Building for Change: Comparative Case Study of Hospital Architecture

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Abstract

Objective: This study assesses how architectural design strategies impact the flexibility of hospitals to change over time. Background: Most hospitals are designed for highly specialized medical functions, which is often in conflict with the need to design the hospital facility to accommodate evolution and change of functions over time. Architectural design strategies provide different approaches to the need to design for a specific medical program while planning for its future change. Methods: The study compares two hospital buildings with a very similar configuration and medical program but with significantly different architectural design strategies: One was designed for an unknown future medical function, and the second was designed for a specific medical function. The study analyses the two hospital buildings by their design strategy, planning, design process, and construction by phases and compares their change in practice over the last twelve years. Results: The design strategy to fit a specific function limited the hospital affordance to make changes during the design process, construction, and occupancy phases. Systematic design of system separation for an unknown function, in contradiction to a “tailor-made” approach in the design for a specific function, was found to support a variety of changing medical programs. Conclusions: Architectural design strategies developed in an early stage of the design process has a major impact on the future evolution of the hospital facility. The different results between the two projects also demonstrate the greater influence of healthcare policies, hospital organization culture, and infrastructure funding models on the architecture and flexibility of hospitals.

Keywords

hospital design, design strategies, function, flexibility, future change, medical program

Most hospitals are designed for highly specialized medical functions. This purpose may conflict with the need to design the hospital facility to evolve and change functions over time (Kendall, 2008). While many buildings are currently designed to be loose fit, such as residential, offices, or commercial buildings (Lifschutz, 2017), hospitals need to be designed to optimally fit a specific function and still be designed as loosely as possible to accommodate future functional changes. This challenge raises important questions: Can hospital design meet both our current needs and future demands? What is the optimal design? Is it a design

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that fits a specific function or one that supports future change of function?

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Hospital design for a specific medical function is often based on the current known needs of the hospital specified in the projects’ brief. The functional goal, usually a result of a participatory design process of the design team with the local medical team and management, often drives hospitals’ design processes and serves as the main criteria to evaluate the design success. Hospital flexibility to support future change of function is also an important design goal, considered to be more critical in hospitals than in most other types of buildings since the frequency and degree of change are both greater. Accordingly, flexibility is often a requirement to be built into the hospital plan to anticipate the growth and changes of the facility.

The unprecedented rate of medical, technological, and social change has led to the development of different healthcare architectural approaches to design for a specific medical program while planning for its future change (Preiser et al., 2018). In his book *A Pattern Language*, Christopher Alexander questioned if it is possible to create a space specifically tuned to the needs of people and yet capable of an infinite number of various arrangements and combinations within it (Alexander, 1977). Brand suggested developing scenario planning instead of programming. He explained that like programming, scenario planning is a future-oriented formal process of analysis and decision. Unlike programming, it reaches into the deeper future and instead of converging on a single path, its whole essence is divergence. The building is treated as a strategy rather than just a plan (Brand, 1994). Cole explained that strategic planning of new healthcare facilities needs to address two planning horizons: specific planning requirements for short to midterm based on statistical analysis and emerging models of care, and generic planning requirements for the mid- to longer term based on much less firm knowledge and a more global hypothesis (Cloe, 2006). The Clinic 20XX series studies by HKS Center for Advanced Design Research and Evaluation (CADRE) defined four spatial attributes of flexibility: versatility, modifiability, convertibility, and scalability, to allow hospitals to plan operational strategies against specific spatial modifications over the building’s life cycle (CADRE, 2019).

A more extreme approach by Llewelyn-Davies and Weeks declared that functions change so rapidly that designers should no longer aim for an optimum fit between building and function. The real requirement is to design a building that will allow change of function (James et al., 1986). Zeidler declared that the concept of “form follows function” does not meet the modern-day requirements of a hospital, and therefore, the true gestalt of a hospital lies in the acceptance of the unpredictability of future needs (Zeidler, 1974). Kendall also argued that the functionalist approach to facility design is obsolete. While this way of thinking has been the norm, we can no longer assume that if we determine a program of uses and design a hospital to suit, its future functionality is assured. The opposite is more often true; building designed according to the functionalist paradigm performs poorly, while those designed to accommodate varying functions gain value over time (Kendall, 2011). The open building theory, developed as a response to the rigidity of a “whole” design solution, a departure from the conventional functionalist thinking and architectural management practices, recognizes the different life spans and decision-making processes related to the built environment and proposes a method of system separation between what is relatively stable and what is relatively changeable (Habraken, 1972).

