OPTIMIZING HEALTHCARE FACILITIES: A MEDICAL PLANNING STUDY

Master Thesis

Construction and Real Estate Management - ConREM -

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&

Metropolia University of Applied Sciences

from

OMAR FAGAL

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2nd Supervisor: MARTIN MEYER

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Conceptual Formulation
Master Thesis for Mr. Omar Fagal
Student number 2212790 (Metropolia), 585963 (HTW)

Topic: **"Optimizing Healthcare Facilities: A Medical Planning Study"**

Signature of the 1st Supervisor:
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Martin Meyer

Background:

Healthcare Facilities (HCFs) are well-known as one of the most complex building typologies among the Architectrue-Engineering-Construction (AEC) projects. It impact its surrounding environment, medical staff, and patients' health and well-being. Medical Planning (MP) is a process uniquely linked to HCFs, aiming to identify and determine the medical needs of a community and establish prioritized goals to meet those goals. (Millsap, 2007). It is a comprehensive process seldom overlooked by some clients who hire a reputable architect/ designer without engaging with a Medical Planner. (Eriksen, 2007).

Medical Planning should be closely linked to the overall Lifecycle of a HCF project. It is applied on large macroscales, determining the medical demands for an urban area and which medical service to prioritize and provide. Moreover, it is used on the building scale by giving a well-functioning space program, the optimum hospital size, the number of beds, and efficient workflow inside or outside the HCF with surrounding supplementary services. (Tabish, 2003). Furthermore, Medical Planning can contribute during the post-occupancy and operation of the facility in the event of future extensions or changes of use.

Additionally, concerning the reasoning of this research, medical planning is a rarely addressed topic from a consultancy perspective. Most of the literature discussed how users and medical staff reacted to the HCF project after its operation. (Symons, 2021). Thus, discussing the difference that medical planning can make during the early phases of a HCF project supports and justifies the urgency of this thesis topic.

The main concern of the research is how the planning of HCFs can be taken one step ahead. How the consultancy & collaboration of a Medical Planner can assist in addressing multiple issues parallely such as bridging design ideas to non practiontioners/ business people. In addition to an MP's contribution to costs savings and positive enabling of different parties involved in a HCF project.

Research Questions:

1. How can MP help deliver and align a healthcare facility project with the *Finals* model of a client?
2. What challenges and benefits arise in promoting collaboration among medical planners, architects, engineers, officials, and other stakeholders for decision-making in healthcare facility projects?
3. How can a medical planner contribute to potential savings in construction modifications, operational efficiency, and long-term maintenance of a healthcare facility?

Research Objectives: This paper aims to:

1. Explain the role of the medical planner in aligning a healthcare facility project with a business suitcase.
2. Identify Evidence-based-design (EBD) approaches and solutions for efficient stakeholders enabling.
3. Examine the cost-saving opportunities in hiring a comprehensive medical planner.
4. Identify regulatory challenges faced in healthcare facilities projects and how a medical planner can respond to them.

Research Gap/ Reasoning:

1. Healthcare facilities make a constant building type that is always in demand. Addressing the significance of proper Medical Planning for these facilities will result in useful improvement if how HCFs are approached.
2. A topic rarely addressed: Most research addressed medical planning from a post-occupancy approach, not during the planning stage of a HCF project.
3. Lifecycle long impact: Medical Planning affects all phases of the HCF project, from strategic & feasibility studies to delivery & occupancy.
4. Personal Expertise: As an architect, HCF projects build up most of my work portfolio.

Methodology:

Since this research discusses a comprehensive process that nearly affects all project phases, the methodology and data gathering shall be diverse.

1. Literature Review:
   1.1. Primary Concept: Medical Planning, Healthcare Investment, Healthcare

Construction
1.2. Secondary Concepts: Evidence-Based Design, Patient-Centred Design, __)
2. Non-Structured Interviews: Practitioners, Medical Planners, and Facility Managers (regular/remote)
3. Questionnaires: Non-practitioners and End-users
4. Case Study Testing:
   4.1. Children Cancer Hospital of Egypt (CCHE 57357)
   4.2. Theoretical Case Study(ies): Bonus for further assessment & comparison
5. Data Analysis & Methods Preparation: Incorporating MP in HCF Design

Resources:

1. Access to CCHE's documents/ drawings.
2. Sources & readings with a subscription fee.
3. Survey/ questionnaire platform
4. Contact with an additional HCF similar to my contacts with CCHE.

Proposed Phases Schedule:

February	March	April	May	June
Literature (1st Layer)				
	Methods & Case Study: Data Gathering			
		Literature Finalizing		
				Results & Discussion

References:

1. Bengts, A., Eloranta, V., korkeakoulu, T. j. s., School of Arts, D. a. A., Mc Grory, P., University, A., & Aalto-yliopisto. (2020). *Towards a shared logic in Finnish hospital design*.
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3. Eriksen, A.M. (2007). Participatory Planning and Design of a New Children's Hospital.
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Abstract

This thesis addressed the role of the medical planner exclusively in healthcare projects. Knowing the speciality if the building typology, it was justifiable to conduct this research. The research started with laying a theoretical base under two main titles, healthcare facilities and medical planning, orderly. Focus was given t the cost, investment, stakeholders, and regulations aspect of the healthcare facilities. An architecture precedent, Helsinki's New Children's Hospital followed the theory part as a transition before the main case study of the research, the Children's Cancer Hospital of Egypt (CCHE). The knowledge testing was then performed on the Egyptian paediatric oncology hospital. Nonstructured interviews were conducted with professionals at the CCHE. The interviews assisted in having a better understanding of the practical aspect of the research questions concerning the medical planner's role. The end results confirmed the significant contribution of the medical planner and identified multiple spots of benefits which a medical planner can offer a healthcare facility.

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List of Abbreviations

HCFs	Healthcare Facilities
MP	Medical Planning/ Medical Planner
WHO	World Health Organization
AEC	Architecture Engineering Construction
ROI	Return on Investment
KPI	Key Performance Indicator
CCHE	Children’s Cancer Hospital of Egypt
NCI	National Cancer Institute
AFNCI	Association of Friends of National Cancer Institute
ECN	Egypt Cancer Network
C&S	Core and Shell
ER	Emergency Room
OP	Out-Patient
BMT	Bone Marrow Transplant
JCI	Joint Commission International
GAHAR	General Authority for Healthcare Accreditation and Regulation
HCIM	Healthcare Investment Management
RFP	Request for Proposal

Chapter One: Research Outline

1.1 Introduction

Healthcare Facilities (HCFs) are well-known as one of the most complex building typologies among the Architecture Engineering Construction (AEC) projects. A building type that affects, and is affected by, various parameters, systems, and users. Due to their nature as public buildings HCFs are running around the clock, even if not at full capacity. This continuous state of operations enlarges the amount and intensity of impact these facilities can make on the people and the surrounding environment.

Figure (1) shows the affected parameters such as: local economies and job markets, communities' health assessments, traffic and infrastructure, property values, surrounding environment jammed by the medical waste generated and massive energy consumption, traffic and infrastructure, noise, and pollution, as well as education and trainings, etc. It is clear that a HCF project requires extra caution and attention during the planning and design phases.

Parallelly, Medical Planning (MP) is a process uniquely linked to HCFs, aiming to identify and determine the medical needs of a HCF project and establish prioritized goals to meet those needs (Millsap, 2007). Furthermore, the medical planning process ensures the proper translation of the necessities of health services into a constructable functional building. It is a comprehensive process that is seldom overlooked by clients who inapplicably hire a reputable architect/ designer without engaging with a medical planner (Eriksen, 2007).

Medical planning should be closely linked to the overall lifecycle of an HCF project. It is applied on large macroscales, determining the medical demands for an urban area and which medical service to prioritize and provide. Moreover, it is used on the building scale by giving a well-functioning space program, the optimum hospital size, the number of beds, and efficient workflow inside or outside the HCF with surrounding supplementary services (Tabish, 2003). Furthermore, medical planning can contribute during the post-occupancy and operation of the facility in the event of future extensions or changes of use.

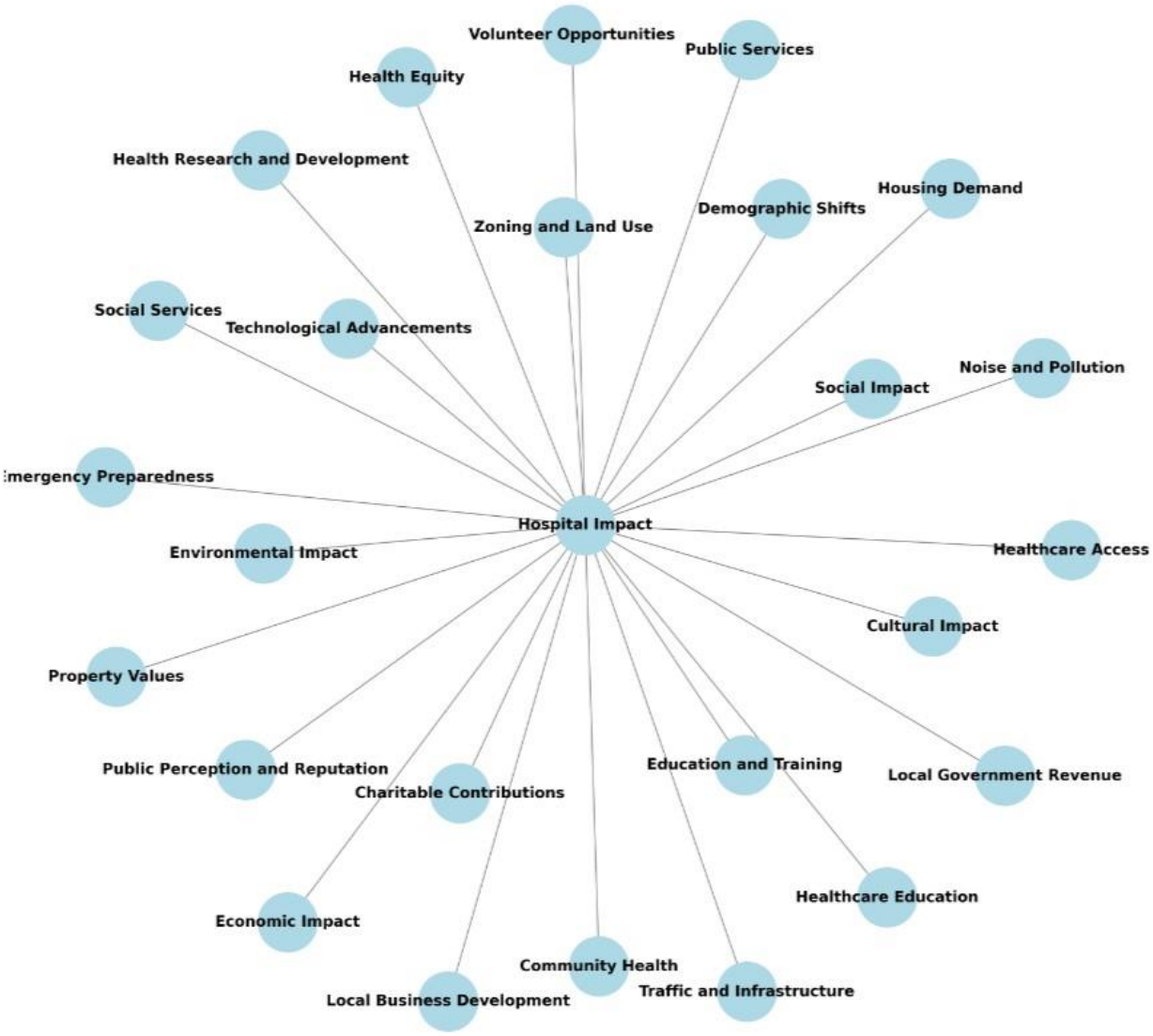


Figure: 1 Parameters affected by HCFs projects. Source: Author

(Symons, 2021) argued that most of the literature discussed how users and medical staff reacted to the HCF project after its operation, resulting in scarce research that addresses medical planning from the consultancy perspective. Thus, discussing the difference that medical planning can make during the early phases of a HCF project supports and justifies the urgency of this dissertation.

The research explores the possibility of taking HCFs one step ahead. The main concern is “How the consultancy & collaboration of a medical planner can assist in addressing multiple issues raised by decision makers who might not necessarily be engineers/ architects/ planners?”.

1.2 Research Problem

The research addresses the gap in HCF design by the lack of collaboration of a medical planner. By studying the complexity of HCFs, the thesis explores the transformation in the medical process and workflow by incorporating the insights of a medical planner during the design process.

1.3 Research Questions

The research addresses a certain set of questions which are:

1. How can a medical planner help deliver & align a Healthcare Facility (HCF) project with the "*Finals*" model of the owner/ client?
2. What challenges and benefits arise in promoting collaboration among medical planners, architects, engineers, officials, and other stakeholders for decision-making in HCF projects?
3. How can a medical planner contribute to potential savings in construction modifications, operational efficiency, and long-term maintenance of a HCF?

1.4 Research Aims and Objectives

This paper aims to:

1. Explain the role of the medical planner in aligning a HCF project with a desired finals criterion.
2. Identify approaches and solutions for efficiently enabling stakeholders.
3. Examine the cost-saving opportunities in hiring a comprehensive medical planner.
4. Identify regulatory challenges faced in HCF projects and how MP can respond to them.

1.5 Research Design

The following section briefly discusses the research approach and the adopted methods and tools applied to address the problem of this study and to answer the research

questions raised about the planning of HCFs and the difference an MP can make when actively engaged in such a complex building type.

1.5.1 Research Approach

The research in hand follows the qualitative approach to reveal the complexity of the studied building type, in addition to the significant role believed to take place from the medical planner/ healthcare architect's end. The qualitative research allows the development of in-depth understanding of the matter under study, including subjective understandings of the way the job is practically done. In contrary to the quantitative research, qualitative research does not prioritize generalizations of the findings.

1.5.2 Research Methods

Since this research discusses a comprehensive process that nearly affects all project phases, the methodology and data gathering shall be diverse:

Reviewing Previous Literature: Healthcare Facilities, Healing Architecture, Medical Planning, Investment & Healthcare Construction

1. **Healthcare Facilities:** Part of this research is concerned with the overlapping areas of interest and influence between medical planners and the decision makers such as the owners and operators of the HCFs. It is addressed by reviewing previous literature about the financial perspective in addition to nonstructured interviews with top management professionals.
2. **Medical Planning Process:** The second part is interested in the multidisciplinary manner through which the HCFs project phases encounter. Attempting to answer this question invited literature research on the flow of the medical planning process and its multiple stakeholders involved and the stance of the medical planner through it.
3. **Cost and Financials:** The third pillar of this research spots the light on the medical planner's ability to save resources through his/her medical layout of a HCF. It was addressed first by understanding the aspects which consume most cost in HCFs through literature investigation.

Research Design:

1. **Theoretical Review of a European HCF Project:** New Children's Hospital in Helsinki
2. **Case Study Testing:** Children Cancer Hospital of Egypt (CCHE 57357)
3. **Non-Structured Interviews**: Six Interviews with Practitioners, Medical Planners, and Facility Managers (regular/remote). The nonstructured interviews require additional tools to validate and reflect on a more practical level.

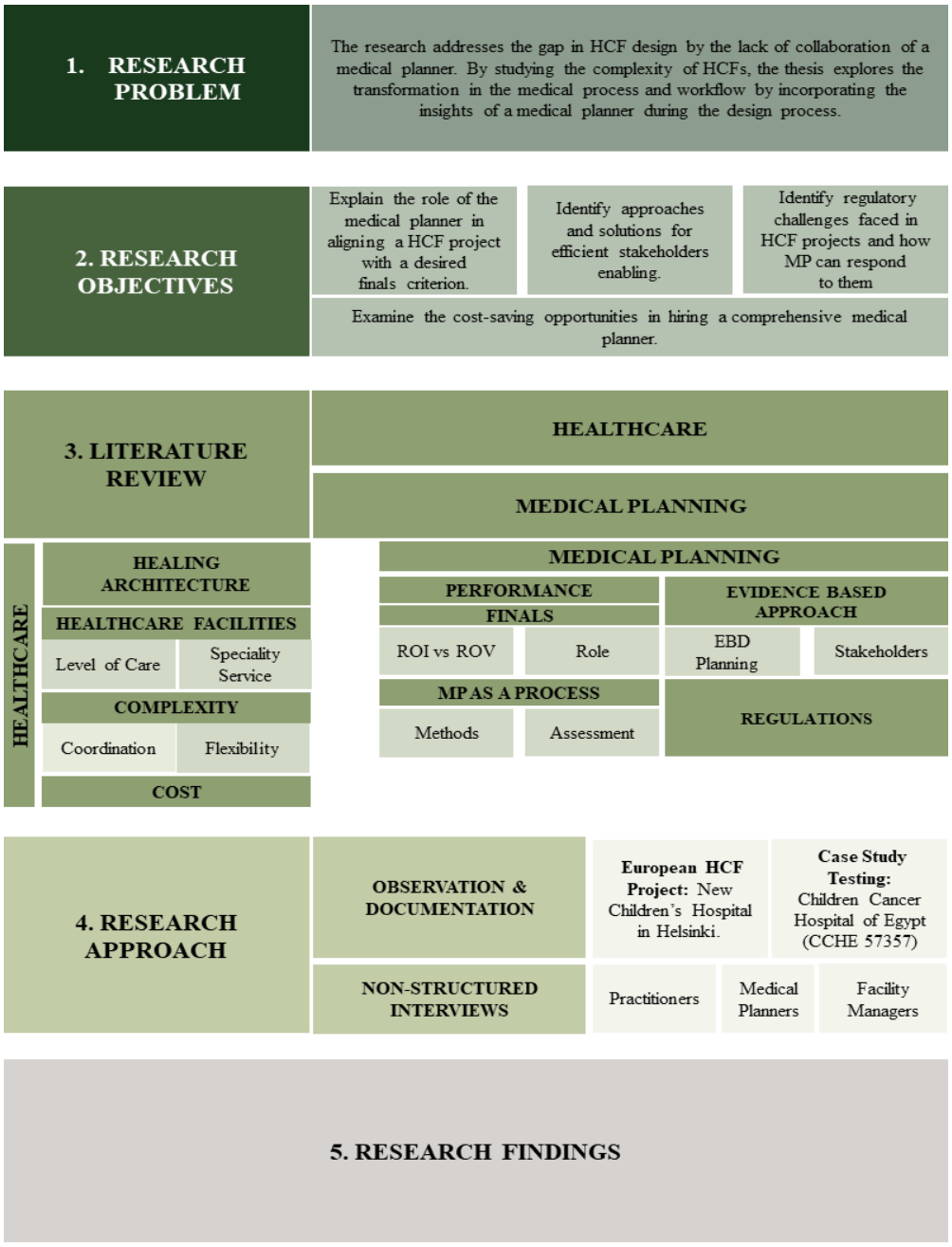


Figure 2: Methodology

1.5.3 Research Structure

This research is made up of three main parts, conducted in 5 sequential chapters:

Chapter One || Research Outline: Introduces the topic and provides an overview of the research problem, its reasoning, and justification. Moreover, it outlines the research by briefly laying out the research objectives, used methods, existing theoretical base, case study selection, and the structure of the thesis in hands.

