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IDENTIFICATION OF SPACE MANAGEMENT PROBLEMS IN PUBLIC HOSPITALS: THE CASE OF MAHARAJ CHIANG MAI HOSPITAL

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Abstract:

Purpose: In the last decades, public hospitals in Thailand have developed gradually and been characterized by an incremental development of the hospital facilities. Firstly, this study investigates the factors that have caused the incremental development and how such development has affected the hospital's architectural layout. Secondly, the paper assesses the functional quality of nonclinical areas in the Maharaj Hospital to identify space management problems.

Design/methodology/approach: The first part of the study is based on a literature review of the Thai healthcare landscape. The second part includes the functional quality assessment of nonclinical areas, walk-through observations, and documentation. Obtained data were synthesis using building quality method and measurement criteria and analytical drawing techniques for design assessment.

Findings: The first part identified three factors: (1) the lack of local general practitioners, (2) the limited number of public hospitals, and (3) the implementation of Thailand's universal coverage scheme. These factors have resulted in a dramatically high number of patients in public hospitals. The second part identified problems regarding (1) poor accessibility, (2) a low level of spatial flexibility, and (3) poor spatial orientation. These problems are related to a lack of appropriate strategic space planning and lack of integration of the Thai culture into hospital design processes.

Practical implication: An identification of space management problems is a prerequisite to the improvement of hospital facilities.

Originality/value: This paper presents the first study of space management problems concerning nonclinical areas in Asian hospitals.

KEYWORDS: Thai public hospital, building assessment, functional quality, space management, patient journey.

1. INTRODUCTION

The development of the hospital landscape, medical treatments, and hospital architecture in Thailand is strongly influenced by Western countries (Jungsateansup, 2016; Muangman, 1987; Seangwichean, 1988). This influence began in the early nineteenth century and the influence has continued until the contemporary period. Today, Thailand provides public and private hospitals; both are under the authorization of the Ministry of Public Health.

Changes in demography, legislation, and technology have impacted awareness of the importance of the healthcare industry throughout the world (Zengul & O'Connor, 2013). The Thai government spent 2,865 billion Baht (7 billion Euros) on healthcare infrastructure between 2016 and 2018 (Thailand Bureau of Budget, 2015), and 302 billion Baht will be applied

on planning and administration of hospital and health center operations (Thailand Bureau of Budget, 2018).

Interest regarding hospital design has been raised due to a paradigm shift in healthcare service, where patients are seen as end-user (Ferguson, 2002). The focus of hospital design has transitioned from building functions to user friendliness, especially patient and staff needs (Becker & Parsons, 2007). Hamilton (2003) believes that design decisions based on information available from research is the best way to improve hospital clinical outcomes, economic performance, productivity, customer satisfaction, and cultural measure.

This paper presents the results of a literature review of the Thai healthcare landscape and fieldwork observation at the Maharaj Hospital Chiang Mai, Thailand. This review unveils problems with the current situation concerning functional quality in Thai hospitals. The results from assessing the current physical settings of the Maharaj Hospital and the study of how the Thai healthcare system is framed provide a deeper understanding of government hospital functional quality.

This study investigates the functional quality of nonclinical areas the Maharaj Hospital (major public hospital in Thailand). Nonclinical areas are the areas of a hospital that do not relate to, involve, or are concerned with the direct observation and treatment of living patients. Nonclinical areas include waiting areas, parking lots, restaurants, shops, cafés, hallways, staircases, elevators, etc.

The analysis of the data identifies specific problems regarding space management of hospital nonclinical facilities.

2. RESEARCH OBJECTIVE

The aim of this study is to gain a better understanding of Thailand's healthcare system and how the service of Thai primary healthcare and the public healthcare system are organized. An investigation was conducted to identify problems in relation to functional quality in the Thai public hospitals, using walk-through observation representing patients' journeys. This paper intends to contribute to further research on which hospital design approaches can be implemented in Thai public hospitals and how facilities planners, designers, and other related professionals can collaborate and improve their functional quality. Therefore, this paper explores the following research question:

What space management problems can be identified in Chiang Mai Government hospital in relation to functional quality of the nonclinical area?

3. BACKGROUND

The background of this study is categorized into three sections: hospital building assessment and space management strategy concept. The hospital building assessment identifies criteria for evaluation processes. The space management strategy identifies the strategy planning and development of the hospital space for long-term adaptation. The Analytical drawing techniques for design assessment identifies the tool that we used to analyze the relationship between users and functional quality.

3.1 Building assessment for hospital

Hospital architectural quality can be evaluated with many different evaluation methods (Fronczek-Munter, 2017). In this study, we chose three building assessment approaches that are widely used to evaluate hospitals and healthcare facilities: Evidence Based Design (EBD), A Guide to Clinic Design Post-Occupancy Evaluation Toolkit (The Center for Health Design, 2015), and Building Quality Assessment Method and Measurement.

3.1.1 Evidence Based Design

Evidence Based Design (EBD) is a "process for the conscious, explicit, and judicious use of current best evidence from research and practice in making critical decisions, together with an informed client, about the design of each individual and unique project" (Hamilton & Watkins, 2009 cited in Zengul & O'connor, 2013). The EBD concept was first presented in a publication by Roger Ulrich in Science (Ulrich, 1984) with the self-explanatory title "A view through a window may influence recovery from surgery". There are more than 700 scientific studies providing evidence that a hospital's physical environment can promote better clinical outcomes, increase safety, and reduces stress for both patients and staff (Ulrich *et al.,* 2004).

This approach is a dynamic process which can be applied to many types of healthcare facilities. EBD seeks the best concrete information in order to make a decision. It is a reciprocal and collaborative process that includes both the EBD team and the client who wants to utilize EBD for the construction of a new healthcare facility or the renovation of an existing one.

3.1.2 Post-Occupancy Evaluation

Evaluation and feedback are key components for continuous improvement of the built environment (Center for Health Design, 2015). Post-Occupancy Evaluation (POE) is one of the most known building assessment methods among building inspectors and planners. According to the definition of Preiser *et al*. (Preiser et al, 1988; Preiser, 1989; Preiser, 1995), POE is "the process of evaluating buildings in systematic and rigorous manner after they have been building and occupied for some time." As the assessment of functional quality in hospitals is complex, triangulation and multi-methods of evaluation are required (Lindahl *et al*, 2012). Research has shown that hospital projects use various evaluation methods for several reasons (Fronczek-Munter, 2013, 2017). Recent research by Deuble & de Dear (2014) sees POE as "one of the suite of tools to measure building performance and should be used in conjunction with other methods to evaluate all aspects of a building, including the social, psychological, and physical." They suggest a combination of building performance data and satisfaction ratings to achieve a valid and reliable evaluation of the building. In 2011, the Center for Health Design (CHD) introduced a precise guideline for POE to evaluate hospital buildings, called "Clinic Design POE" (Center for Health Design, 2015).