While many studies have investigated the topic of hospital flexibility, only a few have assessed how architectural design strategies—design for an unknown function versus design for a specific function—impact the flexibility of hospitals to change over time. This study explores and compares the two design strategies in the context of two hospital buildings in Israel: The Sammy Ofer Heart Center at the Tel Aviv Sourasky Medical Center (Hospital Building 1), and
The Joseph Fishman Oncology Hospital and Eyal Ofer Heart Hospital at the Rambam Health Care Campus in Haifa (Hospital Building 2). The study was based on primary data collected from the hospital and the architecture firms, including architectural drawings, programming documents, and reports. The design and construction process were analyzed based on unstructured expert interviews, including hospital management, chief architects, project managers, and consultants. Survey information was also obtained by site visits and observations of the building’s construction and performance-during-use from 2006 to 2018. A systematic analysis of the documents and interviews revealed a framework of five main categories for comparison: (1) design strategy, (2) planning, (3) design process, (4) construction by phases, and (5) change in practice. The comparison of the hospitals by these categories in the discussion leads to conclusions regarding the impact of the design on the functionality and flexibility of the buildings to change and evolve.

| Architectural Data          | Hospital Building 1 | Hospital Building 2 |
|----------------------------|---------------------|---------------------|
| Architects                  | Ranni Ziss Architects & Sharon Architects | Mochly-Eldar Architects |
| Location                    | Tel Aviv, Israel    | Haifa, Israel       |
| Opened                      | 2011                | 2016 (only south wing) |
| Funding                     | Mostly private donations | Mostly private donations |
| Total medical area          | 38,000 m² (409,000 ft²) | 24,000 m² (258,300 ft²) |
| Floor area                  | 3,100 m² (33,300 ft²) | 2,500 m² (26,900 ft²) |
| Structural grid             | 7.6 m × 7.6 m (25' × 25') | 8.4 m × 8.4 m (27.5' × 27.5') |
| Number of floors            | 12                  | 8/9                 |
| Underground emergency       | 3 Floors            | 3 Floors            |
| Fortified medical units     | 1 unit              | 3 units             |
| Building height             | 53 m (174 ft)       | 38 m (125 ft)       |
| Floor height                | 4.20 m              | 4.08 m              |
| Symmetric                   | Yes                 | No                  |
| Design process              | 7 + 6 years (continues) | 8 years (continues) |
| Construction phases         | 5                   | 5                   |
| Designed for unknown function | 60%               | 0%                  |

[1] The Sammy Ofer Heart Center at the Sourasky Tel Aviv Medical Center and [2] the Joseph Fishman Oncology Hospital and Eyal Ofer Heart Hospital at the Rambam Health Care Campus.
Comparative Case Studies

Hospital building 1 and hospital building 2 have a very similar typology, program, and vision. Both buildings were constructed in 2010–2018 in Israel by local architecture firms (Table 1). They have a similar architectural configuration, scale, and style (Figures 1 and 2). Both hospitals accommodate similar medical programs of oncology and cardiovascular care (Table 2) and provide service as part of the Israeli health system, dealing with similar challenges of health policies and demands. Both projects were designed by a multidisciplinary team and were realized through private donations of funds raised by the hospital. The two projects had a long design process and were constructed in phases, supported by a method of system separation (Figure 3). Despite these similarities, they significantly differ in their design strategy for functional change. Hospital building 1 was
Table 2. Comparison of the Hospital Buildings Current Program.

