AN OVERVIEW OF THE END-USERS’ PERSPECTIVES IN HOSPITAL PLANNING

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ABSTRACT

Background: Hospitals are a key component of an integrated health system. Hospital planning is a very complex process. The participatory approach in hospital planning involves input from the end-users who are those who will be using the facility, and their involvement are at all stages of hospital planning, namely: the project identification, appraisal and selection, implementation (designing, construction, commissioning) and evaluation. This paper aims to review the process of hospital planning, design, and construction from the end-user’s perspective and the inherent challenges.

Materials and Methods: This general review gathers the relevant articles from public domain databases, namely PubMed, ScienceDirect, and Google Scholar. Official reports, guidelines and grey literatures related to hospital planning, design, and construction processes and written in English were also included.

Result: Hospital planning can be divided into several stages, namely the project identification stage, briefing stage, design stage, construction stage, commissioning stage, and post-occupancy evaluation stage. Throughout these stages, the end-users play both active and consultative roles to convey their needs and perspectives. The challenges of hospital planning from the end-user’s perspective are related to the changing healthcare trends, facility requirements and technological advancement. Balancing the demands of end-users and the other stakeholders is a challenging task for hospital planners.

Conclusion: Hospital planning is a very complex but organised process to make sure the needs of the end-users translated well into the final product. Henceforth, the end-user’s involvement either actively or consultatively in every stage along the hospital planning processes are very important.

Keywords: Hospital planning, hospital design, hospital construction, end-user.
1.0 Introduction

Hospitals provide acute or continuous care to the population and is a key component of an integrated health system (WHO, 2018). The classifications of hospitals differ across different health systems, but in general they may be categorised geographically (district, state, regional or national hospitals) or by the specialised services they offer (Gooijer, Siem Tjam, & Stott, 2000), such as secondary hospital and tertiary hospital, or by their specific functions such as referral hospital, teaching hospital (university hospital) and military hospital. The public perceive hospitals as an indicator of healthcare provision in the country due in part to the visibility of the institutions (McKee & Healy, 2000). Hospital reforms in the Sustainable Development Goals era are essential to turn them into more cost-effective institutions through optimal hospital planning (Hatefi et al., 2016).

Hospital planning is a very complex process. Hospitals are immoveable physical structures that take years to materialise from the planning to implementation process, whilst high costs are incurred to refurbish or build new hospitals (Garthwaite, 2017; McKee & Healy, 2000). The complexity of the planning process not only lies within the intricate structural standards, but also the differing and often conflicting demands made by the myriad of user groups, funders, government bodies and project consultants (Loosemore & Davies, 1993).

Existing frameworks from the literature have outlined that the aims of hospital planning are reducing costs, optimisation of resources used, and efficiency in hospital decision making (Hans, van Houdenhoven, & Hulshof, 2012; Roth & Van Dierendonck, 1995; Vissers, Bertrand, & De Vries, 2001). At present, health managers and administrators dominate the hospital planning process. However, there has been a recent rise of more participatory approach in facilities planning involving input from the end-users (Våland, 2009). Poor decision making may result in problems arising at any stage in the hospital planning process (JNU, 2013), which can be disastrous and costly. Therefore, it is imperative to balance demand-input and decision making during the hospital planning processes.

In view of the numerous valuable inputs from the end-users that can optimise the hospital planning process, this paper aims to review the process of hospital planning, design, and construction from the end-user’s perspective and the inherent challenges.

1.1 Process of hospital planning

There are several versions of the facility planning processes available in the literature. Nonetheless the fundamental process has four major stages as shown in Figure 1 (Abdul Hamid, 2018), namely;

1) project identification,
2) project appraisal and selection,
3) project implementation and
4) project evaluation
World Health Organization on the other hand constitutes hospital planning into several stages (WHO, 1998), namely:

1) project identification stage,
2) Briefing stage,
3) design stage,
4) construction stage,
5) commissioning stage,
6) post-occupancy evaluation stage.