Clinic Design POE

In recent years, there has been unprecedented growth in community health center (CHC) renovation and construction (Center of Health Design, 2015). The CHD has recognized the importance of clinic design in improving healthcare outcomes and been eager to create a knowledge resource around clinic design. Therefore, in 2011, the CHD developed a standardized Clinic Design Post-Occupancy Evaluation toolkit. The guidelines are intended to be general directions and can be adapted to any hospital project. The CHD defines the conceptual framework of Clinic Design POE as "the evaluation tool that focuses on how the environment design supports the achievement of organizational goals relevant to this particular facility." During the design process, these organizational goals are translated into a set of specific designs/design features, and the decisions lead to a set of environmental conditions (e.g., lighting level, window views of nature) presented in the building after construction. The environment conditions impact healthcare outcomes (e.g., patient satisfaction) after occupancy. The POE results are then used to confirm whether the design intents have been realized and to

adjust organizational goals for future renovation or construction. Figure 1 illustrates the conceptual framework of the Clinic Design POE.

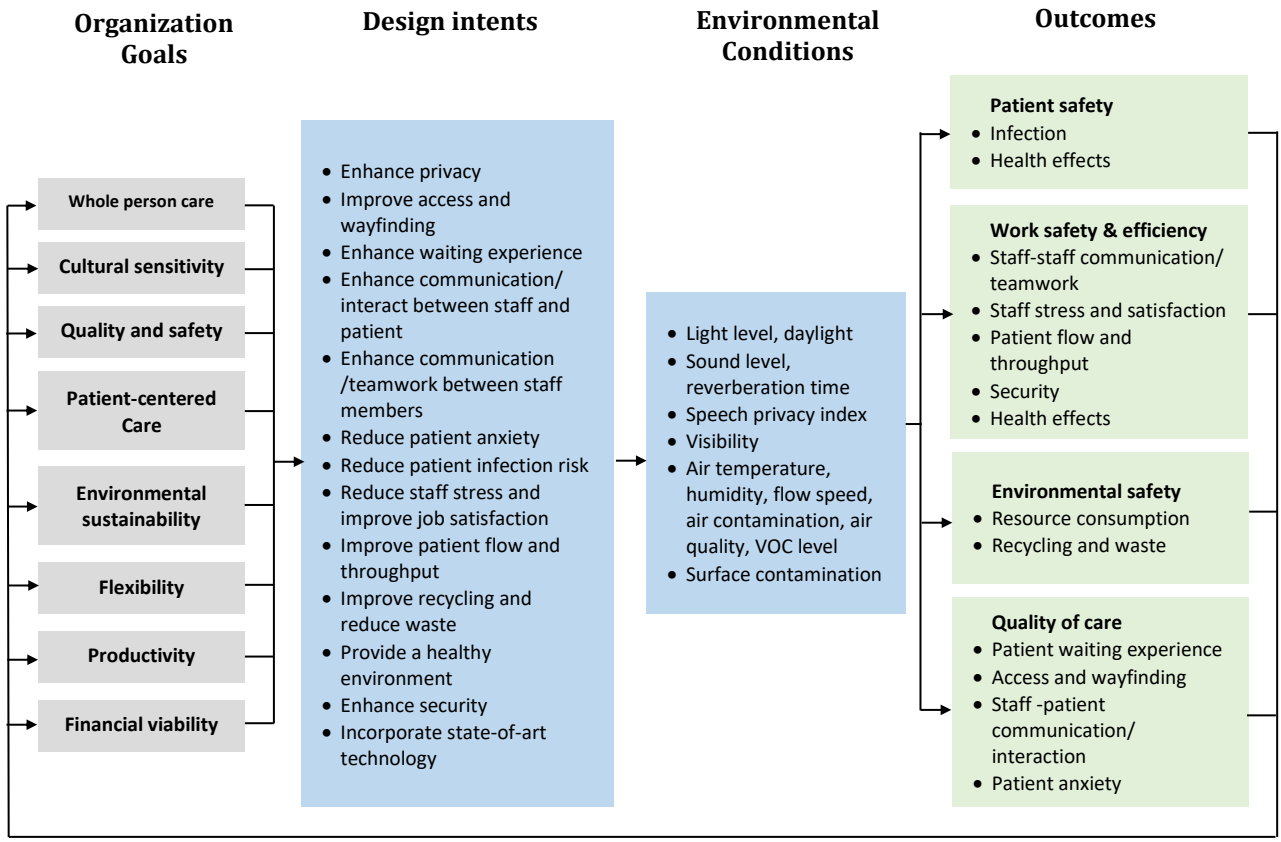


Figure 1: Conceptual framework of clinic design POE (available at: https://www.healthdesign.org/insights-solutions/clinic-design-post-occupancy-evaluation-toolkit-pdf-version. Accessed 25 August 2018)

A precise data collection process is included in the Clinic Design POE—a toolkit with five tools for collecting a variety of data on the physical environment, subjective perception of users, and objective healthcare outcome. The following is brief description of each tool:

Tool 1—General Information, Organizational Goals & Design Principle: This tool is used to collect general information on organization and focuses on the organization goals, which lead to the design principle.

Tool 2—Audit of Physical Environment: This tool is intended for an interdisciplinary team including a facility manager or another individual who is familiar with the facility design operation as well as designers and selected frontline staff members. The auditors may bring an evaluation sheet and a digital camera. The auditors will walk through various spaces such as the parking lot, waiting areas, patient-clinician interaction space, and staff workspace. Each auditor independently verifies whether each design feature is implemented and how well it meets one or more criteria listed in the tool. In addition, photos of each type of space should be taken according to the photo checklists included in the tool. After completion of the evaluation, auditors assess the data to determine the quality of the architectural function of each area. Photo and floor plans rigorous the evaluation results.

Tool 3 —Patient Questionnaire: This tool is used to gather patient perceptions of the clinic environment and service quality.

Tool 4—Staff Questionnaire: This tool is focused on staff perceptions of the environmental design and work experience.

Tool 5—Outcome Data Collection Form: This tool is intended to facilitate the data collection on outcomes related to the selected goals and design intents. For example, a rating scale form or self-completion questionnaire.

The criteria set in the Clinic Design POE framework has been developed from data obtained by the Evidence Based Design approach. The requirements for the hospital physical environment, both in Clinic Design POE and EBD share similarities; however, the Clinic Design POE has precise evaluation criteria.

3.1.3 Building Quality Assessment Method and Measurement

Several parameters of the physical environment can be implemented in the evaluation process. This study aims to identify the functional quality of the existing hospital and present preliminary findings. Therefore, we integrated the Clinic Design POE framework with the criteria for functional quality created by Van der Voordt & Van Wegen (2005) as tools to assess the Maharaj Hospital building. The Clinic Design POE provides standard criteria with a clear method of obtaining data. A building quality assessment provides clear criteria for building function evaluations.