Chapter Two || Healthcare Facility Projects: It is the first chapter of the literature review. It lays the first layer of theory by discussing the first half of the research topic which is healthcare facilities (HCFs). A clear exploration of the building typology in discussion is essential for better understanding of the topic.

Chapter Three || Medical Planning: The second layer of theory is laid by reviewing the existing literature of medical planning as a process and profession. It is mainly discussing three aspects of HCFs projects, that are related to the research questions of this thesis, which are the cost, involved stakeholders, and the regulatory and codes aspect.

Chapter Four || Case Study: Children's Cancer Hospital of Egypt (CCHE 57357): Introduces the selected case study used to test the set of literature knowledge obtained from the two scientific layers previously demonstrated. The chapter begins with a logical justification for selecting the Children's Cancer Hospital of Egypt 57357 (CCHE 57357) to be the case study. Following that, the chapter provides a brief contextual background for the CCHE 57357 before demonstrating the findings of the unstructured interviews conducted with managers, directors, and service providers working with the CCHE.

Chapter Five || Conclusion and Discussion: This chapter summarizes the key findings of the research. It classifies the findings into three categories referring to the triangle of cost-stakeholders-regulations previously described. The chapter ends with final thoughts about the research work that raises questions about how the obtained knowledge can address the existing stock of HCFs.

Chapter Two: Healthcare Facilities Projects

2.1 Introduction

There are diverse range of facilities within the healthcare sector, from general hospitals and specialized clinics to outpatient care centres and long-term care institutions. This is believed to be useful to understand the spectrum of HCFs, especially to clearly perceive the nature of the introduced case study for this thesis later in chapter 4.

The complexity of HCFs is mainly caused from the integration of multiple systems such as medical, mechanical, and technological infrastructures that must function cohesively. This complexity necessitates careful coordination among architects, engineers, healthcare professionals, and other stakeholders to ensure that these systems operate seamlessly.

This chapter provides an in-depth exploration of HCFs as a building typology, offering a comprehensive understanding of their definitions, types, complexities, spatial requirements, and costs. The discussion begins with the fundamental concepts of healing and healthcare architecture, emphasizing that HCFs are designed not just as functional buildings but as therapeutic environments that enhance recovery and well-being, for the patient and his/ her family/ visitors.

2.2 Healing and Healthcare Architecture

Even though healthcare facilities demand a unique approach from the architect when designing, there remains much knowledge to learn about how architecture affects the healing process of patients and users of healthcare facilities. This notion is referred to by the term “Healing Architecture”, which has recently been surfacing in discussion and research especially in the Nordic countries. Healing architecture is a progressively prominent feature of contemporary healthcare facilities design that is widely seen taken into effect in medical planning and design studios. It can simply be explained as the connecting feature between the physical environment of a hospital and the healing rate of its patients (Simonsen et al., 2022).

It is a focused field of architecture practice which is precisely concerned with the planning and design of healthcare facilities (HCFs) such as outpatient clinics, hospitals,

whether specialized or general, medical laboratories, offices, and other built environments acquiring any health-intertwined activities or services (Health Spaces, 2023).

Afterall, a successful healthcare system is greatly dependent on the physical environment which is what this architecture typology provides (Henriksen et al., 2007). Substandard healthcare architecture can cause unfavourable events such as healthcare-associated infections, patients' complications, less confidence in the healthcare system by the community. An unpleasant situation for the healthcare providers, either state or private, which any attempts to enhance it will consume extra resources (Elf et al., 2015). Figure 3 shows the levels of an optimal healing environments that transcends the healthcare facility from its mere function as a medical centre.

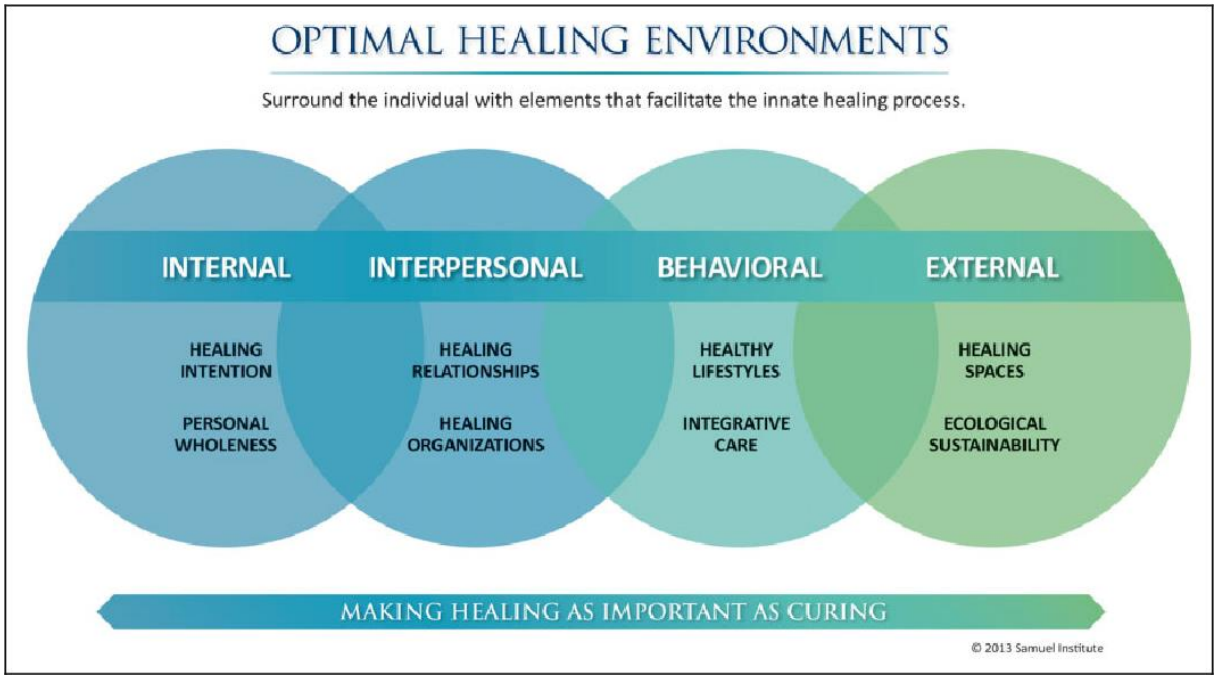


Figure 3: Levels of a Healing Environment, Source: DuBose et al, 2018

Therefore, it is logically justified to commit and implement the concepts of healthcare architecture when strategically planning a new HCF project whether it is a new construction or renovation project (Henriksen et al., 2007). As a matter of fact, a large portion of the investments in new healthcare facilities are blindly driven without understanding the unique nature of these built environments. A better understanding based on systematic accumulation of knowledge from practice, widely known as Evidence-Based-Design (EBD), which will be discussed in section 3.5, or from research will result in more efficient utilization of these healthcare investments and funds (Elf et al., 2015).

2.3 The Spectrum of Healthcare Facilities

Healthcare facilities are basically the facilities in which any kind of activity related to healthcare and medical services takes place. This definition applies to whether the facility is open for the public/ patients, or it is only accessed and utilized by staff/ personnel. Following this meaning, offices for doctors and medical staff, nuclear cyclotrons serving oncology hospitals, central laundry, etc. are all considered as HCFs demanding similar requirements in planning, design, and specifications (South Africa Health, 2001)

By norm, a hospital building is basically the type of healthcare facility that comes to mind whenever the term “healthcare facilities” is mentioned. Nevertheless, it is now clear that the spectrum of the HCFs is wide enough not to be confined to just a hospital building. Due to the large number of facilities that are, in one way or another, labelled under the medical and HCFs, there had to be different ways of classification to easily categorize them for both research and practical benefits. For instance, HCFs can be categorized based on their ownership, function, specialty, level of care provided, etc.

2.3.1 Classification by Level of Care

Figure 4 visualizes the classification according to the level of care with which a HCF is meant to provide. At the base of the pyramid lies the primary care category where general hospitals and health centres can be found. On the second level, HCFs offering the secondary level of care are located including emergency hospitals/ departments and acute and surgical centres. Finally on top, tertiary level of care is located with specialist medical care/ service facilities such as radiotherapy centres (Sakharkar, 2009).

It should be noted that this categorization is valid to apply on the larger scale of HCFs, as a comprehensive building typology, and on a smaller scale in the sense of the units and departments allocated under the roof of a single HCF.

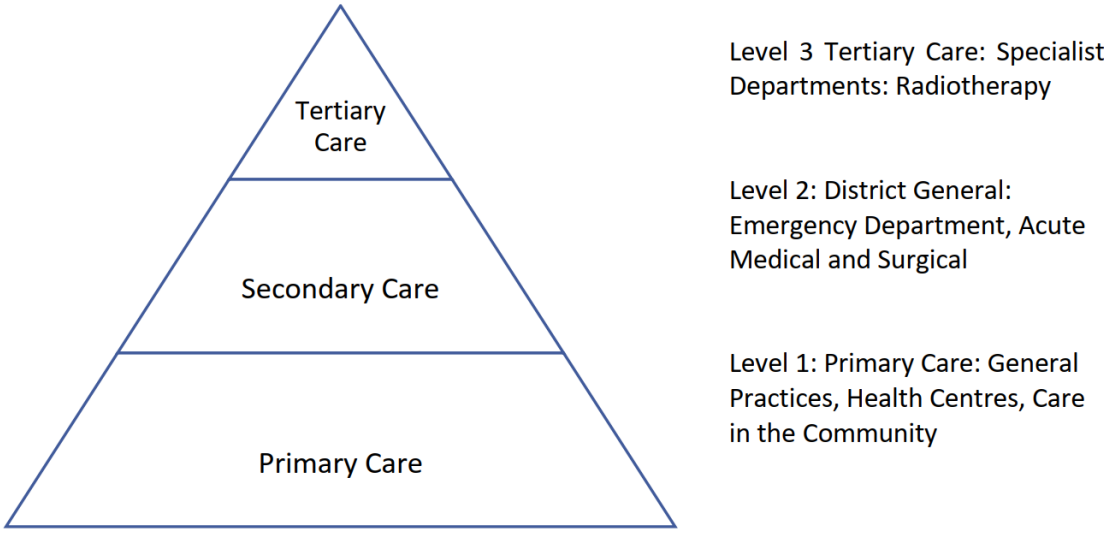


Figure 4: Levels of Care. Source: (Sakharkar, 2009)

2.3.2 Classification by Speciality

Another example is the classification according to the specialty service offered by the HCFs, as shown in figure 5. Basically, the general hospital has always been the origin from which the rest of the specialty spectrum has evolved.

The health science has developed much that resulted in specialized knowledge of different heath conditions for people. Thus, the evolution of specialized hospitals and HCFs, as seen in figure 5, treating one specific disease or medical branch such as cancer, cardiovascular, neurology, etc, was expected. Furthermore, there is hospital specialization based on a family's medical needs such as paediatric hospitals for children, maternity, gynaecology, etc.

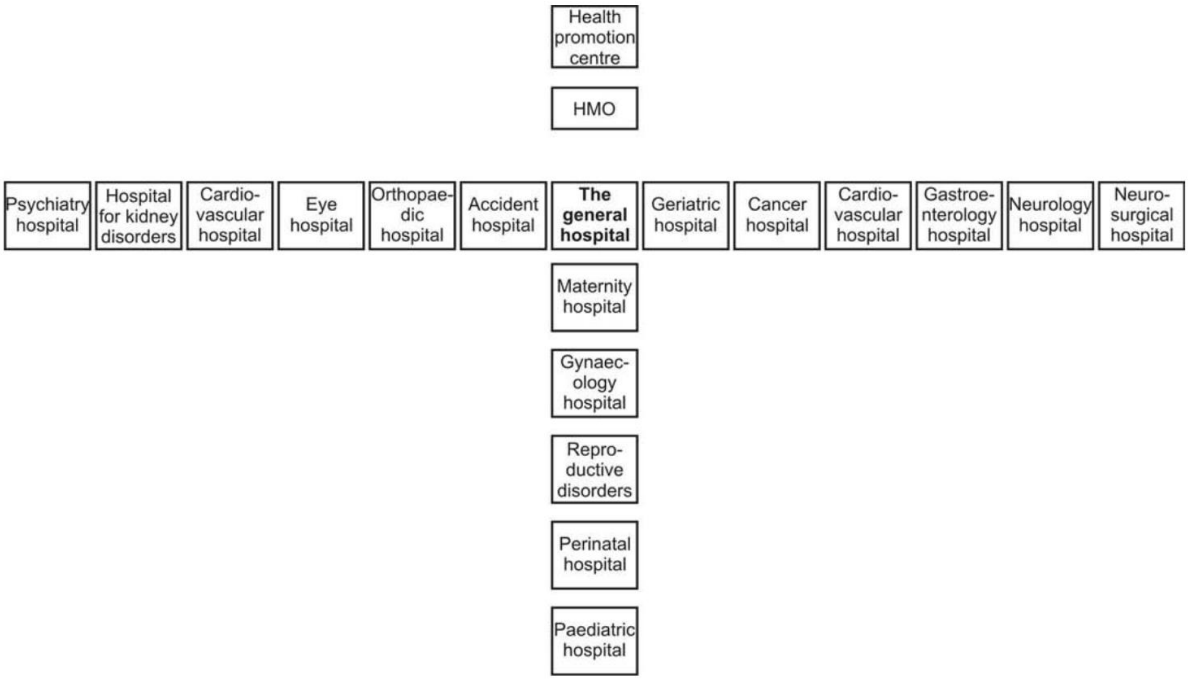


Figure 5: Specialty Spectrum

Source: (Sakharkar, 2009)

The Health Maintenance Organizations (HMO) and Health Promotive Centres are more concerned about preventive medicine focusing on diet, working out, rehabilitation, and checkup medical services. This scope of HCFs is expanding every day and usually added as extensions to existing HCFs (Sakharkar, 2009).

A focused study of healthcare architecture draws attention to the convoluted nature of a building where many users, with different needs, come together to function under one roof. (Zook & Sailer, 2022) A roof that is usually demanded to acquire multiple disciplines and systems which are obliged to meet certain standards and regulatory requirements for the building to sustainably operate.

2.4 Complexity of HCFs

Healthcare facilities, namely hospitals, are considered one of the most challenging building typologies to work on throughout the project lifecycle (Bernhardt et al., 2022). From the early planning stages to the construction of the hospital, in many situations the decision makers will find themselves confused from the contradicting demands of a typical healthcare facility (Zook & Sailer, 2022). These decision makers could be

owners of the facility, operators, medical planners, or even construction managers on side of the owner.

2.4.1 Hospital System

Part of the contradictory needs, offering privacy for the caretakers and patients (user A) for the sake of their psychological and emotional wellbeing, while maintaining clear visual access for the caregivers and medical staff (user B) for the sake of an efficient uninterrupted medical observations.

A hospital/ HCF is a building type more than the addition of the components making it (Sakharkar, 2009). Figure 6 displays the main components of a hospital system which contribute to the complexity of this typology. Each level of subsystems comes with its own demands and operational necessities that serve the needs of the facility and its users.

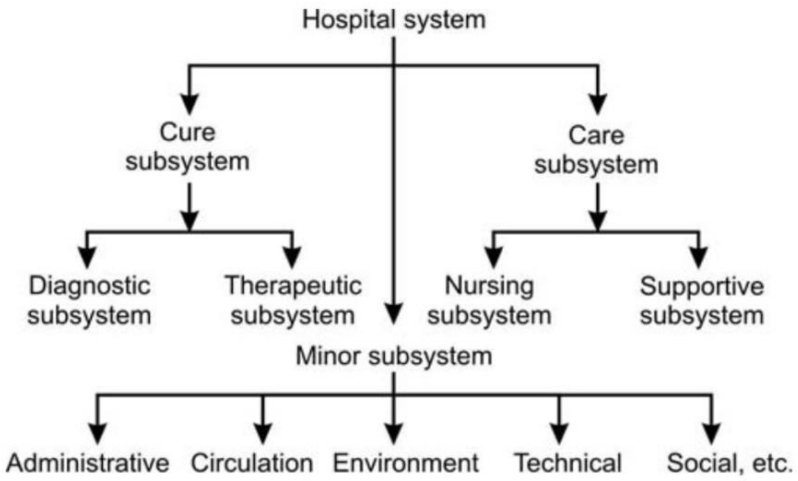
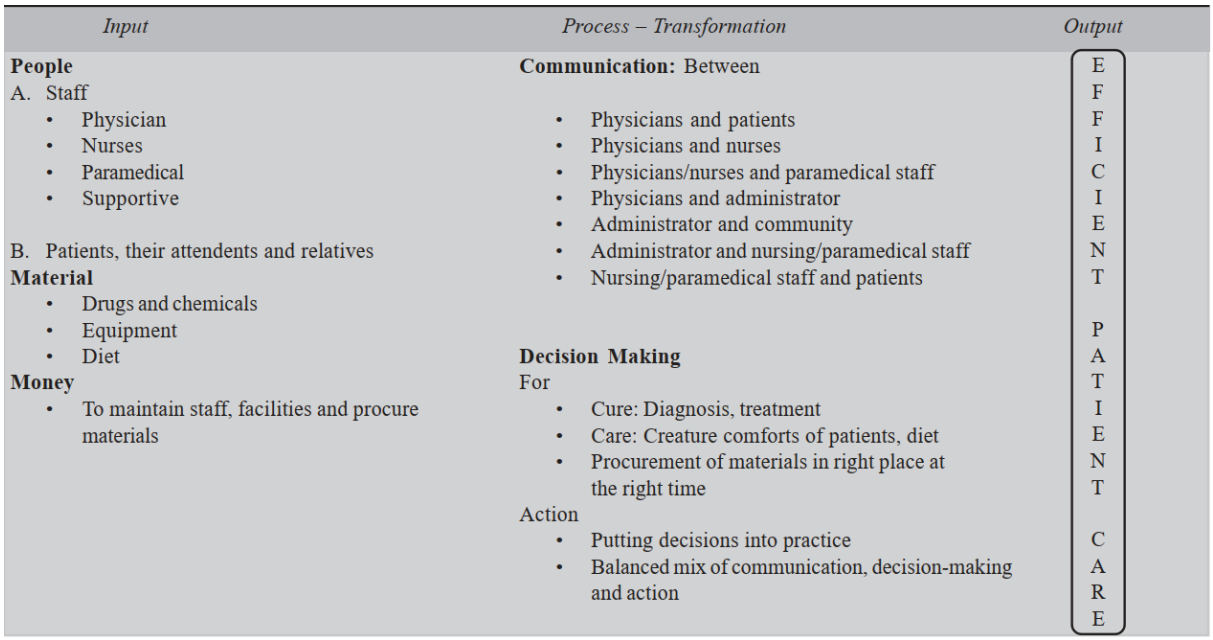


Figure 6: Components of a Hospital System - Source: (Sakharkar, 2009)

Furthermore, the number of parties, communication routes, materials handled in a hospital/ HCF project is intimidatingly large, as listed in figure 7. The healthcare facility is expected to offer its staff, medical and nonmedical, a suitable environment for them to work and communicate efficiently and make decisions for the better good of the main user, the patients, without compromising any of the users' needs or necessities.