The initiation of hospital planning can be either in a top down or bottom up approach. Bottom up approach is where the needs of the community from the grassroots is being brought up to the attention of the higher up authorities, while top down means identification of perceived needs by administrators and top managers in the governing organizations (Mohd. Nawawi, 2000).

1.2 End-Users

The base of sound design of a facility starts with a thorough understanding of user requirements (Henriksen, Dayton, Keyes, Carayon, & Hughes, 2008). Thus, the project management team is required so that input from all disciplines involved is being considered to make sure that the final result meets the needs of the actual users of the hospital, and able to offer the best available health care service to the population. End-user such as nurses need to be involved in planning, evaluating and testing the layout of patient rooms to ensure comfortable environment for both patients and clinician (Reiling, Hughes, & Murphy, 2008).

Multiple stakeholders are involved in the hospital planning process. The position of end-users as one of the stakeholders is depicted in Figure 2. End-users in hospital planning processes are those who will ultimately be using the facility. End-users may include representatives from
facilities management, clinical personnel, pharmacy, laboratory, radiology, clinical engineering and support services staff (such as housekeeping and food service) (Fishbeck et al., 2012).

**Figure 2. End-users as stakeholders in hospital planning.** (Source: Adapted from Sengonzi, Demian, & Emmitt, 2009).

Although the end-users of a hospital include the patients, patients’ relatives, and visitors to the hospitals, the planning of a hospital project in terms of practicality rarely see these people be included in the project management team. However, their opinion or point of view are usually shared together and by other end-users such as the staffs and clinicians.

A hospital that is well designed can give positive impact to its end-users. In a review of more than 600 articles by Ulrich, Quan, Zimring, Joseph, & Choudhary in the year of 2004, they found that there was a link between the physical environment and the end-users’ outcome such as fewer adverse event for patients, and reduced stress and fatigue for the staffs.

### 1.3 Planning theories in hospital planning

Planning of a hospital does not only cover the planning and design of the physical structure of the facility, but also planning in other area, which is concerning the human resource to man the facility, and the equipment inside the facility. These processes, however, does not occur separately, but rather simultaneously at every stage of the hospital planning.

Theories are used to simplify and objectify the intricate process of planning. Hospital planning is a component of healthcare planning within the health system. The same planning theories are applicable to health planning and hospital planning. There are many theories that have been applied to health planning but the three most commonly utilised are the rationalism, incrementalism, and mixed scanning planning theories.

The rationalism planning theory entails a thorough view of the goal and all available alternatives with the aim to maximise the outcome of the best alternative (Berry 1974; Lee, 1979). In the context of hospital planning, the rationalism theory apply to allocation of resources, distribution of finances, hospital bed management and determination of specialist care (Burch & Benatar, 2006). However, as the rationalism theory does not consider value in the planning process, singular use of this theory may not be helpful in a constrained setting such as hospital planning (Lee, 1979).
Incrementalism theory combines values and means in the planning process. Incremental step up looks at existing information in decision making and planning of change (Lee, 1979). The incrementalism used in hospital planning include; manpower planning such as increasing staffing numbers, budgeting, hospital renovations and equipment acquisition (Garthwaite, 2017; Huntington & Hort, 2015).

At the middle of the planning continuum lies the mixed scanning theory. This theory combines elements from both the rationalism and incrementalism planning theories in recognition of the limitations within both theories (Etzioni, 1967). The mixed scanning theory is the most suitable to be applied to hospital planning as it outlines the steps of continuous monitoring of the project planning (Manaf, Juni, & Mohammad, 2018).

Despite scarce reference to a specific theory in the existing hospital planning literature, by relating it to health planning and understanding the elements of these planning theories would lead to a systematic approach in hospital planning.

2.0 Materials and Methods

This general review gathers the relevant articles from public domain databases, namely PubMed, ScienceDirect, and Google Scholar. The search of the databases mentioned above was conducted using main keywords of hospital planning, hospital design, hospital construction, and end-users. Official reports, guidelines and grey literatures related to hospital planning, design, and construction processes and written in English were also included. Results will be discussed based on the hospital planning process; the project identification stage, briefing stage, design stage, construction stage, commissioning stage, and post-occupancy evaluation stage.

