

Between the double pillars, pipes from the double beams go up or down and electricity or voice and data panels are installed, establishing the general system and ordering for the transit of various installations.



Illustration 5 and 6. Sarah/DF – ribbed slabs with ducts for wiring; double beams and columns for the passage of diverse installations.

Source. Author's personal archives.

In the vertical block, the eight towers (which serve the vertical circulation and sanitary environments) support Vierendeel beams, which, in turn, receive the same precast ribbed beams, here composing the six floors of the Admission and medical residency block.

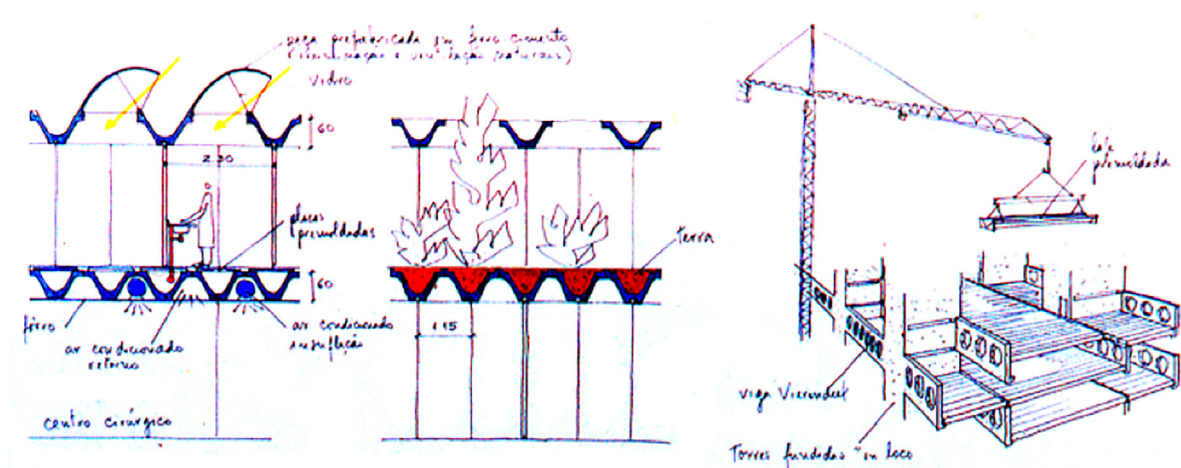


Illustration 7. A part of Sarah/DF preliminary design – on the left: V-shaped ribbed slabs – with passages to hydro sanitary installations, air conditioner, several wirings – it constitutes slabs, sheds, pergolas, hanging gardens; on the right: hospitalization vertical block assembly – João Filgueiras Lima drawings.

Source. Author's personal archives.

The vertical transit of the installations in the admission block is done by shafts organized in sets of metal cabinets located in the towers supporting the Vierendeel beams, these alternately positioned to build the nurse station balconies.

Complementing the system there are an engine room to house fan+coil air conditioner units next to the surgical center (level -3.65 m); installation galleries (level -7.30 m) under the Laboratory and Image Center; and the main gallery for distribution of installations (level -10.05 m) under the General Services block and installation centers.

The work was carried out by engineer Joaquim Cambraia, like in TRH, and with equal care. Inaugurated in 1980, it has undergone adaptations and expansions over the last 40 years, without disturbing the hospital's daily activities. This constructive solution was also used with improvements and small variations in other private and public HFs planned by João Filgueiras Lima.

Group Sarah: a network of hospitals

The plan for the expansion of Sarah Hospital Network was prepared by a broad and specialized team, whose core was formed by physician Aloysio Campos da Paz Jr., economist Eduardo de Mello Kertész and architect João Filgueiras Lima.

After Distrito Federal hospital, the next facilities would be constructed in Salvador (Bahia), São Luís (Maranhão), and Curitiba (Paraná). Designed in an innovative lightweight prefabricated system in reinforced mortar, they were supposed to be produced by Salvador's Community Equipment Factory (CEF), which was overseen by Lelé at the time.



Illustration 8. Sarah/BA (1st version) – prototype of the industrialized reinforced mortar system (in the photo, beams, shingles, sheds, and sheds covers, without the pillars), produced by CTRS for the original project.

Source. Photograph Haroldo Pinheiro. Author's personal archives.

Several problems hindered the beginning of the construction in 1988, so Salvador project was only resumed in 1991, when CEF was no longer available. Without a factory to produce such a volume of reinforced mortar precast, the team had to study different construction systems to adapt the original project.

The hospital in São Luís was adapted to precast reinforced concrete by the office of a local former collaborator, with the author's consent. The one in Salvador was adapted by my office, also with Lelé's consent; and, in this case, we opted for a light steel structure, which could be assembled on top of the industrialized underground galleries in reinforced mortar, which had 70% of the parts manufactured for the previous project available.

The versatility of the metallic structure and its link to the original galleries enabled the technical and economic association between structure and installations, as planned in the original proposal.

The design - in horizontal plan, in two levels to adapt to the terrain - foresaw a large network of galleries under the building. This number of technical corridors was made economically feasible by the construction process designed by Lelé: light reinforced mortar pieces, with low material consumption (panels 2.5cm thick) and manual assembly.

Besides the construction process, the triple function planned for the galleries also contributed to their viability: **(1)** as a ventilation and air conditioning system; **(2)** as a technical floor for installations and maintenance; and **(3)** as foundations for the building.

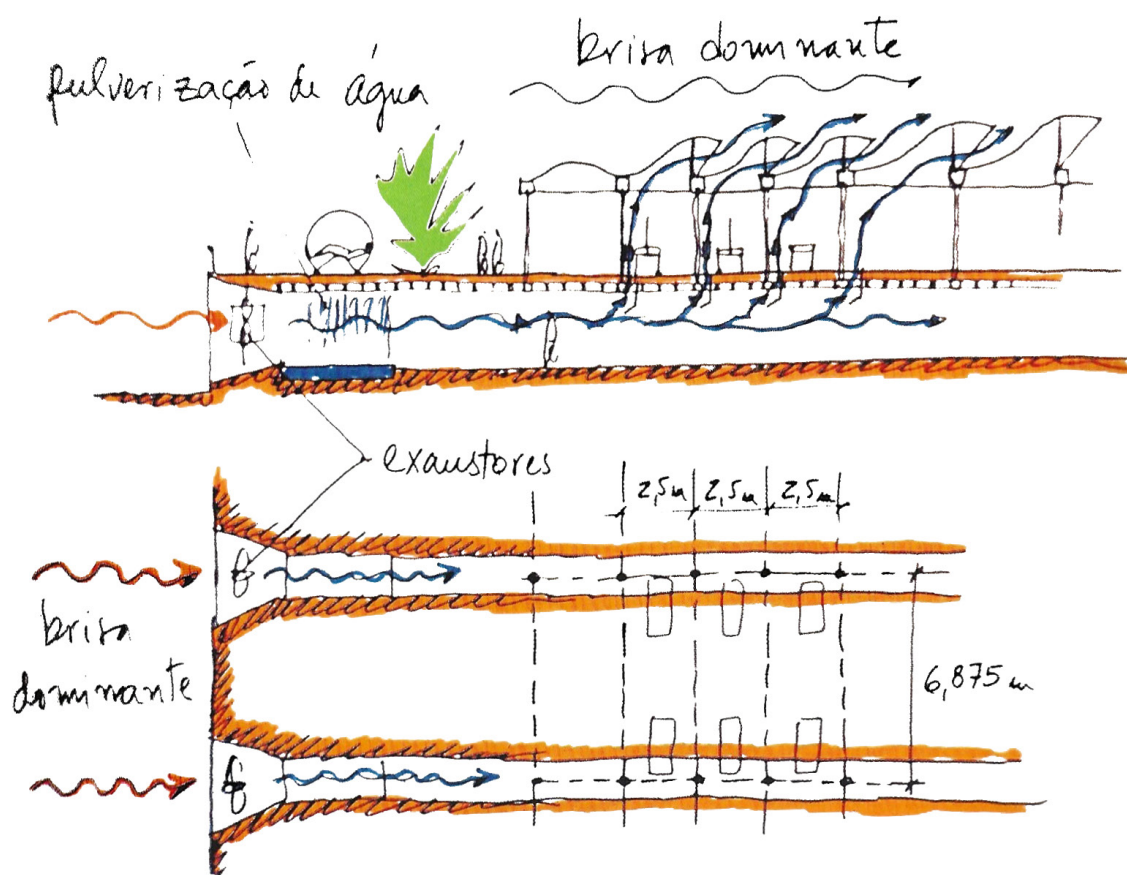


Illustration 9. Sarah/BA – natural and forced ventilation system: bellow, gallery plants (partial); on the top, longitudinal cut in the gallery and in the superior structure with a shed-shaped cover – João Filgueiras Lima drawings.

Source. Author's personal archives.

(1) The galleries face the prevailing winds and have low rotation exhaust fans that are automatically activated when there is a reduction in the speed of the breeze; recirculating water sprinklers are used to filter particles suspended in the air and to reduce its temperature; shell catchers direct the air to cabinets with diffusers that inject the air into the upper rooms that do not require strict temperature control; and the air is drawn through the sheds, by convection and suction.

(2) The clean installations are distributed on the ceilings and on one side of the gallery, keeping a free passage for maintenance personnel; the sanitary sewage installations go outside the gallery, visitable through

hermetically sealed side windows; in places where the upper environments require air conditioning, machine rooms are built next to the galleries (with the same panels) to house the fan+coil units.

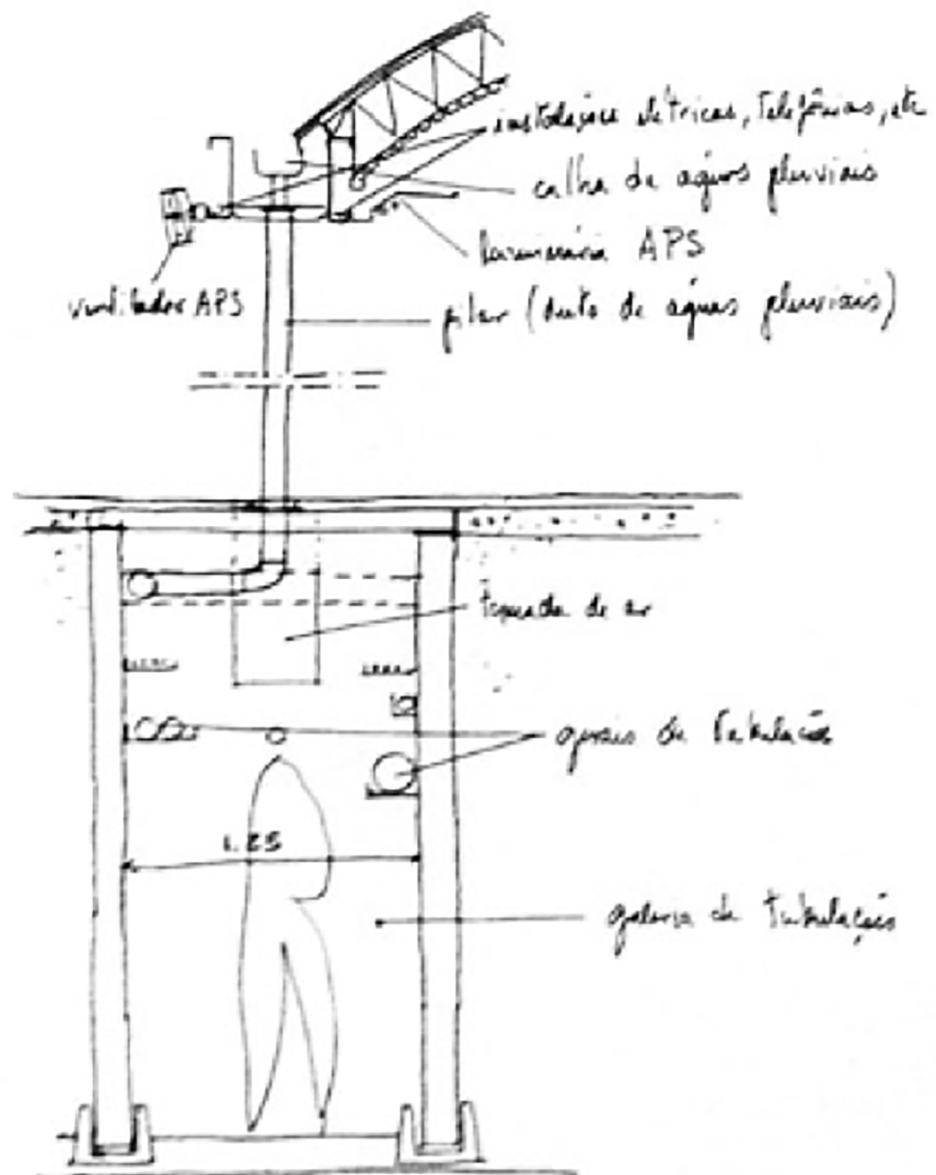


Illustration 10. Sarah/CE – transversal cut in the installation/ventilation/foundation galleries with new metallic structure – João Filgueiras Lima drawings.

Source. Author's personal archives.

(3) The gallery roofs have receptacles for tubular steel columns (also rainwater passages) and the vertical side panels are mounted on a sliding foundation.



Illustration 11. Sarah/BA – gallery network with dentils to assemble tubular pillars.

Source. Photograph Haroldo Pinheiro. Author's personal archives.

Arranged under several settings, the galleries allow the facilities to be reorganized according to new needs. The various pipes go up through the voids in the prefabricated reinforced mortar partitions (two “U” shaped panels, opposing each other, with a horizontal modulation of 0.625 m) or through technical cabinets (electricity, voice and data, hydrants, etc.) that replace partition modules when necessary.

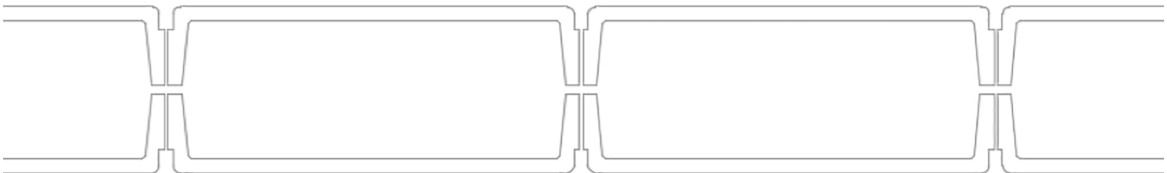


Illustration 12. Sarah/CE - plan of reinforced mortar partitions: panel thickness = 2.5 cm; total assembled width = 25 cm.

Source. Haroldo Pinheiro drawings. Author's personal archives.

The wires reach the metallic structure of the roof and pass horizontally through channels formed in the double steel beams (in stiffened “U” shape, lying) and in the orthogonal tie beams (designed in stiffened “U” shape, juxtaposed to the walls). Lighting fixtures, speakers, fans, detectors, and other elements attach to the double beams or to the tie beams.



Illustration 13. Sarah/BA - assembly of double longitudinal beams and transversal tie beams.
Source. Photograph Haroldo Pinheiro. Author's personal archives.

The double beams house stainless steel gutters for collecting rainwater, which flows down the tubular pillars and into the galleries for reuse.

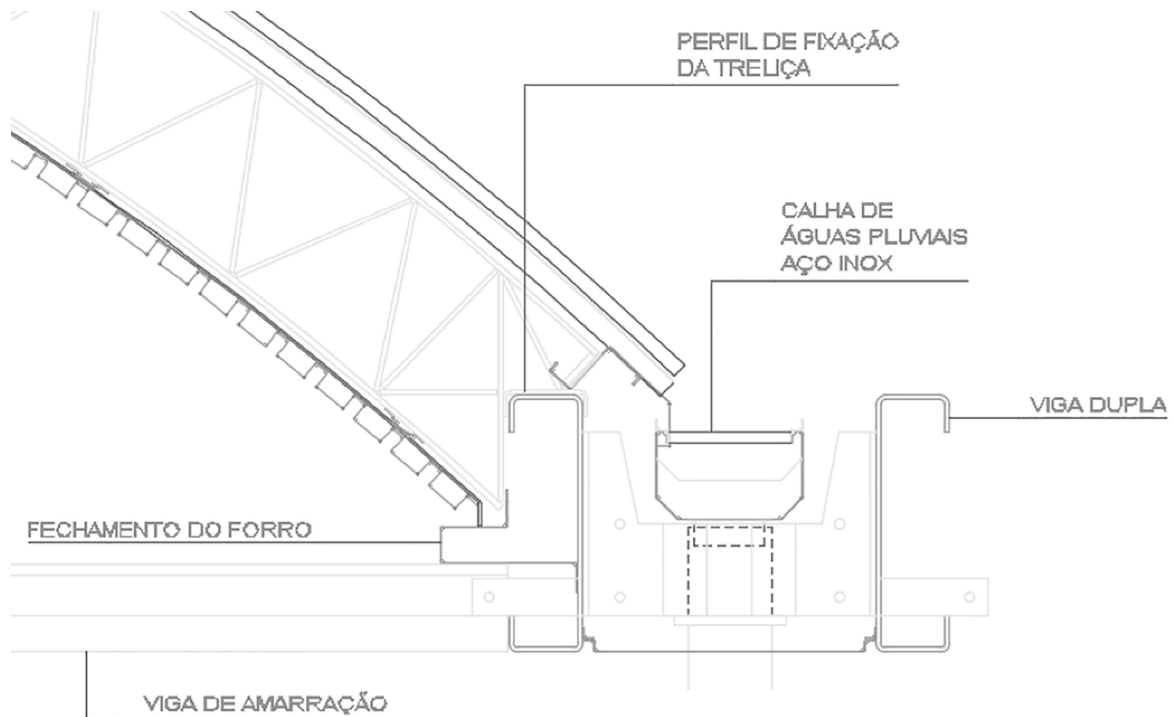


Illustration 14. Sarah/CE - detail of the double beam, lower gutters for wiring (cross section).

Source. Haroldo Pinheiro drawings. Author's personal archives.

The arches of the roof are used to pass the air conditioning ducts, whenever necessary (Surgical Center, Imaging, Laboratories, Auditorium).

In the rest of the hospital, where air conditioner is not technically required, the closed roof is replaced by sheds that provide natural lighting and a vertical flow of cooled ventilation from the galleries, replacing cross ventilation.



Illustration 15. Sarah/BA - double beams with attached light fixtures, tie beams and roof being assembled: foreground with shed; background, without shed (for balconies and air-conditioned rooms).
Source. Photograph Haroldo Pinheiro. Author's personal archives.

After Sarah/BA, Lelé planned and implemented Sarah Network Technology Center (SNTC), also in Salvador, where for twenty years he produced and assembled hospitals and other public buildings; urban equipment (footbridges, slope retaining systems, urban furniture); fixed and moving hospital furniture; and other equipment for buildings designed and built by SNTC (elevators, locks, fans/exhausters, lighting fixtures, loudspeakers, "brise-soleil" with automatic movement, retractable roofs).

The solution studied for Salvador, despite being an adaptation of the project originally designed for industrialization in reinforced mortar, worked well and evolved, welcoming the necessary variations to adapt to other characteristics of the locations, such as topography, lot dimensions, climate conditions.

Moreover, other hospitals were built in Belo Horizonte, Fortaleza, Belém, Brasília, Macapá, and Rio de Janeiro, in addition to extensions for Distrito Federal's facility, also under my office's coordination. Two further hospitals were designed using the same system, for Pernambuco and Rio Grande do Norte, whose construction has not yet been carried out.

The hospital in Rio de Janeiro (Sarah/RJ), built by SNTC and carefully assembled by architect Adriana Rabello Filgueiras Lima, was the last healthcare facility designed by Lelé.

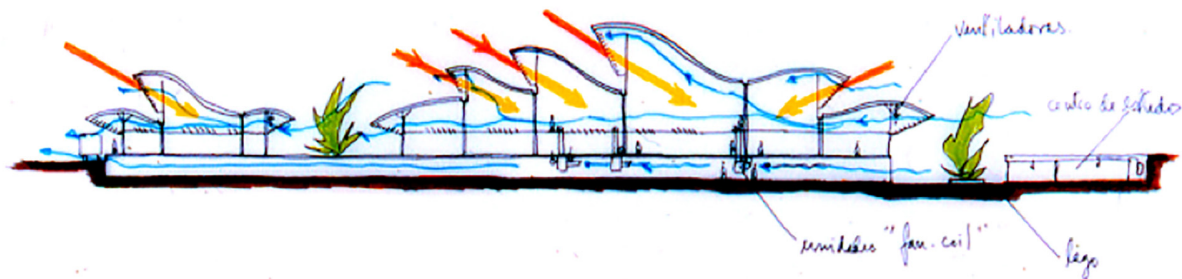


Illustration 16. Sarah/RJ - aerial view and drawings by João Filgueiras Lima.
Source. Author's personal archives.

It was a personal and deliberate choice not to include Rio de Janeiro's hospital design in this brief article, since I consider it a special and different chapter in João Filgueiras Lima's work evolution - it certainly deserves a dedicated article.

Reference

LIMA, João Filgueiras. **Arquitetura: uma experiência na área da saúde.** São Paulo: Romano Guerra Editora, 2012. 336p.

Design Insights from a Research Initiative on Ambulatory Surgery Operating Rooms in the U.S.

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Abstract

This paper reports on significant physical design implications and findings of a multidisciplinary iterative research-design-prototype initiative focused on the development and systematic evaluation of an ambulatory surgery operating room (OR) prototype. The overall goal of this project was to design a safer, more ergonomic, and efficient OR prototype for ambulatory surgery through evidence-based research that can inform the design of future ambulatory surgery ORs. The methodology involved initial literature and case study research, observations, and coding of surgical flow disruptions in 35 related surgical procedures, an iterative prototype design-fabrication-testing-redesign process, and ultimately a post occupancy evaluation of an operating room in a new facility that was designed in part on the results of the research. Overall findings from the study include design recommendations about OR size and layout in terms of surgical table positioning and the location of information displays and workstations.

Key words

Surgical environment, Operating Room, Built Environment, Evidence-based Design, Prototype Development.

Introduction

Existing research, clinical practices and design guidelines for the design of surgical environments indicate that the operating room (OR) is a complex milieu with a significant potential to impact clinical outcomes for patients, safety outcomes for both patients and clinicians, and operational efficiency and effectiveness outcomes for surgical processes (ELBARDISSI *et al.*, 2011). The numerous technical and functional forces and constraints driving OR design decisions are everchanging, often compounding and, at times, conflicting in terms of optimizing these outcomes (ROSTENBERG & BARACH, 2012). At the same time the overall physical configuration of operating rooms demonstrates little change since the mid-twentieth century, typically consisting of square or rectangular rooms with the operating table centrally located on the axis of the room.

According to the United States Institute of Medicine, adverse events such as surgical site infections and medical errors often result from flawed systems rather than negligent clinicians (DONALDSON *et al.*, 2000). Studies show that such adverse events occur in the OR setting as a result of everyday delays, flow disruptions, and minor errors, often overlapped and inter-related, which are in turn caused by mismatched organizational policies, processes, technology and the built environment (PARKER *et al.*, 2010; WIEGMANN *et al.*, 2007). Previous studies suggest that the built environment is a contributing factor to the safety and efficiency of surgical procedures due to features such as layout, lighting, acoustics and ergonomics. Certain features also potentially contribute to surface contamination and disruptions in the flow of air, people, and equipment (AHMAD *et al.*, 2016; JOSEPH *et al.*, 2018-I).

Environmental sources of disruption in the OR can include door openings, loud noises and alarms, environmental clutter and constrained spaces (WAHR *et al.*, 2013; JOSEPH *et al.*, 2018-I; JOSEPH *et al.*, 2018-II). Coupling small and cluttered ORs with high foot traffic inside of the OR as well as movement in and out of the room may contribute to flow disruptions (e.g. people or equipment blocking visibility and communication between surgical team members) and increase infection risks (e.g. non-sterile surgical personnel bumping into a sterile instrument table) (PALMER *et al.*, 2013; GURSES *et al.*, 2012). Additionally, poorly organized storage spaces and the lack of proximity between key functional areas can result in unnecessary travel and time wasted during surgical procedures, ultimately causing delays and adding costs to healthcare organizations (GURSES *et al.*, 2012; FREDENDALL *et al.*, 2009).

Aimed at embodying an evidence-based design process to uncover the role of the built environment in this complex OR work system, the research project presented in this paper (Realizing Improved Patient Care

through Human-Centered Design in the Operating Room – RIPCHD.OR) developed a five-year multidisciplinary approach to iteratively understand, develop and evaluate OR design features impacting safety, efficiency and human experiences. Due to the multidisciplinary expertise needed to design surgical environments, the study included teams from Clemson University (Architecture, Industrial Engineering and Business departments) and the Medical University of South Carolina (MUSC). The research team included healthcare design researchers, architects, industrial designers, human factors and health professionals, healthcare providers and industry partners. As depicted in Figure 1, the research project was developed over five years, comprising an extensive multi-method problem analysis phase (year 1), the development of OR design alternatives based on the evidence found (year 2), the iterative process of evaluating and refining the design through mock-up-based simulations (year 3), and the evaluation of the final design prototype (year 4).

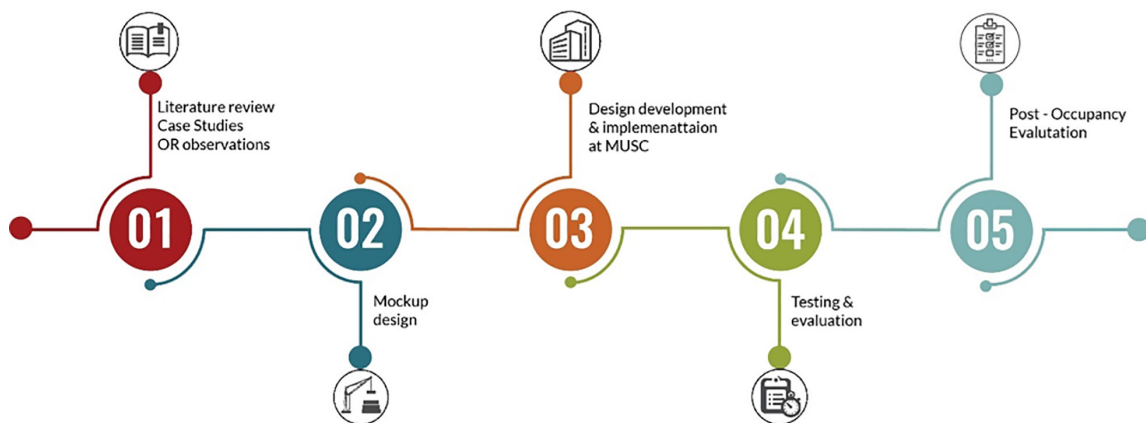


Figure 1. Timeline of the RIPCHD.OR research project.

Summary of Research Methods

The RIPCHD.OR research kicked off with a review of 198 articles, which helped identify key categories of OR outcomes (e.g. disruptions, errors, satisfaction, performance) and design factors impacting those outcomes (e.g. air quality, acoustics, lighting, materials, layout, visibility). Summarized in another publication (JOSEPH *et al.*, 2018-I), these findings helped to focus data collection efforts for the team, providing structure to the video observations and case studies being conducted. Data from the literature review, observations and case studies were used to develop several design prototype alternatives, while also informing multiple data analysis strategies such as spaghetti diagrams and discrete-event simulation models created to better understand flow patterns in the OR.

The OR prototype was refined through several stages of mock-up-based simulations with end-users (surgical team members), iteratively refining the OR prototype towards its final version. The final OR prototype was then evaluated via high-fidelity simulations of surgical procedures in the physical mock-up, as well as by a computer-based simulation approach (proactive modeling) testing different versions of the prototype (different room size, shape and layout) against traffic flow patterns pre-determined in observations. Finally, ORs built in an Ambulatory Surgical Center in the Southeast US were partially informed by the research and evaluated via a Post-Occupancy Evaluation study.