Input	*Process – Transformation*	*Output*
People A. Staff • Physician • Nurses • Paramedical • Supportive B. Patients, their attendents and relatives **Material** • Drugs and chemicals • Equipment • Diet **Money** • To maintain staff, facilities and procure materials	**Communication:** Between • Physicians and patients • Physicians and nurses • Physicians/nurses and paramedical staff • Physicians and administrator • Administrator and community • Administrator and nursing/paramedical staff • Nursing/paramedical staff and patients **Decision Making** For • Cure: Diagnosis, treatment • Care: Creature comforts of patients, diet • Procurement of materials in right place at the right time Action • Putting decisions into practice • Balanced mix of communication, decision-making and action	E F F I C I E N T P A T I E N T C A R E

Figure 7: Hospital as a System - Source: (Sakharkar, 2009)

This coordination of multidisciplinary processes is expected to take place in an efficient manner that does not deplete the resources and materials of the HCF. Not to mention the crucial operations of this HCF in a financial sustainable operating, to maintain the HCF's ability to continue serving its users.

2.4.2 Physical Space & Flexibility

Many of the buildings that the people use, on a daily or weekly basis, are switching to provide services online to reduce physical presence or to catch up with the technological advancements of the remote service providing platforms. The package of services provided by the healthcare facilities primarily remain offline. (Marinelli, 2020). The caretakers, in many cases, are obliged to show up at the premises of their nearest HCF. Thus, the need for a comprehensively designed physical space remains a crucial aspect to consider whenever a HCF project is planned and built.

This physical nature of a healthcare facility is one more reason why great attention should be given to the planning and design of such buildings. A typical large-scale hospital is planned a decade or two in advance with an expected lifespan that is likely to last beyond 40 years of operation (Carthey et al., 2011). In other words, a medical design planned today will affect patients, visitors, and medical staff for more than a half century.

Additionally, the design and plan of this hospital is expected to show efficient flexibility that enables the resilience of the building against any forced updates throughout its lifecycle. The long lifespan of a HCF puts the building designed today in unavoidable challenges that will take place in a 40 to 50 years' time. Changes in the demographics, medical technological advancements, epidemiological patterns, and the capacities vs capabilities ratio, require optimal flexibility and adaptability of any typical HCF (Marinelli, 2020).

There are three facets of flexibility in HCFs each applied when needed. Adaptability, convertibility, and expandability. Firstly, the adaptability is the facility's ability to respond to changes in services demands without physical changes. Secondly, the convertibility is how attainable it is to apply changes on the technical and structural scales while minimizing the resources usage and interruption of the running facility. Lastly, expandability is the ability of the HCF to increase its size and capacity to meet the rise in demands (Olsson & Hansen, 2010).

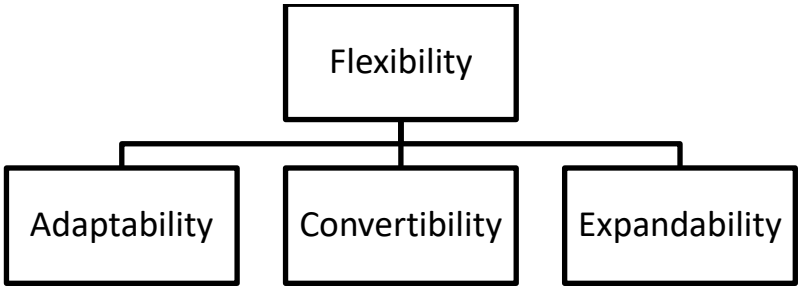


Figure 8: Three Types of Flexibility – Source: Author

Another advantage of building HCFs with flexibility in mind is aligning with the sustainable development concepts that are highly prioritized in this time. A flexible healthcare space is a sustainable space that is immune to time changes. When demands change, flexible HCFs can undergo repurpose instead of demolition (Healthcare Spaces, 2022). Building with a longevity mindset preserves the future generations access to today's built HCFs, which is the core of the sustainable development.

2.5 Costs of HCFs

In accordance with the World Health Organization (WHO) perception, a health system is made up of all entities, individuals, and initiatives that are primarily concerned with the betterment, restoration, and preservation of a community's or nation's health

(World Health Organization., 2007). Knowing this, it is expected that in most countries the health system consumes a significant share of the country's yearly expenditures. For example, compared to the gross domestic product (GDP) of each country, the health expenditure is the highest globally in the United States reaching 16.6% for the year 2022. Germany ranks second world-wide, and first on the European scale, with percentage of 12.7% for the same year. Plausibly due to its population size, Finland's share drops to 10% (OECD Stat., 2022).

2.5.1 Investments and Assets

A major player within the health system are the healthcare facilities, specifically hospital buildings. They account for a huge impact on the GDP, labour opportunities, energy consumption, continuous change. Thus, certainly a decent portion of a country's healthcare budget (Mckee & Healy, 2002). Knowing the vital role which the hospitals, and other healthcare facilities, are nowadays playing resulted in putting this health real estate on top of the list of promising investment and assets for investors and developers (Sdino et al., 2021).

Additionally, the continuous advancement of the health sector, in terms of communal demand, medical technology and clinical knowledge, anticipates a regular flow of investment to cover and finance the upgrading and adjustments of hospitals and HCFs (Sdino et al., 2021). Conceivably, any discussion involving investment will unquestionably form a discussion about cost, even in a preliminary manner. Afterall, the financing which an investor, or a state, will have to provide for building or renovating a hospital is undoubtedly expected to be high (Sdino et al., 2021).

Furthermore, a well-planned and efficiently built hospital or HCF will operate in an effective manner, lowering basic expenses and promoting revenue without compromising the quality level of services and medical outcomes. In other words, decisions made in design and planning phases will affect the level of performance and running costs in the operation phase. Thus, promoting the early investment is substantially crucial, and adequate discussion of a financer's main concern, costs, is now clearly justifiable (Wagenaar & Mens, 2018) (Sakharkar, 2009).

2.5.2 Cost Estimation

Nevertheless, due to its changing nature and complicated projects requirements, attempting to estimate the costs of hospitals projects at an early stage can in many cases be a challenging task. Among researchers and practitioners, an investor's initial expenditure can be equivalent to nearly 12 months of operation costs of a typical hospital similar to the project under feasibility (Clark & Hakim, 2019). Nevertheless, having even a rough measure is a must for feasibility and investment planning in such healthcare sector (Sdino et al., 2021).

Another method of HCFs cost estimation is the "per bed" method, which is widely used in practice. From its name, the hospital size in beds count is multiplied by the common market rate of the bed cost (Sakharkar, 2009). Obviously, this rate varies according to location and project time. However, the generality of this method does not serve the complexity of contemporary HCFs and excellency centers which their programs might not necessarily be limited to bed-based services.

2.5.2.1 Cost Estimation Tool

In the same context of cost estimations attempts, a study, (Sdino et al., 2021), introduced a tool which eases the landing of an estimate for the initial cost of hospital/ HCF project. The tool is also able to provide the amount of variations in the cost when planning and programming a hospital. Most importantly, it is meant to be used by various parties involved in the early stages of a hospital planning should they be investors, planners, financers, decision makers, etc.

The main concept was to select key attributes of a typical hospital/ HCF project that are largely influencing the costs. These attributes are complexity, size, typology, location, technology integration, and age (Sdino et al., 2021). Experts' input and best practices were the main reference for the selection of the attributes and their respective affecting weight.

The selected attributes compensated for the over generalization of the "per ped" method since more rates, five, are now in the cost estimation equation instead of just one. It reflects more parameters which makes it a more reliable method to use.

2.5.2.2 Cost Estimation Attributes

These attributes are briefly explained as follows:

1. The complexity of the hospital/ HCF is concerned with the intensity of care provided to the care receivers at the facility. There are three categories of complexities in the healthcare framework. HUB facilities for central facilities handling serious cases, SPOKE facilities for a lower level of service on the peripheral, and lastly BASE facilities offering the entry for the healthcare system through primary and preventive care.
2. The size of the hospital/ HCF in terms of number of beds is immensely linked to the amount of investment needed for the project.
3. The typology and area of service of the hospital/ HCF is concerned with the level of sophistication needed to make this building exist and operate. For example, the program of a polyclinic building project cannot possibly be as complicated and multidisciplinary as the program of a cardiovascular excellency centre project.
4. The location in which the project is situated is one more factor affecting the cost of a hospital/ HCF. Depending on the region's economics and the availability of resources and necessary materials, the cost will be flexible from one place to another.
5. The technological integration in the project is an additional factor which affects the amount of capital needed for investment. A HCF purposed to be a specialized centre for specific treatment shall integrate the latest technology and medica system advancements from an early stage. On the contrary to, for example, a temporary-built hospital/ HCF in an event of emergency or pandemic outbreak where the technological integration will not be of high priority.
6. The age of the facility determines to a great deal the initial and running costs of a hospital/ HCF. It is common for aging HCFs to consume more expenses to renovate and maintain a minimal accepted status to abide by the obligatory operating regulations.

2.5.2.3 Findings

A significant finding of the study, introducing the above-mentioned tool, was the order in which each of the 6 attributes affect the estimate of the HCF initial cost. It was found that the age factor, on existing HCFs, has the highest influence on the investment estimation process, followed by the location, complexity level, typology, level of technological integration, and bed numbers respectively.

From the understanding of how HCFs operate, the study concluded that the effect of age and the HCF becoming obsolete can be indicated to from the amount of expenses needed for the maintenance and management of the facility (Sdino et al., 2021). In other words, the running costs are validly used as indicators on high impactful the age of the existing HCFs is.

In conclusion, it is necessary to point out that the study was conducted on an Italian national level, nevertheless, the concept remains well-founded. The previously explained tool provides a solid approach for investors and planners to decide how much might be needed for a hospital/ HCF project. It also gave insight into an unspoken investment aspect to consider when deciding upon investing in a newly built HCF or in the refurbishment of an existing facility. Especially if the building has aged long over the common lifecycle of HCFs which is around 60 years (Sdino et al., 2021).

2.6 Conclusion

The uniqueness of the healthcare buildings typology turned out to be more than just a place for medical care receiving. A whole branch of architecture is now introduced to the architecture community which is healing architecture. In other words, hospitals, and healthcare buildings demand an extra layer of attention from designers to ensure it performs its function as a healing and recovery space.

Nevertheless, the transition from concept discussion about healing features to the more detailed aspects such as the specialized facilities, medical regulations, infection control guidelines, users' routes, vertical and horizontal circulations, etc. has been an intimidating shift. Reading this chapter, the HCFs are now seen in a more practical, technical, and engineering scope.

The wide range and types of HCFs invites more and more sub specialization. Having hospitals and health centres specialized in a certain age or gender group treatments

such as the maternity or the children related hospitals. Moreover, specialties also went according to the disease such as the cancer, eyes, or accidents hospitals.

On the market scale, this sub specialization is clearly visible in the diverse medical equipment firms, for example, out in the market. Firms and service providers are now specialized in clean rooms installation or even operating theatre capsules. Others are specialized in specifically interior solutions for kids, primarily targeting the paediatric healthcare facilities.

On an architectural scale, the flexibility of a HCF is now obviously as important as an open plan office, in a healthcare contextual manner. A hospital design is expected to show maximum flexibility both horizontally and vertically and to be ready to function in case there must be a change in use of certain parts of the hospital.

Furthermore, this flexibility matter recalls moments when there was an immediate need for readaptation of the world's healthcare facilities during the COVID19 outbreak in 2020. Existing HCFs underwent a design test, and it is believed that those with adaptive-ready design showed better reactions.

Finally, establishing a better understanding of the theoretical and practical methods of preliminary cost estimates for a HCFs project proved important. It is understandable that having a precise figure for the cost of such a complex building type is challenging. However, exploring a base estimation tool that is usable by various parties in the project is promising. The big question has always been if a project proposal is still within budget or not. Applying the Italian introduced tool is helpful to answer that question.

A limitation remains whether this tool is applicable to be used in a non-European context. Moreover, its methodology was based on selecting the level of complexity of the HCF from only three levels of care. This might not be the most suitable concepts to apply on HCFs that fall out of this triangular dropdown menu.

Chapter 3: Medical Planning

3.1 Introduction

Planning is the first phase that takes place in all Architecture Engineering Construction projects (AEC) which will probably shape the projects in their final phases. These planning activities require a full compliance with main objectives and owner's goals while abiding by the guidelines and regulations. Not to mention the importance of doing this planning activities in an effective cooperated manner between all involved stakeholders, internals were or externals (Joint Commission (Oakbrook Terrace et al., 2015).

A healthcare facility (HCF) project is not an exception to this fundamental concept of an adequate early-phased planning. Knowing its complexity as a building type, a HCF is always easier and cheaper to plan and design effectively before it is constructed. This is because that once the facility is planned, constructed, and operated, adjusting the design, and attempting to intervene for more effective changes rarely proves feasibility (Garg & Dewan, 2022)

In practice, medical planning as a term is often referring to the process of the assignment and selection of medical equipment necessary for the furnishing of a HCF after construction or renovation. However, in the context of this research, it is referring to the translation of the medical needs and demands to operate a hospital/ HCF into a constructable efficient layout and design.

This section starts with defining medical planning as a phase in AEC, followed by the role of a MP to introduce a key actor responsible for this task. After that, a more detailed explanation of the processes and phases logically follows to describe the practical steps that the medical planner takes and what are the techniques and approaches usually followed. Finally, the standards are discussed last to ensure that all what was mentioned earlier is understood within the abiding context of regulations and frameworks.

3.2 Reasons and Objectives

A countless number of medical care systems around the globe are coping to sustain their performance and operations especially in an always changing environment like that of healthcare systems (Humphreys et al., 2022).

It is important to note that the technological and medical advancements in the healthcare sector have been rapidly growing, introducing new treatment techniques, developed medications, etc. This resulted in higher rehabilitation rates, quicker recovery of patients, shorter stays in hospitals, etc. From this stance the HCFs planning is now obliged to speed and catch the clinical advancements pace with the hands of architects and medical planners (Tabish, 2003 ;Valkeisenmäki, 2020).

Finally, an essential goal of any planning is to assess the efficiency and effectiveness of the interventions it suggested/ introduced. Ideally with the medical planning of HCFs, evaluation is a crucial process to assess the efficiency of the situation before and after (Hamilton, 2023). With systematic comparison, the updated situation / result can be utilized as new updated evidence on the efficiency of this planning intervention. Eventually, knowledge will expand, and the proved evidence will greatly influence the guidelines, codes, and standards (Hamilton, 2011).

3.3 *Finals*: Performance Expectation

Finals is a term that expresses the comprehensive statehood of what a project is expected to perform on various aspects. For instance, the sustainability aspect, consumption, operational, financials, investments, etc. The same perception is applied to the healthcare projects to focus the attention on how good or bad a hospital/ HCF is doing.

One of the crucial features of the Finals of a HCF is its financial behaviour and economic resilience necessary for a sustainable existence, in the continuance sense of the word. Knowing the great impact a design has on the performance of HCFs, it is reasonably justified to question the areas of intersection where the medical plan/ design can influence the financial fashion of the project. Afterall, the financial aspects of a HCF project are of great concern for the financial provider/ investor/ doner/ etc. no matter what healthcare model is followed. In other words, a state-owned hospital is

eager to maintain a promising financial pattern the same way as a private hospital eager for maximizing earnings (Sakharkar, 2009).

Key performance indicators (KPIs) are one of the tools that assist in assessing whether a project is functioning on track or has unfortunately deviated (Sekáč, 2023). The selection and utilization of KPIs is applicable to different scales, processes, and even strategies. Afterall, without the convenient KPIs, managers and practitioners are left to a blind swim (Marr, 2012).

From the management point of view, the measurement of performance is a basic activity to run an organization/ facility/ etc. It singles out the deficit between the aimed level of operation efficiency versus the current level and demonstrates the required rate of progress to narrow down this shortfall. Moreover, with the precise selection of the suitable KPI, the areas in need for enhancement are easily identifiable and intervening to level up the low performance is greatly effective (Sekáč, 2023). Regular assessment of KPIs remains the key method for facilities/ organizations/ businesses to reach the aimed targets, as well as to stay informed of their status and possible means to advance and develop (Sydle, 2023).

3.3.1 Return on Investment vs. Return on Value

One of the many KPIs that provide a judgement of how a project is doing financially is the metric figure of the return on investment (ROI) (Andru & Botchkarev, 2011). The ROI can be examined independently, or in reference to similar businesses and programs, or even in contrast to the counterfactual (Parand et al., 2014). It is true that the ROI was first exclusively used in commercial contexts. Nevertheless, the moment it was introduced to healthcare frontlines it developed from just a metric figure into a deeper concept of understanding how to make the best return and quality from a healthcare investment (Thusini et al., 2022).

The introduction of ROI into the healthcare context has raised valid concerns, the least of which is the language being used (Masters et al., 2017 ;Price et al., 2020). A rebranding of the term was raised to suit the humanitarian side of the health sector. For instance, one proposal altered the return-on-investment into the return-to-care (Leggat, 2007), while another called for a return-to-value (Fischer & Duncan, 2020).