3.0 Result and Discussion

The four broad health facility planning stages as outlined by Abdul Hamid (2018) can be further broken down into six stages of hospital planning dependent on the task, input, and output of each stages to incorporate the WHO, 1998 hospital planning stages. Table 1 summaries the stages in hospital planning, the task carried out, the input required and the expected outcome in each stage, and the working team involved, with particular attention given to the end-users.

| Table 1. Stages in hospital planning, tasks, inputs, outputs and working teams |
|------------------|------------------|------------------|------------------|------------------|------------------|
| Stage | Task | Input | Output | Working team | Working team | Working team |
| | | | | Active | Consultative | Active | Consultative |

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<table>
<thead>
<tr>
<th>Project identification</th>
<th>Needs assessment</th>
<th>Feasibility study</th>
<th>Information Indicators</th>
<th>Projections</th>
<th>Project proposal to construct</th>
<th>End-Users</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preparing Project Brief</td>
<td>Statement of Needs Feasibility Study Report Services to be delivered</td>
<td>End-Users</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Briefing</td>
<td>Preparing Briefs of Requirements (also known as Design Brief)</td>
<td>Functions requirements</td>
<td>Medical Brief of Requirements (MBOR) Technical Brief of Requirements (TBOR)</td>
<td>End-Users</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design</td>
<td>Preparing the design</td>
<td>Medical Brief of Requirements (MBOR) Technical Brief of Requirements (TBOR) Additional data from the End-Users</td>
<td>Facility design Exterior façade and interior loaded plan</td>
<td>Architect/ engineers/ quantity surveyors End-Users</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction</td>
<td>Execution of the construction work</td>
<td>Design of hospital Working drawings</td>
<td>Hospital in physical form</td>
<td>Architect Builder Engineer</td>
<td>End-Users</td>
<td></td>
</tr>
<tr>
<td>Commissioning</td>
<td>Testing and commissioning of the hospital</td>
<td>List of staff List of furniture List of equipment List of supplies</td>
<td>Appointment and training of staff Procurement of furniture, equipment, supplies</td>
<td>End-Users</td>
<td>Procurement staff Personnel staff</td>
<td></td>
</tr>
<tr>
<td>Post-occupancy evaluation</td>
<td>Evaluation</td>
<td>Evaluation report</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Due to the complexity of hospital planning, a project management team that is usually led by the architect or the engineer and involves multiple discipline such as the health planners, functional planners, equipment planners, financial planners and physical planners, quantity surveyors, finance managers, staff responsible for procurement of supplies, and end-users such as doctors and nurses is greatly required (WHO, 1998). For each of the planning and designing stages, each member of this team will have a role to play, either actively or consultatively, and as for the end-user who is the owner and final user of the hospital, will involve actively project identification stage, briefing stage, commissioning stage, and post-occupancy evaluation stage, but assumes the consultative role during the design stage and construction stage (WHO, 1998).

### 3.1 Hospital planning cycle

#### 3.1.1 Project identification stage
This is the earliest stage of hospital planning. Needs assessment is one of the tasks in this stage. Needs assessment is not simply a process of listening to patients or relying on personal experience, but a systematic method of identifying unmet needs of a population and plan to meet these unmet needs (Wright, Williams, & Wilkinson, 1998). At this stage, there will be a needs assessment team consist of the planners and end-users such as the hospital staff and the community (WHO, 1998). They are responsible in getting information, indicators, and projections such as the needs, range of services to be provided, the target population or catchment area, the financial feasibility of the project with cost-benefit analysis and the scale of the hospital (WHO, 1998). Figure 3 showed the people involved in the team.

Feasibility study, also one of the tasks in this stage, is conducted to determine the viability of an idea, such as ensuring a project is legally and technically feasible as well as economically justifiable, which will be compiled together with the Statement of Needs into the Feasibility Report. Using these input, project brief will be prepared, and the outcome that must be achieved at this stage is to have the decision to (or not to) construct a hospital (WHO, 1998).