Van der Voordt *et al.* (2005) described the concept of functional quality as a building that is suitable for the activities for which it was intended. The people inside the building must be able to function efficiently, comfortably, healthily, and safely. Van der Voordt *et al.* (2005) provide nine aspects for functional evaluation: (1) reachability, (2) accessibility, (3) efficiency, (4) flexibility, (5) safety, (6) spatial orientation, (7) privacy, (8) health and physical well-being, and (9) sustainability. According to Huisman *et al*. (2012) aspects (1) through (8) can have direct effects on patient and staff health and well-being. In Table 1, these 8 aspects are further defined based on Van der Voordt *et al*. (2005). Table 1 describes the criteria for the assessment of healthcare facilities with precise details. Healthcare facilities may include hospitals, clinics, outpatient care centers, and specialized care centers such as birthing centers, nursing homes, and psychiatric centers. Whereas the World Health Organization (2018) defines hospitals as health care institutions that have organized medical and professional staff, inpatient facilities, and deliver services 24 hours per day, 7 days per week. They offer a varying range of acute, convalescent, and terminal care services using diagnostic and curative tools.

Table 1: Evaluation aspects and requirement for healthcare facilities (Van der Voordt, 2005)

Aspect	Requirement
Reachability	- Reachability by goods vehicles, private cars, and public transportation
Accessibility	- Minimum requirement for corridor width that will not restrict the egress in the event of emergency evacuation (International Health Facilities Guideline, 2015) (1) patient corridor; inpatient units, operating units, intensive care unit minimum clear corridor widths of 2450 mm (2) staff only corridor (with no patient traffic) corridor may have a clear width of 1200 mm and length must not be greater than 12 meters (3) public corridor; interdepartmental corridor is 2450 mm and public corridor should not be less than 1600 mm
Efficiency	- Favorable location provides suitable routes for people and good arriving and departing - Adequate access arrangements for the building - An efficient layout such as sort walking distances, clear hierarchy between public and private space - Sufficient floor area to allow the desire activities to be carried out

	-	Sufficient vertical dimension (care unit 3000 mm, corridor and public passage 2700 mm) (International Health Facilities Guideline, 2015)
	-	Functional use of color and materials to support spatial orientation, reconcilability, and identity
Flexibility	-	Easily adjusted to suit changing circumstances, which means buildings should be easy to adapt without having to do much in the way of breaking down walls and without incurring high costs.
	-	Plan for development of services 7- 15 years and spaces 3 – 30 years
	-	Spatial flexibility must ensure that the organization continues to have satisfactory accommodation available in the event of change lot its primary activities or method of working
Safety	-	User safety includes safety accessible rooms, safe passageways, avoidance of sharp edge and corners, safe stairways, handrails and banisters appropriately installed, non-slip and level floor finished, unsafe place screened off, sufficient illumination, avoidance of loose leads, functional-specific measures e.g. separate sections between infection waste and normal waste
Spatial orientation	-	Clear overall shapes and easily understandable access routes
	-	Clear distinction between public, semi-public, and private spaces
	-	Map of the areas should be provided for easy identify the direction and wayfinding
	-	Color and lighting should be implementing in coordination with wayfinding, and specific areas
	-	Use of ornament or material to identify different locations and directions
	-	Directional sign should be available at or before every major intersection, major destination
	-	Sings should be place every 4.6 – 7.6 m if there are no key decision points along a route
	-	Information desk or information points at the entrance of wards or clinics
Privacy	-	Clear separation between consultant rooms and examination rooms
	-	A clear distinction between non-clinical area, staff area, and clinical wards
	-	Separate entrance and route between each area
	-	No direct connection between non-clinical areas and clinical ward
Health and physical well-being	-	Light: (1) provide windows for access to natural daylight in patient rooms along with provisions for controlling glare and temperature (Joseph, 2006) (2) the amount of light (for general-use rooms such as waiting rooms, corridors, day rooms)
	-	Noise: the maximum recommendation for noise level in hospital is 30-45 dB (for general-use rooms) (Cunha and Silva, 2015)

We use the requirements mentioned in Table 1 to evaluate the functional quality of the Maharaj Hospital. The criteria that we focus on during the evaluation are efficiency, flexibility, and spatial orientation, because these three criteria indicate the functional quality of the nonclinical area.

3.2 Space management strategy

Major decisions regarding space management in most western companies are usually made every 3 to 5 years (O'Mara, 1999, cited in Jensen, 2006). The decision is made when new building projects are initiated, buildings are going to be bought or sold, or major rental arrangements started or ended. In these situations, the importance of space decisions is obvious, because they can have serious long–term consequences on the company's economy and potential to develop with numerous side effects on staff and collaborative partners. According to Jensen (2006), space management strategy does not get much attention from the board of top management committees; space is usually just taken for granted.

3.2.1 Strategic adaptation of space

One of the most important aspects of space strategy is to ensure that long-term adaptations of space fit a company's need for development. Space strategies enable competitive advantages by supplying the right resources with economical, wise decision making. There are three generic space strategies based on the space development analysis of American companies: incremental, standardized, and value-based (Becker & Steele, 1995; Jensen 2006; O'Mara, 1999).

An incremental strategy means that adaptations of space are made only in small steps when absolutely necessary, and extra space is usually rented to avoid major capital investments. This strategy is mainly applied by companies with uncertain situations. It is a typical strategy for new companies during the start-up stage, where the demand for the company's product is unpredictable. This strategy can also be applied by companies under fast growth, where acquiring extra space rapidly has high priority.

A standardized strategy means that both designs and decisions on space are strongly regulated and based on strict long-term plans. This strategy is mainly applied by well-consolidated companies with a high degree of certainty concerning their future development.

A value-based strategy means that the symbols and values of the organization play a key role in decisions on space. This strategy is mainly applied by companies with medium uncertainty. This is typically companies that use building projects to promote their position both by creating optimal physical frames for production processes and by utilizing the buildings as a symbol in relation to the surrounding world.

3.3 Analytical drawing techniques for design assessment

To achieve optimum solutions in building assessments, spatial or floor plan analysis is considered one of the most reliable methods; it can give precise information about how the building is being used. Architects, facility planners, and project managers employ the integration of POE and functional floor plan analysis to obtain insights and create optimized design guidelines (Van der Voordt *et al.* 1997). One of the standardized methods commonly used by planners and designers for design assessment is called Space Syntax (Van der Zwart & Van der Voordt, 2015). Bill Hillier and his colleagues from University College London developed the Space Syntax approach as a tool to define people's patterns of movement and interactions within a building. The movements of people within a building's spatial arrangement create geometry and a network typology of spatial patterns in the built environment (Hillier & Hanson, 1984; Hillier & Iida, 2005 cited in Van der Zwart et al. 2015). Space Syntax contains several tools that can be used to assess building design for optimized design guidelines. In this study, we adopted two Space Syntax tools, functional floorplan analysis and spatial configuration analysis, to analyze the relationship between users and a building's spatial arrangement.