Furthermore, there was the major concern about the monetizable nature of the ROI's methodology. Applied in healthcare, it was important to figure out a way to consider the non-monetizable benefits when calculating the benefits and return of assigning capital into healthcare (Solid, 2020). This way of widening the scope of an ROI figure in healthcare was crucial since most of the investments benefits in HCFs are not directly expressed in terms of cash (Thusini et al., 2022). In other words, and as figure 9 shows, the KPIs used in a healthcare context should consider the influence of the non-monetizable wins on the investment-related decision making (Masters et al., 2017).

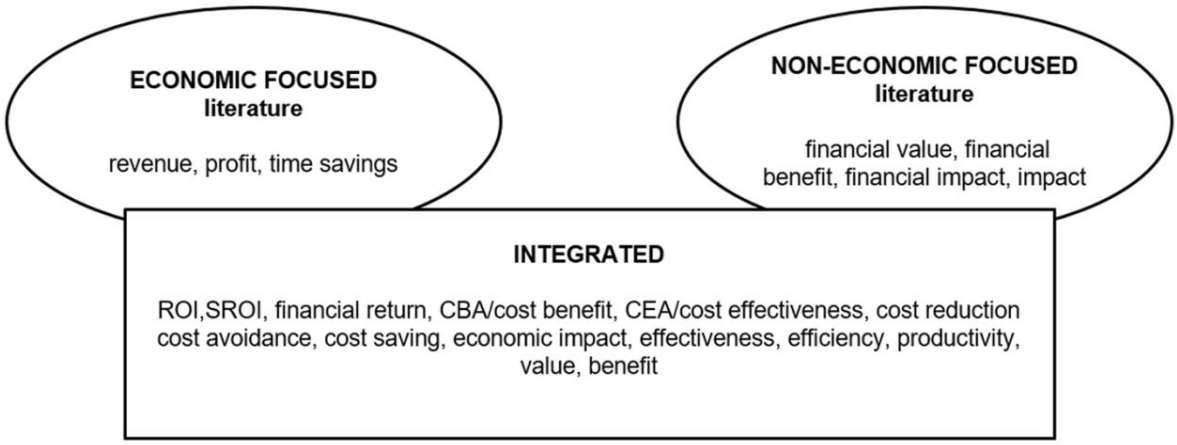


Figure 9: ROI-Like Concepts – Source: (Thusini etal., 2022)

The main drive for this recognition of the hidden benefits in healthcare interventions is because managers and leaders in the heath sector, like any other sector, need to advocate for the funds/ investments they are asking for (Thusini et al., 2022). Whether it is private investment or state funds, the competition or the prioritization for the investments/ funds is complicated. Applying a basic time-value-of-money rule may result in redirecting the investments/ funds away from HCFs if not advocated for smartly (Danzon et al., 2018).

3.3.1.1 Influence of the Medical Planner on the ROI

In practice, designers and medical planners attempted to investigate how their designs can influence the optimum utilization of costs for a better ROI performance of a HCF project (Taylor, 2014). An obviously logical attempt since the design phase accounts for nearly 70-90% share of a project's lifecycle costs (Korpi & Ala-Risku, 2008).

A case in point, material selection by the designer can have a significant impact on the effective use of cost and resources. For instance, hospital sites investing in PVC shock-absorbing floorings for their sports and rehabilitation facilities proved to be cost-

effective in the long run (Latimer et al., 2013). The cost utility analysis of the design decision was based on patient falls and pain treatments through follow-up assessments, and it showed higher return in value on long term.

Another example of the design influence on ROI in healthcare was evaluating the effectiveness of patient lift and transfer devices in reducing injuries among nursing staff within the James A. Haley Veterans Hospital. Before taking the design decision, the designers considered various factors such as the initial purchasing investment, equipment installation, maintenance costs, and staff training expenses. Moreover, they also considered the cost of losing the staff's productivity due to absence and recovery time, as well as injury compensations, prescriptions, and diagnostic tests. Brilliantly, an overall reduction in costs was observed resulting in an annual direct net benefit of about two hundred thousand US dollars (Siddharthan et al., 2005). This is, undoubtedly, good news to the healthcare leaders in this facility.

3.3.1.2 Cost Effectiveness

Finally, yet importantly, In Canada, researchers analysed the cost-benefit of private versus semiprivate rooms when planning a hospital. They discovered a net present value benefit of about 70,000 Canadian dollars per bed, with potential additional health benefits related to preventing death or serious illness estimated at around $11,475 for a bed annually (Boardman & Forbes, 2011). This results in a total present value of nearly $270,000, which, again, demonstrates how medical planning design decisions can influence the financials of a typical HCF.

In the same context, The Fable Hospital Model is cost-effective prototype initiative of a typical hospital is popular among healthcare designers. It is a hypothetical 300-beds health facility in a medium sized American regional city. The model generated the design-quality-costs discussion among practitioners, when it was first initiated in 2004, and even after an update in 2011 (Taylor, 2014).

The Fable concept suggested a group of interventions claiming that when implemented it would result in decent cost savings in the long run. The suggestions were categorized into two main groups, group one which is backed by research and proved peer-reviews while group two is supported by practical positive experience but not backed with a solid evidence base yet (Sadler et al., 2011).

Among the evidence-based interventions were larger single patient rooms that are acuity-adaptable to reduce medical errors and patient falls, with larger windows for daylight flooding and better recovery rates. Moreover, ceiling-mounted patient lifts to reduce musculoskeletal injuries of the hospital staff. Additionally, enhanced indoor filtration using high quality filtration systems like the HEPA filter reduces the hospital-acquired infections (Sadler et al., 2011).

3.3.2 Role of a Medical Planner

In a typical HCF project, it is the responsibility of the architect/ medical planner to recognize the needs and goals of the provider end. Translating the clinical and work operations requirements into a comprehensive program, layout workflow, and circulation routes, in an architectural and engineering language. This is expected to be done while considering all project constraints, regulations, supporting systems, and utilities (Sakharkar, 2009).

Surprisingly, achieving the expectations of the owner/ client is seldom not fully met and the delivery of the design solutions fulfilling the requirements is below what is expected. Some reason this failure to the fact that HCFs projects delivery and construction is usually following a design solution that was agreed on many years before the actual operation of the hospital/ healthcare facility (Symons, 2021). Another reason might be the misstep of engaging with architects and medical planner who are well equipped with HCFs projects experience (Sakharkar, 2009).

One of the main and early tasks of the architect/ medical planner, involved in the planning and design of a hospital/ HCF, is to decide for the adjacencies and relationships between the different departmental units in the HCF under design (Lorenz et al., 2015). Especially in the initial phases, the architect/ medical planner is expected to prepare the spatial composition of the main components of the hospital/ HCF. Due to its long-lasting impact on how the HCF will efficiently function, this task does not tolerate any compromise (Li et al., 2023).

The architects/ medical planners are among the vital players whose work can significantly impact the level of optimal operation of a HCF. If done correctly, their work can bring the costs of resource transportation down while maximizing the utilization of some of the adjacency requirements obliged by safety or functional regulations. They

can always resolve the often-contradicting needs and demands to end up with an efficient, safe, and user-centric HCF (Li et al., 2023).

Figure 10 demonstrates the interconnected knowledge involved in a hospital design and it depicts the severe comprehensiveness which the medical planner is expected to offer. Engaging with specialized professionals from supporting fields is one crucial activity to happen for a better understanding of the different activities taking place inside the hospital and the way they affect each other (Sakharkar, 2009).

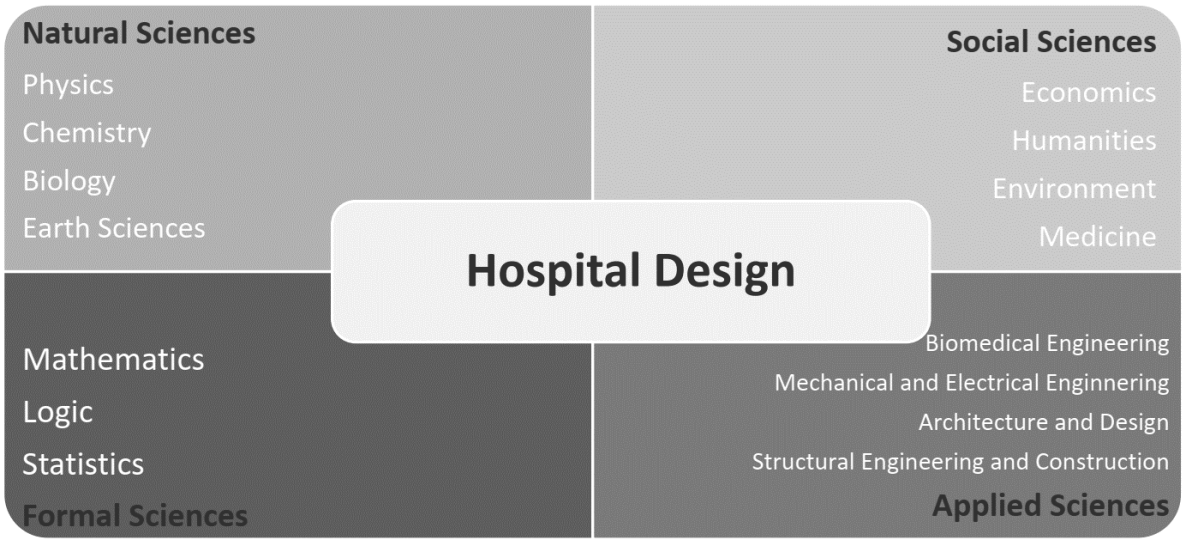


Figure 10: Relationship between Hospital Design to Theory - Source: (Symons, 2021)

3.4 Medical Planning as a Process

A HCF planning can be performed in a top-down or bottom-up approach. A bottom-up approach enables the planners to unmistakenly identify the needs of the end users of the facility. This is undeniably a time-consuming approach which not all HCFs projects can luxuriously follow. On the other hand, a top-down approach derives the needs of the HCF, and its users, mainly from the input of managers, planners, and top administrators. The latter approach is the one more likely to be applied in most HCFs projects (Nawawi, 2000).

Several approaches of HCFs planning can be found available in the literature differing in some details of the methodologies (Nafis et al., 2019). Nevertheless, nearly all versions have a set of fundamental stages in common due to the universal nature of HCFs projects as places of health delivery.

3.4.1 Methods of Planning

For instance, the WHO divides the hospital planning process into seven stages (WHO, 1998). These stages in order are project identification, briefing, design, construction, commissioning, and finally the post occupancy evaluating. Another school of HCF planning claims the medical planning is typically done in three consecutive phases; namely: Definition and Planning, Design and Permitting, and Bidding and Evaluation (Millsap, 2007).

Briefly, the first phase focuses on defining the hospital project as an idea and developing a clear project request along with a strategic plan. In addition to that, an assessment of the needs of the hospital/ HCF is made and a specific program is developed which is used to guide a preliminary concept design. The second phase is concerned with converting the concept into a schematic design then developing it afterwards. The documentation of all necessary construction documents also starts with phase as well as the initiation of contact with relevant governmental parties and authorities to secure relevant building permits. Finally, the third phase includes the most hectic processes in a typical hospital/ HCF project: bidding, construction works, licensing, operation, and post occupancy evaluation. It is crucial to note that according to (Millsap, 2007), these three phases are based more on the American flow of processes in HCFs projects in the United States of America. Nevertheless, a similar sequence is commonly followed in HCFs projects elsewhere.

3.4.2 Assessment Process

For further elaboration on the outcomes of the first phase, it is essential to remark that when planning a hospital/ HCF project, especially large ones, an in-depth attention should be given to how this new project falls withing the long-range strategic and capital planning processes of the mother organization. This is accomplished with a clearly defined Project Request (Millsap, 2007).

The second thing to do in the first phase is assess the status of the proposed project in relation to the Strategic Plan of the hospital/ HCF/ organization. It is a comprehensive scheme which is prepared through the engagement of the involved stakeholders: administration, medical staff, patients and their families, and board of directors (Millsap, 2007). The plan is meant to act as a future control datum of the desired scope

and level of patient care for about five years, according to experts. At this point, the proposed project should be evaluated to decide whether it proves consistency with the strategic plan or not.

Thirdly, a Facility Needs Assessment is performed to determine the different systems needs of the departments in a hospital/ HCF. It clearly defines the workload of each department for the current time and the expected increased load for the future. The workload projections will assist in having a sense of the space requirements needed for now and later through future adaptability and remodelling to accommodate the ever-changing workload needs (Millsap, 2007).

The fourth outcome of the first planning phase is the Specific Program of the project. It is a more specific translation of the project space needs and major equipment zones (Millsap, 2007). The operation policy of the hospital as well as workflow diagrams, of staff, patient, material, etc., are taken into consideration. At this point, estimate ratios and percentages are acceptable to apply for a preliminary sense of the size of service and mechanical zones of the project.

3.5 Medical Planning and Evidence Based Approach

The Evidence Based Design (EBD) terminology refers to the methodology used, in any process/field, when decisions are made based on available proven evidence. It is an approach that is now widely utilized in many fields and aspects, not just design and architecture and has been proven very beneficial in healthcare facilities planning as well.

3.5.1 EBD Planning Approach

When applying the EBD planning approach, the aim is to comprehend the whole lifecycle of the HCF to ensure the beneficial returns of this planning. From the early planning phases, through design and construction phases, until operation and post-occupancy evaluations. This all-inclusive project management manner will optimize the utilization of the available information seeking optimal decision making (Becker & Parsons, 2007). After all, applying evidence backed planning secures the pursuit towards a sustainable development since it is based on drawing knowledge from various disciplines for effective problem solving (Game et al., 2018).

However, concerns are growing that EBD planning approach might be more of a limitation to the design processes, especially architectural designs since it provokes an analytical/ systematic way of thinking instead of the creativity upon which the architects thrive on. One more concern is that due to the lack of scientific training and practice, EBD might end up as a trivial method where designers or clients apply it on shallow levels while the major issues are tackled using the old planning and decision-making methods (Valkeisenmäki, 2020).

On some occasions, results obtained from an EBD analysis may sound contradictory to each other. This contradiction requires extra attention when interpreting and analysing the results. Perhaps this evidence-backed solution should not be too generalized, especially when dealing with issues that are more likely to differ from one person to another, from one patient to another (Valkeisenmäki, 2020).

The contradiction of the brings up a sense of personalization of the needs which consequently invites the factor of user groups and stakeholders involved in a project. Engaging with stakeholders in an active manner is a main activity which the medical planner must go through when engaged in a HCF project.

3.5.2 Stakeholders Collaboration

Post-occupancy evaluations, not exclusively in HCFs projects, frequently reveal shortcomings in effectively engaging with the project's stakeholders. These evaluations highlight challenges in proper understanding of stakeholders' needs, clear communicating means, and efficient management of their involvement at the right stages of the project, and to what extent (Symons, 2021).

In HCFs projects, the number of stakeholders usually involved is typically large due to the complexity of the processes in a healthcare context. The intricacy of this type of projects and its many stakeholders, each from different backgrounds, introduces major challenges such as conflict of interests and needs, convoluted interactions, as well as high chances of uncertainties and controversies (Tampio et al., 2022).

Thus, it is a leading act to clearly identifying all relevant stakeholders that might influence, or get influenced, by a HCF project (Tampio et al., 2022). Especially that many of the pivotal decisions are decided upon during the initial planning phases of the project in most of the cases (Elf et al., 2012). This is the time when the admissible

stakeholders meet and take up together the basic needs, requirements, constraints, and expectations that will shape future design decisions (Pemsel et al., 2010) (Elf et al., 2015).

3.6 Regulations and Licensing

There is no doubt that healthcare building types are characterized by a high degree of complexity throughout the HCF project lifecycle. From planning, design, and construction all through the operation are all phases encountering interdisciplinary nature of work (Enache-Pommer et al., 2010). This complication of HCFs is caused by the multiple systems and diverse lists of requirements involved in a single project. Not to mention, the uncertainty factor strongly affecting the workflow of a HCF and demanding repetitive changes in the onsite built environment (Tzortzopoulos et al., 2005).

3.6.1 Regulatory Constraints

HCFs design is strictly bounded by multiple layers of regulations and prescriptive set of information which the design must adhere to. These regulatory constraints must be always checked during the design review processes to ensure a guaranteed access to permits necessary to operate legally (Soliman-Junior et al., 2020).

3.6.2 Egypt’s General Authority for Healthcare Accreditation and Regulation (GAHAR)

In healthcare, regulatory compliance is usually developed into licensees and accreditations on both international and national scales. An international example is the Joint Commission International (JCI) which is a well-recognized global leader in healthcare accreditation which provides objective assessments of quality, patient care, and safety. It is an accreditation which helps a HCF measure, assess, and improve operations performance (Joint Commission Accreditation JCI, n.d.).

For the national scale, and to consistently serve the sake of this research, Egypt’s General Authority for Healthcare Accreditation and Regulation (GAHAR) optimally serves as a national license example. It is an updates book of standards developed by the collaboration of the Egyptian government, private sector, academic figures, and

relevant professional syndicates to align local standards with the international datum while complying with the Egyptian laws, regulations, and culture (GAHAR, 2021).

The regulations biding the HCFs projects are related to both medical and non-medical necessities. The medical aspect is more concerned with the crucial healthcare process that will take place in the facility such as the infection control, department zoning, vertical and horizontal circulation, medical waste disposal, etc. While on the other hand, the nonmedical regulations apply in the same way they apply on any typical public use facility such as fire and structure safety, handicapped accessibility, environmental codes, etc.

For instance, in the GAHAR, part of the lists of compliances is concerned with absolute medical care processes such as continuity and transition of care, integrated care delivery, diagnostic and ancillary services, medication management, etc. Most of these issues are related to the medical and caregiving processes. Correspondingly, further compliances are more related to the national safety requirements, fire planning, safety and security, safe construction and renovation works, etc. (GAHAR, 2021)

For a further Egyptian context, a recent study addressed the factors which affect the implementation of JCI international standards in Egyptian hospitals. Among the reasons affecting the success or failure of JCI compliance were changes in hospital design, unsafe environment for patients and staff, high infection rates, hospital design and infrastructure not complying with standards, etc. (Mohamed Hassan Abdrabou, 2024).

To sum up, fulfilling the standards and regulatory guidelines, especially in HCFs, eases the ability to offer and maintain safety which remains an uncompromisable element in this type of buildings (Joint Commission (Oakbrook Terrace et al., 2015).