The end-users involved at this stage are mainly the administrative who wield the power and authority to make the decision regarding the establishment of a new hospital. Their general perspectives at this stage is to close the gaps or meet the unmet needs of the population in terms of health services with the hospital project that is implementable, cost sensitive, and flexible.

3.1.2 Briefing stage

Once the project proposal has been approved, the next step is to prepare the finer details of the project based on the needs and wants of the end-users; as well as the estimated floor size of the facility guided by the services which will be provided. These details are compiled in two documents called the Medical Brief of Requirement and Technical Brief of Requirement (Abdul Hamid, 2018). Involvement of the end-users are the most at this stage (WHO, 1998). Technical brief concerns on the technical aspects of the facility and is usually prepared by consulting the related engineers.

This stage occurs after the needs and the size of the hospital have been determined in the previous stage. A briefing team consists of architects, engineers, and the end-users will sit
together to prepare the key document namely the design brief; a written expression of the end-user’s needs (WHO, 1998).

Design brief will help designer to understand better on the activities to be carried out later in the hospital. In general, end-users who usually be represented by experience people in their respective fields will give input and suggestion to the designers on what design may be helpful in achieving optimal function of their respective departments and optimal patient care. Inputs from end-users are very crucial, especially, in a case when the designers themselves do not have enough experience dealing with hospital or healthcare facility projects.

A good brief is the base for good design and should provide information about the hospital such as shown in the Table 2:

Table 2. Items in a good design brief

<table>
<thead>
<tr>
<th>No</th>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Functional content</td>
<td>size and content of departments.</td>
</tr>
<tr>
<td>2.</td>
<td>Philosophy of service</td>
<td>what the departments will and will not do.</td>
</tr>
<tr>
<td>3.</td>
<td>Workload</td>
<td>the number of hours and the time that the hospital departments will work, the shifts, maintenance time, overtime.</td>
</tr>
<tr>
<td>4.</td>
<td>Planning principles</td>
<td>policies and procedures of the hospital regarding patient movement, staff movement, supply delivery, disposal of used goods, laundry service, food service and domestic services.</td>
</tr>
<tr>
<td>5.</td>
<td>Staffing</td>
<td>number and types of staff, peak work periods.</td>
</tr>
<tr>
<td>6.</td>
<td>Functional relationship</td>
<td>between departments, between rooms within a department.</td>
</tr>
<tr>
<td>7.</td>
<td>Environmental factors and engineering</td>
<td>hospital policies regarding fire protection, electrical supply (mains and stand-by), sterilising and sterile supply, security, hot- and cold-water supplies, heating and ventilation, lighting, medical gases and vacuum, emergency alarm system, other engineering services, landscaping and pollution control.</td>
</tr>
<tr>
<td>8.</td>
<td>Schedule of accommodations</td>
<td>list of all rooms and spaces in each department, type and number of occupants, sizes and activities performed in them.</td>
</tr>
</tbody>
</table>

(Source: adapted from WHO, 1998)

At this stage, the end-users again assume active roles to deliver their needs. Figure 4 showed the people involved in the briefing team.
Figure 4. Briefing team
(Source: WHO, 1998)

The perspective and needs of the end-users at this stage largely depends on their role in the hospital, which can be basically divided as those who are in the administrative positions, clinicians, clinical support and non-clinical support as discussed in the following paragraphs.

3.1.2.1 Administrative positions’ perspectives

The administrators supervise the entire process of the discussion in preparing the Medical Brief of Requirement and Technical Brief of Requirement (Design Brief). The administrators ensure that the requests or needs of the end-users are in line with the entire facility’s mission, vision, objectives and budget.

3.1.2.2 Clinicians’ perspectives

Clinicians consist of several distinct groups based on their training and specialty. Each specialty may have specific needs to enable them to provide the best care for the patients. Clinician may come from medicine, paediatrics, surgery, obstetrics and gynaecology, orthopaedic surgery, dentistry and psychiatry department (WHO, 1998).