3.3.1 Functional floorplan analysis

In functional floor plan analysis, the floor plan is analyzed in terms of functional, purposeful attention. Usually, the functions are made visible in the floor plans by using a code of colors. When applying functional floor plan analysis, important building elements such as building fabric, structural system, the color and finishes of furniture, and installations are usually omitted. On the other hand, floor plans provide essential information on the most permanent part of the buildings: the shell and structural grid. Furthermore, architectural floor plans embody the social nature of the building, through which it localizes people and modulates their interaction (Van Hoogdalem et al., 1985; Van der Voordt et al., 1997 cited in Van de Zwart, 2015).

3.3.2 Spatial configuration analysis

This method is used to analyze the relationship between users and specific spaces in the building. As people move within a building while performing their role-defined tasks, the

configuration of the circulation network and the location of specific functional spaces within the network (the origins and destinations) generates a pattern of movement. When analyzing the building using this method, all the interior spaces and their adjacent relationships to other spaces are reduced to justified maps of dots and connection lines (van der Zwart, 2014). These maps are generated by designating each room as a circle with lines radiating from it to signify access points. The circle and lines are then rearranged to reveal how many particular rooms are removed from a starting point, usually the entrance. These maps enable the analysis and comparison of the social interactions between spaces (Hillier & Hanson, 1984).

4. METHODOLOGY

This study combines different methods, which includes a literature review regarding the general context of the Thai healthcare system and the selected methodologies of building assessments for hospital (Clinic Design POE), space management strategies, and analytical drawing techniques for design assessment. We have crated the methodology employed in the study (figure 2).

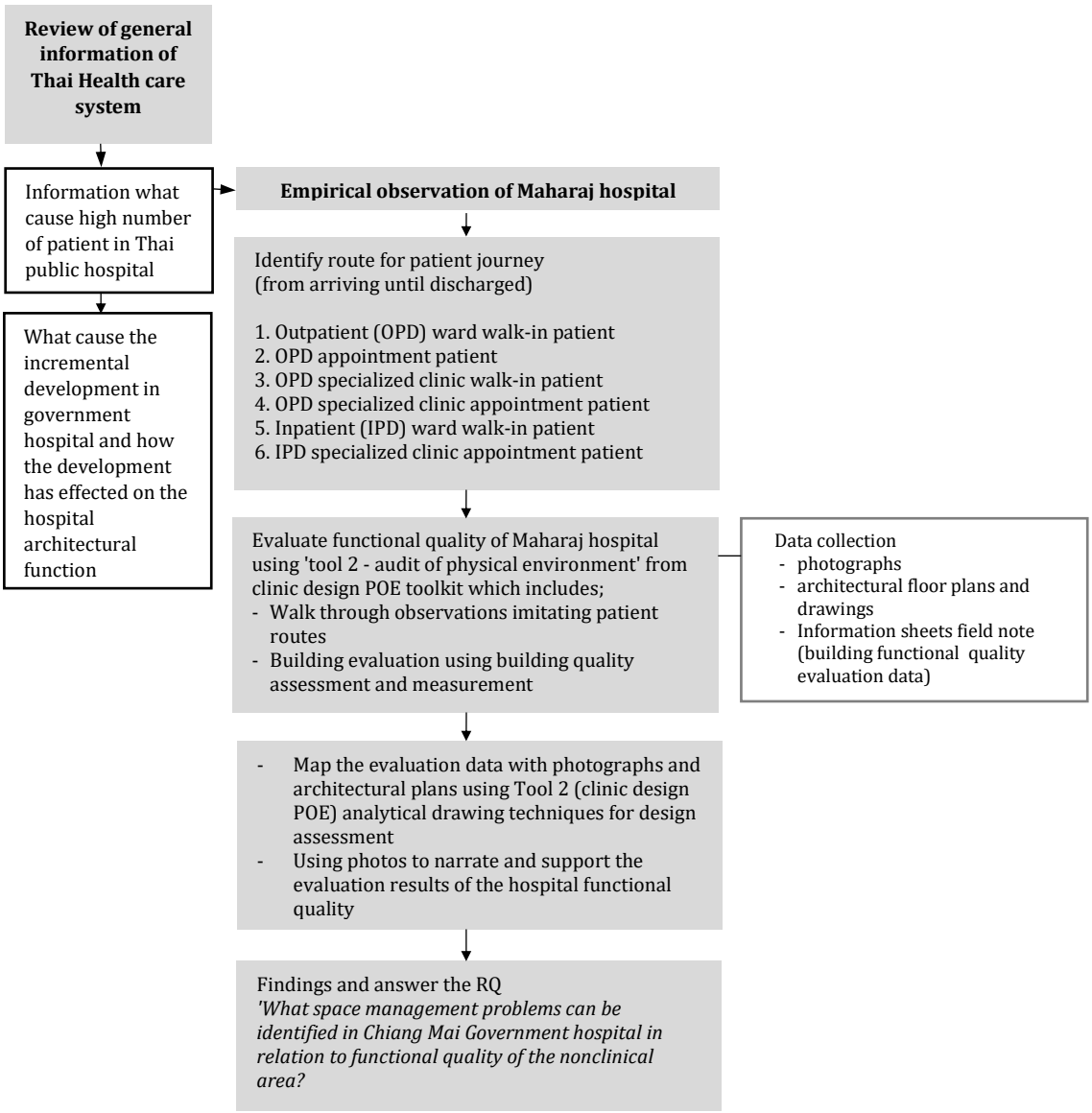


Figure 2: Flowchart of the methodologies implemented in this study

We divided the methodologies applied in this study into five steps, as follows:

- Review of Thai healthcare system—this part gives an overview of the Thai healthcare landscape, and how the system has impacted the design of the hospital and its organization.
- Empirical observation of the Maharaj Chiang Mai Hospital—we identified the typical patient journey and routes. In this step, we selected only the most common routes when patients come to the hospital which are (1) outpatient (OPD) ward walk-in patient (2) OPD by appointment patient (3) OPD specialized clinic walk-in patient (4) OPD specialized clinic appointment patient (5) Inpatient (IPD) ward walk-in patient (6) IPD specialized clinical appointment patient.
- Imitate patient routes—in this step, we employed "Tool 2" (Audit of Physical Environment) of the Clinic Design POE to obtain data regarding the functional quality of the Maharaj Hospital. For this part, we conducted six walk-through observation routes imitating patient routes and assessed the functional quality of the building using "hospital functional quality assessment."
- Data analysis—we synthesized all of the obtained data from both the literature review and empirical observations. We mapped the evaluation results from walk-through observations (imitating patient routes) into the architectural floor plans of the Maharaj Hospital. We employed the functional floorplan analysis and spatial configuration techniques to see the relationship between hospital spaces and their users (patients and visitors). The analytical drawing technique gives an overview of the connection between users and each area. We supported the evaluation results with analytical drawing techniques for precise and rigorous findings.
- Findings and conclusions—we concluded our study by answering research question we had set.