| Hospital Program                          | Hospital Program | Hospital Program | Hospital Program | Hospital Program |
|------------------------------------------|------------------|------------------|------------------|------------------|
|                                          | Building 1       | Building 2       | Building 1       | Building 2       |
|                                          | Include | Change | Include | Change | Include | Change | Include | Change |
| Cardiovascular Center                    | ✔       | +      | ✔       |        | ✔       | +      | ✔       | +      |
| Preventive Cardiology                    | ✔       | +      | ✔       |        | ✔       | +      | ✔       | +      |
| Rehabilitative Cardiology                | ✔       | +      | ✔       |        | ✔       | +      | ✔       | +      |
| Cardiac Hospitalization                  | ✔       |        | ✔       |        | ✔       |        | ✔       |        |
| Cardiovascular and Chest Surgery         | ✔       | +      | ✔       |        | ✔       |        | ✔       |        |
| Cardiac Intensive Care *                 | ✔       | +      | ✔       | +      | ✔       | +      | ✔       | +      |
| Interventional Cardiology                | ✔       | +      | ✔       |        | ✔       |        | ✔       |        |
| Cardiac Catheterization                  | ✔       |        | ✔       |        | ✔       |        | ✔       |        |
| Electrophysiology                        | ✔       | +      | –       |        | ✔       |        | ✔       |        |
| Noninvasive Cardiology                   | ✔       | +      | ✔       | +      | ✔       | +      | ✔       | +      |
| Breast Health and Imaging Center         | ✔       | +      | –       |        | ✔       | +      | ✔       | +      |
| MRI and Electrophysiology                | –       | ✔      | +       |        | ✔       | +      | ✔       | +      |
| Cardiac Outpatient Clinic                | ✔       | +      | ✔       | +      | ✔       | +      | ✔       | +      |
| Oncology Center                          | ✔       |        | ✔       |        | ✔       |        | ✔       |        |
| Oncology Inpatient Hospitalization       | ✔       | +      | ✔       |        | ✔       | +      | ✔       | +      |
| Oncology Clinics                         | ✔       | +      | ✔       | +      | ✔       | +      | ✔       | +      |
| Oncology Outpatient Units                | ✔       | +      | ✔       |        | ✔       | +      | ✔       | +      |
| Radiation Unit                           | –       | ✔      | +       |        | ✔       |        | ✔       |        |
| Radiotherapy Inpatient                   | –       | ✔      | ✔       |        | ✔       |        | ✔       |        |
| Chemotherapy Inpatient                   | ✔       | +      | ✔       |        | ✔       | +      | ✔       | +      |
| Other Functions                          | Emergency Hospital | ✔       | +      | ✔       | +      | ✔       | +      |
| Underground Parking                      | ✔       | +      | ✔       |        | ✔       | +      | ✔       | +      |
| Entrance Lobby and Cafe                  | ✔       |        | ✔       | +      | ✔       |        | ✔       | +      |
| Transplantation Clinic                   | ✔       | +      | –       |        | ✔       |        | ✔       |        |
| Obesity Center                           | ✔       |        | –       |        | ✔       |        | ✔       |        |
| Nutrition and Dietary Unit               | ✔       |        | –       |        | ✔       |        | ✔       |        |
| Conference Hall                          | ✔       |        | ✔       |        | ✔       |        | ✔       |        |
| Internal Medicine Units                  | ✔       | +      | –       |        | ✔       | +      | ✔       | +      |
| Neurology                                | ✔       | +      | –       |        | ✔       | +      | ✔       | +      |
| Neurosurgery                             | ✔       | +      | –       |        | ✔       | +      | ✔       | +      |
| Dermatology                              | ✔       | +      | –       |        | ✔       | +      | ✔       | +      |
| Video-EEG Monitoring                     | ✔       | +      | –       |        | ✔       | +      | ✔       | +      |
| Epilepsy Unit EEG Lab                    | ✔       | +      | –       |        | ✔       | +      | ✔       | +      |
| Research Labs                            | ✔       | +      | ✔       | +      | ✔       | +      | ✔       | +      |
| Cytotoxic Pharmacy                       | ✔       | +      | ✔       | +      | ✔       | +      | ✔       | +      |
| Administration                           | ✔       |        | ✔       |        | ✔       |        | ✔       |        |
| Storage                                  | ✔       |        | ✔       |        | ✔       |        | ✔       |        |
| Staff lockers                            | ✔       |        | ✔       |        | ✔       |        | ✔       |        |
| Archive                                  | ✔       |        | ✔       |        | ✔       |        | ✔       |        |

Note. [1] The Sammy Ofer Heart Center at the Sourasky Tel Aviv Medical Center and [2] the Joseph Fishman Oncology Hospital and Eyal Ofer Heart Hospital at the Rambam Health Care Campus.
designed to provide flexibility to change medical programs, and hospital building 2 was designed to fit a specific medical program.