End-users from specific departments or units may request specific design and requirement. These may include accident & emergency, intensive care, operation theatre, and many more.

End-users that work in the accidents & emergency (A&E) will express their priority on ‘patients flow’. Flow of patients into, within and out of the department should be considered. This is important to ensure smooth registration, discharged and avoid congestion of patients especially at peak hour. For example, easy access to public, better ambulance access and appropriate approach used in dealing with non-ambulance attendance; i.e. covered drop-off areas, nearby parking for visitors or helipad. Common feature of many accident & emergency department is their wide “front door”. The Big Front Door concept may enable faster diagnostic assessment and discharge rates. A&E end-users should always be prepared to provide a continuous service even though in a major incident with sudden rapid increase in numbers of patients. Thus, emergency preparedness planning needs to be tied into design for decontamination and infection control and be included as its end-user perspective. Apart from that, A&E should have convenient and direct access to other clinical-support services such as diagnostic and imaging services (Department of Health, 2013).
On the other hand, intensivist who treat patients in the intensive care units (ICU) may suggest specific elements which include single-occupancy ICU rooms, adequately placed hand washing facilities, appropriate surface selection for easy cleaning and disinfected, specialized rooms for isolation, and proper ventilation and air circulation (Bartley & Streifel, 2010).

Surgeons may express their need for four different zones in operating theatre (OT) based on degree of cleanliness and contamination. The four different zones may include protective, clean, sterile and disposal zones. The classification of zone is crucial to ensure surgeries to be performed under aseptic conditions. End-user will give input on activities at respective zones, patient flow, staff flow and waste and disposal flow. With these perspectives in mind, proper ventilation system in operation theatre can be planned which include different air pressure system at OT entrance, specific air flow pattern within the OT and controlled temperature, humidity and ventilation throughout the OT (Rao, 2004). The size of the OT, medical instrument needed, and other specifications may differ depending on services being provided.

Apart from specific requirements for each of the department that the clinician is working, they also need call rooms are private rooms that provide area for resting or sleeping during overnight shifts. As distance to call rooms increases, it may become more challenging for providers to use these spaces while also maintaining patient care responsibilities (Murphy, 2014). End-users will therefore preferred call rooms that are both high quality and with relatively acceptable distance to their patients. Failure to recognise these needs will cause the call rooms constructed not serving their purpose. As stated by Murphy in his report in 2014, during his site visit to a hospital, one obstetrician remarked that the calls rooms are of low quality and distance away, thus further reducing their usability.

### 3.1.2.3 Clinical support group’s perspectives

Clinical support group may consist of nurses, medical assistants, radiology, clinical laboratory and pathology technicians (WHO, 1998). As part of the end-users, their input is very valuable in the planning of the facility. For example, nurses may give their input on their rest areas and patients’ beds location and configuration. Poorly planned rest areas and patient areas would result in unproductivity.

Due to their workload and long working hours, nurses require a place for them to have a quick rest, preferably near to their work station. However, sometimes due to faulty design, designated place for them for this purpose was not fully utilised. An example is like a common lounge at Tuba City Regional Health Care Corporation is rarely used because of its distance from the nursing station (Murphy, 2014).

Nurses also prefer patient’s room to be close to one another as distance between patient’s room can greatly impact workload. A report by Murphy in 2014 showed that nurses may find themselves literally running between rooms with sprawling units layout compared to closely-spaced, efficiently laid out units, as shown in Figure 5.
End-users who are involved in the Infection control unit may want the hospital to be designed in such a way to minimise the risk of infection transmission and thus, their input and perspectives in infection control are required. End-users may identify dirty and clean areas so that proper separation can take place. Thus, controlling movement of general traffic and air flow from dirty to clean areas. For example, air flow from isolation wards for infectious cases should not circulate out to general wards. Dedicated way-out for garbage and clinical waste disposal should be planned i.e. dedicated lift. Apart from that, patient care areas and nursing station should have adequate number of wash hand basins to facilitate handwashing norm among doctors and nurses (Rao, 2004).