Video Observations and Coding

Using a human factors systems approach (Systems Engineering Initiative for Patient Safety 2.0 – SEIPS 2.0, by HOLDEN *et al.*, 2013), the research team observed 35 outpatient surgeries (pediatric and orthopedic procedures) conducted in five different ORs at a healthcare facility. Using video cameras installed in four corners of each OR, a coding software (Noldus Observer®) and a coding protocol developed from a previous study (PALMER *et al.*, 2013), nine trained researchers recorded the type, location and duration of surgical flow disruptions and activities performed by key surgical team members (e.g. circulating nurse, scrub nurse, surgeons and anesthesiologists) and objects (e.g. instrument tables) in each surgery. Door openings and surgery phases were also recorded.

To optimize coding and make results more meaningful, each OR was divided into various location zones based on their functions (e.g. surgical table zone, circulating nurse workstation zone, supply zone), and activities were categorized in terms of what they related to (e.g. patient, equipment, information). Surgical flow disruptions, on the other hand, were categorized as they related to layout (inadequate use of space, impeded visibility, connector positioning or furniture positioning hindering the surgical team from doing their tasks), environmental hazards (e.g. objects causing collision/bumping or the risk of slipping/falling/tripping), usability (e.g. malfunctioning furniture and equipment), equipment failure, and interruptions (e.g. surgical team members spilling/dropping/picking up items, or searching for missing surgical items). Moreover, surgical flow disruptions were also coded in terms of their severity (from no/minor impact to momentary distraction, disruption, and repeated task).

Case Studies and Flow Mapping

In order to more deeply investigate best practices in OR design across the United States, the research team visited three surgical facilities with varying spatial configurations and operational models, in addition to the

observation site. The goal was to not only learn lessons about design and technology related facilitators and barriers to OR outcomes, but also gain insight into spaces around the OR, understanding multiple flows of people and objects feeding into the surgical procedure by traveling around the surgical suite and other areas such as the sterilization processing department. To meet these goals, the research team developed a case study tour approach that included a flow mapping tool (MACHRY *et al.*, 2020) focused on documenting and evaluating eight different types of flows within the surgical unit (patient, family, surgeon, anesthesiologist, instruments/materials, supplies, movable equipment and waste) and how discrete steps within these flows may be impacted by spatial configuration. The tool guided interviews with stakeholders, the development of flow diagrams, and a process-based spatial evaluation framework focused on efficiency. Spaces used for traveling (e.g. elevators and corridors) or storage steps, for instance, were evaluated as to whether they were likely to present risks of delay to the next surgical case in the form of bottlenecks and/or longer distances from one step to the next.

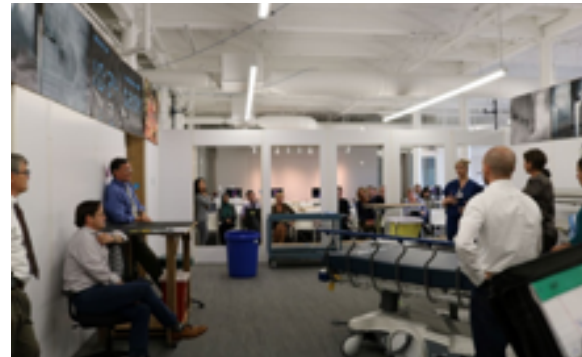
Development and Simulations of OR Prototype and Mock-ups

Developed in parallel to data collection, the final OR prototype and high-fidelity mock-up resulted from four intense cycles of design-fabrication-testing-redesign, in a process involving the cross disciplinary research team, an advisory committee and graduate students. The initial task was to collectively build an evidence-based framework to guide the design of the prototype (Figure 3 in the next section). This was done based on the literature review and workshops bringing the entire team together to filter evidence and best practices relevant to the project. After reaching consensus and clarity on the design vision and guidelines to focus on, several design solutions were developed, narrowed down, and replicated in a low-fidelity tape on the floor mock-up.

Flexible enough to reflect various design alternatives, the first tape-on-the-floor mock-up was tested through a set of simulations with end-users used to refine the design. This mockup confirmed basic room floor area and dimensions. It also tested several potential door locations. As depicted in Figure 2, this process was repeated two more times with cardboard mock-ups, allowing for a dramatic reduction in the number of design alternatives being tested each time, and ultimately leading to the development of the final version of the prototype to be reproduced in a high-fidelity mock-up with real walls and surgical equipment.



Mock-up 1. Tape on floor (low-fidelity)



Mock-up 2. Cardboard (level 1)



Mock-up 3. Cardboard (level 2)



Mock-up 4. Real walls and equipment (high-fidelity)

Figure 2. Four stages of mock-up development.

Structured around the prototype design and mock-up fabrication, simulations were developed to test OR design alternatives in each stage described above, with simulation results informing the redesign of the prototype in the next stage. A set of tools was adapted from the Health Quality Council of Alberta (HQCA, 2016) to evaluate each simulation, testing the design against guidelines established in the project's framework (test whether the design was able to optimize movement and flow, for example). Based on the HQCA structure and assisted by clinicians in the research team, a simulation-based evaluation toolkit was developed with simulation scenarios and protocols that were tailored to simulate surgical tasks and sequences (BAYRAMZADEH *et al.*, 2017). Scenarios depicted different types of ambulatory surgery procedures (specific pediatric and orthopedic surgeries), surgery phases (preoperative, perioperative, postoperative and turnaround phases), and OR configurations (e.g. with one or two doors; with or without adjacent rooms such as the induction room). Always including end-users (e.g. surgeons and nurses), each simulation protocol defined a simulation director, participant roles and tasks, equipment and tools involved, and a simulation schedule involving a sequence of discrete/shorter simulations (e.g. patient bed entry/exit

sequences). Each simulation was followed by debriefings and focus groups to discuss perceptions and lessons learned from the simulation right after it happened.

As the quality and fidelity of mock-ups improved, so did the level of detail in simulation scenarios (e.g. tasks including specific furniture/equipment becoming available in higher-fidelity mock-ups) and evaluation tools. During the first two rounds of simulations (mock-ups 1 and 2), conclusions were essentially drawn based on content analysis of debriefing notes, observation notes and annotated sketches and floor plans. The third round of simulations (mock-up 3) deployed more structured and detailed scenarios, tasks, observations and evaluation questions (see details in another publication – BAYRAMZADEH *et al.*, 2017). The final round of simulations, on the other hand, was more detailed due to the high level of fidelity of the mock-up (mock-up 4), and included longer uninterrupted simulations (entire surgery as opposed to discrete parts of it) and video observations. Thus, more advanced data collection procedures were utilized in the final round of simulations, including surveys, behavior mapping and coding (e.g. tracking movement and surgical flow disruptions), and focus groups.

Computer-based Simulations of the OR Prototype

Once the final design of the OR prototype was defined and built in the high-fidelity mock-up, a digital simulation method was deployed to manipulate some of its features (size, shape and layout) and test their performance against the flow patterns obtained from coding video observations of actual surgeries (Figure 3). As explained in detail in another publication (TAAFFE *et al.*, 2020), a computer-based simulation modeling approach was created to simulate these flow patterns in the different versions of the OR prototype (Figure 4). Different OR sizes (421, 579 and 739 square feet or approximately 39, 54 and 68 square meters), shapes (square and rectangle) and layout (surgical table positioned perpendicularly or angled to OR walls) were compared to see how they performed in terms of flow measures impacting safety and efficiency during surgery – the number of contacts between people/equipment, the distance traveled by surgical team members, and the number of transitions near the surgical table area.

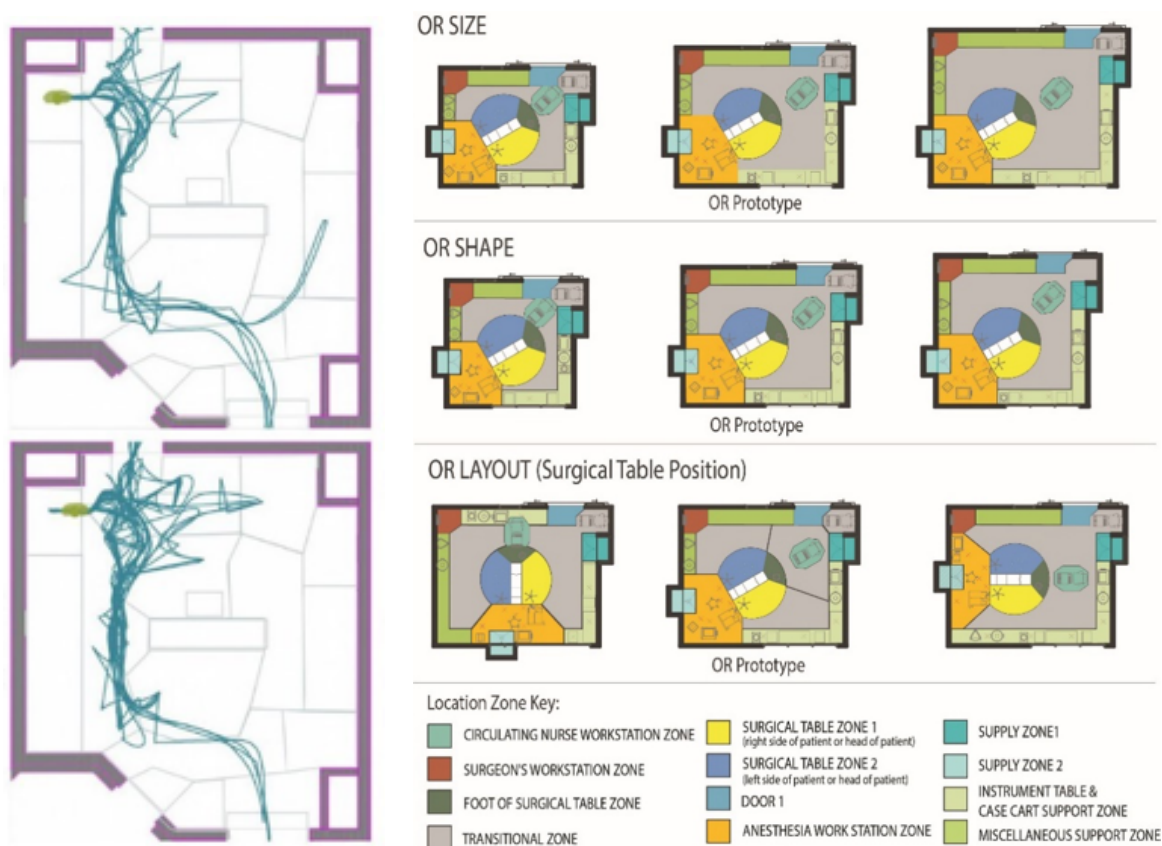


Figure 3. Spaghetti diagrams depicting flow patterns obtained from coding video observations of 35 surgeries.

Figure 4. Manipulations of the OR prototype in terms of size, shape and layout that were tested against proactive simulations of flow patterns.

Post-Occupancy Evaluation of Built Facility

Completing the evidence-based cycle of the research, a post-occupancy evaluation (POE) was conducted to further evaluate design features of the OR prototype during actual surgical procedures. Largely designed to reflect findings from the aforementioned simulations, the ORs built in the Ambulatory Surgery Center (ASC) were similar to the OR prototype in overall size and layout (e.g. location/position of the surgical table), and different in terms of features such as the number and position of doors and information displays. See Figure 5 comparing both rooms.

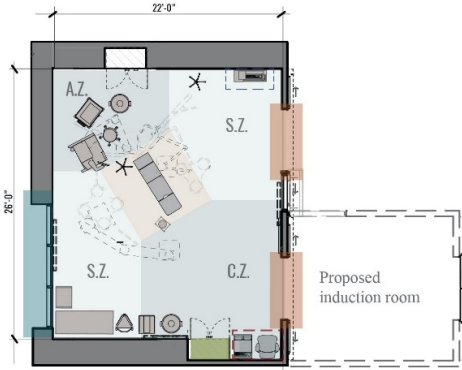
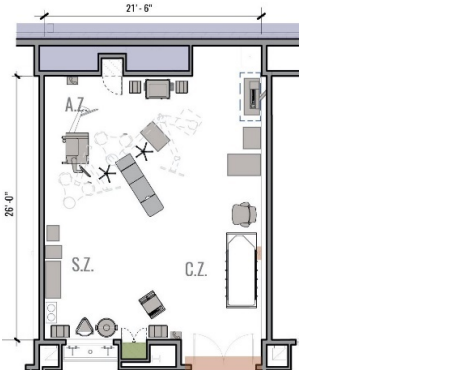
	High-fidelity Mock-up OR	Built ASC OR
Room photo		
Room plan		
OR size	22' x 26' / 579 square feet / 53.8 square meters	22' x 26' / 579 square feet / 53.8 square meters
Induction room location	Physically adjacent to OR	Located across the corridor from the OR
Door location	On longer OR wall	On shorter OR wall
Door type	Sliding door	Swing door
Visual displays	Two ceiling-mounted monitors Three large wall-mounted displays	Two ceiling-mounted monitors No large wall-mounted displays
Flooring pattern	Rooms zones clearly demarcated by pattern	No pattern (uniform flooring)
Window	Simulated window views and access to daylight	No window views or access to daylight
Scrub sink location	Adjacent to OR, along longer wall With direct window view into OR	Adjacent to OR, along shorter wall With direct window view into OR
Circulating nurse Workstation	Alcove for workstation 'parking'	No alcove for workstation 'parking'
Surgeon Workstation	Positioned at short wall, close to anesthesia area	Positioned at long wall, close to anesthesia area

Figure 5. Comparison between OR prototype and built ASC OR.

Replicating some data collection procedures previously described (video observations, coding, flow mapping, surveys and focus groups), POE results were compared to simulation results from the high-fidelity mock-up.

Architecturally Relevant Findings

A major outcome from the initial phases of this research (literature review, video observations and brainstorming workshops) is the confirmation of a project vision and a series of evidence-based design goals and guidelines. A set of five evidence-based goals – 1) optimize operational efficiency and effectiveness, 2) optimize clinical outcomes, health and safety, 3) optimize the experience for both patients and staff, 4) optimize green and sustainable practices, and 5) optimize the ability to accommodate changing needs over time – led to a series of nine inter-related OR design guidelines – optimize movement and processes, maximize visual awareness, integrated information display, minimize institutional clutter, minimize surface and airborne contamination, controlled access to daylight and appropriate artificial lighting for the range of activities in the OR, and a flexible room/suite chassis with flexible and interchangeable plug and play elements. See Figure 6 illustrating the framework guiding the design of the OR prototype, which is then depicted as a floor plan on Figure 7.



Figure 6. Diagram of framework guiding the design of the OR prototype.

OR Size and Shape

The overall net dimension of the final OR prototype was 22' x 26' or approximately 6.7 x 7.9 meters. With an alcove for parking a circulating nurse workstation and storage, the net area of the room ended up being 579 square feet or 53.8 square meters. As described earlier, this area and dimension were evaluated in simulation models compared to larger and smaller room areas and dimensions. Findings from simulations (both mock-up-based and computer-based) indicate the prototype room size and dimensions performed well in terms of flow patterns and disruptions, showing fewer incursions into the sterile zone than smaller rooms and fewer travel/steps than larger rooms (TAAFFE *et al.*, 2020).

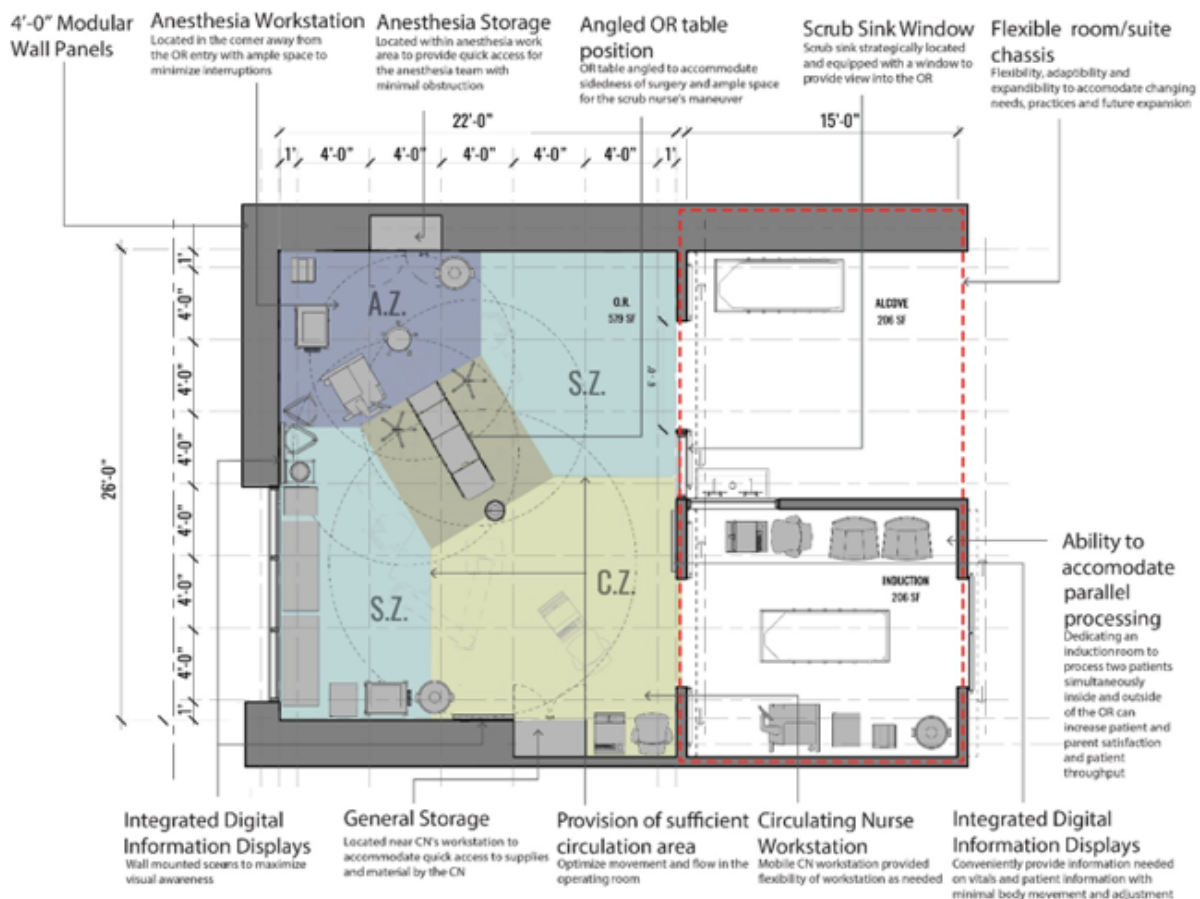


Figure 7. Annotated floor plan of the final OR prototype.

OR Layout

The OR prototype is fundamentally organized into four designated zones around the sterile field at the OR table: an anesthesia work zone (AZ) at the head of the table, surgical work zones (SZ) on either side depending on left or right-side surgeries and a circulating zone (CZ) at the foot and entry corner of the room. These zones were demarcated in the prototype by flooring colors, which facilitated the surgical flow according to focus groups. The surgical table placement and orientation off center and diagonal in the room opens up the foot and side areas around the table for circulation, equipment and procedure setup while placing the anesthesia work area so that it is more protected and less prone to movement through it by other surgical team members. According to simulations and the POE, such atypical positioning of the surgical table also allows for more efficient and effective use of space in the room by eliminating the need to access space typically found in the far corner of the room, behind the anesthesia boom and between the primary surgical zone and anesthesia zones, which otherwise would be accessed by passing through either the anesthesia or surgeon workstation zones. Furthermore, research findings showed that the surgical table orientation and placement away from the patient entry door facilitates maneuvering and minimizes effort during patient bed flow in and out of the room.

Mobile Circulating Nurse Workstation

Based on feedback from mock-up-based simulations, the OR prototype proposed a mobile circulating nurse workstation that allows flexibility for the position of the nurse during surgery, therefore facilitating repositioning based on visibility and flow needs, irrespective of the surgical table orientation. This enables the circulating nurse to optimally position the workstation to view the procedure while documenting or monitoring the surgery in the computer. A parking alcove is provided for this workstation when it is not in use (e.g. during turnaround or postoperative phases). Observations and focus groups also highlighted the importance of cord management, outlet positioning, and the location of environmental control devices (e.g. lighting) when it comes to the mobile workstation, since it requires a power outlet for charging and some staff reported preference for having the workstation plugged in at all times.

Information Displays

The OR prototype was designed with integrated patient information retrieval and display technology in addition to adjustable boom mounted displays around the surgical table. Proposed wall-mounted information

displays were located on three walls of the prototype, envisioning a continuous band of digital display integrated into the wall panels surrounding the entire room. The prototype was fabricated with three wall mounted monitors: one on each long wall and one on the footwall of the room. Aiming to enhance situational awareness, displays were positioned to allow optimal visibility for the entire surgical team at any time during the surgery, on either side of the surgical table, and while moving around the room. Simulations found that displays were initially installed too high for comfortable viewing and sight lines were blocked from some points by overhead surgical booms and lights.

OR Flexibility

The basic room chassis of the OR prototype was designed to accommodate various suite configurations, including a clean core for storage of sterile supplies requiring access from the side of the OR opposite the general patient-staff corridor. Based on observations at one of the case studies visited, the prototype chassis was designed to accommodate the option of an adjoining induction room for pediatric cases. Given most pediatric surgeries are of a short duration with a longer preoperative stage involving induction, this allows the next case to begin the induction process with a separate anesthesia team outside of the OR while a procedure was still in progress. This enables parallel processing with quicker turnaround times and throughput of surgical cases in a given day. The separate induction room also allows family members to be with the child during the intimidating induction process without the need for gowning.

Simulations showed that the configuration of the OR prototype was able to accommodate these different configurations with minor changes, incorporating adjoining ancillary rooms such as an induction room or postoperative instrument breakdown room, and a scrub sink/entry alcove. The prototype was tested in simulation for both postoperative instrument breakdown associated with orthopedic surgeries and induction outside the OR for pediatric surgery. The induction room scenarios were viewed as beneficial for short duration pediatric cases and ultimately adopted in the subsequently built facility as a means to improve room turnover and overall productivity.

The prototype was built with a modular and adaptable overhead structural frame to support surgical booms, surgical lights and other ceiling-mounted items (Figure 8). It was designed to enable the relocation of these overhead elements with minimal effort and cost. The simulations did not explicitly evaluate the original placement of overhead surgical booms and lights although anecdotal feedback indicated there were some difficulty in optimally positioning the surgical boom and lights across different

procedures and clinician positioning. Insights indicated that the mounting locations of the booms were too close to the center of the OR table and would be better placed further apart to minimize conflicts in boom rotations.



Figure 8. Overhead boom and light structure

Applied but Untested OR features

Like the modular ceiling structure, a simulated window was included in the prototype but not tested in the research study, considering it did not face an outdoor area and was not able to simulate the experience or exposure to daylight. Nonetheless, the window was included in the prototype based on anecdotal evidence that shows how windows with appropriately controlled daylight, privacy and thermal controls were both desirable and beneficial for surgical team members. It is also speculated that windows with daylight and views could be stress reducing for ambulatory surgery patients, which is especially relevant with the increase in minimally invasive surgeries and the progress in anesthesia strategies. This suggests that more patients in the future may maintain some level of consciousness for at least periods of time in the OR, potentially increasing the need for positive distractions in the room.

The OR prototype also included sliding doors which are common in some countries but have not had widespread adoption in the US. It is speculated that sliding doors reduce effort, flow disruptions and air turbulence in the OR, but these features were also not evaluated in simulation. Likewise, overall room lighting concepts were conceived in the design but not incorporated or evaluated in simulations. The prototype was designed to minimize institutional clutter, unnecessary articulations in surfaces and minimize unnecessary horizontal surfaces to ease cleanability and potentially reduce surface contamination. Again, these features were not tested.

Conclusions

The size, dimensions and configuration of the OR prototype enabled an effective and efficient use of its space. As a major finding validated by simulations as well as the POE, placing the surgical table diagonally and off-center in the rectangular shaped room, away from the entry door, improved movement and flow in the OR, facilitating patient entry, transfer and positioning. Additionally, this position of the surgical table facilitates movement around the room without interference with the anesthesia and sterile zones around the patient, therefore avoiding flow disruptions in these areas, such as bumps, trips, and related safety risks for patients and staff. The prototype design was also successful in improving situational awareness with the location and orientation of the surgical table, the mobile nurse workstation, and multiple wall-mounted information displays. Combined, these features enabled ample visibility between surgical team members and facilitated movement for the circulating nurse, a critical role supporting the entire surgical procedure. As charging capacity and reliability improves, control devices become more available on wireless devices and smart system integration becomes more widely adopted, therefore increasing the flexibility and capacity to position and operate mobile workstations in the OR.

Simulations of the prototype mock-up indicated that the overall room design provides flexibility for a variety of pediatric and orthopedic ambulatory procedures requiring different surgical teams, equipment and positioning of the procedure and team members. Other features of the prototype that were not tested are anticipated to enable room chassis standardization with component flexibility and adaptability over the life of the room. Significant features for flexibility include a structural mounting system in the ceiling that can enable the easy repositioning of structural support and placement of overhead surgical booms and lights. Modular plug and play stainless steel wall panels are designed to allow for reconfiguration of wall integrated and mounted systems and enable repair quickly and cleanly with minimal downtime and disruption.

Limitations

Most of the limitations on evaluating the prototype design were known at the outset and framed by the scope of the study, schedule, budget and mock-up site. The prototype evaluations were focused on a limited set number of ambulatory pediatric and orthopedic surgical procedures. Several architectural design features of the OR prototype were not evaluated due to a variety of limitations. The research did not study issues of overall room lighting or evaluate the configuration of overhead booms and surgical lights. Due to the nature of simulations and overall constraints of space, time and funding, the prototype did not include mechanical systems, nor could actual surgical procedures be performed for obvious reasons, so therefore the study did not evaluate the mockup design in terms of infection control. Based on similar limitations, the study did not evaluate the impact of artificial lighting scenes, daylight or connections to nature for either patients or staff, even though considerable attention went into considering these attributes in the prototype design. Likewise, the study could not test issues of flexibility beyond accommodating the select range of pediatric ambulatory surgery procedures. These issues all deserve further consideration and evaluation in the future.

Bibliography

AHMAD, N., HUSSEIN, A. A., CAVUOTO, L., SHARIF, M., ALLERS, J. C., HINATA, N., ... & GURU, K. A. **Ambulatory movements, team dynamics and interactions during robot-assisted surgery.** BJU international, 2016, 118(1), 132-139.

BAYRAMZADEH, S., JOSEPH, A., ALLISON, D., SHULTZ, J., & ABERNATHY, J. **Using an integrative mock-up simulation approach for evidence-based evaluation of operating room design prototypes.** Applied Ergonomics, 2018, 70, 288-299. doi:<https://doi.org/10.1016/j.apergo.2018.03.011>

ELBARDISSI, A. W., & SUNDT, T. M. **Human factors and operating room safety.** The Surgical clinics of North America, 2011, 92(1), 21-35.

FREDENDALL, L. D., CRAIG, J. B., FOWLER, P. J., & DAMALI, U. **Barriers to swift, even flow in the internal supply chain of perioperative surgical services department: A case study.** Decision Sciences, 2009, 40(2), 327-349.

GURSES, A. P., KIM, G., MARTINEZ, E. A., MARSTELLER, J., BAUER, L., LUBOMSKI, L. H., ... & THOMPSON, D. **Identifying and categorizing patient safety hazards in cardiovascular operating rooms using an interdisciplinary approach: a multisite study.** BMJ Qual Saf, 2012, 21(10), 810-818.

HOLDEN, R. J., CARAYON, P., GURSES, A. P., HOONAKKER, P., HUNDT, A. S., OZOK, A. A., & Rivera-Rodriguez, A. J. **SEIPS 2.0: a human factors framework for studying and improving the work of healthcare professionals and patients.** *Ergonomics*, 2013, 56(11), 1669-1686.

HQCA. **Simulation-based Mock-up Evaluation Framework.** Calgary, Alberta, Canada: Health Quality Council of Alberta (HQCA), 2016. Available from www.hqca.ca/humanfactors.

DONALDSON, M. S., CORRIGAN, J. M., & KOHN, L. T. (Eds.). **To err is human: building a safer health system** (Vol. 6). National Academies Press, 2000.