5. REVIEW OF THE GENERAL CONTEXT OF THAI HEALTHCARE LANDSCAPE

According to our literature review of the general Thai healthcare landscape, high patient volume is the main factor that has impacted the architectural layout and function of Thai government hospitals. Three main factors of this are listed as follows:

5.1 The lack of local general practitioners and poor primary care services

Primary healthcare services in rural districts of the country are provided by small local healthcare centers. However, the acceptability of local healthcare centers as the first line is poor when compared with the competing hospital-based services; all hospitals (from community to large) provide all services, including primary care, which is also available at local health centers (Guinea *et al*., 2015; Pongpirul *et al.*, 2009; Prakongsai *et al.,* 2009; Satayavongthip *et al.,* 2016). Moreover, the Ministry of Public Health in Thailand has not launched strict regulations that obligate every citizen to go to a local healthcare center for primary care services (Ministry of Public Health, 2016). Therefore, people prefer to go to government hospitals where the medical expenses are fully covered by the government's universal coverage welfare and social security services scheme (Satayavongthip *et al*., 2016).

Furthermore, people in Thailand have a strong belief that tertiary referral hospitals can perform better treatments. According Srivanichakorn & Van Dormael (1998), doctors attending the outpatient department of community hospitals, 230 out of 442 cases (52%) could have been treated at a local healthcare center. Thus, public hospitals are overloaded with patients. The daily routine in public hospitals is often chaotic, and hospital services are inefficient due to the overwhelming number of patients (Pongpirul *et al*., 2009). In the healthcare network, local healthcare centers and general practitioners (GPs) are the first approach, before patients reach any hospital (Singh and Lillrank, 2018). Therefore, the lack of GPs and poor services of local

healthcare centers has a significant impact on the high number of patients in public hospitals; anyone can directly go to any hospital.

5.2 Limited number of government hospital
Major hospitals are usually situated in the cities (monocentric location). There are 202 government hospitals; however, 78 hospitals are located in Central Thailand, and 60 of these hospitals are based in Bangkok (Ministry of Public Health, 2016). Nonetheless, there are only 8 main hospitals in Chiang Mai, the second-largest city, and less in small cities and suburban areas. The ratio between number of hospitals and its patients is 1:320,000 from the total Thai population of 65.9 million (Thai Statistic Bureau, 2016). People from rural districts commute into the cities in order to visit hospitals; this is another reason why public hospitals are always overcrowded.

5.3 The implementation of Thailand's universal coverage scheme
The Thai universal coverage scheme (UCS) was introduced in 2002 and has had a direct impact on healthcare access among Thai citizens. The scheme has given the Thais easy access to healthcare services and changed health-seeking behavior (Peak *et al.*, 2016). The number of patients has increased, especially the number of low-income, vulnerable, and female patients. This has created two major problems: accessibility (such as a long waiting queue or transportation; hospital wards that are overloaded with patients) and acceptability (low-quality services and dissatisfaction) (Limwattananon *et al*., 2011; Damrongplasit & Melnick, 2009; Limwattananon *et al*., 2012; Peak *et a*l., 2016).

Summary
Three factors constitute the general context of the Thailand healthcare landscape, which includes the financing and structure of government hospitals, and healthcare services provided by the Thai government. This has caused an imbalance between the number of hospitals and patients. Easy access to government hospitals has resulted in overcrowded patient wards; as a result, government and public hospitals are expanding rapidly. This rapid growth has caused an incremental development of hospital buildings.

6. FINDINGS FROM EMPIRICAL STUDIES AT THE MAHARAJ HOSPITAL

6.1 General information on the Maharaj Chiang Mai hospital
The Maharaj Chiang Mai hospital was established in 1956 as Chiang Mai University teaching hospital and promoted to Chiang Mai regional hospital in 1959. The fist main building of the hospital was constructed in 1972, and it is still in use as a main medical building for the whole hospital compound (Maharaj Hospital, 2017). The hospital has expanded throughout the years. Today, there are five main medical buildings: Boonsom Martin, built 1972, eight floors; Tawan, built 1975, six floors; Sujinno, built 1984 fifteen floors; Sriphat, built 1994, fifteen floors; and Charempabaramee, built 2006, fifteen floors.

6.2 Current state of Maharaj hospital
The Maharaj Hospital is the largest hospital in the Northern region of Thailand. This hospital is an affiliation between the Ministry of Public Health and the Faculty of Medicine at Chiang Mai University as part of the teaching hospital (Maharaj Hospital, 2018). It is a 1,400-bed hospital providing primary, secondary, and referral treatments. The hospital compound contains several types of buildings, including five main medical buildings.

The hospital's facilities have been developed and remodeled several times to adjust to the present state of medical function, services, and number of patients. Long-term development of spaces in the Maharaj Hospital illustrates the "incrementalism space adaptation strategy". The hospital has expanded from a total approximate area of 2,325 to 200,000 square meters in the

past sixty years. The hospital developed an incrementalism space strategy as a “quick-fix” for the use of space. One major reason why the Maharaj Hospital rapidly expanded is a constantly high number of patients. In the year 2017, there were approximately 1.3 million patients in the outpatient departments and 48,000 in the inpatient department (Maharaj Hospital, 2018). Therefore, the daily situation of the hospital is always chaotic and overcrowded.

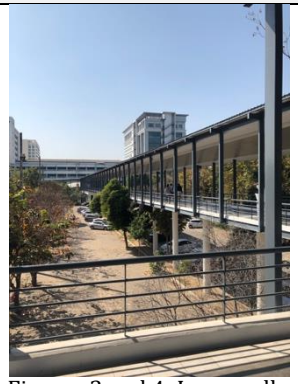
Waroonkul & Jenjapoon (2016) did an evaluation study regarding the healing environment of the hospital’s medical wards. The evaluation results, which examined assessments from patients and visitors of the medical ward, were poor. The spatial layout criteria received the lowest evaluation score (rated as poor), especially (1) unclear signs designating paths and (2) long distances between medical wards.