3.7 Case Study: Helsinki’s New Children Hospital

Helsinki’s Children’s Hospital, known as Children’s Castle, treating children since 1964, became inadequate in its facilities and capacity to accept patients which increased from 90 to 700 annually. The building fell into disrepair that required extensive renovations and expansion, however, protected by the National Board of Antiquities and Historical Monuments, a modern annex or extension “The New Children’s Hospital” was issued for construction (Archello, n.d.).

Source: Archiinfo

The new building opened in 2018, as part of HUS Helsinki University Hospital complex at the Meilahti campus. It is now considered the leading paediatric care in Finland and designed to cater for a specific set of users facing the design challenges to produce a child-centric design. The New Children's Hospital took on creating a more "healing environment" that surpasses just its intended function as a medical facility (Tarkettsee, n.d.)

The winner of "Finlandia Prize for Architecture" building was designed by Sarc Architects and Architect Group Reino Koivula (a new unit specialized in children's medical care in Helsinki), as described by forensic orthodontist Helena Ranta "was so empathetically designed with the comfort of the young patients and their families" (*Archinfo*, n.d.). The hospital ensures the optimal flow of medical operations as well as providing a humane and comfortable environment for their patients. "This project didn't proceed with architecture first but with user needs first," says Antti-Matti Siikala of SARC Architects (*My Helsinki*, n.d.).

3.7.1 Cost and Funding

As forementioned in of this dissertation, the cost and funding of HCFs is affected by its complexity. The original building was funded by the entire nation where Finns were extremely invested in the construction of the children's hospital in the 1940s which was a symbol of the reconstruction of Finland post the Great War. The project ended up gathering a fund of 24 million from the Mannerheim Children's Welfare Association's central office (*Ylppö.Fi*, n.d.). The new innovative project was similarly funded, not just

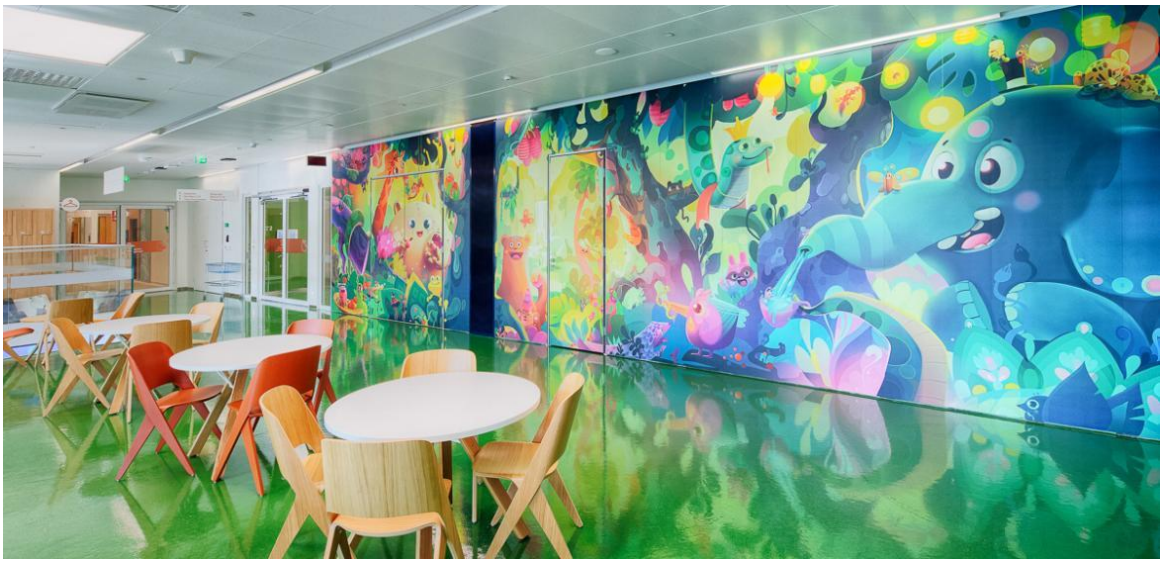
by the central government, but by external donations offered by companies and individuals (*Sarcsigge*, n.d.).

3.7.2 Design Layout: Merging Aesthetics and Function

The design for the 1964 hospital opted for functionality with tower-like dormitories and curved four-story treatment. The façade holds decorative elements and structures that were inspired by the post-war architectural romanticism. However, the design was widely critiqued for its extreme façade decoration and its overly functional design (*Docomomo*, n.d.).

The Old Hospital - Source: Google

The new building took an entirely different approach with its exceptional assortment of vibrant colours both in the exterior and interior that cements its foothold as a children's hospital. Chief architect Siikala states that "We created our own fictional narrative to shed light on the actual experience that patients and visitors would have at the hospital." (*Archinfo*, 2018). Each floor follows a theme adorned with nature-inspired artwork from Finnish children's stories, illustrated with quotes and drawings on walls, floors and elevators spanning 33,000 m2 of coverings (Tarkettsee, n.d.).



Source: Myhelsinki

The themes of the eight levels start with Sea in the basement, Beach on the ground floor, Jungle, Forest, Valley, Magic, Space and Star on the rest. “Art gives children something to explore as well as contributing to the general appeal of the environment,” comments Pekka Lahdenne, Associate Professor of Pediatrics at HUS, who led the operational design of the hospital (*My Helsinki*, 2021).

The building overflows with natural light through large windows and skylights, that puts both patients and staff in mind to optimize the healing and work environment. The functions distributed on the full hospital scale level are not only fixated on the medical facilities, but also provide lounges, kitchens, playrooms, outdoor and indoor areas. The entrance hosts a floor-to-ceiling interactive animated aquarium.

3.7.3 Medical Planning

The user-centred design merged the playful colourful assortments of architectural design with medical planning, incorporating the hospital staff, care personnel and hospital management (Tarkettsee, n.d.). The zones were meticulously distributed with the patients in mind, adjacently placing the family rooms to the children’s private rooms with the staff areas centralized in the building mass. The layout opts for optimal workflow by minimizing the walking distance between departments, providing easy access to the required medical supplies and offering circulation routes that makes the hospital easy to navigate and reduce time required for patient transfers. The hospital, because it caters not to a specific operation, was a complex piece of design because it

accommodates all hospital operations in one unit since it treats children from ages 0-15 in multiple health issues (*My Helsinki*, 2021).

The design merges the bustling medical process and everyday life of children, with the challenge that then, hospital design was only fixated on the medical operations of the facility (*Sarcsigge*, n.d.)

3.8 Conclusion

This chapter demonstrated the primary topic of the thesis which is the medical planning process of HCFs. It started off with basic definitions and how this process is perceived in the literature of healthcare design. It also briefly explained the goals and objectives expected to be achieved by the end of this planning process. This literature touring enhanced the understanding of the author of a process which was mainly taught through professional practice.

It is now clear that the word Finals better serves the idea of “Comprehensive Fulfilment” on all aspects from the client/ owner/ develop point of view. As a matter of fact, the term serves brilliantly any healthcare model adopted, whether the American/ middle eastern model where healthcare is more privatized and business oriented. Or on the other hand, the European, especially the Finnish model where healthcare is not at all perceived as a business sector, on the contrary, most of the HCFs in Finland happen to be state-owned.

Nevertheless, the term Finals serves the financial discussion, for example, whether the talk is about “Funds” or “Investments.” From here it was useful to introduce one popular KPI to monitor the successful behaviour of any project. In the context of this research, the understanding of the ROI measurement was logically linked to the efforts of a medical planner and how the design decisions made can influence this indicator.

Referring to the reasons of accreditation failures in Egypt, multiple factors were concluded from the Egyptian study mainly related to the operational policy of the facility. However, three out of eight reasons for compliance failure were related to the design and layout of the HCF. This is a clear indication on the influence which the designer/ medical planner can have on the certification’s pursuit.

Additionally, a limitation of the Egyptian accreditation example, GAHAR, is its exclusion of some HCFs from its standards such as day-care hospitals, wellness centres, long-term care facilities, etc. This limits the comprehensiveness of the Egyptian book unless there was a future update to widen its scope.

The framework concluded from this chapter opted towards a better understanding of the medical planning phases. It illustrated that the tendency for a HCF to succeed or fail is greatly affected by the efficiency of its stakeholder's collaboration. This serves as a highlighted matter for the author to test the case study of this thesis, in the next chapter, since, from real life facts, it scored multiple points concerning this aspect. Testing the reasons for this and reflecting it in the literature was greatly motivated.

Chapter Four: Knowledge Testing: Children's Cancer Hospital of Egypt (CCHE 57357)

4.1 CCHE Profile

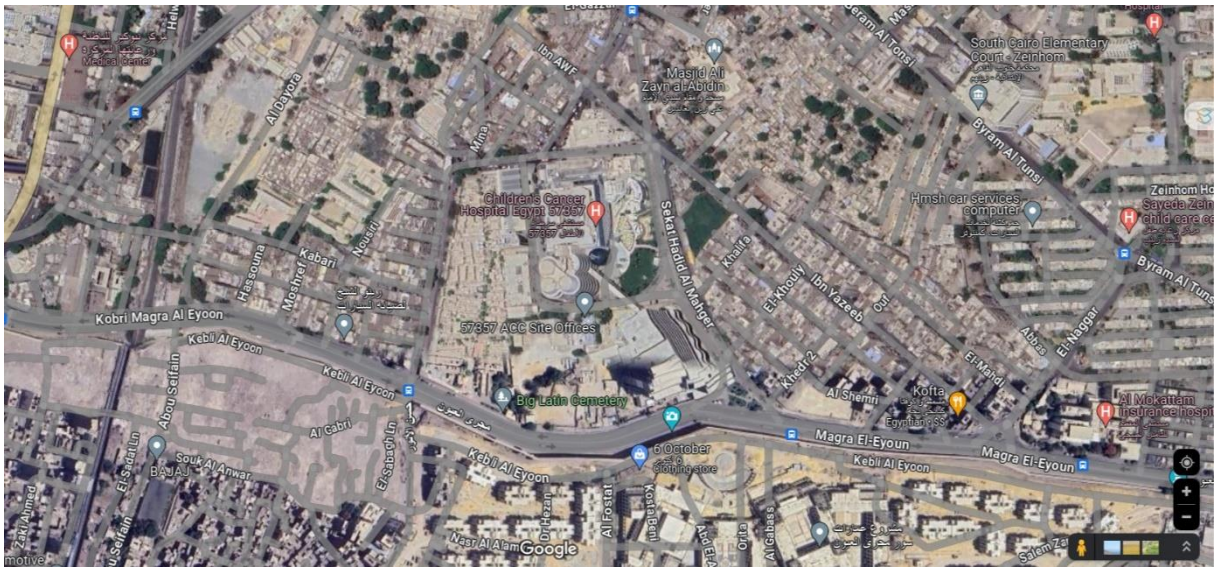
This chapter deals with the practical case study of this thesis: The Children's Cancer Hospital of Egypt (CCHE), also known as Cancer Hospital 57357 or short with the "57 hospital". It provides a brief introduction and the story behind the establishment of the hospital to serve the reader a tangible connection with the CCHE as an HCF.

The information in this section is derived from the hospital's website in addition to the observations and data from the author from the time employed at the hospital as an architect between 2019 and 2022.

4.1.1 CCHE Contextualized

Opened on the 7th of July 2007, the Children's Cancer Hospital of Egypt (CCHE) has been providing the needed paediatric oncology care for Egyptian, later expanded to serve MENA region, children free of charge no matter the social class level. This healthcare model was new to the Egyptian population where having ultimate healthcare service was usually linked to serving significant costs.

The idea of building a specialized paediatric oncology centre was first seeded in the early 1980s. It was a natural response to the poor recovery rates of children with cancer being treated at the National Cancer Institute (NCI) in Cairo. Witnessing the passing of 13 children out of 16 in a single ward, the group of paediatric oncology physicians at the NCI vowed to make a change. Among these doctors was Dr. Sherief Aboulnaga, one of the founders, and the current chief executive officer (CEO) of the CCHE.



Context of the CCHE

The hospital is located in the heart of the old fabric of Cairo, which was relatively uncommon in the paradigm of new major constructions trend of building in the new suburbs of Cairo to escape the stacked crowded metropolitan city. Nevertheless, there was an unspoken desire to stay close to the people and children's families by locating downtown, thus, saving the families the effort of commuting to the suburbs. This desire demonstrates how the decision makers understood their patients' nature and needs.

The CCHE founders were firstly inspired by the St. Jude Research Hospital in Memphis, Tennessee, in the United States of America. This enthusiasm happened during one of the field visits which the board used to do before initiating the CCHE project in the late 1990s. The American facility, established in 1962, had similar challenges to those the CCHE founders experienced in Egypt related to funds and communal needs. Moreover, the model of a specialized paediatric charity institute was particularly relatable to the model the founders had in mind. This is mainly because of their earlier exposure to the majority of the Egyptian cancer patients at the NCI and how needy their social segment is on a financial level.

Following that, architect Jonathan Bailey was invited to provide the conceptualization and the design of a new children cancer treatment institute in Egypt on an international scale. To have a better sense of the medical oncology care in the Egyptian context, Mr. Bailey and his London-based associates visited the NCI. The visit offered the designer crucial insights into how the facility operates and especially on the social aspect. It was clearly agreed among all stakeholders involved, during this planning & initiation

phase, that a typical copy-&-paste from an existing precedent would not work efficiently.

The CCHE started off with 180 in-patient beds in 2007 and, after two waves of expansions, became the largest paediatric cancer hospital worldwide in terms of capacity hosting now around 345 beds. It is important to consider that the survival rate is a weighty indicator of performance for healthcare facilities. For paediatric oncology, the international survival rate of childhood cancer lies between 75-80%. After 16 years of operation, the CCHE has managed to increase the childhood cancer survival rate in Egypt from merely 40% to a record of 71% following its model of healthcare service and methodology (CCHE 57357, n.d.-a).

4.1.1.1 Stakeholders: 57357 Group

The Children Cancer Hospital is result of collaborative efforts of different groups and parties engaging together, forming what is called the 57357 Group. It is fair to say that the real beginning of this oncology paediatric centre was in 1998, when the Association of Friends of the National Cancer Institute (AFNCI) was established. The primary mandate of the association was to promote the state of cancer patients treated at the NCI, and the children with cancer were on top of its priorities.

The AFNCI was I charge of the hospital project and took responsibility for the design, tendering, design implementation and construction of the hospital. The association also was accountable for the interior works, equipment installation, furnishing and the fundraising throughout the CCHE project execution (CCHE 57357, n.d.-d).

In 2004, and as the construction was almost complete, the Children's Cancer Hospital Foundation 57357 (CCHF) was founded to be handed the hospital after construction works. The CCHF's taking over the hospital was mainly to prepare for the operations and running of the hospital as a healthcare medical facility.

The CCHF was established as an independent non-profit organization to act as the operator of the children's hospital hired by the hospital's owner, the AFNCI. Its vision is "to be the unique worldwide icon of change towards a cancer-free childhood". The CCHF is concerned with overseeing strategic directions and securing a sustainable financial operating for the hospital.

Two additional entities complete the 57357 Group which are the Egypt Cancer Networks (ECN) in the United States of America and Canada. Both chapters are purely

fundraising chapters founded in 2011 to provide additional fundraising opportunities to secure a decent share of the highly competitive charity sector, for the children's hospital in Egypt. The fund raised by the two north American entities is streamed resources for patient care, research, education, staff training, and equipment advancements.

The institutional framework currently integrates all 57357 affiliates, the AFNCI, hospital, foundation, and both ECN chapters, into the 57357 Working Group. Management of operations is overseen by a board of trustees, an executive committee, and a 57357 Working Group Board. The restructured boards are composed of dedicated and diverse professionals from various fields, including medicine, education, finance, marketing, and business. These mindsets have quickly recognized that maintaining the status of the CCHE as a leading paediatric oncology centre, focused on cancer prevention and treatment, depends heavily on a strong commitment to research, innovative education, and high-quality care.

4.1.1.2 Architecture of CCHE

Among the healthcare facilities spectrum reviewed in chapter 2, the CCHE falls in the specialized HCFs category. As a paediatric oncology centre, the CCHE is providing its services to a focused group of caretakers, children until the age of 18, to help them fight cancer diseases such as leukaemia, brain tumours, lymph nodes, liver, kidneys, and bone cancers. (CCHE 57357, n.d.-b)

The 57-Hospital is a six-story facility built on a 19,000 square meters land plot with an initial total built up area up to about 43,000 square meters when it first opened in 2007. The hospital was built on 55% of the site, with a footprint of +10,000 square meters, leaving about 8500 square meters utilized for outdoor landscape.

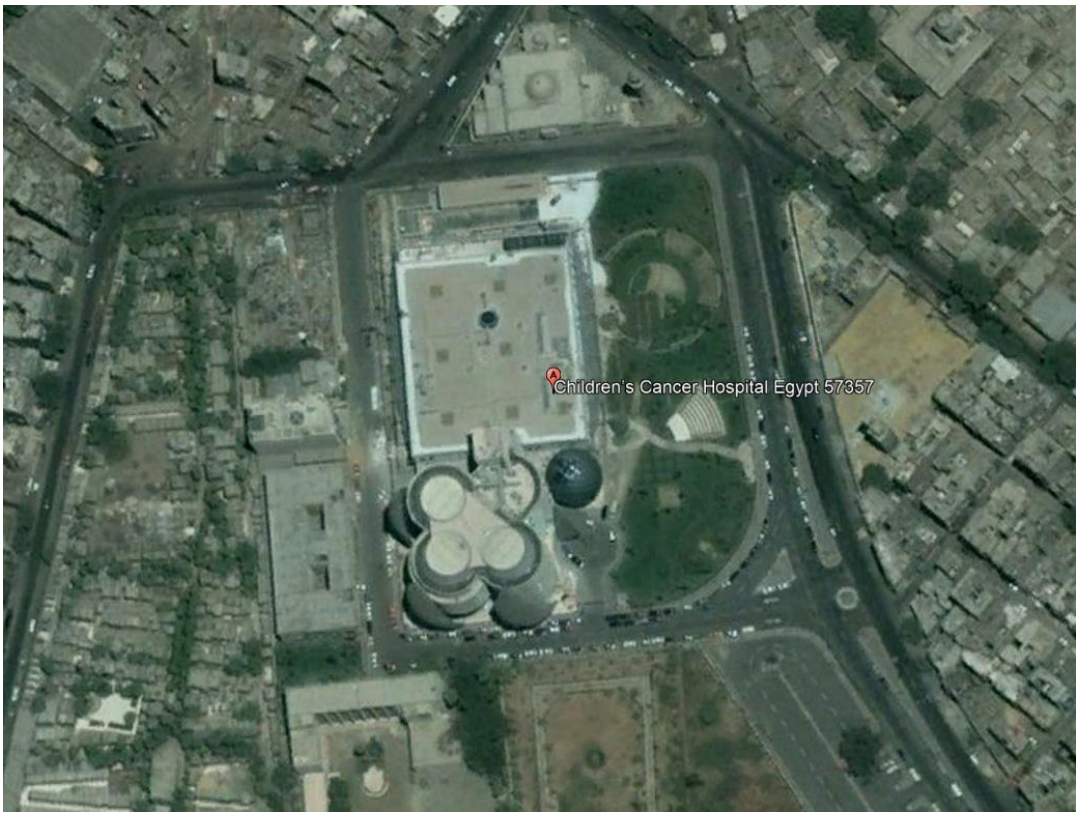


Figure: CCHE After Construction – July 2007

The hospital building is made up of a rectangular mass connected to a cloverleaf like six-story tower with a blue shade glass ball structure to the east. The glass ball serves as the main entrance lobby, info desk, donations office, and the 57357-gift shop. Because of its distinguished shape and scale, it became the hospital's most famous visual memory.