JOSEPH, A., BAYRAMZADEH, S., ZAMANI, Z., & ROSTENBERG, B. **Safety, performance, and satisfaction outcomes in the operating room: A literature review.** *HERD: Health Environments Research & Design Journal*, 2018 (I), 11(2), 137-150.

JOSEPH, A., KHOSHKENAR, A., TAAFFE, K. M., CATCHPOLE, K., MACHRY, H., & BAYRAMZADEH, S. **Minor flow disruptions, traffic-related factors and their effect on major flow disruptions in the operating room.** *BMJ quality & safety*, 2018 (II). doi:10.1136/bmjqs-2018-007957

MACHRY, H., JOSEPH, A., & WINGLER, D. **The Fit Between Spatial Configuration and Idealized Flows: Mapping Flows in Surgical Facilities as Part of Case Study Visits.** *HERD: Health Environments Research & Design Journal*, 2020, 1937586720928350.

PALMER, G., ABERNATHY, J. H., SWINTON, G., ALLISON, D., GREENSTEIN, J., SHAPPELL, S., ... & REEVES, S. T. **Realizing improved patient care through human-centered operating room design a human factors methodology for observing flow disruptions in the cardiothoracic operating room.** *The Journal of the American Society of Anesthesiologists*, 2013, 119(5), 1066-1077.

PARKER, S. E. H., LAVIANA, A. A., WADHERA, R. K., WIEGMANN, D. A., & SUNDT, T. M. **Development and evaluation of an observational tool for assessing surgical flow disruptions and their impact on surgical performance.** *World journal of surgery*, 2010, 34(2), 353-361.

ROSTENBERG, B., & BARACH, P. R. **Design of cardiovascular operating rooms for tomorrow's technology and clinical practice—Part 2.** *Progress in Pediatric Cardiology*, 2012, 33(1), 57-65.

TAAFFE, K., JOSEPH, A., KHOSHKENAR, A., Machry, H., Allison, D., & Reeves, S. T. **Proactive Evaluation of an Operating Room Prototype: A Simulation-Based Modeling Approach.** *Journal of Patient Safety*, 2020.

WAHR, J. A., PRAGER, R. L., ABERNATHY III, J. H., Martinez, E. A., Salas, E., Seifert, P. C., ... & Sanchez, J. A. (2013). **Patient safety in the cardiac operating room: human factors and teamwork: a scientific statement from the American Heart Association.** *Circulation*, 2013, 128(10), 1139-1169.

WIEGMANN, D. A., ELBARDISSI, A. W., DEARANI, J. A., DALY, R. C., & SUNDT III, T. M. **Disruptions in surgical flow and their relationship to surgical errors: an exploratory investigation.** *Surgery*, 2007, 142(5), 658-665.

A study on the development of the concept growth and change on hospital architecture in Japan

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Abstract

This study aims to find how the concept Growth and Change on hospital architecture proposed by U.K. architect John Weeks has been introduced and developed in Japan. Literature review and interviews were carried out and the findings are as follows; 1) John Weeks was introduced to Japan by Professor Makoto Ito in 1965 followed by Weeks' concept Growth and Change by Professor Tadashi Yanagisawa in 1969 while similar concept has already been found by Rintaro Mori in 1899 and theorized by Masao Takamatsu in 1923; 2) After 1969, Weeks' concept has spread and was accepted throughout Japan through textbook and drawings of its application, Chiba Cancer Center, though some questions have been raised; 3) The concept has been found unsuccessful in the case of Northwick Park Hospital he designed in 1970.

Keywords

John Weeks, Richard Llewelyn Davies, Northwick Park Hospital, Evidence-based Design, POE, Hospital Planning History

1 Background and purpose of the study

It is a common understanding among hospital designers that hospital buildings are repeatedly expanded and reconstructed as medical care and equipment progresses, and when they reach a dead end, they are forced to be rebuilt. For this reason, hospital designs are often required to anticipate future expansions and rebuilds at the beginning of design. The concept of *Growth and Change* by John Weeks (1921-2005), a U.K. hospital architect, is often cited in such cases. Many of them are illustrated with the layout of Northwick Park Hospital, which he designed. It shows a long hospital street with space for expansion at the end of the buildings along the street and vacant lot for new construction at the end of the street. It is often said that this idea was born when he was looking at an old map of Ashmore Village in the U.K. and noticed that the buildings had changed but the road had not changed in 800 years. This study distinguishes between *Growth and Change* as proposed by Weeks and the general concept of *growth and change* which includes *Growth and Change*, which has become a very common concept in Japan. It also looks at when and by whom *Growth and Change* was imported and how it spread in Japan.

2 Past research

From the late 1960s to the 1980s, Shinya conducted a number of studies on the evolution of hospital layout and floor plan, which he summarized in his doctoral dissertation²³¹⁾ as a compilation. Similarly, Yoon²⁴⁵⁾ also traced the layout and floor plan from the viewpoint of “building and medical standards,” but none of them touched on *growth and change* or *Growth and Change*. Ueno et al.²⁴²⁾ also summarized the planning history of hospitals in the post-war period, but only a few of them mentioned *growth and change*.

3 Research methodology

A literature review and interviews were conducted. In recent years, *growth and change* has become a common concept in hospital architecture as a precondition for proposals and design, therefore, the literature collected was limited to Yasumi Yoshitake's last book, *Architectural Design Planning Pickup I, II* (2004) ^{243,244)}, who is considered to be closely related to Weeks (although Ref. 245 is excluded). In addition to collecting literature on hospital design methods (excluding mere introductions to works) by going back through the reference list, including the previous studies mentioned above, we extensively surveyed medical journals and literature on hospital management. The literature was arranged in chronological order to determine whether the concept of *growth and change* existed in Japan before Weeks, who introduced the concept of *Growth and Change* to Japan, and how it spread.

What was not clear in the literature review was supplemented by interviews with Tadashi Yanagisawa (Professor Emeritus, Nagoya University) and Yasushi Nagasawa (Professor Emeritus, the University of Tokyo), who both had actually met Weeks and quoted *Growth and Change* in their works^{194, 196, 200, 227, 230, 239}).

4 Findings

245 pieces of literature were collected and listed in the reference list at the end of this volume. Below, we describe when *growth and change* and *Growth and Change* emerge and how they spread across time periods.

4.1 Pre-war to mid-war period (before 1945)

The oldest document¹) collected in this collection is an abridged translation of the Naval and War Department's Treatise on Hygiene by the First Head of the Dutch Naval Medical School, Murtin Melman (1866), but it already describes the space for expansion. Hospitals here refer to military hospitals and are classified into three categories: "temporary hospital," "main hospital" (which should be located near the main camp) and "true main hospital" (which should be located in the rear). As the number of patients in the war zone was able to increase rapidly and patients were transferred between hospitals of different types, so that the size of a hospital can not be determined by the number of men in the army. There should be space for future patients in "true main hospital" site. While this is a translation, it is the first document that describes *growth and change*.

The first article³) in the inaugural issue of the Journal of Architectural Institute of Japan is a design method for clinic. "Clinic is what the architect have to pay the utmost attention when designing because that is the most difficult building in terms of design" is the beginning of the article, in which he explained that hospital building emerged in the 18th century and the building layout of Hôpital Lariboisière in Paris was the first perfect practice in this short building type history. In addition, he pointed out the importance of the view and clean air, which is in line with the current Evidence-based design, through the layout and sanitation of clinic buildings in Europe, saying: "If such a place has an open view and fresh air, patients will feel refreshed by themselves and their illnesses will be cured quicker." The dimensions of the 1,500-2,000 cubic feet of air volume per bed required to prevent infection, as well as the dimensions of eight feet between bed center lines are roughly in line with the figures in Florence Nightingale's "Notes on Hospitals" (1863).

Mori⁵) was the first to mention the "corridor" and "pavilion" style of building arrangement, as well as hospital trains. Mori compiled many hospital design methods based on his four years of dispatch to Europe from 1884, and he explained in the second edition¹³) that the Oresunder

Hospital in Copenhagen had prepared a 320-square-meter/bed site because “they will require space on the premises for additional buildings to be built on other days.” It was Mori who first became aware of the concept of *growth and change*, through what he had learned from the Danish case study.

A report by the Architectural Institute in U.K., introduced by Ishii¹⁶⁾, states that “Even though many hospitals nowadays bear the stigma of ill-health, the cause of this stigma is not due to negligence in the construction, enlargement, or remodeling, but mainly due to defects in the detailing of the building.” This may be because, already in this period, there were some hospitals having failure to cope with *growth and change* and the buildings were not able to meet the sanitary needs. In addition, there is an episode¹⁷⁾ in which someone named a hospital “a health factory,” which shows the influx of a new concept of hospital in Japan.

It was Takamatsu³¹⁾ who was most influential in hospital architecture during this period, and even referred to the theory of *growth and change*. He noted that, in the U.S., the plan of a hospital ward was designed to be flexible so that large rooms could be made smaller, and if expansion was expected to take place in the future, it needs to think about expansion in proportion to the size of the ward. In the case of large hospital, clinical department should anticipate future expansion. Therefore it is also important to think about the future development regarding hospital site. Thus, the theory of *growth and change*, first introduced to Japan, was learned from American examples. Takamatsu further divides the ends of the pavilion type into “open end” and “closed end,” but he does not discuss the future expansion of the open end. As he said: “Hospital architecture can be thought of as a large, so-called instrument,” he seemed to recognize that hospital architecture was a kind of medical equipment. He also stated³²⁾ that hospital facilities should be transposed to the grand architecture that organize the reconstructed capital after the Great Kanto Earthquake in 1923. That is to say, he compared the plan of hospital architecture to the urban planning for the first time. He wrote: “The orderly proportion and arrangement of each room and corridor on floor plan was achieved by land readjustment and reconfiguring roads and The unified arrangement of each part and the clinical and social classification and zone in patient wards are created by establishing and implementing their own regional characteristics of residential, commercial, industrial, and mixed communities.” Unlike Ashmore Village, he supposed a good hospital can be created by scrap-and-build and zoning, which remind us a popular method in disaster-prone country.

On the other hand, Nagane³⁵⁾ measured the dimensions of hospitals in Kansai region and Tokyo and compared hospitals in Germany and the U.S. to describe the design of the entrance area. He counted the number

of outpatients going in and out of the Keio Hospital in Tokyo, which he had planned, “as 40 people going out (for 4 minutes from 10:00 a.m.), 21 people coming in,” and judged that the number was too large for the dimensions of the entrance, then proposed an example of improvement. This is the first example of improvement in which not only numerical evidence was collected, but also a POE (Post Occupancy Evaluation) was carried out and reflected in the design.

The first systematic textbook in Japan by Yoshida³⁷) also explained the design method using examples from abroad, including the U.S., the U.K., Germany, Austria, and Denmark, which stated: “Vacant spaces between wards should be as close as possible each other unless blocking the sunlight to the rear wards in order to save land and traffic labor, and to remove a risk that vacant spaces between wards will be used for future expansion,” suggesting that an unplanned expansion had already taken place. It also states: “A building itself must be considered a means of medical treatment. The treatment of patients will be further promoted if the environment, facilities, lighting, ventilation, temperature, and humidity are as perfect as possible in a hospital room. Herein lies the importance of hospital architecture.” Although the scope of the article is rather narrow, the author indicated the perspective of hospital architecture as a treatment device.

Other important aspects of hospital design are mostly brought to the pre-war period, such as Osawa⁴⁵) and MT⁵⁵) (note: anonymously, but Takamatsu Masao) who organized hospital equipment, Takamatsu⁴⁸) who described wayfinding and Kondo⁶⁰) who emphasized patient privacy while simulating the number of steps a nurse would take.

Osawa⁶³) said: “Today is the Age of Health. Hospitals are both instructors and patrons of health” suggesting that in a broader sense architecture affects health. In the third edition of the same book⁶⁴), in addition to Nagane’s statement³⁵), “There are many theories about the number of latrines, and some say one latrine for every 30 patients, but in my experience, when there are more than 500 to 600 outpatients, there are a few cases where one latrine is provided for every 25 patients even the urine examiners use this facility.” He made such a scale planning using numerical evidence based on precedents and observations.

Ref. 66 is the hospital section out of a 26-volume systematic textbook, in which Takamatsu shows many examples of photographs and drawings from Europe, the U.S. and Japan, while also addressing the nightingale as an architect.

According to Takeda⁶⁸), “There always comes a time when a hospital needs to be expanded and enlarged, and it is unavoidable to build on a narrow site without much space so that finally hospital will have to move

or be left as an obsolete one. Therefore, hospital buildings should be built on half or one-third of the site as a high-rise building from the beginning.”

4.2 Post-war to reconstruction period (1945-1959)

Ref. 87 is a serialized translation of “Design and Construction of General Hospital” by Marshall Shaffer, U.S. Public Health Service Senior Engineer, in *Architectural Record* from August 1945 to August 1946. It says: “The most typical general hospital of the 40-bed type is fundamentally expanded to 50-60 beds and It is necessary to consider that in the future it may be necessary to add facilities that may not be employed at present.” Specific design techniques such as Minimal configuration and services, Facilities such as laundry or anatomy rooms can be omitted according to local conditions, Surgery, delivery, emergency, etc. should be separated, and Administrative wing can be expanded are shown with drawings.

Ref. 102 is also a translation of the same “Design and Construction of General Hospital” as Reference 87, 118-121, but out of the four parts of the diagrammatic plan (model plan), design and structure, elements of a general hospital (detail drawings) and equipment table, only elements of a general hospital is picked up.

Ref. 107 deserves special mention as a step-by-step design method that anticipates *growth and change* from the beginning. The reason for this is that although reinforced concrete construction was prescribed for hospitals due to post-war requirements for fireproofing and seismic resistance, this was still an economically difficult time. “It is easy to build a wooden extension, but with reinforced concrete, it turns difficult to construct a limited part of the department, within limited budget, which prepares the building, piping and wiring connections to expand in the next budget period.” Therefore it must be an architecture that integrates the limited functions of the first phase with future functions, traffic lines, and plumbing that will be connected to the second and later phases, in artistic shape.

Around this time, the plan of 186-bed wooden general hospital model plan by the Central Council for Medical Institution Development (hereinafter referred to as Yoshitake Model Plan), which Yoshitake led, appeared in rapid succession^{96,103,104,106}. Yoshitake Model Plan included 53 design tips along with the first and second floor plans, and stated that the site should be large enough to accommodate the need for sufficient vacant space around the building to maintain the hospital's environment, and since all hospitals will need to expand in more than ten years, the site should be large enough to accommodate these requirements. Yoshida¹⁰³) even commented on the reduction: “I think it is possible to stack them appropriately, or to expand them to accommodate more beds, or to reduce them to small hospitals.” Since Yoshitake does not mention

expansion in the text, the site size requirement in Yoshitake Model Plan for expansion might have been proposed by Yoshida. However, there is no word to the reduction in the process of preparing Yoshitake Model Plan in Ref. 232 or in the "Text of Professor Yukio Yoshida" in Ref. 244.

Here Yoshitake¹¹²) suddenly questions the preparedness for expansion. "The problem with the high-rise layout of ward blocks is the difficulty to meet the future expansions and annual budgets from the government. Expansion, which was extremely important under the traditional concept, may become less of a problem when the hospital is considered a component of a national organizational network. This may mean that if the U.S. hospital function sharing system is introduced, the functions of each hospital will be fixed and will not need to be expanded or reconstructed." This is the only paper in this study that suggests that expansion will not be a problem.

Richard Llewelyn Davies, co-researcher and designer of the Weeks, appears in Yoshitake's London Architecture Research Conference Report¹¹³). Hospitals were presented in three papers, and "the first two hospitals are notable papers that are based on research into the actual use of buildings and are aimed at new developments in functional design planning. This type of research was rare in Europe and the U.S.. It is a pity that there was no reflection on what they designed," he said with POE-prone viewpoint. The first paper is a report on the ward survey by Davies and concludes with the following statement: "Hospital services change and create new solutions as medical and social developments occur. Hospital research is not about seeking a fantastical solution to all problems permanently, but rather the accumulation of knowledge and experience of hospital problems, which is never completed in that sense." The third paper is by Marshall Shaffer, who appeared in references 87 and 102, and lays out the special points on hospital design developed by the Hill-Burton Act in 1946. "Clinical part of the hospital is most susceptible to change. Consider future developments."

Osawa's Ref. 115 was an addition to Ref. 64 and added the phrase, It is even said that the site should be enough to accept hospital expansion by 100%. This specific figure "100%" was often mentioned until much later^{118-121,123,140,145,193}), but the basis for this concrete percentage probably originates from Ref. 87, as explained below.

Ref. 118-121 are translation of "Design and Construction of the General Hospital," same as Ref. 87 and 102. It consists of four parts: a diagrammatic plan (model plan), design and structure, elements of a general hospital (detail drawings), and equipment table. "It is necessary to be able to expand at least 100% of the total floor area to be built therein in the future, and it is also considered to expand the structure. In any project, it is important that the future expansion plan is thoroughly considered."

Ogawa notes that after the completion of the first part of Ref. 118, at the author's request, the work was resumed for the time being, and then ended, because the expanded version, including the model plan, was released in the U.S.. The next version, translated by Ogawa in 1955¹¹⁹), was based on the translation of the supplementary edition, as well as on Ogawa's translation of the criteria and model plan for the Japanese ward and outpatient departments and on a translation of the "Mental Ward Attached to the General Hospital" by G. Guttersen of the U.S., but the content of the translation remained largely unchanged.

On the other hand, Yoshitake's translation in 1956¹²⁰) gives a detailed account of the translation process in the preface. The original was published in *Architectural Record* in 1946, but in 1950, Yoshitake group first came across a French translation in *L'Architecture d'aujourd'hui*, April 1948 issue. Although Japanese translation from the French was in progress, he obtained the original (probably an enlarged version) at the end of 1953 and worked on it at once, and it was expected to be ready for Publishing in the spring of 1954. However, the translation was delayed until 1956 due to Ito's convalescence and Watanabe's death. In addition to this delay, the fact that article includes a letter from Marshall Shaffer stating his acceptance of the translation and that Yoshitake and the U.S. Public Health Service had agreed on a unified translation for the book suggests Yoshitake and Ogawa were rivals.

Takano¹²³) wrote about the site: "I would like to have a site that can accommodate a building about twice the size of the original plan for future expansion. It would be sufficient for a block-type building to be 100m x 100m for 50 beds, 150m x 150m for 100 beds, 200m x 150m for 200 beds, and 200m x 200m for 300 beds."

Yoshitake¹²⁶) describes each department based on American-style hospital management and evaluates three hospitals in the U.S. The central treatment department was positioned as a central facility where "advanced facilities are added or changed in response to the progress of medicine." Regarding the idea of dividing the central treatment department and wards into separate buildings and connecting all floors with a corridor, the report negatively says: "It is convenient to have a central treatment facility on the same floor that corresponds to the wards and the central treatment facility, and there is less congestion of elevators, but on the other hand, the connection with the wards is not always on a one-to-one basis and there is a lack of flexibility for future development." The reason for the difference in assessment with the current approach of making patient wards in independent building which grows and changes less is probably because of the impossibility of combining wards and central medical departments in the same department on the same floor.

Ref. 137 and 138 are encyclopedias of architecture and revised in 1980²¹⁶). 1956 edition recommended to adopt the new hospital management systems and standard designs because of “full of examples of how each successive expansion has made the system more disorderly and recommended to consider the rapid advances in medicine, medical practice and the development of the community at the same time.” It also states that the ceiling should not be set too high, which is a different approach from the current design. This is because “a hospital is divided into small rooms, and it is advisable to decide carefully not to raise the ceiling too high in view of the mood of the rooms and the economy. Note that the ceilings of operating theaters and X-ray rooms may be higher than others.”

Ref. 153-155 does not describe *growth and change* in the paper by Yoshitake, Ito, Ura, Kurihara and others on the architectural side, but describes the prospects for future changes in volume study and functional allocation as new hospital management becomes widespread. In contrast, the medical side¹⁵⁶) said “It is natural that a block system will be adopted. However, even then, we should have some foresight about future expansions and consider measures to deal with them. Block systems are far more difficult to expand than pavilion systems, and yet not a few of them do not take this into account at all.”

4.3 Rapid economy growth period (1960-1979)

Ref. 164 is a design collection. In the section “Flexibility is required for all buildings and facilities,” it states that “buildings and equipments must always be planned with enough flexibility to accommodate such movements” which mentions for the first time the relationship between *growth and change* and equipments. In addition, the collection of layout drawings places a “first-class plan of Architectural Institute of Japan competition design” at the beginning, emphasizing that the layout is ideal and prepared for future expansion as well.

In contrast, Ref. 165 is a design textbook. In the Foreword, Yoshitake says that he wanted to clarify the significance and content and to deal with the basic policy of the plan in depth and broadly because Ref. 164, which he also edited at the same time, focuses on design methodology. While he states “it is not necessary to raise the ceiling height too high except for the boiler room, kitchen, operating theater, and radiation therapy room,” equipment replacement was taken into account saying “In particular, regional hospitals need to leave space for future expansion, not only to increase the number of beds, but also to improve the standard of medical service in the region as a whole by improving treatment departments.” There is also Davies in the index, but Weeks, *growth and change* and *Growth and Change* have not yet appeared in the index.

Ref. 166 is a revised version of Ref. 165, with the underlined sections added and changed. "Consideration of future expansion is particularly necessary in hospitals. The potential for expansion varies from department to department and is especially great in the treatment department and patient ward. The decision on the floor height in the initial plan will affect the subsequent expansion plan, since hospitals with frequent cart movements will not have steps or ramps. Except for the boiler section, kitchen, operating theaters and radiation therapy rooms, the ceiling height does not need to be very high and can be the same" and the reference reads "It is not good to be too low as a whole, but it is more convenient for future additions to have a uniform height that is not too high. Also, extensions above the building should be avoided." There is no change in the index, so Davies is there, but Weeks, *growth and change* and *Growth and Change* are not yet available.

Ito¹⁸²⁾ states that "the architectural standards of some of our country's hospitals have already reached a considerable point," and Weeks appears for the first time in one of the issues "Hospitals with Hands" as "John Weeks has an insightful view as he cites hospitals, universities, laboratories, and airports as examples of buildings that are in a state of rapid change and calls them Indeterminate Architecture. Designing a hospital that will grow with time always requires a master plan that looks ahead to the future. It would be necessary to make an overall plan for the future as much as possible at this stage, and in any case, an attitude of constructing a part of it first. The above can be further translated architecturally as follows: Hospitals, depending on their scale, should be designed with as many wings as possible and their ends should be free endings. In other words, they should be divergent. It goes without saying that boilers and electrical equipment will need to be added as a result." While not mentioning the word *Growth and Change*, it details even aspects of the equipment, citing progressive patient care, linear accelerators, hyperbaric oxygen chambers, medical equipment and rehabilitation as causes of expansion and transformation.

Nikken Sekkei¹⁸³⁾ says "We have tried to respond to changes and additions. However, it is not possible for us architects alone to think about what treatment methods will be available in the future," calling for joint design with other professions. Around this time, suggestions for *growth and change* from practitioners began to be introduced, and the authors also discussed the need for hospital architects and consultants^{188,192,204,215}).

Here, Yanagisawa¹⁹⁴⁾ introduced *Growth and Change* for the first time, and a whole chapter was devoted to *Growth and Change*. This is also where *growth and change* appears in the book. Based on a survey of 10 hospitals in Aichi Prefecture, he discusses the causes of expansions and renovations, and introduces Northwick Park Hospital as an example of Indeterminate Architecture, with its layout and operating department expansion system.

Yanagisawa and Imai196) visited Weeks to show the design and construction site of Northwick Park Hospital, and also introduced the personality of Weeks and his office, explaining the theory and practice of Indeterminate Architecture with figures and photos. The latter half of the book concludes with an introduction to the plans of four overseas hospitals in consideration of *Growth and Change* and a proposal for the future of *Growth and Change* by comparing a case study of hospital expansion and renovation in Aichi Prefecture, which was introduced in Ref. 194. The general path, planning of structures and facilities that can be changed internally, identifying and separating the departments that will have *growth and change* are mentioned.

Furthermore, Yanagisawa200) reported on the construction site of McMaster University Hospital in Canada, which Weeks encouraged him to visit. The idea of combining a variable interior with basic structure of a large steel truss structure with Interstitial Space is not without problems, and he points out the difficulty of moving partition walls, the irrationality of dividing a small room into a large span, the difficulty of building an extension in the center of the building and many windowless rooms. He also poses the question of whether a rational system and a humanistic space are compatible and advocates a network from acute care to welfare.

Ref. 210 is a special issue that discusses the changes in hospitals from various perspectives, including medicine and economics. In the architecture section, Yoshitake wrote an essay entitled "Hospital Architecture of the Future" based on Nightingale's writings. There is no specific explanation, but it is accompanied by a diagram entitled "Plans for the redevelopment of several hospitals in London" (Fig.1, Davies, Weeks and others: a proposal around 1960, captioned in Ref. 210). Although Davies and Weeks are not mentioned, "Hospital has changed from a pavilion type to an "organic block" type, which is still in use today. In recent years, as building regulations in cities have become increasingly stringent and neighbors have become opposed to the idea of a giant building, it has become difficult to maintain this form, and it seems to me that hospitals would be better off going in the direction of amorphous rather than standard forms. In other words, the hospital should conform to the requirements of the regulations and be fluid in form, while each department should be strictly functional and complete, and each department should be connected to the other by using the latest construction and equipment technology." He advocates Indeterminate Architecture from the perspective of building regulations instead of *growth and change*. In order to realize this, "Prefabrication is unavoidable in the construction method and it is necessary to pursue the structural system, equipment wiring and piping system in parallel. Even if the external appearance of the hospital is destroyed by this kind of amorphism, each of the internal departments should be completed satisfactorily by pursuing new functions."