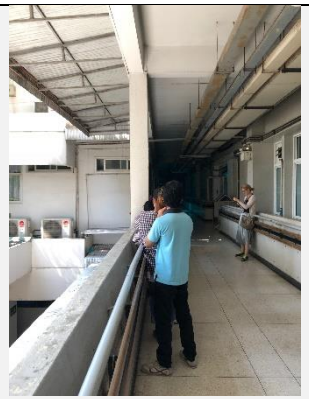
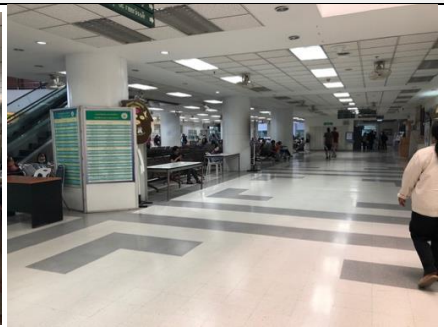
This study aims to investigate the actual situation of this Thai public hospital. Walk-through observations imitating patient routes were conducted to evaluate the functional quality of the Maharaj Hospital and identify problems in relation to space management. Precise data regarding functional quality can be obtained from the six walk-throughs, representing patients’ daily routes (from arriving until discharge) that were conducted.

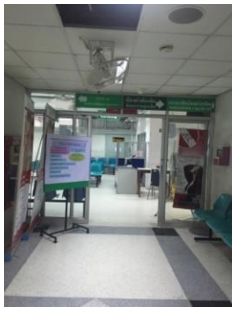
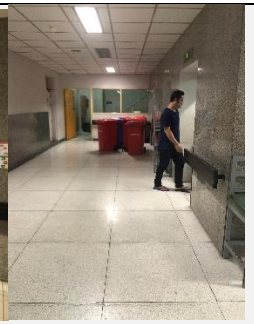
6.3 Results from functional assessment of the Maharaj Hospital

This section provides the synthesis of data collection using Clinic Design POE, photographs, and analytical drawing technique approaches. All photographs illustrated in table 2 were taken by the researcher, Supuck Prugsiganont. The results yield in-depth information regarding the spatial arrangement of nonclinical areas and medical wards. The focus of the walk-through observations is to assess the architecture quality of an incrementalism-focused hospital. Table 2 illustrates these results

Table 2: Results from a functional quality assessment conducted by six walk-through observations at the Maharaj Chiang Mai Hospital

	Route	Results	Photographs
1	**Outpatient (OPD) ward walk-in patient**	**Reachability** - Long walking distance from a parking building - Majority of patients need to walk 15 minutes from parking to clinic **Accessibility** - Confusing route where patient must walk past the radiology ward and laboratory to reach outpatient registering areas - Parts of outpatient corridor are used for display of medical advertisements and storage for beds, wheelchairs, etc. **Efficiency** - Inefficient, as there is no clear designation between medical wards and public routes **Flexibility** - Overlapping areas between the medical wards and public routes **Safety** - Low in safety, as there are public entrances and routes in radiology ward and laboratory **Spatial orientation** - No clear sign or location information of the outpatient department ward - Signage placed every 20- 40 meters - No map nor clear signs from drop-off point to the outpatient ward - Long walking distance from parking space to the ward (1 km walking distance) - No zoning provided in waiting areas **Privacy** - No clear separation between public and patient zones - Low level of privacy because of crossing circulation between radiology ward, laboratory, and public route **Health and well-being** - Noisy due to the cross circulation of public routes in medical wards	  Figures 3 and 4: Long walkway canopy from parking building to the hospital; public route passes radiology ward  Figure 5: the main hospital waiting areas without zoning but with role of seats

2	**OPD appointment patient**	**Reachability** - Both walk-in and appointment patients take same routes to the outpatient wards - Long walking distance from parking building - Majority of patients need to walk 15 minutes from parking to clinic **Accessibility** - No information on ward location in the hospital appointment letter **Efficiency** - Patients are obligated to walk pass the radiology, laboratory, and orthopedic clinic before reaching the outpatient department **Flexibility** - Overlapping areas between public and patient zones **Safety** - Low in safety as there are public entrances and routes in radiology ward and laboratory **Spatial orientation** - No clear sign for information center location - No clear sign for clinic location **Privacy** - No clear separation between public and patients zone - Low level of privacy because of crossing circulation between radiology ward, laboratory, and public route **Health and well-being** - Noisy due to crossing circulation between clinical and public zones	 Figure 6: Intersection of main corridor without any signage
3	**OPD specialized clinic walk-in patient**	**Reachability** - Long walking distance from car parking building to the ward - Majority of patients need to walk 15 minutes from parking to clinic **Accessibility** - Lack of hospital map providing the overall hospital layout and location of information area and clinics - Lack of clear signage indicating location of clinic as the clinics are located in four different buildings **Efficiency** - Inefficient, as there is no clear designation between public and private areas (visitors obliged to walk pass clinical ward corridor to reach OPD ward)	  Figures 7 and 8: main intersection without clear signs or maps for way-finding

		Flexibility - Polyclinics located in four different medical buildings due to the incremental development of the hospital. Therefore, the location of the clinics in the new the buildings must correlate to the location of the clinic in the old buildings. For example, OPD surgery is located on the 2nd floor of the new building due to the location of the main operating theater (located on the 2nd floor of the old building). This has affected the location of more common wards such as OPD internal medicine (higher number of patients) as the ward is located in higher floor. **Safety** - Patients share elevators with toxic waste **Spatial orientation** - Information center located far from the main entrance; many unnecessary signs were installed instead of signage for way-finding - Lack of map and signage at the main entrance of the building and main intersection, resulted in confusing way-finding - No signage to the ward, only signage at the polyclinics entrances **Privacy** - Low level of privacy due to the overlapping area between medical ward and public routes **Health and well-being** - Noisy due to the crossing circulation between public and private zone	  Figures 9 and 10: registration areas far from main entrance and too many signs in front of specialized clinic
4	**OPD specialized clinic with appointment patient**	**Reachability** - Long walking distance from the parking building to the ward **Efficiency** - Crossing circulation due to the location of the new clinics that have to correlate to location of ward in old buildings **Flexibility** - The expansion or modification of the clinics is difficult due to the connection between the wards of old and new buildings.	  Figure 11 and 12: One of patient elevators is used to transport toxic waste

		Accessibility - Same as regular OPD ward; the OPD specialized ward does not inform patients of the location of the wards. Map of the hospital is not given to patients - Majority of patients need to walk 15 minutes from parking to clinic **Spatial orientation** - There is no information desk for OPD specialized with appointment patients. Therefore, patients both walk-in and with appointment walk the same routes. **Privacy** - Lack of privacy due to the crossing circulation between public and private zone **Health and well-being** - Noisy due to the crossing circulation between public and private zone	
5	**Inpatient (IPD) ward walk-in patient**	**Reachability** - Long walking distant from parking building to the wards **Accessibility** - corridors are blocked as part of corridor used for storage and nurse station **Efficiency** - No map provided the location of each clinic **Flexibility** - The area of the wards has been modified for several times - Storage rooms are used as patient rooms and corridors used as storage and nurse station **Safety** - No screening process or information desk; therefore, everyone can enter the ward - Infection garbage and patients using same elevator - Nurse station located in an open space corridor; everyone can access confidential patient and hospital information **Spatial orientation:** - Doctors decide if patients require admission; patient walk same route as OPD walk-in patients until the registering process for room. Then patients walk or are wheeled into the wards, located in four different medical buildings. - Lack of signage or map giving direction to wards - Overlapping areas where nurse station and storage are located in the corridors - Ward does not provide waiting areas for visitors	  Figures 13 and 14: Nurse station and storage in the corridor; crowded patient room without partition  Figure 15: Nurse station and storage located in ward corridor