Hospital building 1 was designed to provide flexibility to change medical programs, and hospital building 2 was designed to fit a specific medical program.

Hospital building 1, The Sammy Ofer Heart Center at Tel Aviv Sourasky Medical Center, designed by Sharon Architects and Ranni Ziss Architects, opened in 2011. The building, located in the center of Tel Aviv, was designed as a monolithic cube clad in glass with prominent red recessed balconies (Figure 1). The building was designed to connect to an adjacent, historical “Bauhaus” hospital building through an atrium. The building consists of 38,000 m² (409,000 ft²) and includes twelve medical floors of 3,100 m² (33,300 ft²) per floor and three underground parking floors designed with the possibility of conversion to an emergency 650-bed hospital. The 15,000 m² (161,400 ft²) underground “sheltered” floors were designed to be resistant to chemical and biological warfare. The construction of the building was made possible through the donation of the Sammy Ofer family to the Tel Aviv Sourasky Medical Center in 2005. The private donation supported the construction of the buildings’ base and envelope and the fit-out of the cardiology center on floors 0–2. The other medical units that were completed in the shell floors 3–9, after the building opened in 2011, including the oncology division, were made possible through additional donations made to the hospital by private donors (Figure 4).

Hospital building 2, The Joseph Fishman Oncology Hospital and the Eyal Ofer heart Hospital at Rambam Health Care Campus in Haifa, was designed by Mochly-Eldar Architects. The building was designed as a cluster of two connected structures, while in fact, it is one structure with two separate medical centers (Figure 1). The two centers, divided vertically, were designed and constructed in separate phases. The Oncology Center was opened in 2016, and the Heart Center was still under construction in 2019. The building consists of 24,000 m² (258,300 ft²) and includes nine medical floors of 2,500 m² (26,900 ft²) per floor and three underground floors with four linear accelerators for radiation therapy, part of the hospital underground fortified emergency 2,000-bed hospital. The construction of the building was made possible through two significant donations. The first donation of Joseph Fishman and his family supported the construction of the oncology center. To maximize the donation, the hospital decided to construct the complete base building including both south and north wings, in addition to the construction of the envelope and interior of the oncology center on the south wing. The donation of Eyal Ofer and his family, years later, supported the realization of the cardiovascular center on the north wing of the building, including its exterior façade and interior units (Figure 4). The hospital continues to seek additional funds to finance the completion of all the medical units and to purchase new equipment. For example, two floors of radiotherapy were completed by additional fundraising in 2016, after the oncology center had already opened.

Design Strategy

The main objective of the Sourasky Tel Aviv Medical Center in the design of the hospital building 1 was to construct the largest structure possible to enlarge the hospital-built area for future development. The hospital management decided to maximize the building area and height by applying pressure on the municipality planning guideline limitations. This objective led to a design strategy aimed to build a “container with capacity” for future infill of unknown medical programs. As a result, the building was designed as a base and envelope with seven shell floors for future fit-out completion, implementing a method of system separation between what is relatively stable and what is relatively changeable.

The design strategy of the Rambam Health Care Campus in the design of hospital building 2 evolved from the west campus development plan that specified the possibility to build only one building on the hospital site. The hospital’s immediate need to develop two new medical centers—one for cancer and one for heart
treatment—led to the decision to locate both of them in the same building. The vertical division of the building was an attempt to create an image of two separate buildings to attract different donors to finance the project. The administration management explained that most donors want their names on a tower in honor of their donation. Consequently, the management even insisted on creating two separate entrances, but the architect managed to convince them otherwise due to lack of space and designed one main entrance leading into two different lobbies with separate circulation systems (Brumberg, 2015).

Planning

Hospital building 1 was initially planned to accommodate a cardiology division. The hospital management decided to relocate all the hospital cardiac units, clinics, and surgery units to one central location. The cardiac program occupied less than 30% of the building on three main floors, leaving seven floors for future programming and planning (Table 2, Figure 4).