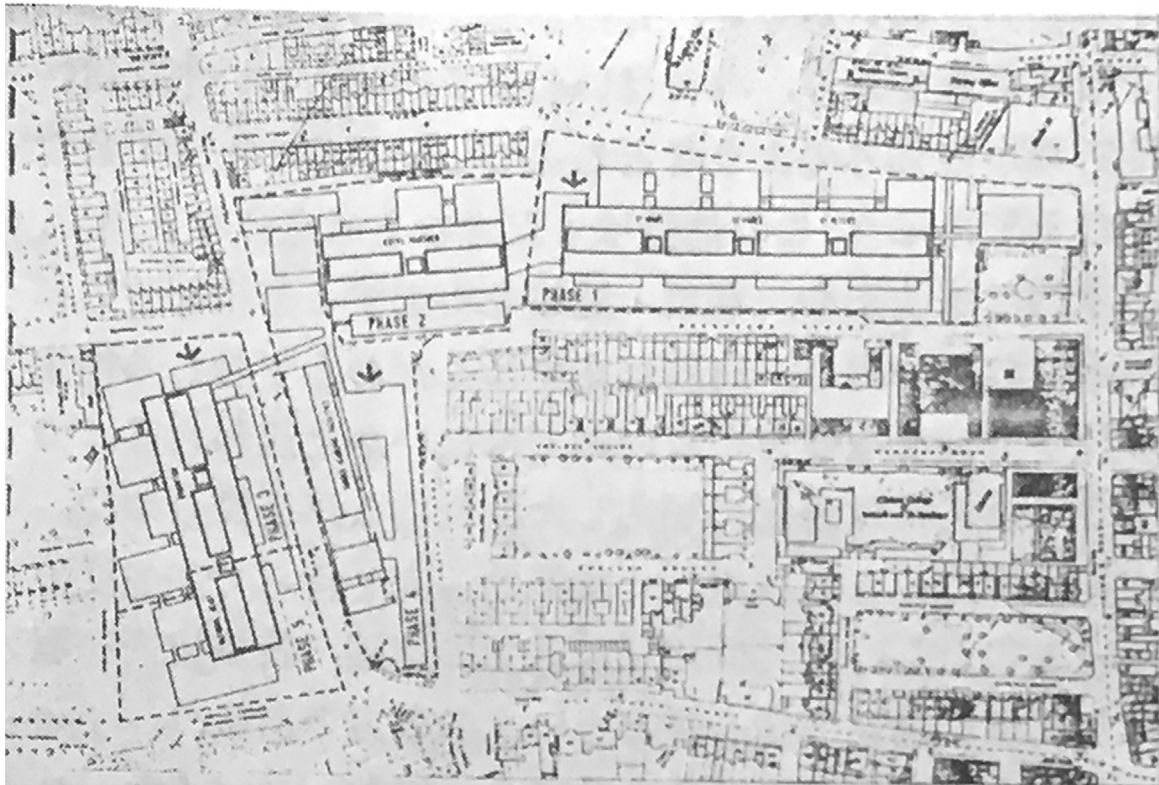
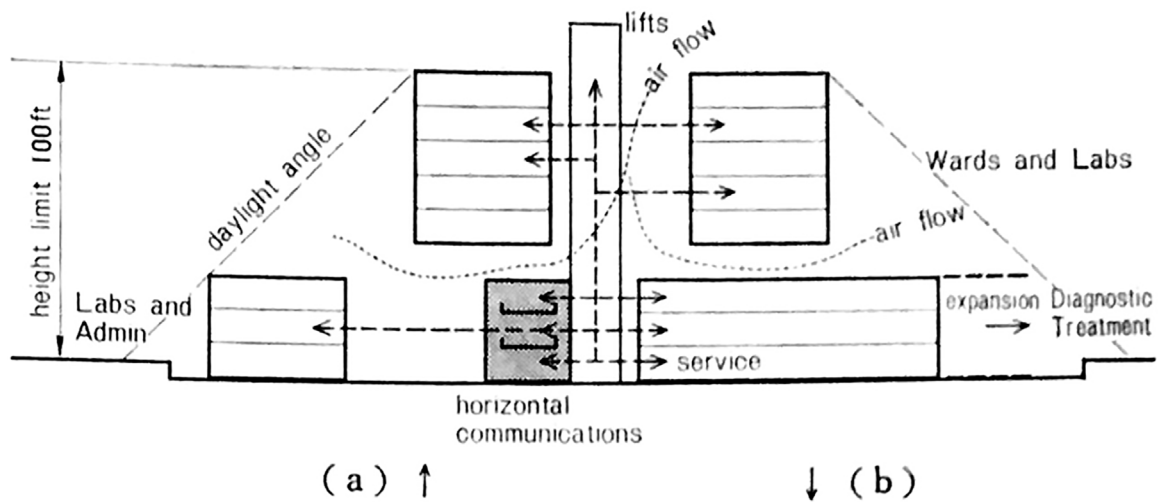


Figure 1. Several hospital redevelopment plan in the city of London, a proposal to build sequentially along the streets (b) in one system with section (a)

In an independent book on the design method and the actual work by Ogawa²¹¹⁻²¹³), he wrote: “The eight medical function groups can expand freely and will begin to grow around the central basic room as their contents change and enrich themselves with the development of medicine. The growth is not necessarily continuous but could be irregular, therefore the hospital architecture must be an instrument which can respond to them. It is also poetically stated that Extensions and alterations are

considered to be an architectural molting phenomenon, and this molting, which comes after maturity, may conceivably have a deeper meaning than nurture or maturity. Therefore, those who are planning additions and alterations must always ask about the past growth history of the hospital, analyze the contents of the present maturity and draw the future image of the hospital through additions and alterations."

4.4 Bubble economy period and later (1980-2004)

Ref. 216 is a revised version of Ref. 138. It includes a section "Space for future expansion," where the site area is quantified as "at least large enough to keep the floor area ratio below 100% as a rough guide." In the section "Responding to *growth and change*," it was noted that "All buildings are forced to be rebuilt, expanded or renovated in step with the times. This is especially true in the case of hospitals, and how buildings should respond to the *growth and changes* in their functions is now a common challenge to all countries." It shows the connecting corridor plan, the Chinese character "king"-shaped plan (outpatient department, central diagnosis department, and wards are arranged in parallel from the south and connected by central corridors), and the consolidated plan followed by the multi-winged plan, which is a "block plan that aims to respond relatively freely to *growth and change* without losing the organicity and functionality that are the strong points of the consolidated plan" with the building layout of Chiba Cancer Center. It also includes a new section "Responding to the *growth and change* in clinics," which specifically states "Nearly half of the clinics that have been in business for less than 10 years, more than three-fourths of those more than 10 years, and about 80% of those more than 20 years have expanded or renovated," and "The floor of treatment department in clinics with beds has increased significantly, from several times to nearly 10 times the size."

Ref. 218 divides nursing into Intensive Care and Total Care, and because it is the former that is changing, "In planning, it is advisable to place more weight on the latter, and to assess the trends and factors in the former before addressing them" and urges planning from a nursing perspective, which has never been done before. It also describes design techniques such as open-ended corridor, partitions by dry construction and equipment space, citing a departmental growth rate and acceleration study by Davies and Weeks.

Ref. 222 is a translation of "Hospitals and Health Care Facilities," McGraw-Hill, 1978, by the American architect Louis Gordon Redstone. The words *growth and change* are not used, but referring to the introduction of Medicare and Medicaid in the U.S., he wrote: "Because of the rapid developments and changes, not only in terms of health insurance,

but also in terms of the demands of the medical profession and the community, the planning of new hospitals should be designed to allow for maximum flexibility and there is an increased focus on considering future incremental development.” However, as “few hospitals are able to adequately respond to future changes in health care, the facilities currently under planning must be designed to accommodate the maximum amount of change or they will be obsolete upon completion. To this end, along with a large site and permanent corridor space, the main corridors, stairways and elevators should not be altered unnecessarily, so as to determine the pattern of the hospital’s expansions and renovations and to ensure that traffic routes are easily understood.” It is also specific to show “flexible and changeable transportation systems, long-span column in anticipation of internal changes and lateral expansion, easy-to-demolish buildings and reduction of built-in equipment.” The American way is that “profitability with respect to safety is as important as the relationship between quality and cost of architecture. Hospitals are no longer immutable and need to change constantly; they should be rebuilt on a 20-year or so cycle, with the expectation that there will be fundamental changes in 10 years or so,” a bold scrap-and-build proposal. The case study describes in detail the concept of Northwick Park Hospital and Weeks, but it quotes only Indeterminate Architecture, not *Growth and Change*, and says, “American readers may think indeterminate principle as unconstrained by the limitations of a program that has no basis in reality with respect to the lifespan of a project by feeling derogatory “ambiguity” or “unclear” in this phrase.” It indicates a difference in attitudes between the U.S. and the U.K..

Ref. 223 devotes almost all of its “Overall Plan” section to explaining *growth and change*. Although Weeks is not mentioned, “The first method of effective planning for “growth” is to make and put extra space. The second method is to build a system of buildings in anticipation of future additions and alterations. It is very meaningful to treat the wing-tips as indeterminate, not as complete.”

Yanagisawa²²⁷) discussed the relationship between facility management and *growth and change*. He mentioned Weeks, Indeterminate Architecture and Northwick Park Hospital, and pointed out that this kind of architectural response tends to be more about the hardware and less about the software with future changes in perspective. Facility management is also discussed in Ref. 233.

Ref. 228 is a revised version of Ref. 166. In the section “Responding to *growth and change*,” the authors categorized the response methods into four types: Up-front investment type, Pavilion type, Equipment floors and Multi-wing type. Up-front investment type is a method that we can hardly imitate, such as building only structural frame. In the “Pavilion type” section, Weeks’ Indeterminate Architecture and Northwick Park Hospital

are discussed along with the layout plan, but “it may not be so easy to make up for the labor spent in coming and going through the corridor. I can’t help but express my disapproval, as I feel that the daily burden is a bit too great for future growth.” In terms of the “Equipment floors,” “The question is whether it makes sense to allocate almost half the building’s volume to equipments regarding construction costs. Such a question or criticism is quite big in the West as well. There have been a few cases in which it has been used only in departments where the need is greatest, and this may be a very effective method.” The final section, “Multi-wing type,” was explained in detail, using the examples of Chiba Cancer Center and Sundsvall Hospital in Sweden, as “a *prima facie* answer to the growth change in the current situation in Japan.” In addition, *growth and change* appears in the index. The second edition²²⁹) evaluates “Equipment floor” as “this would be a clever choice because this would be a fairly effective method.”

Ref. 230 is a commentary on *Growth and Change* by Weeks himself, which has already been introduced by Yanagisawa and others, so there is nothing new in this paper. However, as it includes a diagram of Ashmore Village, it is useful for deepening our understanding of the hospital’s urban nature and its connection to *Growth and Change*.

Ref. 235 reviews the history of hospital architecture, citing examples from around the world. It begins, “In the U.K., the last architects grasping this situation were Davies and Weeks. They created a traditional indeterminate method. Their architectural principles allow for buildings that respond to orderly growth and gentle change.” The authors explain the drawings for Northwick Park Hospital, but say that they are ineffective in urban areas by quoting Weeks’ words, “What is really required is to design a building that is not best suited to a particular function, but at least does not interfere with the change in function.” The index also includes *growth and change*.

Ref. 236 summarizes the history, design methods and examples by building type and presents Weeks, *Growth and Change* and Northwick Park Hospital.

Ref. 239 is an examination of *Growth and Change* by Weeks himself. Northwick Park Hospital has undergone a major change, with the private St. Marks Hospital taking over the site where the Clinical Research Centre left off. There was only one example of an open-ended extension and the rest were unexpectedly built on vacant land or even rooftops. There were also extensions that obstructed Hospital Street and unexpected parking lot extensions, but the site was large enough to continue to grow.

The site visit and verification by Yamashita²⁴¹) also raised the issue of distance between central treatment department and emergency

department extension built beyond hospital street, which was made due to the closure of emergency facilities in the surrounding area. The deputy chairman of the NHS Trust also noted that the *Growth and Change* was a symbol, but not an ideal one.

5 Conclusion

A survey of the literature shows that *growth and change* was noticed by Mori¹³) and theorized by Takamatsu³¹) before Weeks. Although there was a large amount of literature on *growth and change* before the introduction of Weeks, some of the earliest examples focused on building additions to prepare for the rapid increase of wounded and sick due to epidemics and war.

After WW2, the Yoshitake's Model Plan^{96,103,104,106}) stated that sites for expansion should be prepared, and perhaps because of the presence of the Ministry of Health and Welfare in the background of their production, the idea of *growth and change* may have been popularized in various quarters of the medical community as well as architectural one. At the same time, Yoshitake and Ogawa's repeated and competitive translation of the U.S. design method for a general hospital that could be expanded^{87,102,118-121}) may have had an impact.

During the rapid economic growth period, hospital design methods were becoming widespread and the concept of *growth and change* was becoming commonplace, but a specific methodology for how to design for future preparedness had not yet been found. That's when Weeks' Indeterminate Architecture jumped in. It turned out that it was Ito¹⁸²) who first introduced Weeks to Japan in 1965, and Yanagisawa¹⁹⁴) who wrote *Growth and Change* four years later. According to the interviews with Yanagisawa and Nagasawa, who both are Yoshitake's apprentices, Yoshitake at that time made them study Weeks, so there is no doubt that it was Yoshitake who brought Weeks to Japan. *Growth and Change* spread quickly after that, and despite some skepticism from Ito and Yanagisawa, the Chiba Cancer Center was accepted as an example of its application and success.

After the bubble economy period, the rebuilding of the old hospitals constructed right after WW2 were once completed, and a review of the *growth and change* began in preparation for the next rebuilding. However, when a POE of the Northwick Park Hospital was carried out, including by Weeks himself²³⁹), it became clear that it was not necessarily the case that *Growth and Change* had been achieved according to the ideal.

In the pre-war to mid-war period, post-war to reconstruction period, rapid economy growth period and bubble economy period and later,

the percentages of articles describing *growth and change* and *Growth and Change* were 24.1%, 41.1%, 56.9% and 71.0% respectively, indicating that the impact of Weeks' work was significant. However, the "unavoidable relocation" of hospitals pointed out by Takeda⁶⁸⁾ is still common 80 years later, and the methodologies for vertical expansion, rejected by Osuga¹⁰⁷⁾ and Yoshitake¹⁶⁶⁾, have not yet been found. The aforementioned Figure 1 may be the basis for the consolidation of multiple hospitals and the reorganization of buildings promoted by the NHS in the U.K., but there may still be some lessons to be learned from Weeks in this small diagram.

References

All references are written in Japanese. They are listed in order of date of Publishing, but serials and minor revisions are listed consecutively. Following symbols have been added to the end of the references.

+ *growth and change* is mentioned, but no detailed explanation is given.

++ *growth and change* is explained in detail.

* *Growth and Change* is mentioned, but no detailed explanation is given.

** *Growth and Change* is explained in detail, but no mention of Ashmore Village.

*** *Growth and Change* is explained in detail and includes a description of Ashmore Village

No symbol: None of them are mentioned.

Pre-war to Mid-war Period (Before 1945), 20 papers with symbols out of 83

1) Nobuyoshi Tsuboi: Hospital Building Construction Law and Knowledge Requirements, Iji Zasshi, (6), 1874.2+

2) Tadanao Ishiguro: History of the Halkenstein Lung Hospital, Chugai Igaku Shimpo, (77), 1883.5

3) Yuzuru Watanabe: Architectural Law for Medical Clinics, Kenchiku Zasshi, 1(1), 1887.1

4) Hanroku Yamaguchi: Outline of Construction of Sewerage Pipes for the First Clinic of Imperial University, Kenchiku Zasshi, 2(19), 1888.7

5) Rintaro Mori: Nursing of Wounded Soldiers, Army Medical Training Course, 1889.3

- 6) Rintaro Mori: Hospital, Eisei Shinshi, (4), (6), 1889.3, 1889.6
- 7) Heidelberg University New Hospital, Kenchiku Zasshi, 3(33), 1889.9
- 8) Rintaro Mori: New Sanatorium built with Medical Design, Eisei Shinshi, (15), 1890.2
- 9) Jiro Tsuboi: Ventilation volume of a hospital room, Kenchiku Zasshi, 4(45), 1890.9
- 10) Aisue T.Y.: Treatise on Hospital Architecture, Kenchiku Zasshi, 8(86), 1894.2
- 11) Kotaro Sakurai: Hospital Construction Law, Kenchiku Zasshi, 10(113), 1896.5
- 12) Rintaro Mori and Masanao Koike: Hygiene New Edition, Nanko-do, 1896.12
- 13) Rintaro Mori and Masanao Koike: Hospitals, Hygiene New Edition, 2nd edition, Nanko-do, 1899.5
- 14) Rintaro Mori and Masanao Koike: Hospitals, Hygiene New Edition, 3rd edition, Nanko-do, 1904.10+
- 15) Rintaro Mori and Masanao Koike: Hospital, Hygiene New Edition, 5th edition, Nanko-do, 1914.9+.
- 16) Keikichi Ishii: Theory of Hospital Architecture, Kenchiku Zasshi, 11(128), 1897.8+
- 17) Keikichi Ishii: Hospital Architecture, Kenchiku Zasshi, 12(138), 1898.6
- 18) Shunro Watanabe: Infectious Disease and Barracks, Kenchiku Zasshi, 19(225), 1905.9
- 19) Hoyo Okawa: Hospital Construction, Special Building Law Part 2-5, Kenchiku Sekai, 5(1)-(5), 1911.1-1911.5
- 20) Excerpt from the examination bylaws for an application for establishment of a private hospital (Metropolitan Police Department) and Extract from Regulations to Control Infectious Disease Units in Private Hospitals, Special Building Law, Vol. 9, Kenchiku Sekai, 5(8), 1911.8
- 21) Sei Nobukawa: On Hospital Architecture, Part I-13, The World of Architecture, 6(2), (4)-(7), (9)-(12), 7(2)-(4), 1912.2-1913.4
- 22) Naito: Early Modern German Hospital Architecture (1)-(4), Kenchiku Zasshi, 26(308), (309), (311), (312), 1912.8-1912.12
- 23) Shibasaburo Kitasato (ed.): Social education and curing pulmonary tuberculosis, 1913.7

- 24) Tokyo City Hospital Building Regulation Draft, Kenchiku Zasshi, 29(353), 1915.12
- 25) Outline of the present regulations for hospitals, Kenchiku Zasshi, 29(353), 1915.12
- 26) Tokyo City Hospital Building Regulation, Kenchiku Zasshi, 31(369), 1917.1
- 27) Department of Health, Ministry of the Interior: Summary of Tuberculosis Hospitals, Sanatoriums and Tuberculosis Prevention Society, March 1919.
- 28) ST: A few thoughts on hospital construction (1), Architecture and Society, 5(4), 1922.4
- 29) Akira Uenami: Solar radiation in and around hospital buildings, Kenchiku Zasshi, 36(430), 1922.5
- 30) A reporter: Osaka Municipal Hospital to begin construction, Architecture and Society, 6(5), 1923.5
- 31) Masao Takamatsu: On the construction of hospital, The Journal of Medical Science and Devices, 1(5), (6), 1923.9, 1923.12
- 32) Masao Takamatsu: Ideal Hospital Architecture, New Tokyo and Architecture, Jiji-Shimpo-Sha, 1924
- 33) Takehira Okado: Hospital architecture Miscellaneous Impressions: Orders from patients, Architecture and Society, 8(7), 1925.7
- 34) Kemehisa Obata: Wish to be in hospital architecture, Architecture and Society, 8(8), 1925.8
- 35) Sukehachi Nagane: Study of Hospital Architecture, Kokusai Kenchiku Jiron, 1(1), 1925.9
- 36) E. F. Stevens: Design of a Hospital, Ika Kikaigaku Zasshi, 3(4), 1925.10
- 37) Mitsugu Yoshida: Hospital architecture, ARS Architecture, vol. 3, Arusu, 1926-1930+
- 38) Shogo Sakurai: On the Pharmacy Room in the Hospital, Kokusai Kenchiku Jiron, 3(2), 1927.2
- 39) Shogo Sakurai: On the Bathroom Facilities of Hospital, Kokusai Kenchiku Jiron, 3(3), 1927.3
- 40) Gennosuke Osawa: On the X-ray House, Kokusai Kenchiku Jiron, 3(4), 1927.4

- 41) Shogo Sakurai: On the Operating Room, Kokusai Kenchiku Jiron, 3(4), 1927.4
- 42) Sotusaburo Yamamoto: Psychological condition of the sick and miscellaneous impressions of hospital architecture, Kokusai Kenchiku Jiron, 3(4), 1927.4
- 43) Keisuke Murao: A review of tuberculosis sanatorium architecture, Kokusai Kenchiku Jiron, 3(4), April 1927.
- 44) Its Masuda: Construction requirements for hospitals, Kokusai Kenchiku Jiron, 3(5), 1927.5+
- 45) Ichiro Osawa: An Introduction to the Mechanical Equipment of Hospitals, Kokusai Kenchiku Jiron, 3(5), 1927.5+
- 46) Shogo Sakurai: On the Operating Room, Kokusai Kenchiku Jiron, 3(5), 1927.5
- 47) Toshiro Ichimori: On artificial lighting in hospitals, Kokusai Kenchiku Jiron, 3(5), 1927.5
- 48) Masao Takamatsu: On the architecture of hospitals, Ika Kikaigaku Zasshi, 5(1), (2), 1927.7, 1927.8
- 49) MT: Recent progress in overseas hospital planning, Nippon Kenchikushi, 1927.8
- 50) Chinosuke Yamada and Seiichiro Yamazaki: The Latest in Medical and Hospital Architecture and Design, Kanehara Shoten, 1927.9
- 51) Seiichiro Yamazaki: Latest Medical and Hospital Architecture and Design, 6th edition, Kanehara Shouten, 1935.1
- 52) Ichiro Osawa: Outline of Mechanical Equipment of Hospitals (2), The International Journal of Architecture, 4(1), 1928.1
- 53) Juro Kondo: The basic concept of hospital planning, Kenchiku Zasshi, 42(514), 1928.10
- 54) MT: Fire in hospitals and the building structure of special hospitals, Nippon Kenchikushi, 4(3), 1929.3
- 55) MT: Hospital facilities and their preparation, Nippon Kenchikushi, 4(4), 1929.4
- 56) MT: Lighting in hospitals, Nippon Kenchikushi, 4(5), 1929.5
- 57) Juro Kondo: Hospital architecture, The Pocket Book of Architectural Engineering, Maruzen, 1929.7

- 58) Juro Kondo: Hospital architecture, The Pocket Book of Architectural Engineering, Maruzen, 1933.5
- 59) Juro Kondo: Hospital architecture, The Pocket Book of Architectural Engineering, Revised edition, Maruzen, 1949.1
- 60) Juro Kondo: On the architecture of Tokyo Doai Memorial Hospital, Kenchiku Zasshi, 43(525), 1929.9
- 61) MT: Protection against radiation in the planning of the hospital's X-ray department, Nippon Kenchikushi, 5(5), 1929.11
- 62) MT: Trends in hospital construction lately, Nippon Kenchikushi, 5(5), 1929.11+
- 63) Gennosuke Osawa: Hospital and Clinic Construction and Their Equipments, Homeido Shoten, 1931.5+
- 64) Gennosuke Osawa: Hospital and Clinic Construction and Their Equipments, 3rd edition, Homeido Shoten, 1941.8+
- 65) Masao Takamatsu: Modern Western hospital architecture through "Nosokomeion," Kenchiku Zasshi, 46(565), 1932.12
- 66) Masao Takamatsu: Hospital, Higher School of Architecture Vol.15 Hotel, Hospital and Sanatorium, Tokiwa Shobo, 1933.5
- 67) Masao Takamatsu and Tomiya Ibona: Hospital Architecture (Building Section), (Equipment Section), Pamphlet of Architectural Institute of Japan, 5(7), 1933.5+
- 68) Goichi Takeda: Modern tendency of hospital architecture, Architecture and Society, 17(10), 1934.10+
- 69) Saburo Kajiwarra: A study of hospital architecture, Architecture and Society, 17(10), 1934.10
- 70) Kuro Washio: Tendency towards private rooms, Architecture and Society, 17(10), 1934.10
- 71) Saburo Okura: Some Problems in Hospital Architecture, Architecture and Society, 17(10), 1934.10
- 72) Ichiro Osawa: Hospital architecture and its mechanical facilities, Architecture and Society, 17(10), 1934.10
- 73) Kenzaburo Kumagai: On the architecture of special hospitals, Architecture and Society, 17(10), 1934.10
- 74) Masujiro Kinoshita: The characteristics and special facilities of Konan Hospital, Architecture and Society, 17(10), 1934.10

- 75) Tokio Mito: A few findings on the construction of tuberculosis sanatorium, *Tuberculosis* 13(6), 1935.6+
- 76) On the architecture of hospital, Masao Takamatsu's work and writings, Masao Takamatsu's memorial work, Sep. 1935.
- 77) shosaku Hariya: The present situation of tuberculosis sanatoriums in Japan, *Kenchiku Zasshi*, 51(624), 1937.3+.
- 78) Shujiro Haruki: Problems in the construction of tuberculosis sanatorium, *Tuberculosis*, 16(6), 1938.6
- 79) Jun Yamada: Study on hospital architecture and block plan, *Hospital*, Vol. 18, No. 5 (206), 1941.5
- 80) Kunitaro Ochiai: A study of the design of a hospital room for infectious diseases, *The Hospital*, No. 19(214), 1942.1+.
- 81) Outline of Construction of Japan Medical Unity Nuclear Sanatorium, *Hospital*, No.20(228), 1943.3
- 82) Ikuji Nishio: Equipment of university hospital seen from a clerical point of view, *Hospital*, No. 20(235), 1943.10
- 83) Shigeo Kono: Facilities of Japan Medical Center, *Kenchiku Zasshi*, 58(709), 1944.5+.

Post-war to Reconstruction Period (1945-1959), 30 papers with symbols out of 73

- 84) Hideto Kishida: On hospital architecture, *Medical Care*, 3(3), 1948.3
- 85) Fuminori Honna: Institutional facilities for patients, *Medical treatment*, 3(3), 1948.3
- 86) Seijiro Iwai: Institutional facilities for staff, *Medical care*, 3(3), 1948.3
- 87) Hospitals in the Chain System (1)-(5), *Kenchiku Bunka*, (27)-(31), 1949.2-1949.6
- 88) Tani: Japan's first Western-style hospital, *The Hospital*, 1(1), 1949.7
- 89) Yasumi Yoshitake: On the design of foreign hospitals, *Hospitals*, 1(2), 1949.8+
- 90) Eiichiro Hisamatsu: Visiting record of Center Hospital, *Hospital*, 1(2), 1949.8
- 91) Shintaro Kotani: Medical Treatment and Medical Institutions in the U.S.A. (1), (2), (3), *Hospital*, 1(4), (5), 1949.10, 1949.11

- 92) Y. Y.: A Brief History of Hospitals (No.1)-(No.19), Hospitals, 1(4)-6(6), 1949.10-1951.6
- 93) Senji Kobayashi: Hospital Architecture in Japan (1)-(4), Hospitals, 2(1), (3), (4), 3(1), 1950.1, 1950.3, 1950.4, 1950.7
- 94) Shintaro Kotani: Tuberculosis Hospital in the U.S., Hospital, 2(2), 1950.2
- 95) Fuminori Honna: About a few hospitals, Hospitals, 2(2), 1950.2
- 96) Ministry of Health and Welfare, Bureau of Medical Affairs: Outline of hospital site selection and construction plan, Hospital, 3(1), 1950.7
- 97) Building Research Institute: Collection of Model Building Drawings, Building Research Institute, 1950.10
- 98) Ryutaro Azuma: Minimum Standards for Hospitals in America, Hospitals, 4(1), 1951.1
- 99) Ministry of Health and Welfare, Health Bureau: Standard design of national health insurance clinics, National Health Insurance Research Committee, 1951.1+
- 100) Yasumi Yoshitake: On the design plan of hospital architecture, Kenchiku Zasshi, 66(771), 1951.2
- 101) AIJ (ed.): Architectural Design Materials Collection 2, Maruzen, 1951.2+
- 102) Translated by Eiichi Imamura, Takefumi Shimauchi: Elements of the General Hospital, Hospital, 4(3), (5), 5(1), (2), (5), (5), (6), 6(1), (2), (3), 1951.3-1952.3
- 103) Yasumi Yoshitake, Hiroshi Moriya, Yukio Yoshida: On the design of a 200-bed hospital, Hospital, 4(4), 1951.4+.
- 104) Hidetoshi Kishida, Yasui Yoshitake and Molin Kuo: Design of a General Hospital, Research Report of the Architectural Institute of Japan, 1951.5
- 105) Tuberculosis Prevention Division, Public Health Bureau, Ministry of Health and Welfare: A guide to tuberculosis sanatorium construction, Hospital, 4(6), 1951.6+
- 106) Junzo Sakakida: Guide to design of hospital buildings, Relief, (282), 1951.6+
- 107) Yanagi Osuga: Divisional architecture of the Small and Medium City General Hospital (1), (2), Hospitals, 5(2), (5), 1951.8, 1951.11++
- 108) Shigebumi Suzuki and Shunsuke Yamamoto: Hospital Design in Europe and America in 2.3, (13), 1951.8

- 109) Gennosuke Osawa: Architectural Drawings of Hospitals, Shokokusha, 1951.10
- 110) Gennosuke Osawa: Architectural Drawings of Hospitals, Revised and 10th Edition, Shokokusha, 1967.2
- 111) Shinichi Sekine: On the construction of a psychiatric hospital, Hospital, 6(1), 1952.1
- 112) Yasumi Yoshitake: On the Conditions for Designing a Ward and the Handling of Ward Blocks Two Problems of Ward Design in Japan, Kenchiku Bunka, (63), 1952.2
- 113) Yasumi Yoshitake: Report on Hospital Design in London Architectural Research Council (England, USA and Sweden), Kenchiku Zasshi, 67(784), 1952.3+
- 114) Shinichi Sekine: Management of Mental Hospitals, Hospital Encyclopedia 2, Igaku-shoin, 1952.8
- 115) Gennosuke Osawa: Planning of Medical Hospital Construction, Shokokusha, 1952.10+
- 116) Fuminori Honna: Equipment of Hospitals, Hospitals, 3, Igaku-shoin, 1952.10
- 117) Fuminori Honna: Progress of Hospitals, Hospitals, 7(4), 1952.10+
- 118) Takehiko Ogawa: Design and Structure of the General Hospital (1)-(10), Hospital, 7(5)-9(3), 1952.11-1953.9+
- 119) Takehiko Ogawa: Hospital Architecture Planning and Equipment, Shokokusha, 1955.9+
- 120) U.S. Department of Education and Health Sciences, Public Health Service (ed.), translated by Yasumi Yoshitake, Gentaro Watanabe, Makoto Ito: Design and Structure of the General Hospital, Sagami Shobo, 1956.11
- 121) U.S. Department of Education and Health Services, Public Health Service (ed.): Design and Structure of General Hospitals, revised edition, Sagami Shobo, June 1968
- 122) Committee of University Hospitals: Guidelines for improving University Hospitals, Ministry of Education, Culture, Sports, Science and Technology Monthly Report, 1953.1
- 123) Takashi Takano: Planning of General Hospital, Architectural Technology, (25), 1953.6
- 124) Kisaburo Ito: Department and Space of Modern Hospitals, Shinkenchiku, 28(10), 1953.10+