		Privacy - Low privacy with multiple-bed patient rooms - No partition between each bed **Health and well-being** - Noisy - No air condition and not enough opening to create cross ventilation	
6	**IPD specialized clinic appointment patient**	**Reachability** - Long walking distance between parking building and the clinic **Accessibility** - Corridors are used as nurse station and storage **Efficiency** - Lack of map giving information of information area, wards, and clinics **Flexibility** - Spaces in clinics are difficult to modify or expand due to the connection of the areas in between old and new buildings **Safety** - Low privacy due to crossing circulation **Spatial orientation** - Patients walk the same route as OPD walk-in patients until the registering process for room. Then patients walk or are wheeled into the wards located in four different medical buildings. - Lack of signage or map giving direction to wards - Overlapping areas where nurse station and storages are located in the corridors - Some wards (for example, pediatric OPD) do not provide waiting areas for visitors **Privacy** - Low privacy due to crossing circulation and unclear hierarchy of public and private space. For example, nurse station located in the corridor **Health and physical well-being** - Noisy - No air-conditioning and lack of opening and window to create cross ventilation	 Figure 16: Family of patients waiting to visit the patient without any waiting zone providing

6.4 Analysis of the walk-through observations

We obtained concrete data about the functional quality of nonclinical areas in the Maharaj Hospital by conducting walk-through observations imitating patient routes. We later analyzed the data using the evaluation guidelines for healthcare facilities together with the analytical drawing techniques for design assessment. We drew the architectural drawings, and mapped the analyzed data with photographs of the areas and the analytical drawing to provide convincing evidence of the quality of nonclinical areas function. Figure 19 illustrates the functional floor plan analysis; we colored the public circulation areas with yellow and mapped patient routes to the hospital functions.

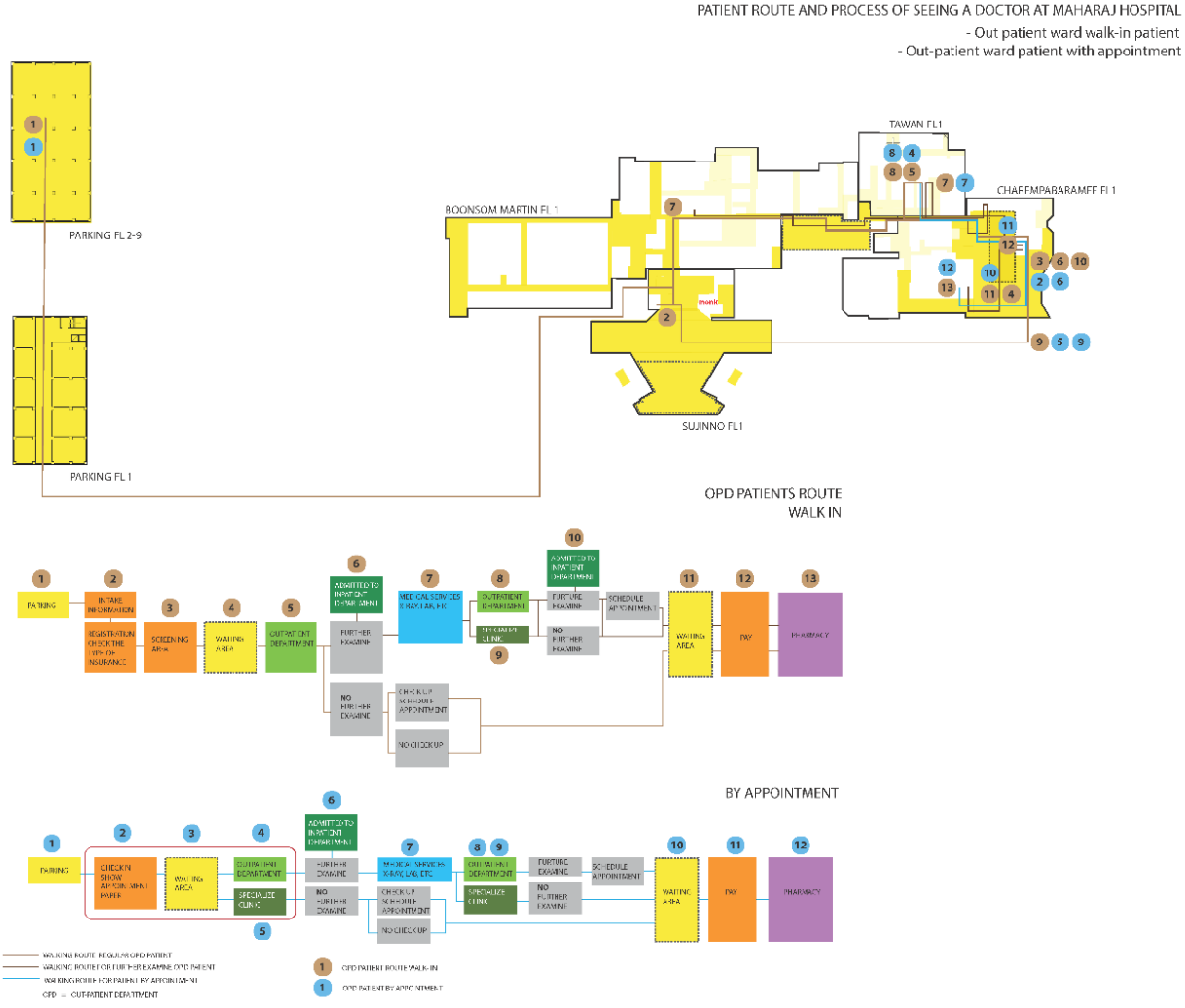


Figure 17: functional floor plan analysis (above) and spatial configuration analysis of the Maharaj Hospital imitating outpatient route (bottom); the functional plan analysis illustrates the use of the hospital spaces where we colored the function and circulation areas in the architectural floor plan. The spatial configuration analysis indicates which area patients first arrive, we connected each area with simplify lines and we applied circle label to indicate the sequence of space which (which area patient first arrive according to medical processes). Drawing and medical processes graphic created by Supuck Prugsiganont.