The two centers in hospital building 2 were planned separately in different periods of the project. The oncology center was designed to offer comprehensive cancer treatments, including linear accelerated chemotherapy, radiotherapy, and brachytherapy, complementary medicine, and outreach programs for prevention and early detection of cancer. The heart center was programmed to consolidate all cardiovascular diagnoses, treatments, research, and disease risk-reduction programs, including cardiac and vascular surgery, interventional cardiology, electrophysiology, advanced cardiovascular imaging, and cardiac intensive care (Table 2, Figure 5). The main concept of planning was to create two central divisions to implement integrated medical care models and to enhance patient-centered care.

The architectural image of the two buildings represents their design strategy. The monolithic cube in the hospital building 1 was planned to...
enable changing functions by not revealing the interior use. The conscious decision to complete the exterior glass facade at an early phase while the interior was still under construction reflects the motivation to create an illusion of a complete “whole building.” The cluster of the buildings in hospital building 2, on the contrary, was planned to emphasize the functional separation of the two medical centers as two complete buildings, and their exterior was designed to distinguish certain functional floors, such as the top floor of the oncology center that was planned for research labs. The floor program later changed to an additional outpatient clinic, but the exterior accentuated design remained.

**Design Process**

The design process of hospital building 1, which began in 2005, reflected a variety of concepts to deal with the unknown future medical function, tight budgetary, regulatory, and environmental constraints. The design team used a method of developing design options and capacity studies to support decision making by the hospital management. The long design process of over 12 years involved many different professionals and decision makers. Many of the hospital medical managers were replaced, resulting in a reconsideration of the design and requests for alternative design options. The development of the project by phases, using system separation, allowed the architects to divide the workload between the two collaborative offices and to control the development of the project by different design teams, project managers, and consultants.

The conceptual division of hospital building 2 led to two separate design processes for the specific functional program of the oncology center, and years later, for the cardiovascular center. The
two design teams, which included different architects, hospital managers, and consultants, worked in different periods and schedules. The design process took over eight years and dealt with many limitations and constraints. The underground sheltered hospital that was constructed five years earlier restricted the design of the structure, the location of the core, columns, and shafts. Also, the decision to build the complete base building at an early phase, years before there was even a program for the cardiology center on the north wing, challenged the team to decide where to locate the cardiac units that needed to be fortified according to the Israeli civil defense unit. This decision had massive implications on the design of the base building and the cardiovascular center. Previous research also demonstrated that fortified structures restrict the units’ future potential to expand, change function, or move to other locations (Pilosof, 2018).

**Construction by Phases**

Hospital building 1 was constructed in five main phases: (1) the underground emergency hospital, (2) base building and envelope of Floors 1–10 including a mechanical roof floor, (3) interior fit-out of floors 0–3, (4) interior fit-out of floors 4–6, and (5) interior fit-out of floors 7–10 (Figure 4). The phasing stages, divided by the floors in the building, created a process of fit-out from the bottom upward. Although this process of deferred completion was planned, it still created a challenge for both the construction and the operation of the running units.

Hospital building 2 was also constructed in five main phases: (1) the underground emergency hospital, (2) base building including the two wings, (3) completion of the south wing including its envelope and interior fit-out of Floors 0–7 of the oncology center, (4) completion of the north wing including fortifying the structure of the third floor, construction of an additional eighth floor, and interior fit-out of floors 0–8 of the cardiovascular center (Figure 5). The construction phases, divided mostly by the buildings’ wings, created a process of vertical evolution. Although this process caused fewer interruptions in the operation of the running units, it affected the image of the building. When the oncology center on the south wing opened in 2016, the north wing was still a construction site with only a concrete core structure (Figure 1).