- 125) Ichiro Suzuki: On hospital planning, Kenchiku Bunka, (83), 1953.10
- 126) Yasumi Yoshitake: Central Clinic Facilities of Hospital, Kenchiku Bunka, (87), 1954.2
- 127) Hitoshi Hoshino: Renovation of a Medical Hospital and Design of an Infirmary, Kanehara Publishing, 1954.10
- 128) Hirotoshi Hashimoto and Kenichi Takino: Outpatient Care in Hospitals, Equipment and Function of Hospitals in Perspective 11, 1955.1
- 129) Hideya Kobayashi: Perspectives on the Construction Plan of University Hospital (1)-(5), Hospitals, 12(5), 13(1)-(4), 1955.5-1955.10+
- 130) Hirotoshi Hashimoto: Equipment and Functions of Modern Hospitals with Photographs, Hospital Encyclopedia 8, Igaku-shoin, June 1955.
- 131) Hideo Kunikata and Masataka Tanaka: The medical ward of Kanto General Hospital, Kenchiku Bunka, (104), 1955.7
- 132) Mamoru Yamada: Block plan of the General Hospital to which I was connected, Kenchiku Bunka, (104), 1955.7
- 133) A Study of the General Hospital Plan (Architectural Record), Kenchiku Bunka, (104), 1955.7
- 134) Yasumi Yoshitake: Planning of Hospital Outpatient Department, Kenchiku Bunka, (104), 1955.7
- 135) Planning of a hospital starts from the flow line, Kenchiku Bunka, (104), 1955.7
- 136) Special Issue on Hospital Architecture, Kenchiku Sekai, 5(4), 1956.4
- 137) Architectural Institute of Japan (ed.): Handbook of Architecture, Maruzen, 1956.12
- 138) Architectural Institute of Japan (ed.): Handbook of Architecture, 2nd edition, Maruzen, 1959.1+
- 139) Yasumi Yoshitake: Recent developments in hospital architecture, HOSPITALS, 16(2), 1957.2+
- 140) Takefumi Shimauchi: Hospital Management, Byoin Zensho 10, Igaku-shoin, 1957.3+
- 141) Takefumi Shimauchi: Hospital Administration, 2nd edition, Igaku-shoin, 1967.10
- 142) Takashi Hirayama, Kunio Maekawa, Yasumi Yoshitake *et al.*: Shinsei Kenchiku Keikaku, 1957.4+

- 143) Makoto Ito: Some Problems of Hospital Architecture in Modern Japan, *Shinkenchiku*, 32(5), 1957.5+
- 144) Yasumi Yoshitake: Recent developments in hospital architecture, *Shinkenchiku*, 32(5), 1957.5+
- 145) Eiichi Imamura: The reality of hospital management, *Igaku-shoin*, 1958.4+
- 146) Yasumi Yoshitake: Hospitals in England and Germany, *The Hospital*, 17(6), 1958.5
- 147) Takehiko Ogawa: Hospital architecture in Europe, *Hospitals*, 17(6), 1958.5
- 148) Shogo Sakurai: Building Facilities of Hospitals in Europe, *Hospitals*, 17(6), 1958.5
- 149) Yasumi Yoshitake and Takehiko Ogawa: Graph of European Hospital Architecture, *Hospitals*, 17(6), 1958.5
- 150) Tokutaro Nishijima: Attendance at the first International Hospital Architecture Seminar, *Hospitals*, 17(6), 1958.5
- 151) Hiroshi Moriya, Takehiko Ogawa, Shogo Sakurai, Yukio Yoshida, Yasumi Yoshitake, Hospital Architecture in Europe, *Hospitals*, 17(6), 1958.5
- 152) Takehiko Ogawa: Hospital Architecture in Europe, *Shokokusha*, 1959.3
- 153) Yasumi Yoshitake and Makoto Ito: On recent medical facilities, *Architecture and Society*, 40(10), 1959.10
- 154) Ryoichi Ura: A proposal for a future medical and health care facility network (A proposal for a large housing complex), *Architecture and Society*, 40(10), 1959.10
- 155) Makoto Ito and Kaichiro Kurihara: On the type and size of nursing units, *Architecture and Society*, 40(10), 1959.10
- 156) Rurushige Miura: A critical look at hospital architecture, *Architecture and Society*, 40(10), 1959.10+

Rapid Economy Growth Period (1960-1979), 33 papers with symbols out of 58

- 157) Yasumi Yoshitake: Tokoname City Hospital, *Kenchiku Bunka*, (159), 1960.1
- 158) Shingo Kawamura: Problems in Hospital Facilities, *Kenchiku Bunka*, (159), 1960.1

- 159) Japan Institute of Hospital Architecture (ed.): Illustrations of Hospital Architecture in Japan, Shokokusha, 1960.2+
- 160) Yasumi Yoshitake, *et al.*: A Study on Architectural Planning of Hospitals, Annual Report of the Architectural Institute of Japan, 1960.7
- 161) Yasumi Yoshitake: Hospital Architecture and Its Functions, The Complete Collection of World Architecture 12, Modern III: Bunka To Kosei, Heibonsha, 1960.8
- 162) Yoshitake Laboratory: Architectural Planning Note (2), Shokokusha, 1960.9
- 163) Kenji Danno, Yasumi Yoshitake, Shogo Sakurai: Architecture and Facilities of Hospital, Problems of Hospital Architecture and Facilities, Hospital, 19(9), 1960.9
- 164) Architectural Institute of Japan (ed.): Architectural Design Materials Collection 2, Maruzen, 1960.12
- 165) Yasumi Yoshitake *et al.*: The University of Architecture <35> Hospital, Shokokusha, 1962.6+
- 166) Yasumi Yoshitake *et al.*: The Newly Revised College of Architecture <35> Hospitals, Shokokokusha, 1969.3+
- 167) Yasumi Yoshitake: The trend of hospital architecture and future problems, Hospitals, 21(10), 1962.10+.
- 168) Yasumi Yoshitake: Planning the Design of Hospitals Length of Stay and Design Planning, Mathematics Seminar, 2(7), 1963.7
- 169) Hospital Architecture Research Group (ed.): Hospital Function and Architecture, Science and Technology Library, Sept. 1963.
- 170) Hirotoshi Hashimoto: A Photographic Commentary on Hospital Management, Igaku-shoin, 1963.11
- 171) Yasumi Yoshitake: Hospital attached to the Cancer Institute, Kenchiku Bunka, (205), 1963.11
- 172) New Clinic/additional volume: Planning and design of clinic architecture, Physicians' Drug Publishing, 1964.1
- 173) Yasumi Yoshitake: On recent hospital architecture, Juntendo Medical Journal, 9(3/4)(634), 1964.3
- 174) Yasumi Yoshitake: Hospital architecture, Hospital, 23(6), 1964.6
- 175) Kisaburo Ito: Hospital architecture plan 1-6, Kenchiku Sekai, 13(10), (12), 14(1), (2), 15(7), (8), 1964.10-1966.8

- 176) Yasumi Yoshitake: Study on architectural planning Architectural planning on the usage of buildings, Kajima Publishing Company, 1964.12
- 177) Planning and Design of Medical Clinic Architecture Vol. 1, Medical and Dental Publishing, 1964.12
- 178) Planning and Design of Medical Clinic Architecture Vol. 2, Medical and Dental Publishing, 1965.2+
- 179) Planning and Design of Medical Clinic Architecture Vol. 3, Medical and Dental Publishing, 1967.5+
- 180) Hiroshi Moriya, Yasumi Yoshitake *et al.*: New Hospital Facilities, Ika Kikaigaku Zasshi, 35(1), 1965.1
- 181) Japan Institute of Hospital Architecture (ed.): Illustrations of Hospital Architecture in Japan, Shokokusha, April 1965.
- 182) Makoto Ito: The future of hospital architecture, Architecture and Society, 46(12), 1965.12
- 183) Nikken Sekkei Hospital Planning Study Group: From the perspective of an architect, Architecture and Society, 46(12), 1965.12+
- 184) Yasumi Yoshitake, Ryoichi Ura, Masao Hayakawa, Norio Nishino, Makoto Ito: Aichi Cancer Center, Shinkenchiku, 41(4), 1966.4
- 185) Yasumi Yoshitake: The design of rehabilitation facilities(2) Rehabilitation Center of the University of Tokyo Hospital, Hospital, 26(1), 1967.1+
- 186) Yasumi Yoshitake: Introduction to architectural planning (1), Corona, 1967.3+
- 187) Yasumi Yoshitake: Hospital architecture and ergonomics, Rinsho Kagaku, 3(6), 1967.6
- 188) Nikken Sekkei: Hospital Architecture, 1967.11
- 189) Takefumi Shimauchi: Hospital Administration, The Latest Nursing Encyclopedia, Special Volume 4, 1967.11+
- 190) Kiyonobu Mikanagi: Fundamentals of hospital architecture, Chiryo, 50(1), 1968.1
- 191) Hospital architecture (Kehiko Ogawa & Associates), Architecture, (94), 1968.6
- 192) Nikken Sekkei Hospital Planning Study Group: Hospital Design Theory, Architecture and Society, 49(6), 1968.6

- 193) Eiichi Imamura: Theory and practice of hospital management, Igaku-shoin, 1968.11+
- 194) Tadashi Yanagisawa: Growth and change in hospital architecture, Journal of Contemporary Medicine, 17(1), 1969.9***++
- 195) Tota Nomura: The present situation and new direction of medical facilities in Europe and America-1, Kenchiku Bunka, (277), 1969.11+
- 196) Tadashi Yanagisawa and Shoji Imai: Designing for Growth and Change: A New Approach to Hospital Architecture, Kenchiku Bunka, (278), 1969.12***++
- 197) Makoto Ito: Hospitals, Architectural Planning 10, Maruzen, 1970.7+
- 198) Ryoichi Ura *et al.*: Medical Care, Architectural Planning 4: Community Facilities, Maruzen, June 1973.
- 199) Architectural Institute of Japan (ed.): A History of the Development of Japanese Architecture, Maruzen, 1972.9
- 200) Tadashi Yanagisawa: McMaster University Health Science Center, Hospital Architecture, (17), 1972.10*++
- 201) Makoto Ito: Hospital architecture and ward equipment, Ika Kikaigaku Zasshi, 43(9), September 1973.
- 202) Makoto Ito *et al.* ed: Building, Equipment and Medical Devices, Hospital Administration Series, Volume 6, II, Igaku-shoin, 1974.1++
- 203) Yasumi Yoshitake: Introduction to Hospital Design Planning, The College of Modern Surgery 1, Nakayama Shoten, 1974.12+
- 204) Nikken Sekkei: Hospital Architecture, Nikken Sekkei, 1975++
- 205) Tadashi Yanagisawa: Medical equipment from the viewpoint of hospital architecture, Ika Kikaigaku Zasshi, 45(11), 1975.11++
- 206) Katsuhiro Hayashi: Hospital Architecture from the Viewpoint of Medical Equipment, Journal of Medical Instrumentation, 45(11), 1975.11+
- 207) Sadamitsu Masuda: Hospital Architecture from the viewpoint of Medical Equipment -Focusing on the wall system of ICU and CCU-, Journal of Medical Instrument Science, 45(11), 1975.11
- 208) Japan Institute of Hospital Architecture (ed.): Illustrations of Hospital Architecture in Japan, Kajima Institute of Technology, 1976.4+
- 209) Special Issue on Hospital Architecture, Kenchiku Gaho, 12(108), 1976.11++

210) Yasumi Yoshitake: Hospital architecture in the future, Hospital, 38(1), 1979.1

211) Takehiko Ogawa: Structure of hospital architecture, Kajima Institute of Technology, 1979.8+

212) Takehiko Ogawa: Structure of hospital architecture, Kashima Institute, 1987.12+

213) Takehiko Ogawa: A method of hospital formation for planning and design practice, Kajima Publishing House, 2000.5++

214) Architectural Institute of Japan (ed.): Architectural Design Materials Collection 6 Architecture-Life, Maruzen, 1979.10+

Bubble Economy Period and Later (1980-2004), 22 papers with symbols out of 31

215) Kajima Corporation Architectural Design Division: Hospitals As a guide for those who build, 1980++

216) AIJ (ed.): Handbook of Architecture I, Planning, 2nd edition, Maruzen, 1980.2++

217) Kensetsu Kogyo Chosaikai: Base Design Document for Hospital Facilities, Kensetsu Kogyo Chosaikai, 1980.4+

218) Yasumi Yoshitake: Introduction to Hospital Construction Planning, Hospital Management System Volume 6, I, Igaku-shoin, 1980.11++

219) New Japan Institute of Architects (ed.): Medical Hospital I: Private Clinic, Shokokusha, 1983.12

220) New Japan Institute of Architects (ed.): Medical Hospital II: Private Hospital, Shokokusha, 1984.5

221) S. Nagel + S. Reinke, translated by Katsuo Komuro: Hospitals, Special Hospitals, World Architecture Photo Series 12: Medical Facilities, Shubunsha, 1984.2+

222) Lewis G. Redstone (ed.), translated by Kazuo Tanaka: Hospitals and Medical Facilities, Contemporary Architecture, 1984.11**++

223) Kenchiku Shicho Kenkyusho Kenkyusho (ed.): Hospital Architectural Design Materials 11, Architectural Materials Research Co.

224) Medical Clinic Planning Editorial Committee (ed.): Examples of Hospital Planning and Design, Shokokusha, 1986.7+

- 225) Medical Clinic Planning Editorial Committee (ed.): Examples of medical clinic planning and design, Revised edition, Shokokusha, 1997.12
- 226) Japan Hospital Architecture Association (ed.): Architectural drawings of modern Japanese hospitals, Kajima Publishing, 1986.11+
- 227) Tadashi Yanagisawa: Growth, Change and Facility Management, Hospital Facilities, 29(4), 1987.7*++
- 228) Makoto Ito *et al.*: Shin Kenchiku Taikei <31> Hospital Design, Shokokokusha, 1987.9**++
- 229) Makoto Ito *et al.*: Shin Kenchiku Taikei <31> HOSPITAL DESIGN, 2nd edition, Shokokusha, 2000.8**++
- 230) J. Weeks, translated by Yasushi Nagasawa: Geography of Hospitals, Hospitals, 46(11), 1987.11***
- 231) Choichi Shinya: A Historical Study of Hospital Architecture in Modern Japan, Kyushu University, 1988.2
- 232) Yasumi Yoshitake: The process of making a model plan for a general hospital (1950), Proceedings of Kanto Branch of Architectural Institute of Japan, (59), 1989.11
- 233) Saburo Kamibayashi: Handbook of Hospital Facilities, Japan Planning Center, Nov. 1989
- 234) Robert Visscher, translated by Hille Lau and Katsuo Komuro: New Challenges in Hospital Architecture: The Coming of the Age of All Private Rooms, Shubunsha, 1990.12
- 235) W. Paul James, William Tatton-Brown, Yutaka Kawaguchi, translated by Midori Nomura: Hospitals: The Development of Hospital Architecture, Planning and Design, Soft Science, 1992.2+**
- 236) S.D.S. Editorial Board: S.D.S. Space Design Series Volume 4: Medical and Welfare, New Japan Hoki Publishing, 1995.7**++
- 237) Sumio Fujie *et al.*: Architectural Planning and Design Series 16 Health Care Facility, Ichigaya Press, 1999.8++
- 238) Kenchiku-Shicho Kenkyusho Kenkyusho (ed.): HOSPITAL 2: Architectural Design Document 72, Architectural Materials Research Co.
- 239) J. Weeks, translated by Yasushi Nagasawa: Can hospitals cope with growth and change? Validation at Northwick Park Hospital, Hospital, 59(9), 2000.9+**

240) Architectural Institute of Japan (ed.): Architectural Design Documents: Welfare and Medical Care, Maruzen, 2002.9+

241) Tetsuro Yamashita: Verification of Growth and Change of hospitals, Hospitals, 62(4), 2003.4++**

242) Jun Ueno *et al.*: A study of the planning history of hospital architecture in post-war Japan, Japan Health and Welfare Architecture Association, 2004.6+

243) Yasumi Yoshitake: Brief Description of Architectural Design Studies I, 2004.11

244) Yasumi Yoshitake: A Brief History of Architectural Design Studies II, Nov. 2004.

245) Yoon Seowon: A Study on Formal Standards in Japanese Modern Hospital Architecture, University of Tokyo, March 2007.

A study on hospital infection control through architecture in 1980: Chapecó Regional Hospital case study

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Abstract

This article is part of a master's research that seeks to investigate architectural developments in healthcare spaces through social, technological, and legislative influences. Part of the work presented here seeks to exemplify and illustrate by means of a case study of how Infectious-Predictive Architecture appeared in Brazil between 1974 and 1994. The Hospital Regional de Chapecó (Santa Catarina), designed by Irineu Breitman in 1980, is analyzed with markings and re-reading of the design plans and points out the design strategies applied in the built environment in order to contain the spread of diseases. The time frame is due to the fact that federal legislative changes have occurred in the period driven by technical support that questioned and transformed the existing paradigms. Through the study, the solutions applied in each situation are questioned, and it is not always possible to understand the design techniques used.

Keywords

hospital architecture, infection control design, architectural design.

A study on hospital infection control through architecture in 1980: Chapecó Regional Hospital case study

Since the emergence of hospitals, numerous changes have occurred due to different factors from several areas of knowledge. Throughout history, the healthcare setting has improved significantly, consequently changing the hospital architectural space. These changes occurred due to new medical principles and procedures, as well as technological innovations, mainly in the health and construction areas. But it is only from the middle of the twentieth century that the beginning of the formulation of Brazilian regulations related to the formation of these environments can be observed.

These regulations arose from the need to generate a minimum standardization in some environments of the hospital so that it could offer the best ergonomics and flow to patients and clinical staff. They reflected the “good practices” gradually built and listed, in addition to the medical knowledge of each period.

Among these reflections seen in hospital regulations in Brazil, we highlight here the Construction and Installation Regulation for the General Hospital, issued by the Federal Government in 1974 and that brought to the legal records the concern about the control of nosocomial infections.

Throughout the 20th century there were several important moments in the change of paradigms regarding the control of contagion and hospital infections. For example, in the 1970's the regulation suggested professionals should: “Avoid crossing clean and contaminated traffic” (BRASIL, 1974, p.5). This recommendation referred to the use of corridors known as “dirty and clean”, which controlled, for example, the entry of clean clothes in the environment and the exit of waste by another path. This is how the sectors containing operating rooms and nurse stations used to be designed. In the 1970's, it used to be strongly recommended for the project to have two circulation corridors, which increased the circulation areas in any hospital plant.

In 1994, the new federal legislative regulation is released addressing healthcare facility physical designs already considering the common knowledge that contagion issues could be controlled with proper hygiene, through asepsis. Such a knowledge emerged in 1980 when the so-called Infection Control Design (BRAZIL, 1995) started to be employed along with medical procedures in the search for the improvement of cure and prevention of nosocomial infections.

The Infection Control Design aimed at achieving safer hospitals, often without a thorough scientific basis. Infection Control Design was the name

given to actions imposed by 1974 regulations, such as septic operating rooms, surgical ward with double aisle, private elevators and freight elevators to transport “dirty” waste, i.e. potentially infectious waste, among others.

In 1980 the consolidation of hospital infection prevention is reformulated. From this point on, through worldwide publications, the understanding of Infection Control Design begins to change. Official documents used to refer to previous practices as “useless magical rituals that only increase hospital costs” and that would be revealed by the new regulation based on technical and scientific findings (BRAZIL, 1995, p.15).

It was in the 1980s that the Universal Precautions, Safety Procedures, and the adoption of Individual Barriers (gloves, apron, mask, and safety goggles) became part of employees and the general public routine within healthcare facilities. By understanding and comprehending individual safety actions in these spaces, hospital architecture becomes collaborative - and no longer decisive - providing the environment accurately for these actions to happen:

(...) a sink, per room, undoubtedly constitutes a solid support to the implantation of the new tendency of care; as well as: water tap, activated by foot command or by other means, able to free the hands and preserve them from contamination; and, also, the provision of space under the sink for the placement of a plastic bag-holder for dirty clothes, a plastic bag-holder for solid residues and a solid container for the safe collection of used injection needles and other sharps, complete the required support: Raised shelves, above the sink, for the storage and ready-use, always at hand, of the “individual barriers” (gloves, mask, apron and others). Elevators and freight elevators are the usual means of transporting clothing; when bagged and packed in closed cars, they do not require additional precautions or safety; the recommendation that transportation be done by elevators, preferably destined for services, or that do not carry patients at the same time, are dictated only for reasons of “humanization” and discipline (BRAZIL, 1995, p.32).

Based on this, the present article presents an analysis of Chapecó Regional Hospital based on remarks and re-reading of the architectural project, as well as supported by beliefs and legislation in force at the time for the best understanding. The choice of this architecture, signed by Irineu Breitman, is justified by the date it was conceived, i.e. 1980. It was a hospital project legally oriented by the restricted regulations of 1974 and executed in a moment of changing knowledge regarding infection control hospital design architecture.

The material used here is part of a broader research, where a new case study is added later, representing the architectural thinking after the

1994 regulation. Our purpose at this point is to illustrate and understand how this knowledge and regulations were translated into the hospital architectural space, considering its peculiarities.

Chapecó Regional Hospital

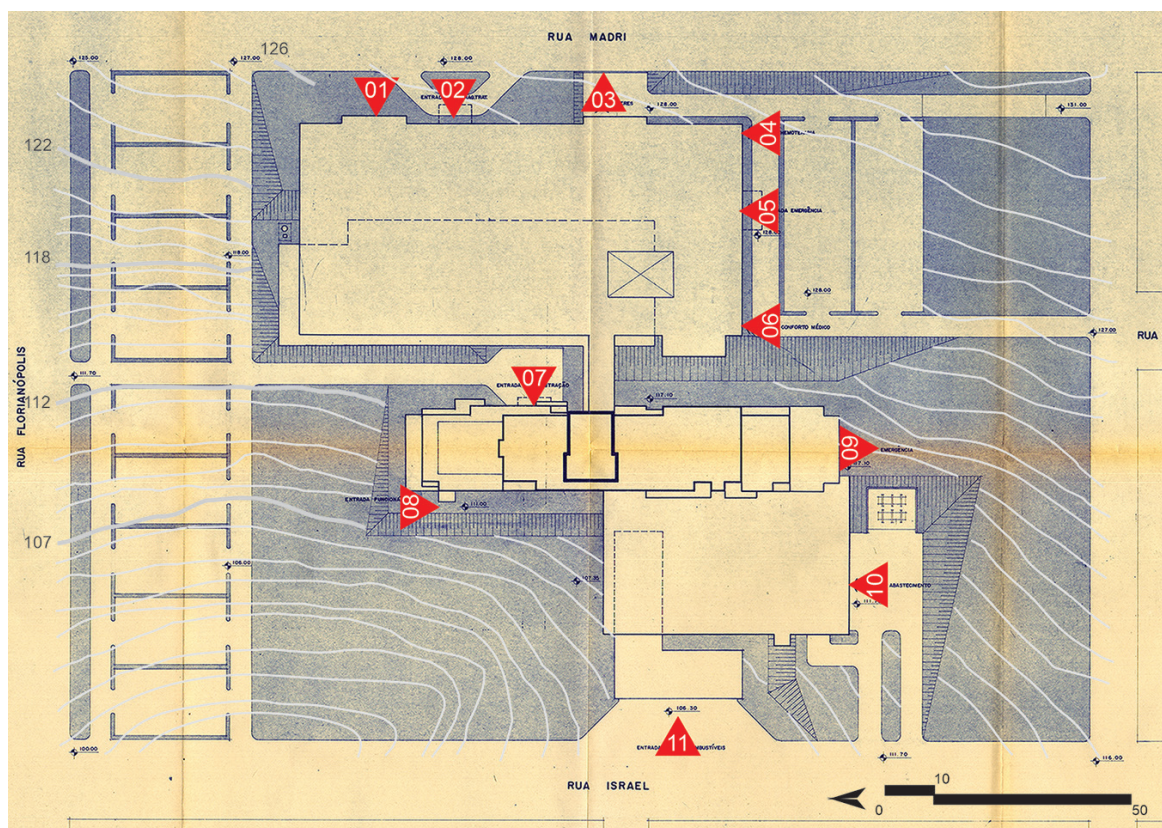
Irineu Breitman was the architect responsible for designing this project being presented and studied here. He also founded, in 1970, HOSPLAN, later renamed to HOSPITASA, which was the office responsible for the project of Chapecó Regional Hospital. The team, besides Irineu, was composed by two other architects and a consulting physician. Their projects presented very striking characteristics seen in other projects by Irineu: predominance of horizontal design as well as favoring natural ventilation and insolation (VICENTE, 2018).

Located in the city of Chapecó, in Santa Catarina state, the building of Chapecó Regional Hospital started in 1982, and in 1986 it was open to the public with 60 beds available. Currently it is known as Western Regional Hospital. As verified in the analysis of the architectural technical drawings in Irineu Breitman's design, the original 1980's design had six main floors, occupying an area of approximately 35 thousand square meters.

The site had 15% inclination in the east-west axis. To obtain six floors, Breitman used 5 plateaus - at elevations 126, 122, 118, 112 and 107 (Illustration 1), therefore naming his design vertical-staggered, connecting the floors through a rigid core (elevators and stairs), allowing direct access to each area.

In Illustration 2 it is possible to see the cuts made in the site and each floor setting. Through sections 2 and 3 it can be observed that the east wing of the fourth floor is partially buried. Breitman justifies his choice: "The need to provide most of these services with air conditioning was explored by placing them on floors with less possibility of lighting and ventilation", a reference to surgical and intensive care services, as will be shown in the individual floor study.

On the first floor were placed boiler and air conditioning centers. It has direct access from Israel Street, and it is supported by the plateau at elevation 107. It also offers direct access for vehicles into the garage and individual accesses into other rooms. In a statement collected for his dissertation research, Lucio Breitman - Irineu's son - pointed out that the difficulty imposed by the high inclination of the terrain made possible the implementation of underground galleries below the first floor, which allowed an easier and faster access to and maintenance of other floors.



LEGENDA			
01 - Acesso Bar	03 - Saída Cadáveres	06 - Acesso Conforto Méd.	09 - Saída Emergência 3 pav.
02 - Acesso Geral	04 - Acesso Exames Sangue	07 - Acesso Administração	10 - Acesso Abastecimento
	05 - Acesso Emergência	08 - Acesso Funcionários	11 - Acesso Óleos Combust.