We applied the spatial configurational analysis as we mapped the sequence of the areas following patient routes and medical processes (which area patients first arrive in and which area is next). Both of these analysis tools lead us to the discussion of common problems regarding the functional quality of the Maharaj Hospital (Table 3).

Table 3: common problems of functional quality in the nonclinical area of the Maharaj Hospital

Topic	Common problems
Reachability	- Long walking distance from parking building to the clinics - Patients have to walk more than 15 minutes from parking to clinic
Accessibility	- Crossing circulation as visitors and patients have to walk past the clinics to reach the waiting areas - Corridors are used to keep wheelchairs, beds, or medical supplies
Efficiency	- No clear designation between method wards and public routes - Lack of map providing the location of wards or clinics
Flexibility	- Areas are difficult to adapt or modify because the relocation of wards must correlate to the location of medical wards between old and new buildings
Safety	- Crossing circulation between clinic and public areas
Spatial orientation	- No clear sign or information of clinics locations or to facilities; for example, toilets, restaurants, and shops - Far distance between each signage (20 to 40 meters) - Overlapping areas as nurse stations are located on patient corridors - Corridors are used as storage spaces
Privacy	- Low privacy because of crossing circulation and overlapping areas
Health and well-being	- Noisy due to crossing circulation between clinic and public zones - Lack of air-conditioning - Lack of opening for cross ventilation

The common functional quality problems at the Maharaj Hospital relate to low quality of building function. Most of the problems fall below minimum requirement criteria for healthcare facilities. The majority of the problems refer to three topics: (1) poor accessibility due to long walking distance between wards and facilities; (2) low level of spatial flexibility because the hospital has been remodeled several times without an overall plan for the layout; (3) poor spatial orientation due to the lack of distinction between public and private spaces, lack of clear signage, poor way-finding, lack of zoning in hospital nonclinical area, crossing circulation, and overlapping areas. When taken thorough the analysis of the problems regarding poor functional quality, two main factors are considered as being cause of the functional problems on the large scale of Thai public hospitals.

Lack of integration of Thai culture in hospital design and architecture

Alexander (2008, 2010) and Fronczek-Munter *et al.* (2011, 2016) stated that a building is usable when the context, culture, and experience are integrated into its design. The design of the hospitals in Thailand are influenced by Western design principles (Seangwichean, 1988). Cultural context is often neglected during the design process; the lack of cultural integration is obvious. As a collective culture (Hofstede, 2011; Riratanaphong & Van de Voordt, 2015), Thais usually visit hospitals accompanied by family and friends for social support. However, most of the hospital's nonclinical areas do not support long waiting hours and user activities besides waiting. According to the walk-through observations, the spatial arrangement of the hospital is not organized according to the behavior of users. Many nonclinical areas are provided without understanding the flexibility of the areas. For example, waiting areas at the Maharaj Hospital can be used only as areas for patients to wait without providing zones for other activities such as, eating, reading, or private discussing. Ulrich *et al*. (2006) suggested that areas which

encourage social support can increase positive clinical outcomes. Waiting areas in Thai public hospitals are not considered an element in the patient healing process; therefore, many waiting areas neglect to provide any more than seating.

Lack of appropriate strategic space planning that fits the Thai healthcare system
Most government hospitals are large scale or university hospitals. In the past twenty years, government hospitals have expanded over time due to a high number of patients. The first medical building of the Maharaj Hospital was constructed in the 70's; within thirty years, the hospital has expanded incrementally, resulting in five medical buildings. The strategic adaptation of space in the Maharaj Hospital is being made in small steps, when necessary. The incremental adaptation of space is being chosen to avoid a major capital investment and remodeling of the hospital. Each hospital building is being added bit by bit without considering the overall architectural lay-out. Each medical building of the Maharaj Hospital is being added every ten years. According to the strategic adaptation method, long-term planning is obligated to cover a 30-year architectural layout plan (O'Mara, 1999, cited in Jensen, 2006). Post-occupancy evaluation and building assessment for functional quality is neglected when the buildings are finished; the research and evaluation results are not being taken seriously. Waroonkun *et al.* (2016) have done evaluations on the architectural quality of the Maharaj Hospital, however, the evaluation results have pointed out that serious action has not been taken due to economically issue and bureaucratic process.

7. DISCUSSION AND CONCLUSION

This study aims to investigate and assess the functional quality of Thai public hospitals using the Maharaj Hospital as a case study. A literature review of the general context of the Thai healthcare landscape reveals the current situation of the Thai healthcare system. Selected methods for empirical observation, including; Clinic Design POE (building functional evaluation and walk-through observations imitating patient journey) and analytical drawing techniques for design assessment, were conducted to analyze and underpin real situations that patients have to face during their journey. The walks were also used to evaluate the functional quality of the hospital using healthcare evaluation criteria. We framed one main research question in our investigation of the hospital: *What space management problems can be identified in Chiang Mai Government hospital in relation to functional quality of nonclinical area?* The incremental development of Thai public hospitals was a major reason; the development of the Thai healthcare system has caused a dramatically high number of patients in government hospitals. This development has affected an incremental development in the hospital architectural layout. Walk-through observations illustrate the functional quality of the Maharaj Hospital, which represents large-scale public hospitals in Thailand. Poor functional quality of the hospital is an effect of two factors: (1) lack of integration of Thai culture in hospital design and architecture, and (2) lack of appropriate strategic space planning that fits the Thai healthcare system. The incremental development of the hospital is not the cause of poor architectural quality but poor strategic management of hospital spaces that cause specific problems.

8. FURTHER RESEARCH

This study provides credible evidence for policy makers of the Thai government hospitals. The results indicate that the functional quality of large-scale Thai public government hospitals is poor. The incremental development could lead to poor functional quality and, therefore, a change during the hospital design brief processes should be considered. The influence of western hospital design should be integrated to local context and the culture of the Thai hospital. Moreover, the design of the hospital should fit with the healthcare system of each country; the Maharaj Hospital design does not fit with the high number of patients.

This paper is the foundation of an investigation into space management and the use of space in public hospitals in Thailand. Findings from this study will set up a scope for an in-depth explorative investigation in nonclinical areas public hospitals. The further study will focus on spatial orientation and the implementation of cultural context in hospital design. The information could, additionally, be used as a precedent case study for hospital planning in neighboring developing country such as Burma, Cambodian, Vietnam, and Laos, as these countries share a similar cultural context.

A continuation of this empirical study will be conducted to compare the architectural layout, architecture quality, cultural context, and the use of spaces with several nonclinical areas of public hospitals in St Olavs, Norway; Rigshospitalet, Denmark; Chulalongkorn, Thailand; and Khoo Teck Puat, Singapore. The outcome of the generic recommendation of improvement for hospital spatial orientation focuses on the influence of cultural context; what can each hospital learn from each other? The core of further investigation is to understand in-depth the relationship between hospital design and the implementation of local cultural context.

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