**Change in Practice**

Following a study of the evolutionary process of the hospital building 1 in the years 2005–2018, documenting the changes that were made to the building during the design process, construction phases, and occupancy (Pilosof, 2018), this study illustrates the significant variety of medical functions in the building, including an oncology division, neurology, dermatology, internal medicine, outpatient clinics, and research labs, transforming it into a multidisciplinary medical center (Table 2 and Figure 4). The seven shell floors, designed for future completion, provided an opportunity for the hospital management to relocate their oncology division and centralize the cancer treatment in one location, to enhance hospital efficiency and patient-centered care. The main change of function from a heart center to a cancer center can be explained by changing needs since cancer became the number one cause of death and statistically surpassed cardiac diseases. Also, the hospital management decided to relocate other functions to the building since their previous locations required renovation or extension or because they received funds to reconstruct a specific medical unit. The hospital also added two shell floors to the building just before construction began, which required redesigning the buildings’ primary system including the structure, Mechanical, Electrical and Plumbing (MEP) systems, and facades and caused a delay of a few months in the design and construction process.

The changes made to hospital building 2 during the design process, construction phases, and occupancy were primarily a result of the design strategy to divide the building vertically into two units. The changes included modifications in the cardiovascular program to fit into the structures’ limitations, as the base structure of the north wing was already constructed (Table 2 and Figure 5). To fit the extended program of the oncology division, the hospital management decided to build an additional eighth floor on top of the existing north
wing structure and to fortify the third floor to include another interventional cardiology unit. The hospital management also changed the program of the oncology center during Phase 3 to add an outpatient clinic on the seventh floor of the south wing for future needs.

Discussion

The difference in the architectural design strategies—to design for unknown future medical functions versus design for specific functions—had a major impact on the planning of the buildings, their design process, phases of construction, funding models, and change over time. The approach to design for an unknown future medical functions led to the design of a monolithic cube with horizontal interior shell floors for future infill, and the approach to design for specific medical functions led to a cluster of two structures with vertical separate medical centers. Both strategies limited the building’s option to grow and expand. Their exterior form was determined in advance, leaving only shell spaces for future completion that were all occupied in a few years. Eventually, the limitations of both the buildings area demanded compromises on the building program. For example, neither hospital included the hematology department with the oncology division even though the building was programmed as a comprehensive cancer center (Table 2). One of the greatest limitations of the vertical strategy at the hospital building 2, according to its architect, is the deterministic size of the units within each wing. Having two different medical programs on the same floor limited the unit’s flexibility to expand or divide the space (Figure 6). The horizontal strategy, on the contrary, at the hospital building 1, enabled changes of unit sizes and forms. The larger floor area, used for the same medical function on each floor, in comparison to the division to two wings with different functions, provided flexibility of use between units and enhanced collaboration between the units’ staff.

To design for an unknown future function, the design team of the hospital building 1 incorporated scenario planning by preliminary schematic capacity studies, which was found to be effective in the development of the design strategy for flexibility. The method of system separation was used in both projects, yet the reason for its implementation was different. The hospital building 2 design team used it only as a method for gaining financial support and subsequently phasing the construction and the fit-out of the two wings. This approach is evident in the unsystematic configuration of the MEP shafts that were located according to the specific needs of each unit with superposition between the floors, without consideration of future changing needs (Figure 3). The hospital building 1 design team also used it as a method for phasing the project, but the primary purpose was to defer the decision on the uses of seven of its twelve floors for later consideration. The need to design shell floors for an unknown function led to the configuration of a systematic structural grid of columns and MEP shafts (Figure 3). This finding is also evident in the architects’ reflections on their designs. In the vision of the
architect of the hospital building 1, the building was designed to be flexible and to provide optimal space for future advances in medicine (Sharon, 2012), while the architect of the hospital building 2 declared that his design was not designated for future change. He explained that the limitation of the site, the hospital requirement to design the building as two separate buildings, and the extended program demanded that they create a “tailor-made” solution.

While the strategy to design for an unknown function supported the flexibility of the building to accommodate a variety of medical programs, the strategy to design for a specific function limited the building potential to change its medical programs to only oncology and cardiovascular units. This limitation is significant since researchers predict that new technologies of personalized and precision medicine will improve cancer treatment protocols and have a substantial impact on occupancy rates of future patients. Such changes were disregarded in the program and the design of the buildings. Another missed opportunity was the option to plan for change in the connections between different medical units as new models of care are developed to treat multimorbid patients. For example, cardio-oncology is an emerging medical specialty that focuses attention on preventing heart damage caused by cancer treatments such as radiation therapy and certain chemotherapy drugs that carry a risk of hypertension and blood clots (Herrmann et al., 2014). This new model of medicine is not supported by the hospitals, although they both integrate cardiology and oncology in the same building. The program and the design of the buildings focused on separating and distinguishing the two medical specialties, for economic and policy reasons, and missed