Illustration 1. Chapecó Regional Hospital Implementation

Source. IPH Collection, 1980. Adapted by the author

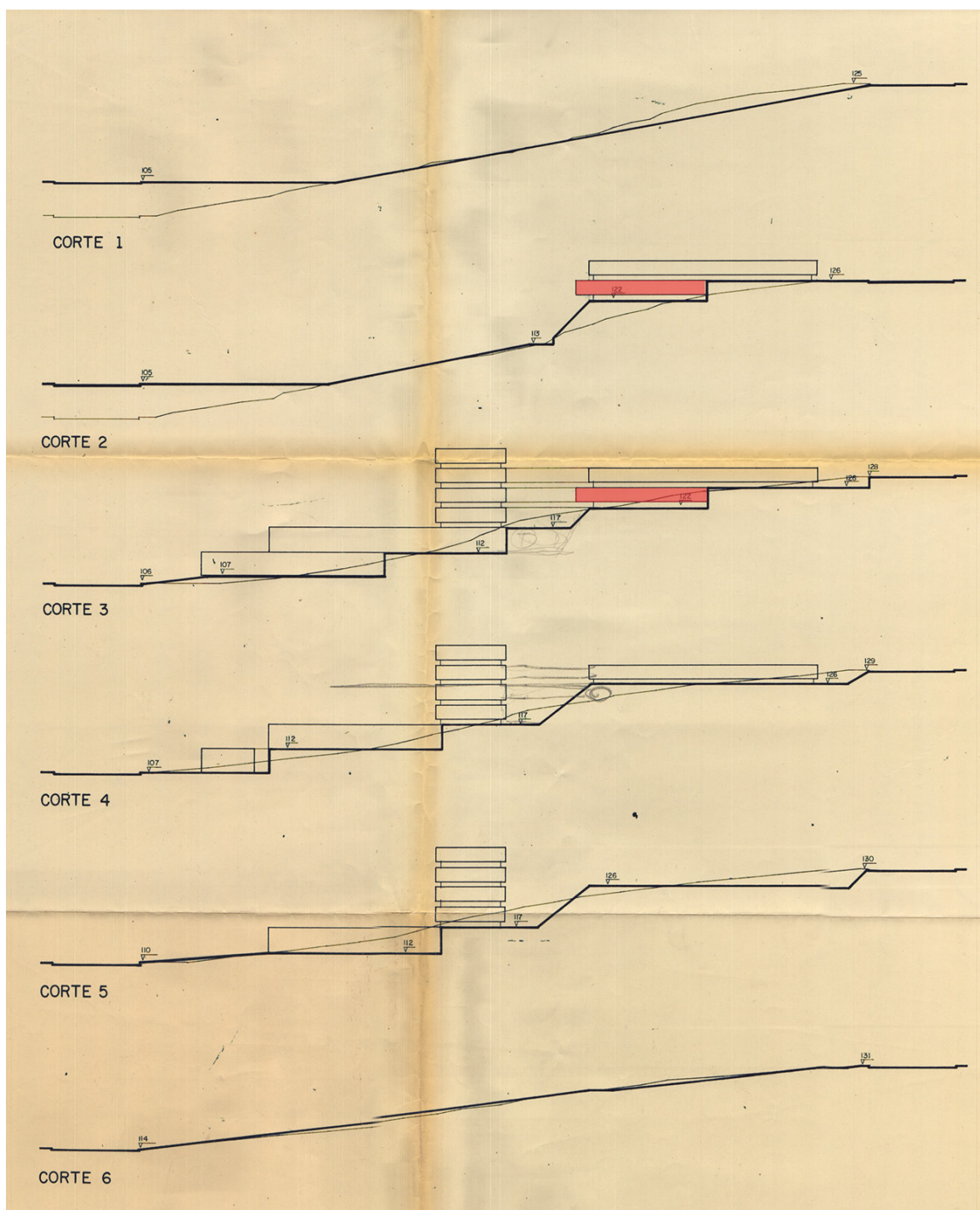


Illustration 2. Schematic cuts of plateaus included in the site, emphasis on the 4th floor
Source. IPH Collection, 1980. Adapted by the author.

The second floor (Illustration 3) is served with an employee access on the north façade, a service access on the south façade, and a third access for the general public located on the east façade. The left block shelters general administrative services and a hospitalization area. The connection with the rest of the floors is through this same block by an enclosed stairway and three elevators. The flows are set apart by the location of the accesses and the distribution of the internal environments, which create a barrier and guide the public.

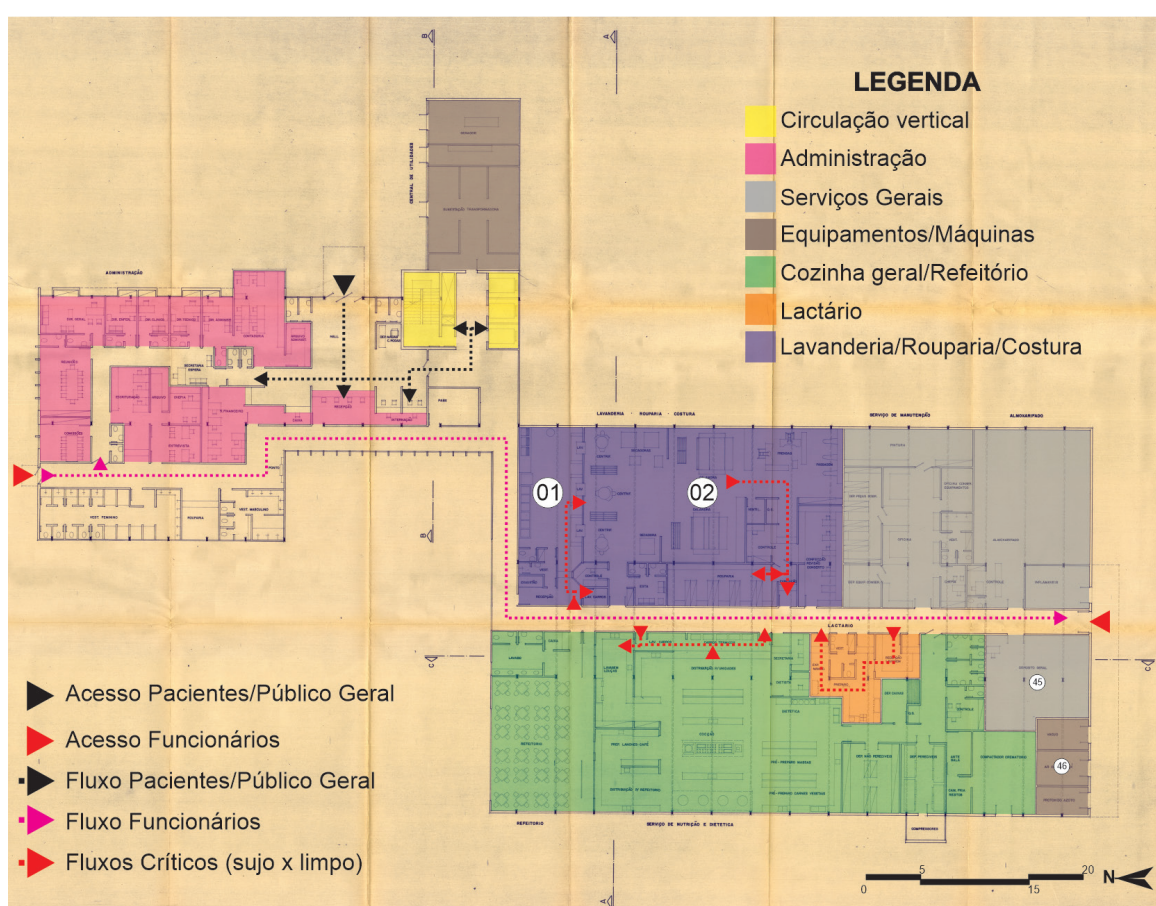


Illustration 3. Chapecó Regional Hospital: 2nd floor
Source. IPH Collection, 1980. Adapted by the author.

The block on the right is served with laundry, kitchen, lactation room, maintenance room, and storeroom services. This block reflects the main beliefs of the time through its architectural design.

Although already equipped with some technological advances and knowledge regarding medical processes, hospitals in the 1980s still hold the architectural solutions accountable for the prevention of infections.

These solutions played the role of building maintenance. The term used by Karman (2011) years later refers to the action of anticipating and executing an architecture that prevents and anticipates the facts so feared at the time.

An example of this belief in Brazil appears in 1972 with Jarbas Karman when he defines the laundry as “a central station that receives and distributes germs.” (KARMAN, 1972, p.59). In 1976 the American Hospital Association publishes the third edition of Hospital Infection Control, and regarding the laundry room it is stated, “In addition to the room for sorting and storing, the laundry room must have separate rooms for processing, stocking clean linen, and sewing for sanitary facilities, and for an office.” (AMERICAN, HOSPITAL ASSOCIATION, 1976, p.59).

We highlighted the flow cited by the American Hospital Association in Illustration 3, which happens through the access, followed by dirty clothes carts passing through a contact-free and isolated room. Between separation and the completion of washing there are no direct exchanges between physical agents, only through the double door washing machines.

The room dedicated to the last phase of washing includes a control antechamber, centrifuges, dryers, calender, presses, ironing, and a new control room. The flow happens from left to right, and before reaching the linen room for new distribution it also passes through the sewing area. This flow and distribution make up the barrier system, delimiting the contaminated and disinfected areas (numbers 1 and 2, respectively) (BRAZIL, 1995).

In the lactation room and in the kitchen the idea of a barrier system is repeated. There is an area to welcome “contaminated” carts, which furthers the distribution of dirty dishes to another environment and carries out the exit for distribution through another access, the “clean” one. Karman (2011) described the rooms making up the kitchen area through the barrier system that was already a reality in 1980:

Under the aspect of physical planning, the conventional system contemplates the following environments and components, subject to minor variations: loading and unloading platform; reception and inspection area for food and utensils; storage area; cold storage area; nutritionist room; restrooms; cleaning material storage; waste collection room; food preparation areas; cooking areas; diet preparation area for breakfast and snacks; area for distribution; area for washing dishes, cutlery and trays; area for washing and storing pans; area for washing carts; cafeterias, snack bar for the public, and snack bar for blood donors; lactation room; room for enteral nutrition (KARMAN, 2011, p. 352).

The third floor (Illustration 4), the first within the hospitalization tower, represents the smallest area. It houses general hospitalization and

isolation, which gives rise to some questions concerning the barriers used in the project. The arrows in the illustration delimit the general hospitalization-isolation area to the left and the clinical hospitalization area to the right.

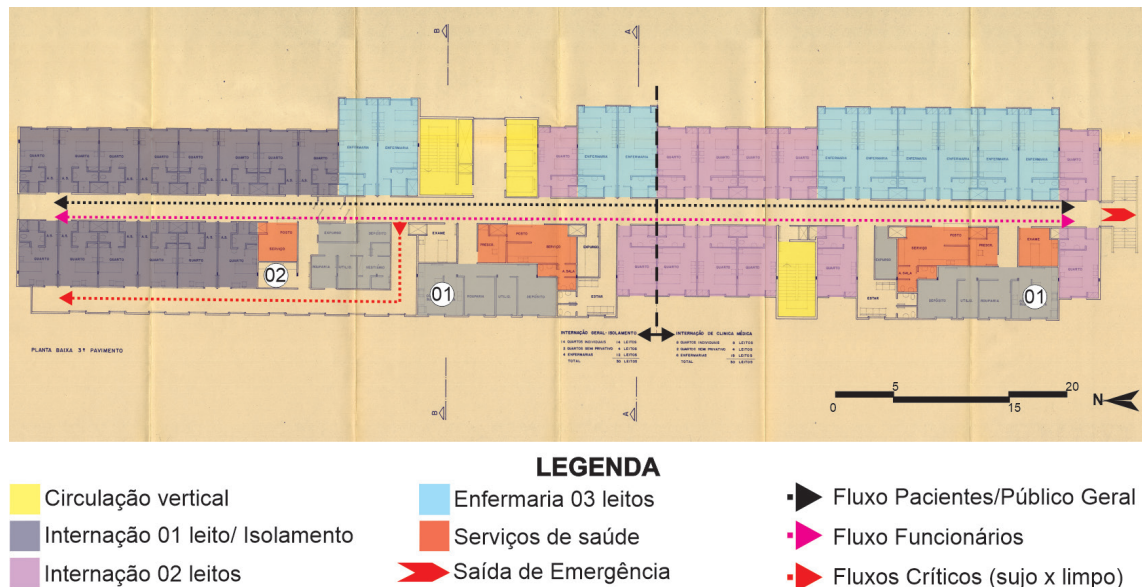


Illustration 4. Chapecó Regional Hospital: 3rd floor
Source. IPH Collection, 1980. Adapted by the author.

The general admission-isolation area is comprised of four nursing wards with three beds each and two semi-private rooms, two beds each. This area is served by the central nursing station, exam room, prescription room, and dirty and clean pantry (number 1). It is interesting to note that the same service occurs in the clinical hospitalization area, but it is not repeated in isolation: the 14 isolation rooms - one bed each, are served only by a smaller size station and one pantry (number 2), with no separation between dirty and clean areas.

Mezomo (197?), in the 70's, exemplified three types of meal distribution systems found in hospitals: decentralized, centralized, and mixed systems. The decentralized was basically preparing the meal in the kitchen followed up by distribution in thermal carts with the support of extra pantries located in each admission unit to separate the portions and identify the trays. The centralized system did not use pantries, preparing, storing, and packing the meals inside the kitchen, leaving only for direct distribution to the rooms. The mixed system is defined as:

It can be the system, for example, where the meals come portioned and identified from the kitchen, and the assembly of the trays is done in the pantry itself. Or then, decentralized distribution for patients with general

diet and centralized distribution for patients with special diets, allowing greater supervision in the latter. Another modality would be the centralized distribution of cold food and decentralized distribution of hot food (MEZOMO, 197?, p. 112).

The excerpt we highlighted may explain the irregular use of dirty and clean pantries present in the project. For example, on the third floor there are dirty and clean pantries to serve the rooms and wards, but only one pantry - without definition - to serve the isolation rooms. This could be justified by thinking that the food for patients in isolation leaves the kitchen and goes straight to the rooms, without going through a finishing process or storage in the clean pantry. The pantry intended to serve this ward should provide a support, if necessary, or just receive dirty dishes.

The same will be observed on the sixth floor, where the children's ward is composed only of one pantry, with no definitions. Mezomo (197?) emphasizes the importance of carefully preparing and transporting baby bottles, stressing that the handling of baby bottles should be kept to a minimum. Through the design analysis carried out here it is understood that Irineu applied to Chapecó Regional Hospital the mixed system. This information was exposed here in order to somehow answer the questioning about the design solutions employed.

There is another question concerning the access to isolated patients, since there is a transfer area in the main corridor and another access through a second corridor. These secondary entrances to the isolation rooms only happen on one side of the floor, leaving six rooms without windows. Still, it does not present any physical barrier, which could indicate a passage allowed only to authorized people. The drawing allows us to understand that this corridor creates two accesses to the rooms. There is an antechamber serving these isolation rooms, which according to the American Hospital Association would rule out the use of extra corridors:

3) an anteroom with sink, cabinets for clean aprons and other materials, and space for a container of dirty materials. This anteroom facilitates the implementation of isolation techniques without the need to use the hallway. Illustration 5 shows a floor plan of an isolation room with an anteroom (AMERICAN HOSPITAL ASSOCIATION, 1976, p. 79).

The third floor is also the only one with an emergency exit, located on the south façade with direct access to the outside area. Regarding the escape routes and emergency exits, the "Fire Prevention Standards and Specifications", published in 1979 by the Santa Catarina Military Fire Department specified:

Article 141 - The number of Enclosed Stairs in buildings for other uses will be calculated according to the following conditions:

- (a) Buildings taller than 30 (thirty) meters must be provided with 2 (two) staircases.
- (b) The floor area for a single Enclosed Staircase cannot be greater than 500 (five hundred) m².
- (c) The maximum distance between the furthest point and the entrance door of the antechamber will be 35 (thirty-five) meters, measured within the perimeter of the building; (SANTA CATARINA, 1979).

Still regarding the third floor - where begins the hospitalization tower - it is noteworthy what Lucio Breitman highlighted as the importance given by Breitman concerning "form and function" of the structure. The 1.20 x 1.20 m grid throughout the design is applied even to the dimensioning of the rooms and the number of beds. The architect used to employ 1 grid or half a grid, depending on the number of patients to be housed in the room. The three-bed nursing wards are approximately 8.40 meters long, while the two-bed rooms are 6 meters long. His rigid way of following the stipulated values in his grids allowed a total use of the space, without waste or over dimensioning of the apartments, providing the façade of the hospitalization tower with a very interesting game of volumes and rhythm. The suggestion of adopting this grid dimension would be addressed years later by the RDC regulation published in 2002.

The fourth floor (Illustration 5) is where we can see the building extension towards Madri Street, currently Montevideu Street (east façade). In this floor there is another hospitalization tower for Gynecology and Obstetrics Hospitalization, with 30 beds, and Obstetrics Hospitalization with Rooming In, with 42 beds. Besides the hospitalization tower, the is served by surgical and obstetrics center, nursery, recovery and intensive care area and sterilized material center.

The transition from one ward to the next is connected through a living room, which is seen as a waiting area for those accompanying patients in surgery. Although justified, the location of this area can be invasive, since accessing the surgical center requires patients and medical staff to walk through freely without physical barriers.

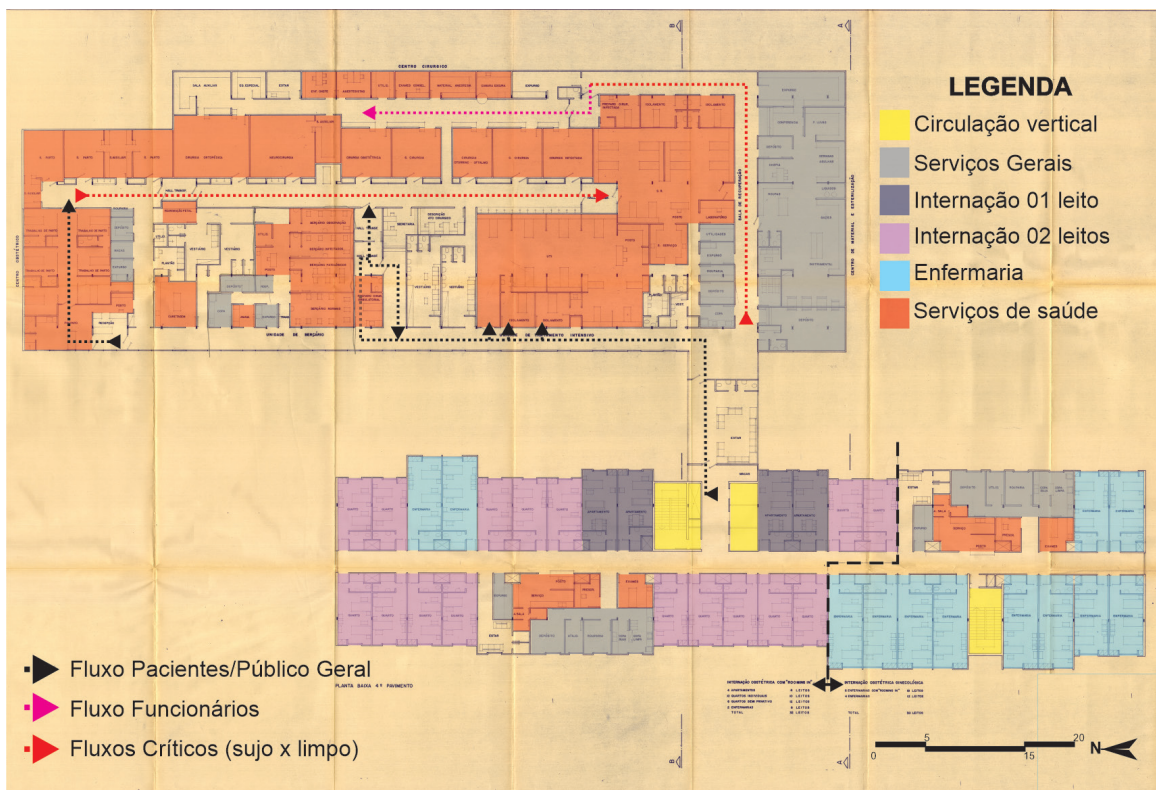


Illustration 5 . Chapecó Regional Hospital: 4th floor
Source. IPH Collection, 1980. Adapted by the author.

The main flow happens through the “dirty” floor, which contemplates the passing through of women in labor, surgical patients, and patients in need of intensive care. The patient access into the surgical corridor happens through two transference areas. When there is no need of ICU transfer the flow from labor room and operation room is straight to recovery rooms. Every access and exit are supported by a transference area. Karman describes such areas as separation spots between one flow and the next:

4. Transference room: The bed or stretcher on which the patient is brought from his room houses and collects considerable amounts of bacteria that cannot penetrate the operating rooms. It is necessary, therefore, that in the transfer room, located at the entrance of the surgical (and obstetrics) set, the clean patient is transferred from his bed to a disinfected stretcher, totally clean and treated with lint fixers (KARMAN, 1972).

To organize the obstetrics center process there is an access through preparation and labor rooms. While the mothers are transferred to the recovery room, the babies are taken to one of the four nurseries available in the hospital: observation, infected, pathologic, and free from pathogenies. The nursery for babies without pathogenies opens a window to the corridor for patients, so relatives and visitors may see them.

The medical flow occurs through the corridor on the right and leads straight to preparatory rooms for surgery. To carry out infectious surgery there is a preparation room specific for the medical team. The “clean” corridor exclusive for doctors and nurses leads to the second access to operation rooms.

Since 1995 the Ministry of Health broadly publicizes that operation rooms must be located between two corridors: “it does not at all contribute to the asepsis improvement of the block; on the contrary, it can mean a hazard to it if another access is introduced; it is a design solution operationally expensive and that lacks technical justification” (BRASIL, 1995, p.57). The contact between medical staff and patient for hours inside the same space and the “sending off” of patients along the same path as dirty materials and clothes does not invalidate the cleanness of the corridor they go through, as long as the waste is properly packed. (BRASIL, 1995).

The fifth and largest floor (Illustration 6) is served with consultation space, physiotherapy, exams, laboratory, pathology, emergency service and medical comfort, in addition to medical surgical hospitalization sector. The hospitalization tower block on this floor offers 68 beds divided between wards, rooms, and private apartments. The connection to the second block is made through the chapel.

This is the last floor that makes direct contact with the street, which in addition to the greater extension and grouping of services enabled the location of several accesses. The three accesses on the east façade are for catering, general entrance for exams and consultations, and access/exit to the morgue (from left to right). The three other accesses, located on the south façade, lead to blood center, emergency and medical comfort (from top to bottom).

The general entrance splits the flow into three options: consultations, physiotherapy, and social work; clinical pathology area; or even exam rooms. The fifth-floor plan organizes flows as on the second floor: distributing environments.

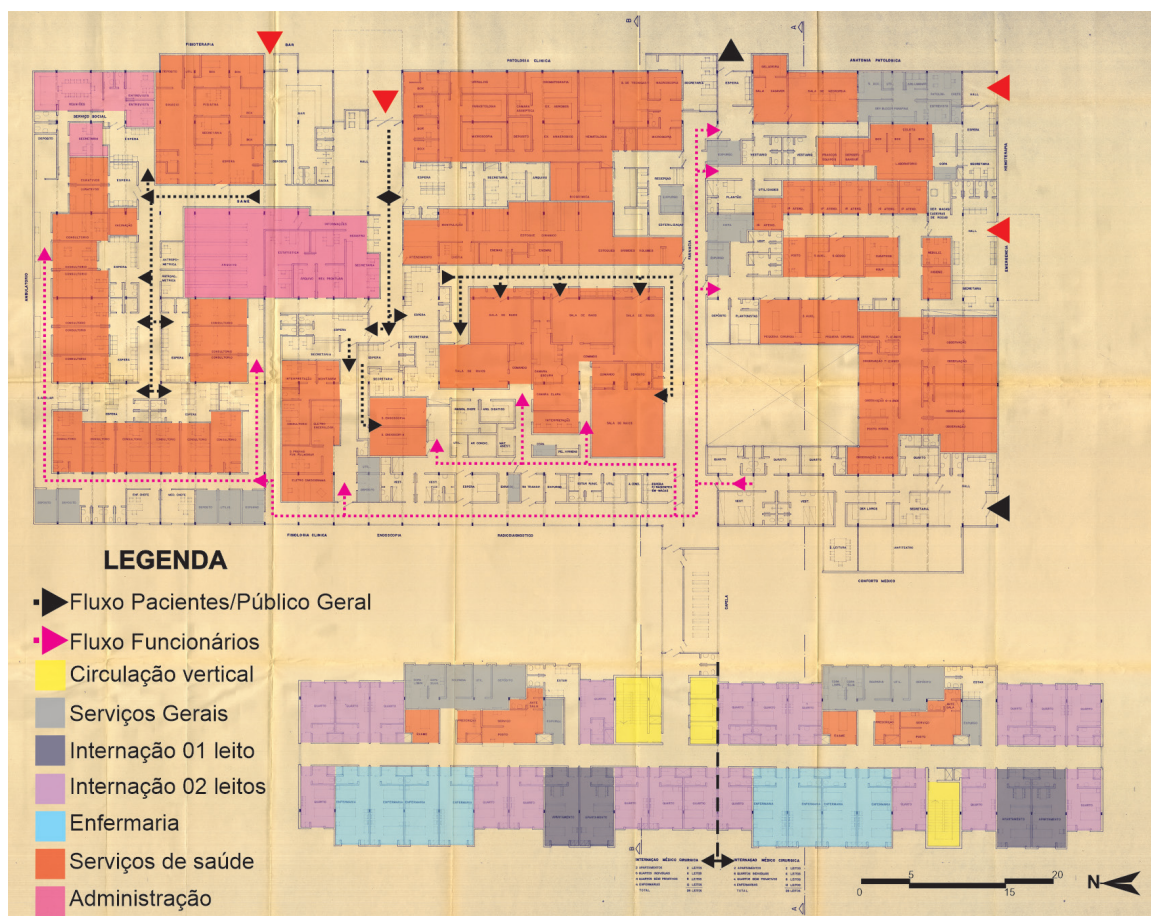


Illustration 6. Chapecó Regional Hospital: 5th floor
Source. IPH Collection, 1980. Adapted by the author.

Every flow leading to a doctor's office comes to a waiting room, therefore there are two accesses to the consultation room. The doctor enters through the corridor coming straight from the comfort area. In addition to the offices, all exam rooms have separate entrances, apart from electros since they are performed by technicians.

The patient access to the emergency service is carried out only through the south façade, and the access for the medical team takes place through the long corridor that divides the exam and emergency areas. There is also a void in this area, which could be used to install windows and enable natural ventilation in the medical staff rooms.

The sixth floor, followed by the engine room, wraps up the tower block. There (Illustration 7) we find the pediatric hospitalization unit, which is subdivided into subunit A and subunit B. Subunit A, on the left side, has four wards dedicated to children between 0 and 2, with six beds each. These wards are monitored by two nursing stations. There are also three private rooms, to kids between 0 to 2, with accommodation for a

companion. Subunit B contains wards for children between 2 and 7 years old; wards for kids from 7 to 12; and semi-private rooms for ages 7 to 12. Each ward serving children between 2 and 7 counts on an individual nursing station, and the others are commanded by a central station.

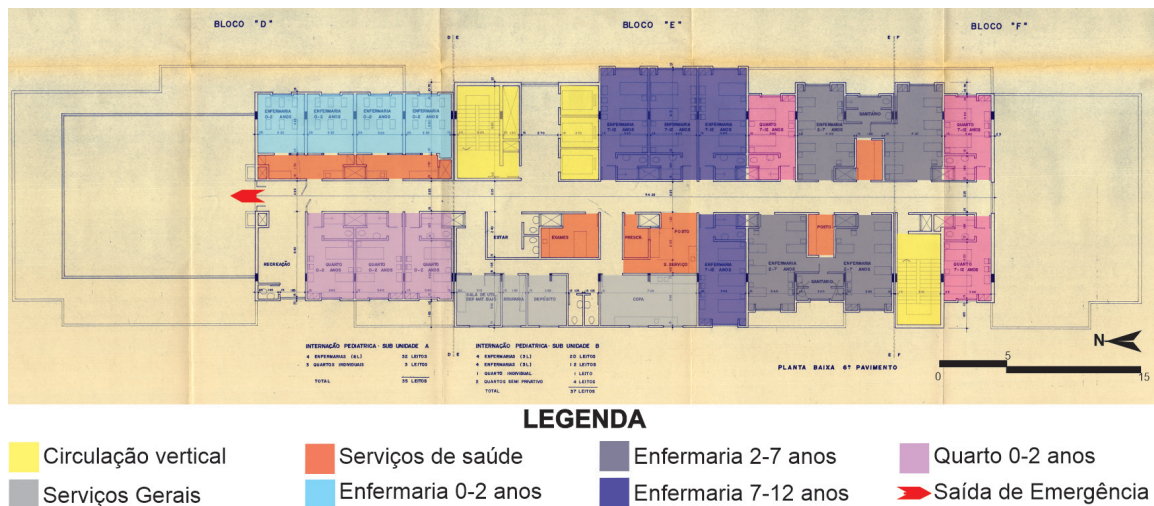


Illustration 7. Chapecó Regional Hospital: 6th floor
Source. IPH Collection, 1980. Adapted by the author.