On the exterior of the cloverleaf building, massive boat-sails-shape screening shades mount on the façade to reduce the heat gain inside the inpatient rooms. The shape was inspired to the designer, Architect Bailey, from the river Nile famous for ship sails of the same shape (HCD Guest Author, 2007).

The three-story rectangular form is considered the busy beehive of the hospital in which the complex medical departments were located. The morphology of the rectangle facilitates the use of convenient design modules that ease the process of planning a layout optimizing the CCHE's workflow.

The distinctive cloverleaf design was devoted for the nursing inpatient units, allocated in the tower, since it offers noteworthy flexibility. This layout ensures that all three nursing substations are within view of one another, allowing them to adapt seamlessly to

any caregiving changes, with support from a central nursing station. Each of the three 10-bed units is versatile and can be reconfigured to provide critical medical, surgical, or hospice care.

Figure 11: Nurse station of inpatient Unit Dome. Source: 57357.org

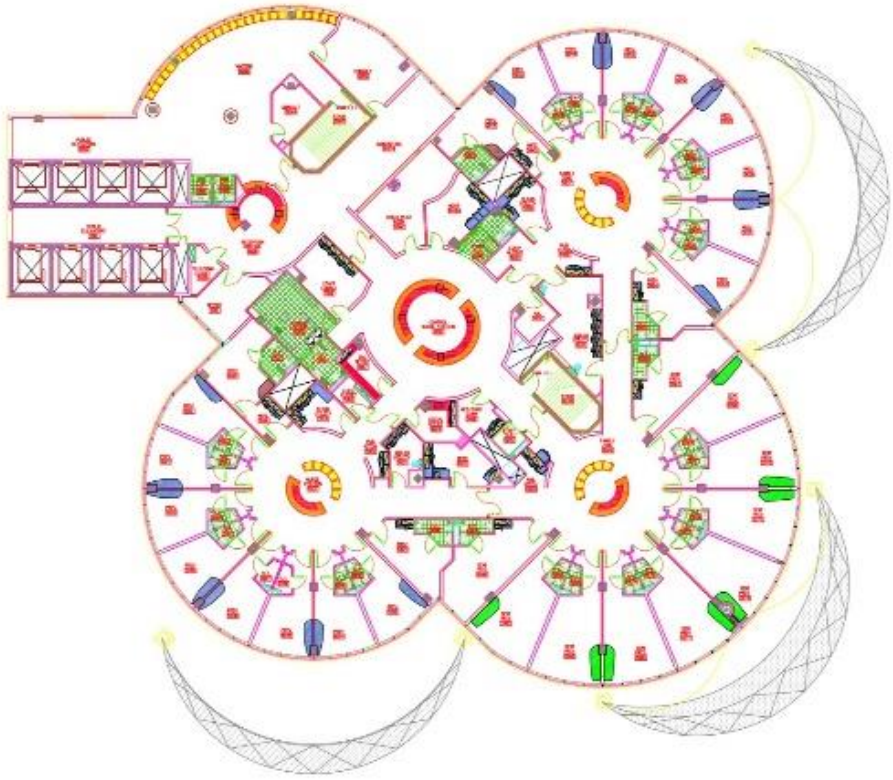


Figure 12: Plan of the cloverleaf tower with 3 inpatient domes

4.1.2 CCHE Medical Planning and Departments

The hospital is composed of 27 medicinal departments in addition to the supporting services such as the central kitchen, laundry, central sterile services department (CSSD), power station, nuclear cyclotron, etc.

From the many departments demonstrated above, it is justified to extra elaborate on the Emergency Room (ER) department since it was recently undergoing a replanning and renovation plan, which the author has participated in almost two years earlier before writing this paper. The renovation and replanning of the ER department can be considered as a small practical example of the optimization of healthcare service and operations through medical planning.

4.1.2.1 ER Department

Originally, the CCHE as an oncology hospital did not require a traditional ER department found in general hospitals. The operating model of an ER service in an oncology facility was primarily relying on the outpatient (OP) department. Since 2007, the ER services in the CCHE have been handled in only two OP clinics operating for 24 hours, and six boarding beds on the 1st floor situated near the surgical suite.

However, with the increasing survival rates of the children, the ER department has been overloaded with more patients visiting the department for specialized emergency treatment. Consequently, the first expansion of the ER department took place in 2013 to operate in seven rooms instead of just two along with seven boarding beds. This capacity enlargement was at the expense of the adjacent outpatient clinics. Thus, the architectural existing setting was not optimum for an ER workflow since it was a typical clinics layout.

In 2021, a new call for renovation of the ER department was raised to enhance the efficiency of department's workflow. The major objective was to better position the department status through medical planning, to meet the evolving needs of both patients and staff. This upgrading was seen to be crucial to provide emergency healthcare service in a more efficient manner.

Similar to a typical design and planning project in an existing facility, there were multiple constraints bounding the medical planning process. Firstly, the workflow had to be optimized within the exact current boundaries of the current ER department, not much expansion was possible. Moreover, significant care was given to ensure minimal

destruction of the existing infrastructure to avoid major loss of value, such as wet areas and the terrazzo flooring finish.

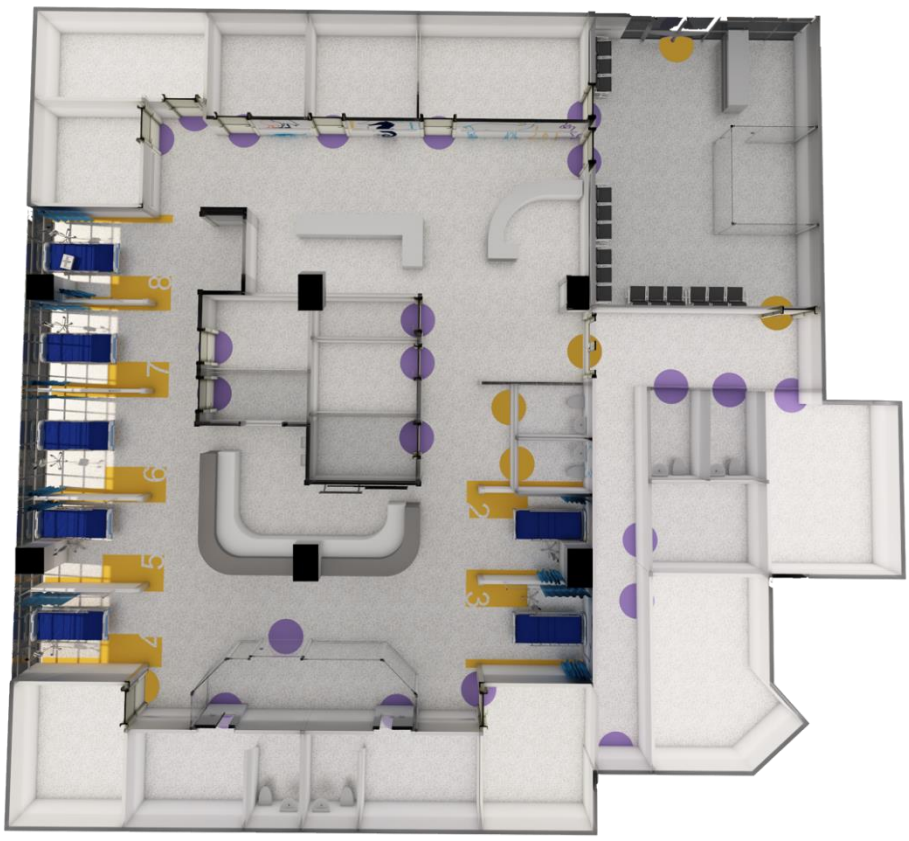


Figure 13: ER Renovation

The in-house medical planner, Architect Shimaa Afifi, played a vital role in on many aspects during the ER renovation planning. She managed to actively engage with the emergency medical staff and nurses to have an on-ground sense of the current workflow and possible means and needs to optimize it. With an active collaboration with Dr. Ahmed Emad, paediatrician and head of ER, the medical planning process incorporated also the non-medical necessities and demands such as the services and patients' flow, and the connectivity with adjacent departments both horizontally and vertically.

Furthermore, the medical planner provided a positive link between the top management, and its major concerns with the budgeting and scheduling of the project. For an already-operating NGO hospital, it was crucial for the planner to be aligned with the assigned budget of the project for an optimum utilization of the funds. Not to mention, the criticality in assigning and planning the schedule of renovations works. The

unnecessarily longer it is, the more the interruption of an optimal ER department operations taking place in a temporary relocation.

4.1.2.2 Findings from the ER Example

The renovation of the ER department at the CCHE demonstrated the meaningful contribution which a medical planner can offer in a HCF project, even on a departmental scale.

- Firstly, the stakeholders were actively involved during the planning and design processes. The top management concerns were clearly identified and implemented as well as the direct users of the project, the ER staff, and personnel. Moreover, the medical planner's early engagement with the contractor was thoroughly helpful for a smoother planning of the relocating, dismantling, and construction works following the layout planning.
- Secondly, the medical planner proved the ability to optimize a medical workflow while preserving a cost savings manner. The ability to fit two isolation rooms at a location suitable to utilize existing infrastructure saved the CCHE the costs of demolition of functionable bathrooms and installation of new ones. Moreover, avoiding major wall demolition for the observation beds saved the resources of fixing a terrazzo flooring that would have cost a fortune in 2022.
- Lastly, the fundamental regulations of infection control and safety were highly promoted with a medical planner actively participating in the planning and design process.

4.1.3 Future Expansion & Flexibility

The initial design of the hospital, developed by architect Jonathan Bailey, enabled the ability for future expansion on horizontal and vertical levels. Over 16 years, the CCHE has undertaken three phases of expansion as the demand for more operational capacity increased. It should be noted that these expansions were not only on the building scale of the CCHE but also on the campus scale.

For the building scale, although the initial capacity of the hospital was 180 beds, the CCHE added a 60-beds expansion on the 3rd floor in 2014 as soon as funds were sufficiently available. It is important to point out that this expansion was planned for beforehand during planning and construction. According to the original medical

planning, the 4300 square meters expansion was handed over by the contractor as core-and-shell (C&S) in 2007, as illustrated in figure 14.

Figure 14: 3rd Floor C&S in 2007 – Source 57357.org – Illustrations: Author

Moreover, and due to the growing load of the pathology diagnosis following the increasing number of patients being served, there was another expansion project for the pathology lab. As shown in figure 15, the lab was relocated and expanded to a newly built expansion area on the 4th floor. Furthermore, another expansion on the building scale was the Art therapy department in 2021. This was an explicit application of the evidence-based design (EBD) decisions observing the positive effect of the art activities on the children's recovery rates.

Figure 15: Pathology Lab & Art Therapy Expansions – Source: 57357.org – Illustrations: Author

The Bone Marrow Transplant (BMT) project on the sixth floor is another form of the expandability at the hospital. One of the inpatient domes at the cloverleafs tower was to be upgraded to host an independent BMT dome hosting 27 beds instead of just nine (CCHE 57357, n.d.-c). The flexibility in this project was demonstrated both on the architectural and mechanical HVAC aspects. Finally, the 2021 replanning and renovation of the ER department, previously demonstrated, was an additional indication of flexibility which the hospital could undergo and the ability of the medical planner to take advantage of. Both these projects are finalized regarding design and medical plan and are undergoing the construction.

On the campus scale, the expansion was gradually increasing according to the capacity demand. At first, the expansions were inside the boundaries of the main campus site then it grew to the surrounding area of the hospital's site. This was crucial to maintain a reliable connectivity between the expansion and the original hospital, as shown in figure 16.

Figure 16: Campus Scale Expansions - Source: Google maps - Illustrations: Author

Figure 16 geographically illustrates the additional facilities which the CCHE has established in a chronological order.

4.1.3.1 Evolution/ Expansion: MP Concepts 2016

More about the campus scale, a visionary schematic design was initiated and funded by Egypt Cancer Network (ECN) in 2016. The main objective of the campus expansion project was to respond to the increasing capacity demands of cancer patients in Egypt and the Middle East North Africa (MENA) region. With a huge outpatient facility incorporating the latest differentiated cancer treatment technologies such as the CyberKnife and proton therapy, as well as research facilities, the project serves a long-term capacity expansion and sustainable longevity (ECN USA, n.d.).

Figure 17: Visionary Campus

The increasing recovery rates of the CCHE has increased the number of following-up patients. This raised the idea of expanding the outpatient (OP) services, such as the clinics, daycare chemotherapy wards and radiology. Meanwhile, there was a continuous need for bed numbers to increase, yet no room for further expansion in the original building. Thus, the concept was to evacuate the OP services to empty some space for beds in the old hospital. The project outcome would be an inpatient and clinical building in the existing hospital, linked with a bridge to the new outpatient building, for essential nonduplicated supporting services.

In 2020, with the national economic setbacks in Egypt, the project came to a halt after the completion of the building's skeleton. The delay caused the revisiting of some projects that cannot wait such as the CyberKnife since it was strategically planned to be a surplus service for additional streams of revenue. It was relocated and built inside the old campus based on the medical planner's suggestion.

4.2 Method 2: Unstructured Interviews

4.2.1 Introduction

Knowing the background of the Children's Cancer Hospital and key examples of its previous and ongoing projects, the selection of it as a case study to seek answers for the research questions of this thesis is more logically justified.

Two main strategies were followed to test the case study against the knowledge provided by the literature. Firstly, previous, and ongoing projects taking place in the CCHE were reviewed and analysed in the light of the research questions raised. Secondly, semi-structured interviews were conducted, with a diverse selection of users and practitioners, in pursuit of a comprehensive sense from different perspectives of the contribution of a medical planner in healthcare projects.

A total of six unstructured interviews were conducted with professionals with or at the CCHE, each from a different background. The diversity of the interviewees' professional backgrounds was deliberately intended to enrich the answers derived from the interviewing method. It is crucial to note that these interviews do not serve as facts for the research topic. Instead, it was a tool used to have an in-depth insight into the real-world practices and to what extent does the literature matches the professional practices when it comes to medical planning of HCFs.

Among the professionals interviewed was Dr. Ahmed Emad, paediatrician, and head of the Emergency Room (ER) department, who provided not only the non-engineering insight into the conversation, but also as a daily user of the healthcare facility. Moreover, an interview was conducted with the facility director, Engineer Reda Atta, of the hospital, as well as the medical planner of the hospital Architect Shimaa Afifi, who worked for the CCHE as an outsource for years before joining in-house. Most importantly, an interview was conducted with Dr. Sherif Aboulnaga, the CEO and one of

the founders of the hospital, who provided a useful insight of how the top management views the role of medical planning, which is the main concern of this study.

Two additional interviews were conducted with professionals who did not work directly at the CCHE but collaborated as service providers. The first was Engineer Omar Abdel-kader, a Chief Executive officer at an operational healthcare management firm in Egypt, and engaged with the CCHE in the form oof surplus service engagement. The second interview was with Engineer Moustafa Elhadidi, a projects director at healthcare solutions company based in Leipzig, Germany. Both interviewees provided different kinds of services to the CCHE varying from consultancy level to medical equipment related services. It is important to point out that the main motivation was to engage outsider parties into the data gathering method of interviewing.

To serve the unstructured nature of the interviews, the questions were open-ended to encourage detailed and thoughtful responses and maintain the conversational flow. The questions targeted four main conversation pillars derived from the objectives & the research questions of the thesis. The pillars were business and Finals, stakeholder engagement, costs and savings, and regulations aspects respectively. General ice-breaking questions were added to the lists of questions and used when needed. The complete set of questions can be found in the appendix.

4.2.2 Interviews: A Replication

This section replicates the interviews with the six professionals in a sequential manner. Further interpretation of the discussion considering the research questions will follow in the next section. Expectedly, each person concentrated on one or two aspects more than the other aspects brought into the dialogue, depending on their backgrounds. Nevertheless, this adds to the overall enrichment of the knowledge needed to tackle the research questions.

4.2.2.1 Ahmed Emad (Paediatrician)

Dr. Ahmed Emad is a paediatrician and the head of the ER department at the CCHE. Aside to his main role in the emergency medical services, Dr. Emad also works during his clinic hours to follow up with the children visiting the hospital for necessary medical procedures. Most importantly, Dr. Emad was the main contact person with the medical

planner, Arch. Shimaa Afifi, and the architecture design team during the ER renovation project. His exposure to the process greatly enriched this interview.

When introduced to the research topic, Dr. Emad favoured demonstrating his answers based on his recent, and still ongoing, experience with the ER project. He stated that this was the closest he worked in close collaboration with a medical planner from the stance of a user and operator to upgrade a running healthcare department. Therefore, he was positive that this perception would better serve the reason of the interview.

At the beginning, Dr. Ahmed started by clearly mentioning the objectives he was focused on when following up with the medical planner throughout the project. He said that the target was to solve challenges through medical planning. “I explained my workflow, current challenges, current deficiencies, and the expected enhancements from the new medical design.”, he said.

One major problem witnessed daily was the unsmooth patient flow. When asked about the reason, Dr. Emad explained “because the current emergency department was not planned to function as an emergency department”. The waiting area is limited, and the arrangement of patients is contradicting the procedures workflow. Moreover, the narrow corridors do not optimally serve the ER. It is always crowded in the department and there are not enough spaces for the patients numbering. Besides, the architecture layout of closed rooms not cubicles does not suit the ER. For Dr. Emad, all these deficiencies affected the operations and consequently the cost of the operations.