![Diagram of the hospital flexibility to locate medical programs](image)

**Figure 6.** Diagram of the hospital flexibility to locate medical programs. *Note.* A, B, . . . Medical Program (Oncology/Cardiology/Other); 1, 2, . . . Medical Units (inpatient/outpatient/surgery/ICU/clinics). [1] The Sammy Ofer Heart Center at the Sourasky Tel Aviv Medical Center and [2] the Joseph Fishman Oncology Hospital and Eyal Ofer Heart Hospital at the Rambam Health Care Campus.
an opportunity to engage a collaborative effort to advance patient care.

While the strategy to design for an unknown function supported the flexibility of the building to accommodate a variety of medical programs, the strategy to design for a specific function limited the building potential to change its medical programs.

Conclusions

The study showed that architectural design strategies, developed in an early stage of the design process, have a major impact on the future evolution process of the hospital facility. The results illustrate the impact of the two architectural approaches—design for an unknown function versus design for a specific function—on the buildings’ evolvement over time, horizontally oriented evolution versus vertically oriented evolution, which defined the affordance to make changes during the design process, construction and occupancy phases. The horizontal evolution process, led by an architectural design strategy to design for unknown future function, supported the change of medical programs in the building and enhanced flexibility of use between medical units on the same floor. The vertical evolution process, led by an architectural design strategy to design for a specific function, restricted change of medical programs and limited the units’ flexibility of use and collaboration with other units located on different floors. The study also found that the size and configuration of the building floors had a major impact on the flexibility of the medical units. System separation was efficient in both projects, yet the systematic design of the structural grid of columns and MEP shafts for flexibility purposes, in contradiction to a “tailor-made” approach to locate the columns and MEP shafts according to the specific needs of the function, was found to support a variety of changing medical programs.

The different results between the two projects also demonstrate the greater influence of healthcare policies, hospital organization culture, and infrastructure funding models on the architecture of hospitals. As most hospitals in Israel are in need to find immediate solutions for their inadequate infrastructures in the face of growing demands and advances in medical technology, hospital directors attempt to maximize the potential for financial support. The dependence of hospitals on private donations to initiate the design process and construction of new buildings has significant implications. The case studies showed that such policy decisions defined the design strategy of the two buildings and resulted in many limitations, not only in the planning and design of the new projects but also in the potential of the hospital to change and evolve over time. Eventually, it even affected the medical care models of the hospitals, limiting emergence of new medical fields.

The dependence of hospitals on private donations to initiate the design process and construction of new buildings has significant implications on the flexibility of the medical facilities to evolve and change over time.

Limitations

This study compared two hospital buildings with different architectural design strategies. Further work is needed to evaluate other architectural design strategies and building typologies. The study documented changes over the last twelve years during the design process, construction,
and occupancy phases of the two hospitals. While this time frame is significant, further work is needed to evaluate healthcare facilities over their full life cycle period. More studies on the economic implications of designing for an unknown function versus a specific function are needed, as well as studies on the impact of funding models, including private donations, on the hospital architecture and performance over time. Further research on healthcare facilities designed for functionality and flexibility from different environmental, cultural, and economic context will enhance the knowledge base needed for the successful design of sustainable healthcare architecture.

Implications for Practice

- Hospitals need to be designed to optimally fit a specific function and at the same time be designed as loosely as possible to accommodate future functional changes.
- Architectural design strategy, developed in an early stage of the design process, has a major impact on the future evolution process of the hospital facility.
- Horizontal-oriented evolution, in comparison to vertical-oriented evolution, supports change of medical programs and enhances flexibility of use and collaboration between medical units on the same floor.
- Systematic design of the structural grid of columns and MEP shafts, designed for an unknown function, in comparison to a “tailor-made” approach to locate the columns and MEP shafts according to the specific needs of the function, was found to support a variety of changing medical programs.
- The dependency of hospitals on private donations for the construction of new buildings has significant implications on the design strategies and future evolution of the hospital.

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Declaration of Conflicting Interests

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