On this floor the pantry is a single space, with no division between dirty and clean areas. In addition to this uncertainty about the spaces, it is questioned why there is no room for patients aged 2 to 7. There is also a recreation area and outdoor area on the floor, also characterized as an emergency exit.

As for insolation and ventilation solutions applied to the project, Breitman says: "The placement of hospitalization units, with patient rooms facing east and west, will enable adequate insolation." It is known that, when designing, the western sun is usually avoided, blocked, or controlled through different strategies. The weather in Chapecó is cold, which may justify the west-facing spaces, so that the afternoon heat may remain in the environment during the night. However, no strategy was used to control, even if just specifically, this insolation.

In Illustrations 4, 5, 6 and 7, it is possible to observe variations in the positioning of hospitalization tower, however the protection from the west sun is null. The west façade contains many openings in this direction, again without any protection. The north façade, which is the most beneficial insolation according to some studies, is served with just a minimum number of openings. Lucio pointed out that insolation and adequate ventilation of environments have always been important considerations in all Breitman projects, and he believes that the option for the east-west orientation to the hospitalization tower is justified by the city cold climate.

Conclusions

When Chapecó Regional Hospital (CRH) was designed the vertical model was already widely accepted and replicated, including in Brazil. However, besides the personal characteristics and preferences of the leading architect - Irineu Breitman - the site did not favor a totally vertical project. I imagine that a single multi-story volume located in the center, or close to some of the surrounding roads, would hinder the development of the project, limit its access, and waste the large space available. Although its unevenness limitations, the scaling and distribution of sectors allowed all areas to be served and grouped as a typical 1980's layout would require.

CRH presents only a rigid core in the project without restriction of use to employees or companions. It should be considered, however, that although the project offers only one vertical flow option, its two largest floors - fourth and fifth - are composed of a horizontal plan, supported on plateaus, and not entirely overlapping, which makes it more difficult to include further options of vertical traffic. Budget issues should also be considered.

When considering this deficiency in the supply of stairs or elevators, critical internal circulation must also be considered. As already pointed out, spaces such as kitchen, lactation room, laundry, sewing room and surgical center were classified as critical spaces, where the concern regarding nosocomial infection was constant. Considering placing another flow option could interfere with these critical intersections.

It is still possible to analyze the hospitalization towers with the ideas of Florence Nightingale and Tenon. Their studies applied to patients hospitalized in long pavilions with openings in both façades and a greater distance between beds were adapted in the 20th century and remain in current projects.

It can be said that a reinterpretation of their studies is applied to the hospitalization towers in the design studied here, as we see that the hospitalization floors are composed of long pavilions with openings on both sides, along which patients are accommodated. What changes is the separation by rooms and the decentralization of nursing stations.

However, for economic maintenance and efficient assistance it is essential that rooms are arranged on both sides of the corridors. Façades and corridors must be occupied only by patient accommodation. It is always good to keep in mind that the most compact layout of beds corresponds to the shortest service path (CYTRYNOWICZ, 2014).

The transfer areas within CRH surgical centers became obsolete after 1994, when the legislation no longer indicated the need to avoid crossing

clean and dirty flows. These spaces used to be employed to exchange stretchers and keep the corridor “clean” and free from microorganisms likely to cause infections.

Finally, there are also individual rooms for anesthesiologists and chief nurses in the surgical centers. Although such spaces may not be essential to the functioning of this center it might be another way to compact the hospital building, for the exclusion of such spaces does not harm the flow or functioning of the surgical wing, on the contrary, makes it more compact and restricted to access only when necessary.

References

AMERICAN HOSPITAL ASSOCIATION. **Controle de infecções no hospital**. São Paulo, SP: Sociedade Beneficente São Camilo, 1976. viii, 203 p.

BRASIL, Ministério da Saúde. **Arquitetura na prevenção de Infecção hospitalar**. 1995. Available at: < <http://www.anvisa.gov.br/servicos/audite/manuais/infeccao.pdf> > Access: 28/02/2020.

BRASIL. Ministério da Saúde. Secretaria de Assistência Médica. Coordenação de Assistência Médica e Hospitalar. **Normas de Construção e instalação do Hospital Geral**. 1974. Acervo IPH.

BREITMAN, Irineu. Projeto Arquitetônico Hospital Regional de Chapecó. 1980.

CYTRYNOWICZ, Monica Musatti, **1964 - Instituto de pesquisas hospitalares arquiteto Jarbas Karman** – IPH: 60 anos de história / Monica Musatti Cytrynowicz. – 1. ed. – São Paulo: Narrativa Um, 2014. 176 p.

KARMAN, Jarbas. **Iniciação à Arquitetura Hospitalar**. IPH - Instituto de Pesquisas Hospitalares Arquiteto Jarbas Karman São Paulo - SP, Brasil - 1ª edição – 1972. Available at: < <http://iph.org.br/acervo/livros/iniciacao-a-arquitetura-hospitalar-6> > Access: 16/3/2020.

KARMAN, Jarbas. Manutenção e segurança hospitalar preditivas / Jarbas Kannan ; (prefácio de Celso Skrabej. - São Paulo :Estação Liberdade; IPH, 2011. Available at: < <http://www.iph.org.br/acervo/livros/manutencao-e-seguranca-hospitalar-preditivas-1036> > Access: 10/03/2020

MEZOMO, Iracema F. de Barros. **Organização e administração do serviço de nutrição e dietética**. [São Paulo, SP]: SBS, 197-]. 199 p.

SANTA CATARINA, Bombeiros Militares de Santa Catarina. **Normas e Especificações Contra Incêndios**, 1979.

VICENTE, E. R. S. **A arquitetura de hospitais de Irineu Breitman**. Revista IPH, São Paulo, n. 15, p.35-56, 2018.

Natural ventilation for hospitalization settings: historical aspects

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Abstract

This article derives from the master's thesis presented in 2020, entitled "The Path of the Winds: The Perception of Natural Ventilation in Hospitalization Settings" presented to the Post-graduation Program in Architecture at the Federal University of Rio de Janeiro. This work focuses on the historical background of healthcare settings with an emphasis on natural ventilation to thus evaluate the changes throughout the process of admitting users.

Keywords

Hospital architecture, Natural ventilation, Environmental comfort.

Introduction

This article derives from the master's thesis presented in 2020, entitled "The Path of the Winds: The Perception of Natural Ventilation in Hospitalization Settings" presented to the Post-graduation Program in Architecture at the Federal University of Rio de Janeiro in which we mapped the historical panorama of natural ventilation within healthcare settings and the current perception of users during the hospitalization process. Two hospitals were chosen as case studies to obtain the results: Gaffrée and Guinle University Hospital (HUGG) and Lourenço Jorge Municipal Hospital (HMLJ). The methodology used to obtain the results included computer simulations, interviews and hygrothermal measurements. The present work addresses the historical background of healthcare settings with an emphasis on natural ventilation to evaluate the changes that have occurred during the process of admitting users.

Historical Background of Natural Ventilation within Healthcare Facilities

The first healing environments came around in ancient Greece and Rome. Mainly in temples, such as Asclepius', God of Medicine. Those were sacred environments that believed rest and treatment of diseases should be done through purifications and dreams. In practice, a healthy and pleasant space where patients waited for divine healing. Its spatial configuration was linear, composed of three blind façades, frontal opening, and Greek columns (THOMPSON and GOLDIN, 1975) (Illustration 1).

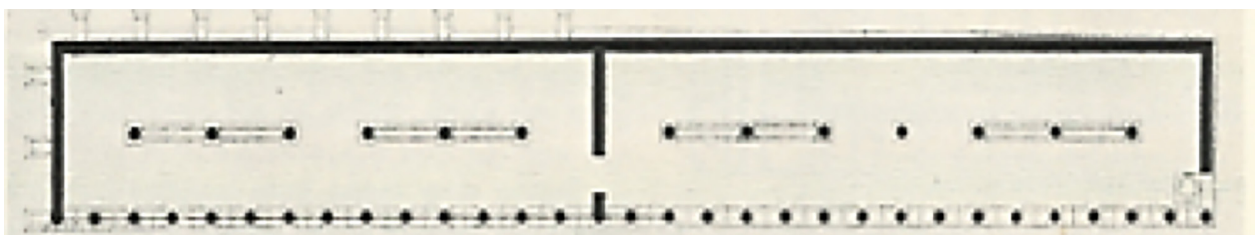


Illustration 1. Double nurse station floor plan in the Temple of Asclepius, 5th century BC
Source. Thompson and Goldin (1975).

Back then the idea of health was related to the balance of moods in the body, and it comes from this period the collection of medical treatises called Hippocratic Corpus, from the second half of the 5th century BC, which relates the temperature of the winds of a city to the diseases of its people and their customs (Cairus, 2005), and On the Winds - Gases, which mentions specifically the air as a means of cure or disease from the last quarter of the 5th century BC (REBOLLO, 2006). They believed diseases were caused by unhealthy miasmas and air was the source of life (DELGADO, 2008).

This concept lasted until the Middle Ages in Europe, where infectious diseases, charity and salvation were seen as one thing (Rosen, 1979). The soul and the body were unique, and the diseases, suffering and poverty were God's design.

Following this proposition, the first hospitals appear. Its purpose was to receive anyone who needed shelter, comfort, or treatment. And it was within this context that Paris' Hôtel-Dieu appears. With four floors and long wards, it was normal to accommodate up to six individuals in each bed as seen in Illustration 2, without any natural ventilation system within the building (TENON, 1996).



Illustration 2. Hôtel-Dieu hospitalization environment.
Source. Tollet (1892).

In the 15th century the concern regarding natural ventilation within hospitals resumes and, in 1456, the Ospedale Maggiore is designed for the city of Milan. The design consisted of nurse stations connected through doors towards an outdoor backyard (THOMPSON e GOLDIN, 1975). It is considered until today the best typology by the World Health Organization (2009). It was also used to air renovation and chimney climatization, therefore exiting the air through pressure (Illustration 3).

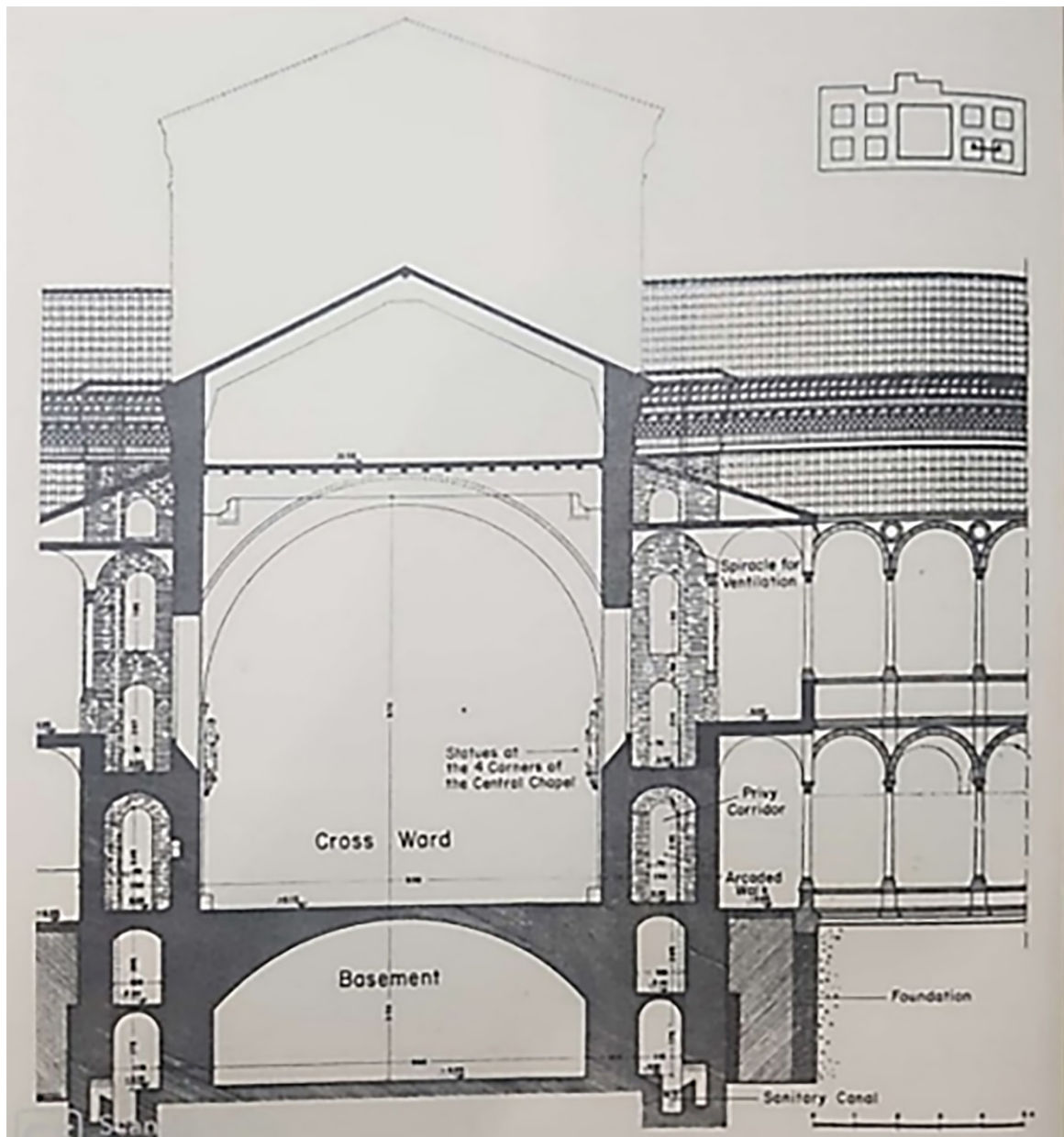


Illustration 3 . Ospedale Maggiore corridors, in Milan, 1504.
Source. Thompson and Goldin (1975).

Due to population growth, epidemics, cemeteries, and sewage in the middle of the city, the miasma theory resurfaces in the 18th century and correlates the emergence of diseases to air contamination (ROSEN, 1979). With the purpose of purifying urban environments, the sick, crazy and criminal were taken to isolated areas (ROSEN, 1979).

In this period, research for the mitigation of the hospital's harmful effects occurred in order to avoid the contamination of the city's population and to maintain the economic and social order in its surroundings (FOUCAULT, 2018).

Along with these changes and the collapse of existing hospitals, Jacques-René Tenon, after successive visits to hospital environments, defines the connections between the number of patients, beds, floor area, as well as the height, width and length of environments and air cubage (FOUCAULT, 2018). In 1846, following Tenon's recommendations, the Laribosière hospital was designed, including high ceiling height to achieve the necessary volume for air renovation. The hospital was composed of five blocks and three floors, separated by courtyards with indoor gardens and connected by a wide corridor with two longitudinal axes (THOMPSON and GOLDIN, 1975), as shown in the floor plan of Illustration 4. Therefore, it presented a complex ventilation and heating system for its time (GALLO, 2003), as shown in Illustration 5. Its windows were occasionally opened, especially in the morning, renewing the air in the wards, and when necessary the climatization (heating) would come in to renew the air coming through the ducts serving the hospital (NIGHTINGALE, 1858).

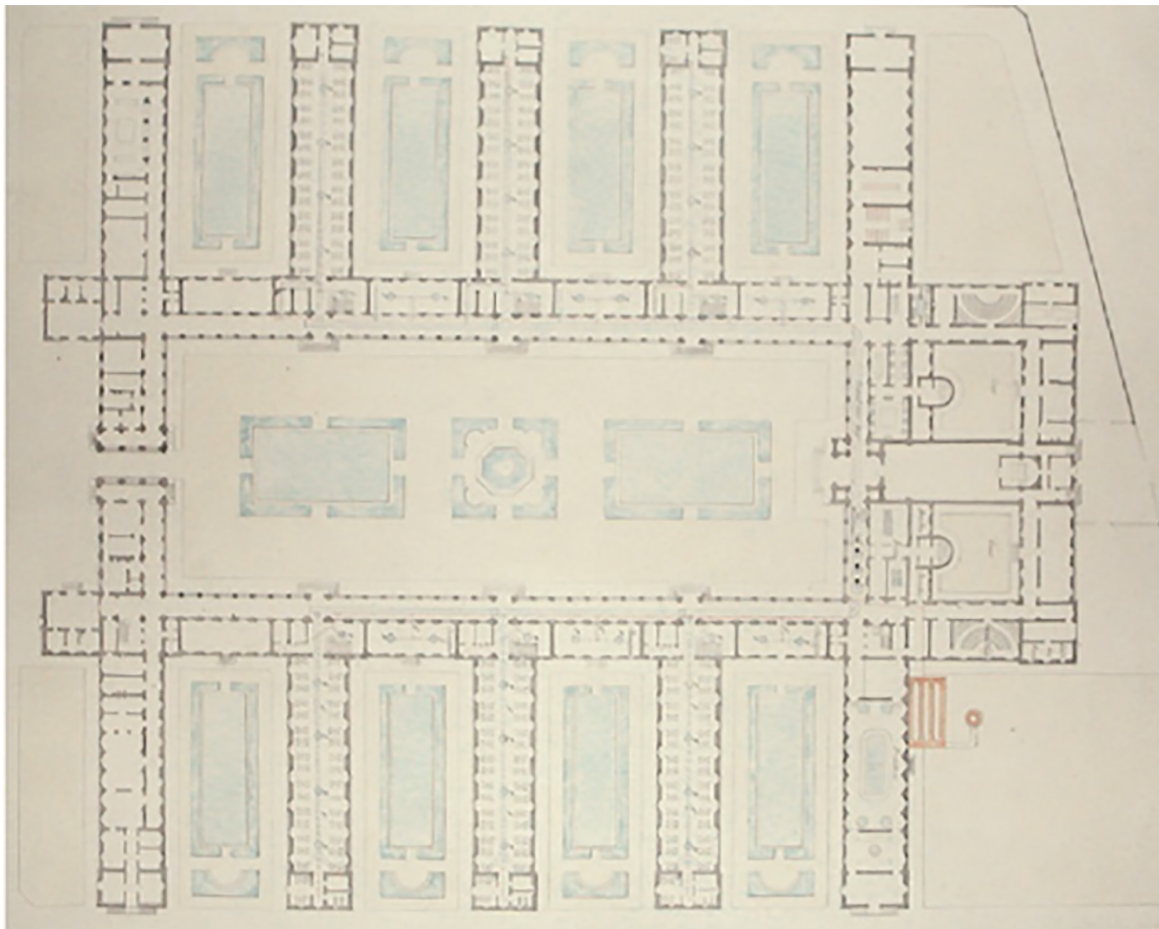


Illustration 4. Laribosière Hospital floor plan.

Source. (GALLO, 2003). Available at: < <https://bit.ly/38JFIWs>>. Access: 8/2/2019.

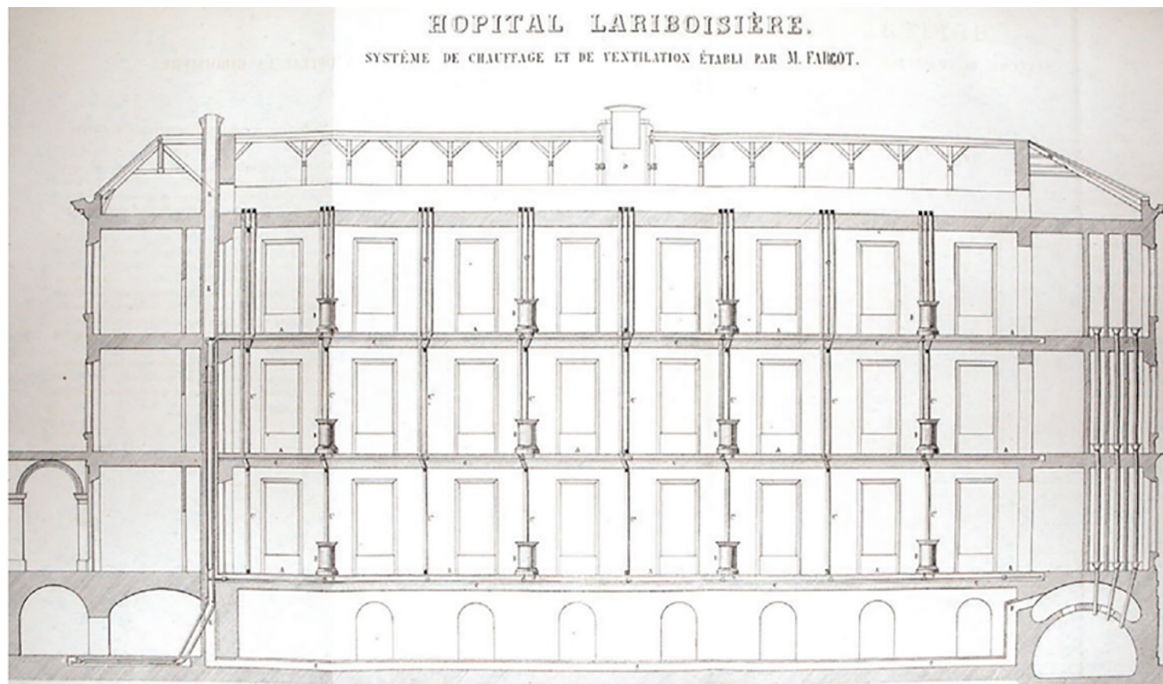


Illustration 5. Lariboisière Hospital: ventilation and climatization ducts for the environments.
Source. (GALLO, 2003). Available at: < <https://bit.ly/38JFIWs>>. Access: 8/2/2019.

In the 19th century, Florence Nightingale used to see patients as the essence of the hospital. During her volunteering time in the Crimean War, she noticed patients died ten times more from diseases such as typhus, typhoid, cholera and dysentery than from battle wounds. On her return to England, she wrote *Notes on Hospitals*, in 1859, and *Notes on Nursing*, in 1860, describing rules and design principles for patient care through ideal nurse stations (Illustration 6).

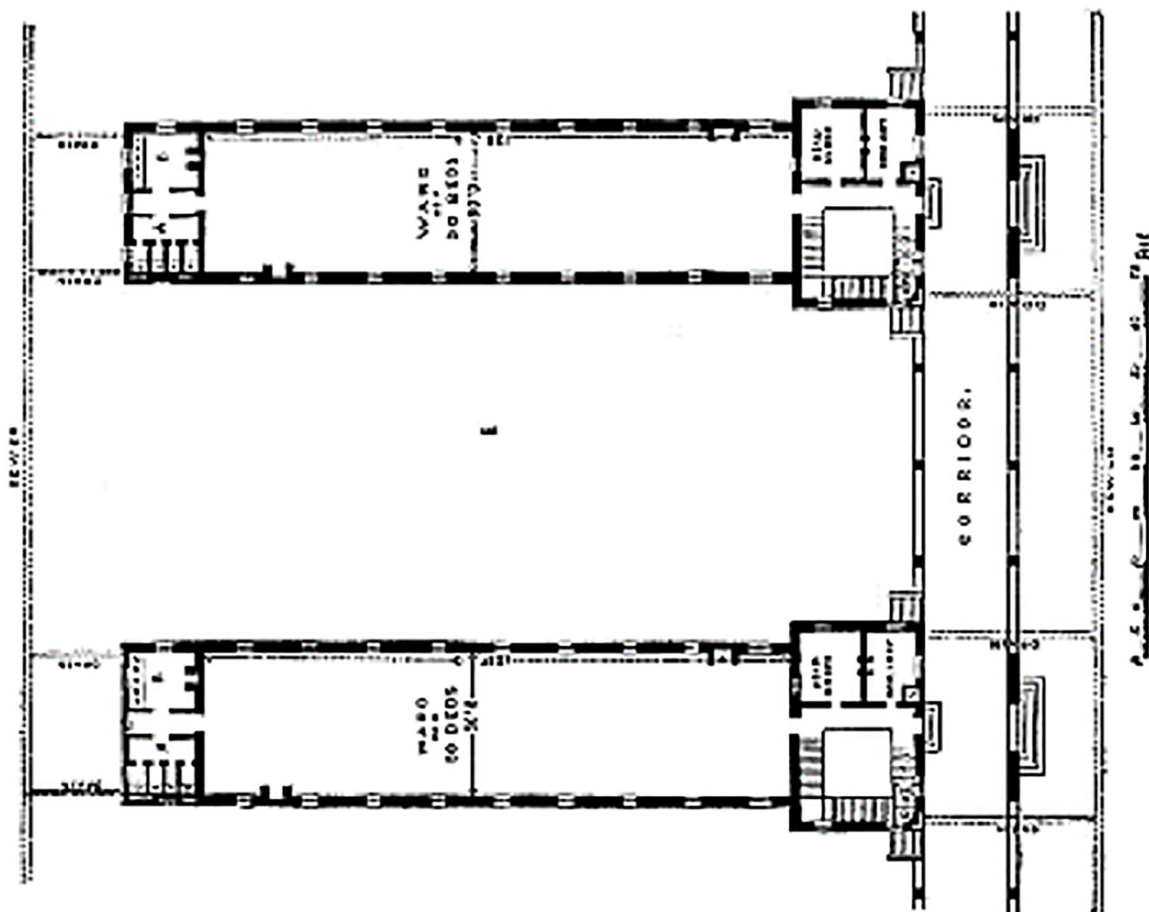


Illustration 6. Ideal nurse station according to Nightingale.

Source. Nightingale (1859).

In her writings, she listed methods of introducing fresh air into the ward and claimed that the lack of fresh air was the greatest cause of damage to health during a patient's hospitalization. According to Nightingale, nurses' first attention should be the purity internal air against the external air, to avoid patient deaths. In her books she pointed out the deficiency of space, ventilation, and natural light as a design deficiency in hospitals, and that fresh air, light, amplitude of space and separation of patients in pavilions or buildings would be essential conditions for the wellbeing of users. She also described minimum standards and dimensions for healthcare environments, recommending a reference nurse ward. As in *On the Winds* (REBOLLO, 2006), Nightingale also stated that fresh air is the source of life (1859).

In 1892, Casimir Tallet suggested a new typology for air renewal in nurse wards. Using Gothic architecture, he took inspiration from arched walls to obtain the necessary circulation, thus ensuring the appropriate renewal of 100 l/s/m³ of air per patient, standardized by himself. For Tallet, a ventilation rate of 70 l/s/m³ would be an improvement for the time (1892).

Tollet (1892) designed air entrances through balconies (A), air exits through the ceiling, via a chimney, or through the floor, via lower floor (B), air entrances between the ceiling (C), through the ends of the wards (D) and through fans (E) (figure 7).