When asked about the medical planner’s collaboration with multiple stakeholders, Dr. Emad listed his views in three parts. For the patient children and accompanying parents, they will benefit from the planner’s strict abidance by the guidelines of infection control. They will also sense a faster flow of patients after the optimization of the ER layout. Thus, less time spent at the hospital and the exposure to infections and the chances of getting sick are both lowered.

For the staff, the open cubicles layout eases the work for nurses and doctors’ patient observation. The newly introduced central nurse station shall offer better care and following up, in addition to the staff work without wasting much “walking time”. The staff lounge incorporated in the new layout proposal allows for a quiet retreat inside the department that will enhance the overall operation of the staff throughout their working shifts.

For the CCHE hospital, Dr. Emad mentioned that the medical planner offered the hospital a better survival rate by optimizing the work environment of the ER department. Together with less costs because of the less delays in emergency patients processing, which also resulted in less stays and admissions to Intensive Care Unit (ICU). Less mortality figures so a better reputation that would translate into better funds. Less manpower because of the enhanced efficiency.

Dr. Emad emphasized the fact that the CCHE focuses on solving problems with limited resources. This was part of his answer when asked whether the hospital engaged with a medical planner since day one of operations or not. He explained that the medical planner was only engaged during the early phases of designing the CCHE, but not during the operation. Back then, it was assumed that there would be no crucial need for a medical planner, and during the first expansion of ER in 2013 there was no medical planner involved.

Dr. Emad added that the medical planner understood the nature of work and how to plan the space to fulfil all the demands, needs, and necessities of the department. “Without a medical planner, I cannot put data into action”, Dr. Emad stated. “I need a medical planner to translate the data and needs into design”, he elaborated. The medical planner is the bridge between the medical staff and the construction people.

4.2.2.2 Omar Abdelqader (Strategist)

When introduced with the thesis topic, optimizing healthcare facilities through medical planning, he actively reacted stating that optimization is a very broad term, however, it can be narrowed down as in enhancing efficiency. He added that the goal of any organization is to decrease its running costs and increase its revenue without deployment of its capital expenditure (CapEx).

Eng. Omar added that cost is not always the main aim of optimization. Aiming to increase the revenues can reduce the percentage of cost in the formula. “So, cost reduction is not always the answer, sometimes the revenue generation is the answer”, he added. It is about a balance between revenue generating and cost expenditure. He further emphasized stating that in many cases, enlarging the revenue is enough to cover for the inefficiencies of the cost. This attempt to boost the revenue is not necessarily through adding capital. It can be by revisiting your workflow.

For example: adding an extra room for the vestier in the MRI room to reduce the dead-time when the staff is waiting for the next patient to be ready. The situation now is that we consume the same running cost but more revenue. As a result, the ratio of cost is less. This is an optimization, which is totally different from expansion. The revenue of the MRI was enlarged without buying an additional device.

Until this point, Eng. Omar considered this as an introduction to the interview. Following that, he was asked how a medical planner can help the management people and decision makers align a HCF with their vision and goals. “Imagine there is no medical planner, just a good architect, what can go wrong?”, he replied.

He stated that in his point of view, architects are not involved in the operation of our medical services. An architect not aware of the processes will design something that looks perfect but does not work efficiently, and it would cost a fortune to correct.

Another example of deficiency due to the medical planner’s absence is the doctor’s wasted footsteps between medical work & paperwork. “We call it Dead time”, Eng. Omar added. While on the other hand, another doctor in another facility, planned and designed by a medical planner, is working more efficiently because the spaces where he works are in an efficient layout and not much dead time is wasted.

When asked about the cost aspect and the influence which a medical planner can have on such aspect, Eng. Omar stated that medical planning is not for the patient only. Medical planning is largely addressing the management, which is always raising the question of how to improve financials without compromising quality. He adds that if the facility design is severely expensive to run, quality will inevitably be compromised. A simple example of that is the management will be hiring a cheaper doctor with less quality of service to the patients.

Moreover, if the medical planner asks for all resources because of uncertainty or lack of confident design skills. For instance, installing medical gases in rooms that do not demand it is an unnecessary consumption of resources. Unjustified extra investments will surely affect the management’s ROIs. In other words, the medical planner can make it difficult to break even!

In the same context of HCFs costs, Eng. Omar adds, when the medical planner mistakenly proceeds with an incomplete medical equipment list, this can affect procurement processes that will consequently affect the operations of the healthcare facility.

Simply, the doctor will not work in the centre before the missing piece of equipment is available. The resulting situation is a fully deployed centre but not operating. “Poor medical planning can result in pre-operation expenses, and the organization is financially bleeding”, Eng. Omar concludes.

Concerning the regulations and codes compliance, Eng. Omar emphasized that a medical planner must be aware of the relevant accreditations and licensing of the HCF he is working with. Any contradictions of the design and workflow with the codes or the accreditations guidelines will mean that this planner has deprived the facility from JCI, for example, for good. Changes are unrecoverable and the optimization of the mistakes will be to a certain limit.

As a strategist in a healthcare management firm, the medical planner for Eng. Omar is the real designer of the hospital. The employer asks for a certain objective, but the real technical brief is on the MP. “He/she is the translator, the focal point of my project”, Eng. Omar added. The medical planner revisits the project requested from the operation point of view, turns it into a layout while considering the governance and license compliance, all the way till the first layer of documentation for the furniture and medical equipment.

One more thing the medical planner does, from the interviewee’s perspective, is the medical planner’s ability to give estimates for the project cost in case a certain phasing is needed for operation and cash flow issues needed by the management. The medical planner knows what services/ departments are mandatory to have, what can follow later in a subsequent phase, what is capacity based and what is not. For example, a dialysis unit is capacity based, it can start with only three stations out of six planned and expand in another later phase. However, on other hand, a cardiac operating theatre has certain necessities that cannot be phased.

Finally, Eng. Omar cleared a confusion between the scope of medical planning and that of healthcare investment management (HCIM), the latter comes first. When the HCIM reaches a feasible project idea it offers the brief to the client/ employer who engages his medical planner or consultants.

On a last note, about the significance of consultancy, Eng. Omar declared that for example he usually engages the contractor very early. to help him proact to the

circumstances. “I don’t like to be led by circumstances. I need to be driven in an evidence-based manner, and I get to decide”, he finalized.

4.2.2.3 Shaimaa Afifi (CCHE’s Medical Planner)

The interview started with discussing the bridging between the management people and the actual implementation of a HCF project. Arch. Afifi stated that in her firm belief, the main role of a medical planner is to transform the vision of the facility’s management/ board/ CEO into engineerable drawings.

To elaborate more on this bridging advantage which a medical planner can offer to the people of management, Arch. Afifi recalled the Bone Marrow Transplant (BMT) unit expansion. She was engaged with the initiation phases and planning with the decision makers as early as the project reasonings discussions. According to the Fishbone analysis, management observed a drop in the CCHE survival rates compared to the international figures due to the small number of BMT operations performed. Correspondingly, a decision was made to expand the capacity of the BMT by increasing the number of rooms serving the children undergoing BMT operations.

From the financial perspective, the hospital can bare to triple the existing number of BMT rooms, from ten to thirty, to operate around 600 BMT operations in a year. Arch. Shaimaa reviewed the desired expansion objective to translate it into a workflow and a functionable medical plan of thirty BMT rooms.

From her medical planning perspective, the thirty rooms layout was unattainable due to the limited area available for expansion, and compromises would affect the vision which the management is seeking. “We regrouped again, and I demonstrated two applicable options, either 70% efficiency with 30 rooms or 100% efficiency with 27 rooms”, Arch. Shaimaa stated. The reason for the number of rooms reduction was because essential services, previously located on different floors, would now be essential to relocate them on the BMT 6th floor for extra efficiency. Expectedly, the board favored an optimum efficiency over the number of rooms previously decided on from the original planning. Arch. Shaimaa added that the relocation would also benefit the 2nd floor and the surgical ICU to expand for better performance.

After the approval, the medical plan was developed into architecture drawings and the rest of the engineering processes followed. As the medical planner of the project, Arch

Afifi followed up with the architect and the engineering teams. Until this moment, she is still involved in the construction especially that the site is in a running facility and many updates emerge and multiple parameters must be considered. She added, “Any major site update should be reported back to its relevant stakeholders, especially if it critically affects the approved design bringing the vision/goal to light.”

Another example of addressing the vision-medical plan-technical gap is illustrated by Hesham Dananah's role in the construction project of Hospital 57 in the year 2000. As the owner representative, Dananah was responsible for understanding and integrating the needs of the hospital. He collaborated closely with the main designer, Jonathan Bailey, the primary architect of the hospital. Dananah's primary responsibility was over-seeing the construction process and ensuring that the hospital's design was effectively implemented at the construction site, especially after the Bailey phases was done. For any updates, Dananah consistently reviewed and ensured that the project remained aligned with the overarching vision of the hospital.

Moving on to the medical planner’s contribution to the cost savings, Arch. Afifi stated that part of the medical planner’s job is market positioning. For example, “if maternity hospitals are all around a new HCF project site, it would be wiser to consider another specialty for our project.”, she explained. A CCHE related example was the the medical planner suggested establishing a clinical pharmacy. Currently, all doses available in the Egyptian market are based on adult requirements. This proposal is a cost-saving idea aimed at creating exact doses tailored for children, thereby increasing their chances of recovery.

The ICU expansion project involved careful consideration of construction expenses by the planner. The construction pathway is a critical aspect that a Master Planner should always consider. This approach avoided the use of manual handling of waste inside the hospital. Ensuring efficient circulation, even during construction, saves money, in-cluding on the level of site mobilization.

Another example of cost savings is the decision to place the CyberKnife bunker under-ground. This simple decision reduced the cost associated with constructing 5-meter-high walls by decreasing the thickness from 2.2 meters to 1.6 meters. This adjustment was made without violating radioactive safety regulations, considering the device in-stalled, its strength, and the radiation levels.

To sum up this point, Arch. Afifi briefed that cost savings will either be in the construction, like the Cyber-knife, or in the operations, like the ER renovation, or through adding new streams of value/ revenue/ service, like in the GMP.

The Cyberknife talk smoothly shifted the interview to the regulatory aspect of this research. Both the interviewer and the interviewee agreed that a HCF project is bound by multiple regulations and codes to function within its guidelines. Arch. Afifi added that one common regulatory that she has repeatedly witnessed during her career in Egypt was the Fire Safety.

She added that in a typical HCF project, the module of columns is established before allocating the medical zones. This is crucial for approximating the location of stairs, knowing the fire safety codes of the country. Following this, zoning of medical services begins. HCFs that do not adhere to fire safety codes will become urban white elephants, leading to either costly corrective actions or nonfunctional facilities lacking a crucial permit like the fire escape permit.

For the radioactive safety codes, Arch. Afifi stated that she encountered a project with a radioactive facility unable to operate because it failed the radioactive testing by the authorities. This defect was a result of poor knowledge, resulting in costly corrections involving six cm of lead insulation. These expenses could have been avoided if the medical planner had been more comprehensive and aware and asked for an audit from a specialist. “Knowing when to raise your hand and request auditing before proceeding with the design is essential for better utilization of resources.”, she said.

4.2.2.4 Sherif Aboulnaga (CCHE’s Founder and CEO)

When asked about the benefits of having a medical planner on board with him as a decision maker, Dr. Sherif said that the medical planner offers the “how”. CCHE founders wanted to build a state-of-art children cancer hospital, but as physicians they did not know how. He added that without a medical planner it would have been challenging to establish a solid understanding and application on site of the wayfinding, workflow, the occupational health and safety, the patient excellence for the personnel. It is the medical planner now who is helping the management transform the CCHE from family and patient-center-care facility to a person-center-care. “It is a new philosophy for us in management, and the planner transfers our ideas into reality”, Dr. Sherif added.

The CEO continued and stated that the sub specialization is highly important nowadays. For example, not all architects will be able to design an airport from the first trial, and the same with hospitals. An example in the children's hospital CCHE is the CAR T-cell project. It is based on my both planners working in-house, the medical and equipment planners. "Without them I would've ended up hiring a cleanroom installation company without understanding the process and most probably I would've ended up paying unnecessary expenses for unnecessary specs that my hospital does not need because I do not understand", Dr. Sherief explained.

With the consultancy of the planners, the CCHE is now able to prepare its requests-for-proposals (RFPs) with better understanding. The advantage of having a medical planner in-house, such as Shaimaa Afifi, is that all disciplines are one door away and any evidence needed for an EBD decision making is available.

For the cost aspect, Dr. Sherif stated that in many incidents he encountered where his medical planner consulted them with better ideas to save resources in the long run. The simplest example is the Corean fixed seats in the waiting areas of the inpatient to withstand the cultural use while not violating the infection control. The planner's idea of using Corean was value engineered and proved to be the most suitable for both workability, low maintenance, and easy infection sterilization. It was a perfect idea back at that time to handle the visiting traffic of families coming from different cultural backgrounds all around Egypt.

When asked about the stakeholders' collaboration aspects, the interviewee mentioned that he learned this lesson early in 1999 when architect Jonathan bailey visited Cairo and conducted his meetings with every stakeholder group related to the hospital for nearly six months. The same happened with RKTL studio during the visionary project of the CCHE campus in 2013. It is all about understanding the culture and the medical planner did his job back then.

For Regulations and accreditations, if an architect/ medical planner is not fully aware of the different codes, especially the medical, and various accreditations, and able to actively collaborate with other disciplines, any certificate and accreditation would not be easily achievable. The medical planner looks four and five years ahead to make sure that the next round of accreditation is guaranteed.

Dr. Sherif controversially added that sometimes a good medical planner is extra costly for the HCF because he/ she will always create demand. There is always room for improvement and his/ her observations will probably be rightful, sincere, justified, and backed up with collaborative evidence.

Finally, when asked about the future paradigm of the CCHE, Dr. Sherif raised the question of enhancing the children's experience, while staying in the same room for more than 30 days to recover, is a big question for him. How to edit the interior theme to suit the age of the child residing in the room. Digitalization of the rooms using virtual realities, holograms, projecting rays to change the theme of built interior architecture could be the answer, at least for CCHE 57357.

4.2.2.5 Reda Atta (CCHE's Facility Director)

Eng. Atta started off stating that a high-quality planner interacts with two critical aspects: culture and workflow. To develop a smooth plan that ensures effective departmental relations and considers all spatial aspects, strict infection control policies for healthcare facilities (HCFs) in addition to environmental and other aspects of architecture serving the sustainable development and resilience.

One idea from Jonathan Bailey was to build a light well to generate electricity for hospitals, potentially selling any surplus as revenue for the NGO hospital. Another idea from him was to incorporate groundwater into the hospital's HVAC system. However, this was not easily applicable in our context for several reasons.

When questioned about his view of the medical planner's contribution to costs related aspects in a HCF, Eng. Atta mentioned the workflow. He furtherly explained that the relationship between departments significantly influences infection control procedures and operating costs. The decision between a vertical layout and a horizontal layout impacts these factors. Vertical traveling can be more efficient, whereas horizontal traveling poses challenges for circulation.

For example, spaces should be precisely what is needed, no surplus nor deficit. The form follows the function and need, a concept credited to Bailey. His design approach was patient focused. In oncology centers, for instance, the ICU is better isolated, as seen in facility 57. Children cannot stay in an open dormitory as it negatively impacts

their psychological well-being, and thus the recovery will be affected, which means more stays, and thus, more costs.

Furthermore, efficient workflow, if well maintained, can reduce sterility service costs and running costs. Additionally, it can decrease Hospital Acquired Infections (HAI), which are expensive to manage. Material selection is also crucial for a healing environment; materials need to be cleanable and maintainable to save future costs.

As a facility director, the workflow's efficiency is paramount. For instance, if circulation between departments is not smooth, a CODE blue emergency will take longer to assemble, potentially leading to complications and additional ICU admissions, again incurring extra costs. An exemplary services layout was observed in a Cairo hospital where the OR theater, ICU, lab, and blood bank were all located nearby. This proximity made operations highly efficient, minimizing time wasted in circulation.

Speaking about the stakeholder’s collaboration, Eng. Atta strongly agreed with the importance of this process by the designers and medical planners to better understand the operations. However, he believes that RKTL, the visionary campus consultant, spent excessive time surveying medical staff, which yielded little return. In Egypt, the medical staff is typically not engaged with their surrounding environment, according to him. The doctors focus on their tasks without much regard for their surroundings, reducing the effectiveness of pre-design surveys.

He argued that at some occasions the standard was adapted to the local culture. For example, doctors insisted on examining patients from their right side, for him, this was an inefficient engagement level. Similarly, balancing room privacy using curtains with infection control in BMT rooms highlighted the ongoing conflict between culture and standards.

About regulations compliance, Eng. Atta emphasizes that any remodeling or renovation in the CCHE should be a collaborative effort. The design's maintainability must be coordinated with maintenance teams, infection control, quality department, facility safety, housekeeping, etc. Comprehensive planning by the medical planner is essential for effective facility support services.

In the interview's closing moments, Engineer Atta discussed the future paradigm of HCFs, foreseeing increased automation and robotic interventions. He highlighted CCHE's adoption of this trend with the Robotic Assistant, "The Aroba," in the clinical

pharmacy. The Aroba allocates pills, assigns them to prescriptions, creates bills, generates inventory reports, and tracks medication consumption. These reports enable deep analysis, identifying medical patterns and trends in children's illnesses.

4.2.2.6 Moustafa Elhadidi (Service Provider)

Eng. Elhadidi started off his work in healthcare projects as a service provider to execute the project work on site after the design and engineering drawings were approved. Once the order confirmation is received, he and his firm colleagues start to install the device and provide their services on site.

Now, the firm’s scope of work has developed to start a bit earlier on a more consulting level. We see the client’s needs and our in-house teams, either here in Leipzig or Cairo, to facilitate the project kick off with studies, specs, and BOQs. “Then this turns to service scope and products, and we make contacts with our suppliers to bring this project to reality. In other words, we do extra work than just execution”, Eng. Elhadidi said.

When asked about the participation of architects and medical planners in a medical equipment company, the interviewee stated that in-house architects and medical planners have always been vital players in the team. They performed studies and surveys with the operators of the project if the client end does not have its own teams. Other clients have their teams. But even if, connection must be maintained.