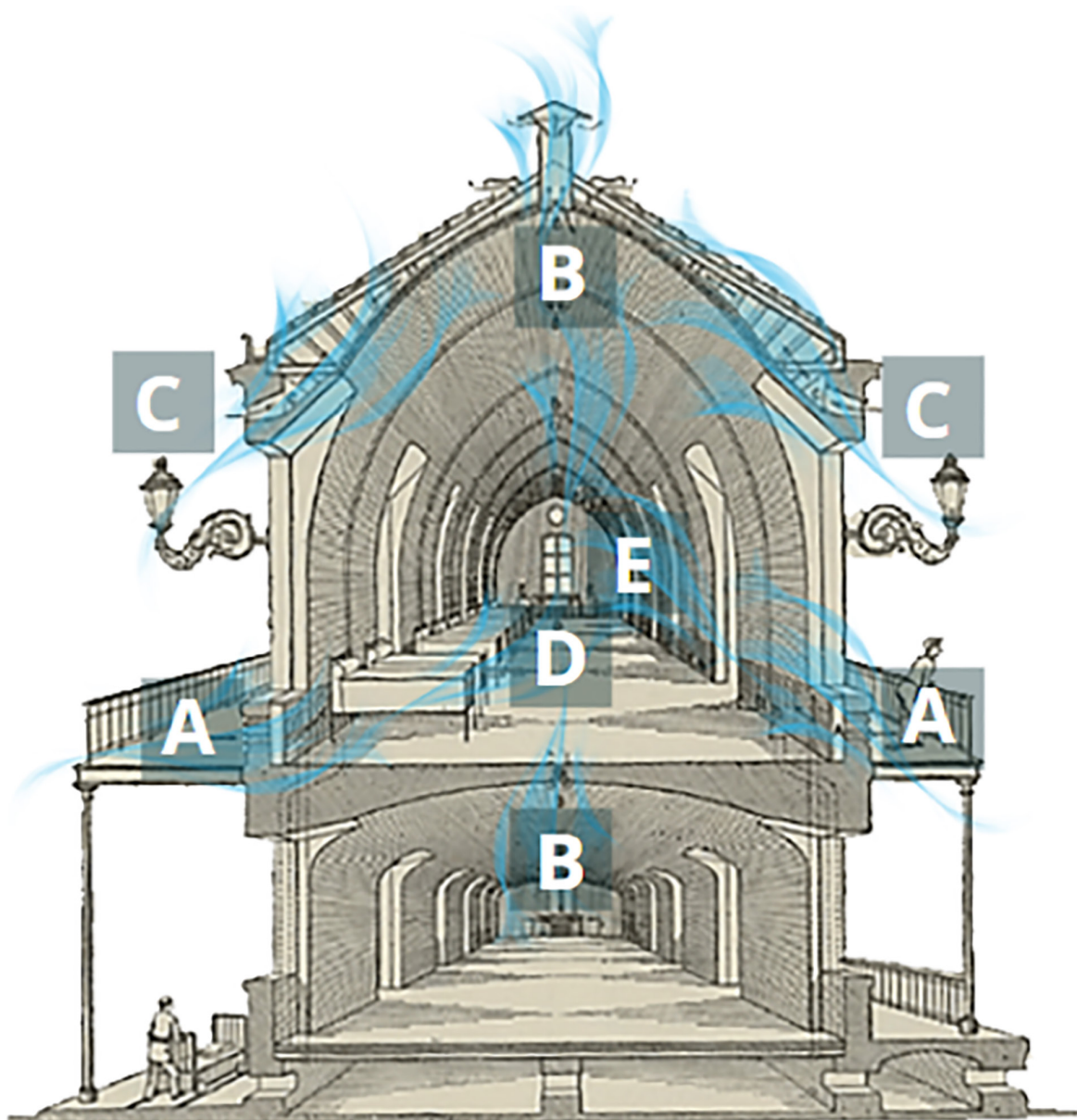


Illustration 7. Tollet's nurse ward for Montpellier Civil and Military Hospital, 1884 – Air circulation in the building.

Source. Tollet (1892) adapted by the author.

With the emergence of tuberculosis, at the end of the 19th century, sanatoriums were created. Always with large balcony windows, natural ventilation was part of the cure for the disease (BRASILEIRO, 2002). Doctor Spengler, while treating his patients, observed climate and altitude had health-improving properties for patients. For him, mountain air, rest and a good diet would be the cure for diseases. Also, in Davos, Switzerland, a complex climatic spa was created (ASPETAR SPORTS MEDICINE JOURNAL, 2016).



Illustration 8. Queen Alexandra Sanatorium in Davos Platz, 1906-1909.
Source. Moralez and Diaz (2017).

In parallel with the transformations of the 20th century, the way of getting sick and caring for the sick changed. "Patients change, diseases change, spaces change. Transformations in the process of cognition, attitudes, representations and medical practices have always had some correspondence with changes in the architecture of the hospital space" (SANTOS and BURSZTYN, 2004, p. 146). Charity is left aside, and hospitals become a healing machine (VERDERBER and FINE, 2000). "Changes can also be described (...) as from the passage from pre-antiseptic to the antiseptic period (...) If bacteriology was right, the need for the pavilions was over" (1997, p. 158).

Due to all these advances, the monobloc typology succeeded, such as the Beaujon Hospital (Illustration 9), exemplified by Verderber (2010) as the most innovative hospital in Europe, with 1,100 beds and built with steel and concrete, its windows were sealed thus giving rise to mechanical air conditioning. The focus is on efficiency and flexibility rather than air and light (KISACK, 2017).

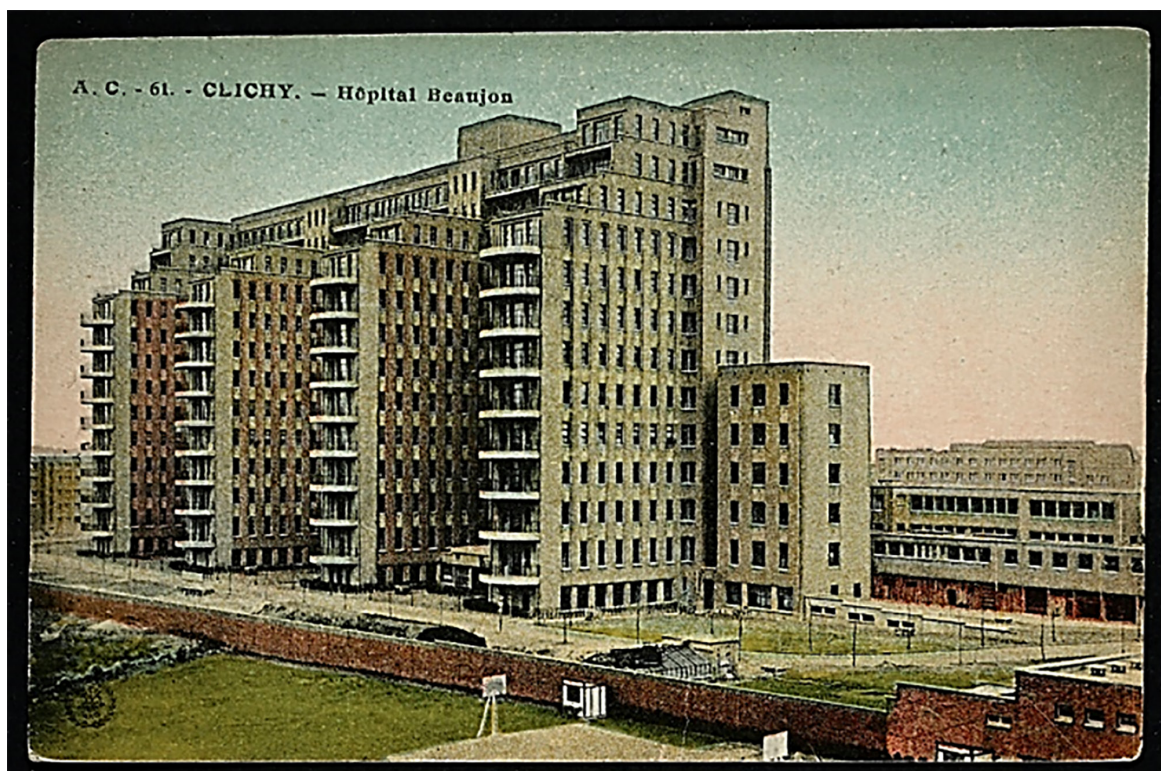


Illustration 9. Beaujon Hospital, 1932 - 1935.

Source. Geneanet. Available at: <http://bit.ly/2Hax846>. Access: 11/2/2020.

According to Verderber and Fine (2000), the monobloc hospital typology compacts hospital units, thus facilitating care in the nurse wards. Natural ventilation is no longer a design requirement for health buildings within this typology. At the end of the 21st century, discussions about hospital humanization are already emerging (SANTOS and BURSZTYN, 2004).

Sérgio Bernardes, Jarbas Karman, Domingos Fiorentini, Siegbert Zanettini and João Filgueiras Lima, aka Lelé, pioneered in the use of natural ventilation in health environments. Sérgio Bernardes, in 1951, designed Curicica Sanatorium, in Rio de Janeiro, RJ, currently Raphael de Paula Souza Municipal Hospital for the treatment of tuberculosis. It is organized in a pavilion-like structure and a large green area, its main premises are ventilation and natural lighting (COSTA, PESSOA, *et al.*, 2002) (Illustration 10).



Illustration 10. Raphael de Paula Souza Municipal Hospital: Outdoor circulation view.
Source. Personal collection (2014).

For Hospital das Clínicas in Pelotas - RS (Illustration 11), Jarbas Karman designed voids between the floors in order to allow ventilation and natural lighting indoors. His design was not carried out to the fullest, losing its voids between floors thus leading to a monobloc building (IPH - INSTITUTO DE PESQUISAS JARBAS KARMAN, 2015).

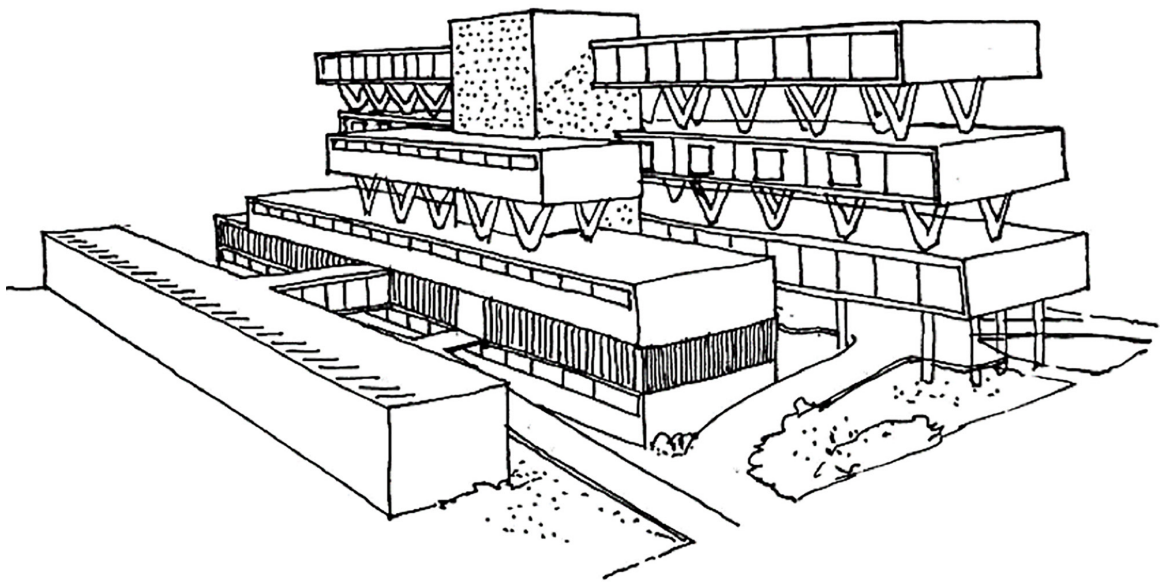


Illustration 11. Pelotas Hospital das Clínicas.
Source. IPH (2015).

In 1993, architects Jarbas Karman, Jorge Wilhelm, and Domingos Fiorentini designed Jozef Fehér building, an expansion for Albert Einstein Hospital in São Paulo - SP, with operable windows that patients have the choice to use to control the best climate for him during hospitalization (MACHRY, 2010).

Sarah Group for Rehabilitation Hospitals designed by João Filgueiras Lima focuses on the user, therefore natural ventilation plays an important role for the building. Lima believes that since we live “in the tropics we can only do architecture like this. Otherwise, it is just wrong” (LIMA, 2012, p. 71). In his last hospital, the Rehabilitation Center in Barra da Tijuca, Rio de Janeiro - RJ, natural ventilation, forced ventilation and air conditioning are used depending on the outside temperature (RISSELD and RISÉRIO, 2010). For João Filgueiras Lima, the completely “hermetic” health facility (IBIDEM, p. 68) strengthens bacteria, giving rise to hospital infections and “an available technology, which is about to be used” (IBIDEM, p. 68). Illustration 12 shows the auditorium at Sarah Group in Rio de Janeiro which, whenever possible, is opened for air renewal and air conditioning.

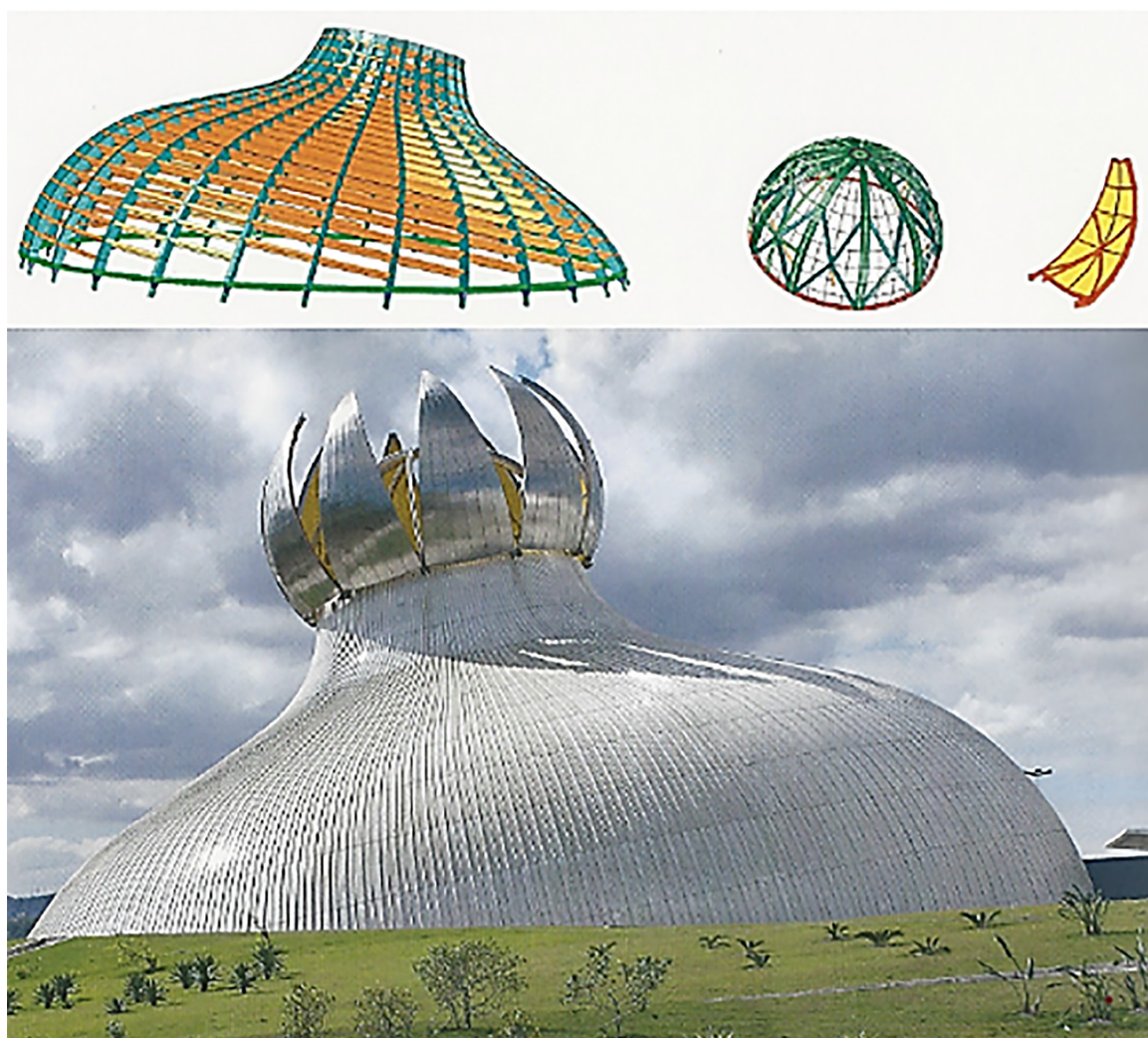


Illustration 12. Auditorium outdoor façade and studies for designing the structure – Sarah Group – Rio de Janeiro.

Source. Risselda and Risério (2010).

Conclusions

It can be observed that the adoption of natural ventilation in health care environments, despite being renegade and sometimes even despised, has been and continues to be used in healthcare environments as a way to support healing. With the emergence of artificial air conditioning, natural ventilation has been losing ground due to the difficulty in verifying air exchanges or its flow, i.e., the path of the winds. For the best use of natural ventilation, the location of the building, the climate, its surroundings (air quality, noise, among others) and changes in the urban network during the life cycle of the building need to be taken into account since the beginning of the project.

The wind path inside a healthcare building is of vital importance, because too little or too much wind can do more harm than good. Air currents are not welcome, and it is necessary that temperatures and humidity within environments also provide comfort to users. For this, good architecture is of vital importance.

Likewise, not all healthcare environments can use natural ventilation because semi-critical and/or critical environments need strict control of air quality, temperature, and humidity.

The possibility to operate windows becomes a link between external and internal building environments, providing users with the choice to either connect with or block environmental factors. This should be a major factor in the development of the design, especially when it comes to healing environments.

References

ASPETAR SPORTS MEDICINE JOURNAL. <https://www.aspetar.com/journal/Default.aspx>. **Aspetar Sports Medicine Journal**, 2016. Available at: <<https://www.aspetar.com/journal/upload/PDF/2016523102735.pdf>>. Acesso em: 22 jun. 2019.

BRASILEIRO, C. D. F. L. **Arquitetura antituberculose em Pernambuco: um estudo analítico dos dispensários de tuberculose de Recife (1950-1960) como instrumentos de profilaxia da peste branca**. [S.l.]: [s.n.], 2002. Available at: <<https://repositorio.ufpe.br/handle/123456789/11138>>.

CAIRUS, H. F. 5 - Ares, águas e lugares. In: CAIRUS, H.; RIBEIRO JR., W. **Textos hipocráticos o doente, o médico e a doença [online]**. Rio de Janeiro: Editora FIOCRUZ, 2005. p. 91-129. Available at: <<http://books.scielo.org/id/9n2wg/pdf/cairus-9788575413753-07.pdf>>. Access: 5/10/2018.

COSTA, R. D. G.-R. *et al.* O sanatório de Curicica: Uma obra pouco conhecida de Sérgio Bernardes. **Vitruvius**, julho 2002. Available at: <<https://www.vitruvius.com.br/revistas/read/arquitextos/03.026/766>>. Access: 11/2/2019.

DELGADO, B. B. **Sobre os Ventos: Mito e razão na Grécia antiga através de um tratado hipocrático**. Belo Horizonte: Universidade Federal de Minas Gerais, 2008. Available at: <<http://hdl.handle.net/1843/ECAP-7D3NJ6>>. Access: 2019.

FOUCAULT, M. **Microfísica do Poder**. 7ª edição. ed. Rio de Janeiro | São paulo: Paz e Terra, 2018.

GALLO, E. Ventilating and Heating Lariboisière Hospital, a Scientific Debate in Paris 1848-1878 ». **poster pour la 3ème conférence internationale pour l'histoire des hôpitaux Form+Function, the Hospital** , McGill University, Montréal - Canadá, 19-21 Junho 2003.

IPH - INSTITUTO DE PESQUISA HOSPITALARES JARBAS KARMAN. ACERVO: Projetos Arquitetônicos. **IPH - Instituto de Pesquisa Hospitalares Jarbas Karman**, 2015. Available at: <<http://www.iph.org.br/acervo/projetos-arquitetonicos/hospital-sao-luiz-158>>. Access: 09/04/2019.

IPH - INSTITUTO DE PESQUISAS JARBAS KARMAN. **O Desenho de Hospitais de Jarbas Karman**. 1º Edição. ed. São Paulo: IPH, 2015.

KISACK, J. Quando a ventilação saiu de moda nos hospitais. **Instituto de pesquisas Hospitalares Arquiteto Jarbas Karman**, n. 14ª edição, 2017. Available at: <<http://www.iph.org.br/revista-iph/materia/quando-a-ventilacao-natural-saiu-de-moda-nos-hospitais>>. Access: 06/07/ 2018.

LIMA, J. F. **Arquitetura: uma experiência na área de saúde** / João Filgeiras Lima. São Paulo: Romano Guerra editora, 2012.

MACHRY, H. S. **O Impacto dos Avanços da Tecnologia nas Transformações Arquitetônicas dos Edifícios Hospitalares**. São Paulo: [s.n.], 2010. Available at: <<http://www.teses.usp.br/teses/disponiveis/16/16132/tde-15062010-130613/>>.

MORALES, E. J.; DIAZ, I. C. V. Hoteles y sanatorios: influencia de la tuberculosis en la arquitectura del turismo de masas. **Hist. cienc. saude-Manguinhos**, Rio de Janeiro , v. v. 24, p. p. 243-260, Janeiro 2017.

NIGHTINGALE, F. **Notes on matters: Health, efficecence and hospital administration**. London: Harrison and sons, 1858.

NIGHTINGALE, F. **Notes on Hospitals**. Edição Digital. ed. New York: Dover Publications - Kindle Editions, 1859.

ORGANIZAÇÃO MUNDIAL DE SAÚDE. **Natural Ventilation for Infection Control in Health-Care Settings**. Geneva: WHO Library, 2009. Available at: <https://www.who.int/water_sanitation_health/publications/natural_ventilation.pdf>. Access: 14/06/2018.

PEVSNER, N. **A History of Building Types**. Priceton: Priceton University Press, 1997.

REBOLLO, R. A. O legado hipocrático e sua fortuna no período greco-romano: de Cós a Galeno. **Scientiæ Studia**, São Paulo, 2006. 45-82. Available at: <https://www.scielo.br/scielo.php?script=sci_arttext&pid=S1678-31662006000100003>.

RISSELDA, G. L.; RISÉRIO, A. **A Arquitetura de Lelé**: fábrica e invenção. São Paulo: Imprensa Oficial do Estado de São Paulo: Museu Casa Brasileira, 2010.

ROSEN, G. **Da Polícia Médica à Medicina Social**. Rio de Janeiro: Edições Graal, 1979.

SANTOS, M.; BURSZTYN, I. Introdução: novos caminhos da arquitetura hospitalar. In: SANTOS, M.; BURSZTYN, I. **Saúde e arquitetura**: caminhos para a humanização dos ambientes hospitalares. Rio de Janeiro: Senac Rio, 2004.

TENON, J. **Memoirs on Paris Hospitals**. Tradução de Dora B. Wiener. [S.l.]: Watson Publishing International, 1996.

THOMPSON, J. D.; GOLDIN, G. **The Hospital**: a social and architecture history. London: Tale University, 1975.

TOLLET, C. **Les édifices hopitalier**: depouis leur origine jusqu'à nos jours. 10º Edição. ed. [S.l.]: [s.n.], 1892. Available at: <<http://1886.u-bordeaux-montaigne.fr/items/show/76344>>. Access: 15/05/2019.

VERDERBER, S. **Innovations in Hospital Architetcture**. New York: Routledge, 2010.

VERDERBER, S.; FINE, D. J. **Healthcare Architecture**: In an Era Radical Transformation. London: Yale University, 2000.

Hospital architecture and its propositions for beginners and experts

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Made for Healing – Architecture and Design Process in Brazil*

Rio Books publishing house, teamed up with IPH and based on the great interest in hospital architecture, is pleased to announce the release of a new and revisited edition of Made for Healing – Architecture and Design Process in Brazil, by Luiz Carlos Toledo.

The book results from the architect and urban planner's master's thesis and was published in 2006 in partnership with ABDEH. Even though it was sold out, it was still in great demand by students and architecture professionals eager to structure their projects and studies on a solid knowledge base about healthcare environments in Brazil.

This long-awaited second edition of Made for Healing came to fulfil this demand, besides including some hospital parameter updates, as Toledo himself explains in his opening, a much-needed update since more than fourteen years have passed since its first publication. The book updates, for instance, 70 m²-parameter per bed, a data often used to base the calculation for the total area of a hospital, to 100 to 150 m² per bed, thus reflecting the new reality of the sector. The author also discusses the increase in modular measures used in drawings and the expectation of further design innovations most likely to emerge after the COVID-19 pandemic.

*The book was only published in Portuguese but for better understanding of this review the title and chapter names were translated.

Professor Antonio Pedro de Carvalho, ABDEH Publishing General Editor, wrote the Presentation for this second edition highlighting the timeliness

and importance of the book and its unique lessons for health architecture. The book also brings a Foreword by Fábio Bitencourt, ABDEH former president (from 2011 to 2014), who points out the importance of the reflections presented, since the historical evolution of hospitals, passing through design compatibility regarding medicine and architecture and highlighting the participation of Brazilian architects who have left a legacy on the subject in their works.

The book is organized into seven chapters, in addition to the References and Appendix. In the first chapter - Some Explanations - the author presents his motivation to focus on the theme, its importance for the valorization of the public health network and the methodology used in his research based on a deep bibliographic survey and numerous interviews with architects known for their work in healthcare facility designs, such as Oscar Niemeyer, Mario Ferrer, João Filgueiras Lima, among many other important stakeholders who have helped consolidate hospital designs in the country.

The second chapter - From the therapeutic hospital to the technological hospital - takes us back in time observing hospital building timeline since its segregation and exclusion profile, passing through its charitable shelter nature for the excluded until the emergence of the "healing machine", as defined by Foucault, by the end of the 18th century. Here we also observe the evolution of hospital buildings in Brazil with its peculiar typological characteristics, from "merciful", through pavilion asylums until vertical buildings - the "mono blocks" - that mark the rising of the modern movement and the organization of health services in Brazil, besides some of its most notable architects who have contributed to the subject of healthcare.

The third chapter - Some theory, a little bit of criticism and a lot of information - talks about hospital design structural issues. It presents two methodologies supporting design quality: the post-occupancy evaluations and the accreditation, presenting both the history and consolidation of its practices. The design process regarding specialized literature section debates on publications and peculiarities of the hospital building, highlighting norms and characteristics of environments. The chapter also brings further reflections on Brazilian architects who have dedicated themselves to some hospital designs, such as Oscar Niemeyer, Mario Ferrer, among others, following some thoughts regarding the effort of standardization in the history of Brazilian norms until RDC 50/2002, the last one published at that moment.

Chapters 4 and 5 - Hospital, this unknown character, and Health planning and hospital building - can be considered fundamental for students and beginners in the subject, as both bring premises and fundamentals to be

considered in health building projects. In addition to typologies, sectors, classifications, and facility profiles, including their inclusion in Brazilian Unified Health System (Sistema Único de Saúde - SUS), they present the stages and premises of hospital designs until it becomes an institution ready for the specificities and purposes of care. Both chapters point out the particularities of the subject in knowing the characteristics of hospitals and marks its importance for all those interested in the subject.

In the sixth chapter - Contradicting history - the author presents us with a study of architectural morphologies and their contribution as a place of healing, according to their layout. Based on these observations, he points out the importance of João Filgueiras Lima's (Lelé) designs for SARAHE Rehabilitation Hospitals with his innovative and brilliant contribution to environment comfort, humanization and modulation aspects employed in his architecture.

Toledo presents his final considerations in the seventh chapter - Paths building up design alternatives - where he indicates possible developments of hospital designs into the future. Here the author shares some pearls with us, such as an informal interview with Oscar Niemeyer, and references of prominent names from Brazilian architecture - such as Aldary Toledo, his father, and Jarbas Karman (20th century) - and from the international context - from Casimir Tollet (19th century), Ernst Codman (20th century) to Verderber and Fine (21st century). The author also stresses the importance of having quality education to train hospital architects and of consolidating the National Health Policy with the valorization of basic and preventive healthcare facilities.

In addition to the References, the book's Appendix presents interviews with architects Regina Barcellos and Flávio Bicalho, who talk about the evolution of the regulation, since Ordinance #1884, from 1994, until RDC #50, from 2002, which they helped elaborate along with the Ministry of Health and ANVISA, presenting a historical perspective of Brazilian consolidated procedures towards hospital architecture.

Made for Healing is a must-read book for students, scholars and professionals involved in the task of designing healthcare facilities. The book's essence reflects the author's life experience as an outstanding architect and urban planner, besides devoted professor, and creative colleague. Toledinho, as his friends call him, is highly cherished by everyone lucky enough to benefit from his good humor. He dedicates his attention to health-related issues and encourages actions regarding social justice, equality, and quality of life. This book teaches us how to think and develop better healthcare facilities, as highlighted by the author, with humanization, equality, and thoughtful care towards human experience within hospitals.



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