As a service provider in the healthcare sector, the company ensures the presence of the relevant personnel to stay in touch with their peers on the client side. For a better understanding and communication between like-minded people of the same professional background. “Without this completed cycle the project is always interrupted and delayed”, he added.

Concerning the alignment of the project with the client’s vision and expectations, Eng. Elhadidi explained that as a service provider, the firm consult with options of project specifications, different supplying sources, and the corresponding costs, etc. to make sure the project stays within constrains, especially financial.

In his experience so far, the clients have been greatly aware of the parameters they are bound with such as the maximum investment, ROI for loan interests to be paid, etc. They know their operational costs and how long they would need to make their

ROIs. Accordingly, his firm fine tune its offers and project scopes, budgets, and materials until an approval and common ground is reached.

When asked about the MP's contribution of collaborating with different stakeholders and parties, Eng. Elhadidi emphasized the importance of the MPs role in maintaining a common harmony among collaborating teams. A medical planner's knowledge of codes and regulations, needs and demands of the other disciplines, medical and non-medical approvals, safety guidelines, saves a lot of misunderstandings and conflicts.

Regarding the regulation's compliance aspect, Eng. Elhadidi affirmed the importance of fulfilling the regulations especially with his firm engaged in projects with different parties in different countries. Agreeing on the specifications and codes reference is usually agreed upon as early as possible to avoid any interruptions when the ordering and supplies are done.

Lastly, when asked about the difference between working on an existing project or a new construction one, Eng. Elhadidi stated that all projects are good and exclusively challenging. Even though working with existing facilities is usually accompanied by extra hustle and parameters to consider which is typically reflected in extra costs and investment needed. Nevertheless, all projects are a success when executed efficiently with adequate coordination.

4.2.3 Interpretation of Interviews: Reflection on Research Objectives

4.2.3.1 Effective Utilization of Funds/ Investments/ Finals Alignment

A sort of contradiction was sensed in the words of two of the interviewees, Arch. Afifi and Eng. Abdelqader, concerning one of the consultancy roles of a medical planner. On one hand, a medical planner can intervene as an advisor to the client/ owner-end on what type of HCF project to develop, scale, size, alternative healthcare services options, etc. This is an early-stage process before any medical planning and zoning is projected.

On the other hand, it is said that it is not a medical planner who does this high-level vision alignment of a HCF investment. Instead, it is a process executed by strategists and usually falls under the scope of healthcare investment management. This is a wider scope than that of a medical planner.

It is agreed that the medical planner looks beyond the management vision. On many occasions, interviewees gave examples of how the medical planner was able to better utilize the resources such as the space and time in a way that would benefit the vision in the long run. His/ her comprehensive view of the function ability of a HCF enables him/ her to be Avant-guard with matters concerning the built environment of the facility.

A common observation was the hidden/ indirect wins which the medical planner offers for a HCF. Better workflow leads to increased efficiency so better survival rates. This is a good important win for the management and decision makers running the HCF. Better layout invites enhanced efficiency and higher infection control, leading to less sanitization costs, and less infections which translates into shorter stay durations, etc.

Another repeated comment was the medical planner's role as the translator. He/ she can translate the medical processes, needs, and necessary facilities into functionable running built environment to meet these needs to fulfill the HCFs vision and targets. This, from the decision maker's point of view, is crucial to avoid him any financial bleedings due to a missing piece of the puzzle.

A medical planner optimum output may not be explicit for the end user to admire/ value. Nevertheless, if it was flowy, the problem would be visible for everyone, and any corrections would be very costly.

Speaking more about the financial performance of a HCF, a medical planner has the ability either to ease or to make it difficult for a HCF project to achieve its return-on-investments (ROIs) or return-on-value (ROVs) and break even. Moreover, MP can give expected estimates of the HCF project cost and reflect it back with the decision makers to reflect on the project financials in case a certain phasing is needed for cashflow matters to be introduced in the MP's proposal.

Supposedly, all HCFs projects are based on feasibilities and initiated to hit certain targets that serves the organization's vision, The medical planner can also be the person who tracks the implementation of a HCF to make sure it is being constructed the same way as planned to meet the vision and goals.

Knowing the fact that all projects undergo updates and unexpected changes due to controllable and uncontrollable reasons during execution. A medical planner can always maintain and control that these changes do not alter the original concept agreed

upon by the decision makers. On site, a HCF with 5 operating theatres cannot simply decrease to 4 without revisiting the medical layout and the people of management.

Introducing the latest technologies and facilities in the field to optimize the operations of the HCF is a MP's role too. Afterall, if the external parties responding to the RFPs did not meet the outline, they will not get hired. The vision and objectives of the projects are not easily comprisable.

The medical planner helps narrow down what the decision maker needs to confidently hire the external parties and service providers by enriching the RFPs with exact needs and details. Without a medical planner the owner/ decision maker could end up with vague RFPs and highly exposed to extra fees/ costs for services that are not actually needed.

As learned from the CEO of the HCF case study, with a medical planner, there is always a room for improvement. The same stance applies with service providers even in their own scope during any services or installations performed on a part of a HCF project.

4.2.3.2 Cost Savings Opportunities

A medical planner can help with both saving costs and the better use of available resources or funds. He/ she, with his space planning and proper understanding of the operation, unlike a regular architect, can reduce the deadtime of the medical staff wasted in walking from one room to another. In other words, A medical planner can enhance the efficiency of the medical operation by considering small additional interventions that would fasten things up. A medical planner is the person who influences how many patients can get their checkups done in one day.

In the context of procurement, A medical planner affects the procurement process in a HCF. Any missing medical equipment if it was not included in the purchase may cause a delay in the HCF operations and back to the financial losses and community services delay.

In the same manner, a well experienced planner will assign exactly what his HCF needs. A simple example is knowing exactly where medical gases are needed. This will save a lot of costs either by not excessively installing gases where it is not demanded, or when reinstalling gases and pipes after construction work are finished because it turned out it was missing.

A medical planner can make it either easy or difficult to reach the breakeven point. For example, project phasing is a tool to arrange the utilization of available resources. The medical planner can assist with this by knowing his knowledge of the different services or departments that can function independently, and which cannot. Which are better to start with and which to postpone to a later phase. For example: A capacity based medical service is fine to start small such the dialysis unit, as Eng Abdelkader pointed out earlier.

Following his work, a medical planner can efficiently narrow down the request-for-proposals (RFPs) to what is exactly needed and requested. A vague undetailed RFP is a station where it is likely to consume unnecessary expenses for unnecessary services just because it is not clearly specified.

4.2.3.3 Stakeholders Engagement in Practice

A major observation from the CCHE case study is how the medical planner benefited most when an open link was established between him and the key stakeholders. Especially those using his project. This collaboration was established to assist the planner better understand the medical process and workflow to translate into an engineerable layout.

In a HCF, many parties are involved and affected and affect the medical planner's work: medical Staff, personnel, patients, and family, and hospital. For this, using his/ her active link with the rest of the active stakeholder, such as the occupational safety officers, infection control, quality assurance departments: the medical planner can take one step further to assist with a smooth safe site mobilization, especially in running HCFs.

Speaking about communication, having an in-house planner is a bonus point to the HCF because it shortens the communications cycle between different parties. Especially inside the HCF, the planner is one door away from the facility director and the infection control specialists. Thus, any necessary intervention can be addressed in the shortest time possible.

It is is crucial for him to understand the nature of the environment and culture he/ her is designing in, especially the cultural. From the interviews, it was a game changer for the CCHE designer to visit Egypt and the NCI to have a better understanding of the

social context of the Egyptian cancer patients and their families as well as the medical staff, their training and working patterns.

For service providers, it is believed that having corresponding professionals on their team to the professionals in action on the client's/ operator's end enhances the efficiency and precision of the project handling. For this reason, they always valued the attendance of an MP on the table to communicate and translate the client's needs and objectives into studies and service proposals.

4.2.3.4 Regulatory in Egyptian Context

A medical planner's awareness of the national regulations enables him to be a vital player for the HCF to apply for accreditations and licenses throughout its lifecycle. A poor understanding of the JCI for example would deprive the facility of this privilege forever. Some corrections are unrecoverable and if applicable then undoubtedly tremendously expensive.

Knowledge of the regulations can result in direct cost savings. In the radioactive safety regulatory aspect for example, the bunker wall thickness was reduced by almost 30% by just which is a direct reduction and saving in the construction cost.

In Egyptian context, the fire safety regulations were the most common regulatory that caused the halt or the delay of the operating of multiple HCFs. The medical planner can greatly assist with granting this license if he incorporated its obligations from an early phase. The MP is believed to be the real designer of a HCF. Incorporating the location of staircases and escape routes before detailing the medical zoning and allocations saves time, money, and revisions, and delays.

Another part of the regulations challenges was the differences in references when working with multiple parties from different countries/ locations. The comprehensive medical planner, since he is the one auditing on all work should be attentive to ensure which regulation reference best serves his/her context.

Finally, the main task of the medical planner, from a facility management point of view, is to build a hospital with an efficient workflow while considering fast and effective horizontal and vertical relationships and circulation. Not to mention that this medical plan layout should not by any means compromise the infection control measures and standards of the HCF.

Thus, the medical planner is fulfilling the medical and infection control regulations in addition to the health and safety guidelines. A comprehensive knowledge of all these regulations is important. Nevertheless, a regulatory challenge was observed from one of the interviewees is that working with international standards have not been an easy task to maintain in the Egyptian context due to cultural challenges.

4.3 Conclusion

The CCHE has proved positive manner of flexibility and scalability as demonstrated earlier the medical planner was able to provide a design that enables future expansion in the long run, and on both scales, building and campus scales. Flexibility, as addressed in chapter 2, is a must-have characteristic in most HCFs. This is a straight match with the literature on a practical scale.

The expansibility of the thesis case study draws attention to the concept of phasing in accordance with the availability of funds. This resonated with the cost/ financial aspect reviewed in the 2nd and 3rd literature chapters, as well as the interview with Engineer O. Abdelqader (to be finally drafted) when he mentioned the role a medical planner can assist in the cash flow with his phasing in design.

The interviews conducted with different professionals with different backgrounds proved the idea of how the experiences influence the feedback and areas of attention of the people. For example, a facility director was more invested in the workflow of the facility while people of top management were more oriented towards the medical planner's ability to translate.

It is also believed that investing much time in the team surveying and getting to understand the user. After all, the main designer and planner of the hospital was not from an Egyptian background and great efforts were made by mediators and medical planners on the CCHE end to bring things together. Thus, an extra day spent with the end users and stakeholders is not a wasted day.

Overall, the evolution of the CCHE through the years, along with the feedback received from six professionals engaged with the hospital on different level, reveals how the medical planning process is able to reach finest details whenever the interaction is possible.

Chapter 5: Conclusion & Findings

In this thesis, the nature, and characteristics of the HCFs as building types were demonstrated, as well as the process usually linked to HCFs projects, medical planning. The main objective of the thesis was to investigate the addition which a medical planner can bring when engaged in the planning and designing of a HCF. For this reason, a practical case study was introduced to test out the theory to practice.

5.1 Research Findings

It is found that a medical planner can greatly contribute to a HCF project on multiple levels, namely the main areas which this thesis addressed.

For the cost aspect, the research confirmed the idea that medical planners can contribute significantly to cost savings in a HCF project and efficient use of funds/ investments. This affirmation was confirmed through both the theoretical literature knowledge and additionally through the words of the interviewees who were interviewed in an unstructured manner. By optimizing the use of space, resources, and technology, medical planners help reduce unnecessary expenditures. Furthermore, the case study of the CCHE illustrated how strategic planning and efficient design can lead to considerable cost reductions on a practical basis.

As for the stakeholders, effective stakeholder engagement is crucial for the success of HCFs projects. Medical Planners play a pivotal role in facilitating communication and collaboration among various stakeholders, including healthcare professionals, administrators, patients, equipment and medical furniture suppliers, and the community. This engagement ensures that the facility meets the needs and expectations of all parties involved, as evidenced in the CCHE case study where stakeholder collaboration was integral to the project’s success. As mentioned by one of the interviewees, the deeper the level of engagement with the stakeholders and users, the more sense decisions would make for years to come.

Finally, the regulatory and licensing fulfilment, compliance with healthcare regulations and standards is a fundamental aspect of HCF planning and design. The study highlighted what kinds of licensing and codes influence a typical HCF. It also demonstrated how Medical Planners ensure that all regulatory requirements are met, thereby

avoiding costly penalties and project delays. The CCHE project underscored the importance of having knowledgeable medical planner in-house to navigate the complex regulatory continuous demands.

5.2 Limitations

While the study provides significant insights, it is not without limitations. The reliance on a single case study (CCHE) may limit the generalizability of the findings, not to mention the specialized type of it as an oncology paediatric HCF. Additionally, the study's qualitative nature, primarily based on interviews and document analysis, may introduce subjective biases.

5.3 Recommendations

Based on the findings, several recommendations can be made:

Policy Aspect: Healthcare policymakers should consider mandating the involvement of medical planners in the planning and design phases of HCF projects to ensure cost efficiency and regulatory compliance as well as evidence accumulation for EBD benefits.

Practical Aspect: Healthcare developers should engage medical planners early in the project to optimize design and operational efficiency. Training programs for medical planners should be enhanced to keep pace with evolving healthcare standards and technologies.

Research Aspect: Future research should expand on this study by including a broader range of case studies and employing quantitative methods to validate the findings. Exploring the role of medical planners in different healthcare settings and countries could provide a more comprehensive understanding of their impact.

5.4 Summary

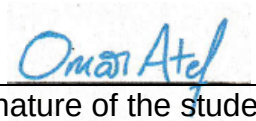
In conclusion, this thesis has highlighted the invaluable contributions of medical planners to the successful planning and design of HCFs. By enhancing investments/ funds utilization and cost savings, fostering stakeholder engagement, and ensuring

regulatory compliance, medical planners play a crucial role in the development of effective and efficient healthcare environments. As the healthcare sector continues to evolve, the insights from this research underscore the necessity of integrating medical planning expertise into the core of healthcare facility projects, paving the way for more sustainable, resilient, and patient-centered healthcare-built environments.

Declaration of Authorship

I hereby declare that the attached Master's thesis was completed independently and without the prohibited assistance of third parties, and that no sources or assistance were used other than those listed. All passages whose content or wording originates from another publication have been marked as such. Neither this thesis nor any variant of it has previously been submitted to an examining authority or published.

Berlin – 05.07.2024



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Appendix

Appendix: Interview Questions

Unstructured Interview Questions for MSc Thesis:

“Optimizing HCFs: A Medical Planning Study”

General Icebreakers:

● Can you tell me a bit about your professional background and how you became involved

in healthcare facility projects?

● What's the most interesting or challenging HCF project you've worked on?

● What do you enjoy most about working in the field of healthcare facility development?

Icebreakers related to HCFs and Medical Planning:

● In your experience, what are some common misconceptions about the role of a medical

planner in an HCF project?

● Thinking about the ideal healthcare facility, what's one design element or functionality

you think is often overlooked?

● Have you seen any recent innovations in medical planning or HCF design that you find

particularly interesting?

Tailored Icebreakers based on Interviewee Role:

● For Architects/Engineers: "How does your collaboration with medical planners typically

influence the design and functionality of an HCF?"

● For Hospital Administrators: "From your perspective, how can medical planning

contribute to a hospital's overall operational efficiency?"

● For Government Officials: "What are some of the biggest regulatory challenges you see

facing HCF projects in today's healthcare landscape?"

Understanding the Business Aspect:

● Can you describe the process typically used to translate the business vision of a

healthcare organization into a concrete plan for an HCF project?

● In your experience, what are some of the biggest challenges healthcare organizations

face in aligning their business goals with the design and functionality of their facilities?

● How do stakeholders, like physicians and administrators, communicate their needs and

priorities during the planning stages of an HCF project?The Medical Planner's Role:

● How can a medical planner bridge the gap between the business vision of a healthcare

organization and the technical aspects of HCF design and construction?

● Can you give an example of a situation where a medical planner's input helped to ensure

an HCF project aligned with the organization's long-term business goals?

● What specific skills or knowledge does a medical planner possess that helps them

translate business needs into functional design solutions for HCFs?

Focus on Business Benefits:

● From a business perspective, what are the key benefits of having a medical planner involved

in aligning an HCF project with the organization's strategic goals?

● How can a medical planner's involvement in the HCF project lifecycle contribute to the

organization's financial performance or operational efficiency?

● In your opinion, how can healthcare organizations better communicate the value proposition

of medical planners to their business stakeholders?

Cost Aspect:

● Can you describe a situation where a lack of medical planning during an HCF project resulted

in unexpected costs? (Follow-up: How could a medical planner have prevented this?)

● From your experience, how can a medical planner contribute to cost-savings in the

construction, operation, and maintenance of a healthcare facility?

● In your opinion, what is the return on investment (ROI) for hiring a medical planner for an

HCF project?

Stakeholder Engagement Aspect:

● What are your biggest challenges in collaborating with stakeholders (investors, medical

planners, architects, engineers, users, etc.) during an HCF project? (Probe further on specific

stakeholder groups)

● Can you describe a successful instance where collaboration among stakeholders led to a

positive outcome in an HCF project? What made it successful?

● In your experience, what strategies or processes can improve communication and

collaboration among stakeholders in complex HCF projects?Regulations Aspect:

● How do regulatory requirements and codes impact the planning and design of HCFs?

● Can you give an example of a situation where a medical planner's knowledge of regulations

helped avoid delays or costly changes in an HCF project?

● How can medical planners stay up-to-date on evolving regulations and ensure HCF projects

comply with them?

General Questions:

● In your experience, what are the key benefits of having a medical planner involved in an HCF

project from the beginning?

● What are some of the biggest challenges faced by medical planners during the HCF project

lifecycle?

● Looking ahead, what are some trends or changes you see impacting medical planning for

healthcare facilities?

Concluding:

● What do you think the future paradigm of HCF projects going?

● Is there anything else you would like to add about the role of medical planners in HCF

projects?

● Have I missed any important aspects of stakeholder engagement, cost considerations, or

regulations in HCF projects?

● Thank you for your time and insights. Is there anyone else you would recommend I speak

with for this research?

Specific Concluding Questions:

● Following up on [mention a specific point discussed earlier], can you elaborate on...?

● Thinking about the future of HCF projects, what role do you see medical planners playing in

the coming years?

● Is there any additional research you think would be valuable in understanding the impact of

medical planners on HCF projects?

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