Radiology and imaging department is an important clinical support end-user. They will decide on what type of radiology and imaging services will be provided parallel to the hospital policies. Several types of imaging modalities are ultrasound, x-ray, mammography, computer-tomography (CT) scan and magnetic resonance imaging (MRI). A small district hospital may only offer ultrasound and x-ray whereas a big tertiary hospital may have all type of imaging modalities. Their input and perspectives in design brief are important as several imaging modalities require specific specifications to be planned and implemented in the hospital design. MRI suites are designed differently than CT scan and X-ray rooms because they involve magnetic field instead of radiation. Instead of lead-lined walls, floors and ceilings, MRI suites require radiofrequency (RF) shield (Yoder, n.d.). However, most of the technical part in installing and setting-up the imaging modalities are out of the end-user role and perspective.

3.1.2.4 Non-clinical support group’s perspectives

Non-clinical support staff include staff members such as dieticians and kitchen workers, laundry, and warehousing (WHO, 1998). Although they are not involved directly in the management of patients, their work ensures the support services are efficiently provided. The non-clinical support staff may be included in the briefing stage to ensure their workstations are optimally planned to ensure good workflow. For example, kitchen workers and dieticians may require additional preparation, storage or distribution space and equipment when dealing with therapeutic diets, and even more so if isolation from production of other diets is required, e.g. in the case of allergen-free diets and risk of cross-contamination of food items (Davidson, Scott, & Bannerman, 2008).
3.1.2.5 Patients’ perspectives

Sometimes, patients and visitors are involved with hospital planning. For example, during the planning of Texas Children’s Pavilion for Women, interviews were conducted not only with local obstetricians and gynaecologists, nursing staff and leadership, but also mothers and patients (Silvis J., 2012).

Patients attended hospital outpatient areas in China ranked design for cleanliness, air freshness and noise among the most important whereas design for entertainment facilities, furniture layouts and presence of art objects as the three least important (Zhao & Mourshed, 2017).

In another study done, it was noted that patients wanted to have control over their privacy, such as having privacy curtain that they can control to avoid being ‘on display’ to the people in the hallway, using the bathroom without being seen or heard, and a sense of security like knowing who’s entering the room and their role (Patterson et al., 2017).

3.1.3 Design stage

After all the end-user’s clinical and administrative needs have been established in the design brief, the abstract ideas will be translated into architectural and engineering plans. This require the main design team consisting of engineers, architects and quantity surveyors. The end-users and the approving authority may play consultative roles to the main team. As a whole, the team will combine their expertise to produce the instruments for implementing construction, starting from preliminary investigation to the final designs with technical specification, tendering documents and detailed working drawings and estimates of cost (WHO, 1998).

The design team should be able to come out with the detailed design of the hospital during this stage and to achieve this, they will need additional data from the consultants; i.e. the end-users (WHO, 1998). The architects and engineers might come up with a design which seems to be in line with the design brief but was not actually translated well in terms of practicality in the end-users’ point of view, thus requiring more consultation with the end-users. Several design faults such as slippery floors, inappropriate door openings, poor placement of rails and accessories, and incorrect toilet and furniture heights can cause patients to fall (Brandis, 1999), and consulting the end-users will avoid these mistakes. Figure 6 showed the people involved in a design team.

![Figure 6. Design team](image-url)
3.1.4 Construction stage

Construction stage follows the design stage. It is a stage where the physical form of the facility with all the technical specifications being constructed by the construction team within the prescribed time and cost (WHO, 1998). This team consists of engineers, architects, and builders, with the consultative role played by the end-users shown in the Figure 7 below.

![Figure 7. Construction team](Source: WHO, 1998)

Again, at this stage, the end-users’ needs as stated in the design brief and designed in the detailed drawing of the hospital must be translated well. Regular and consistent consultation among the engineers, architects, and builders with the end-users is therefore needed.

3.1.5 Commissioning stage

The commissioning team is responsible to staff the facility, commissions and procures the equipment, furniture, and supplies needed so as to prepare the new hospital for operation (WHO, 1998). Figure 8 below showed the commissioning team.

![Figure 8. Commissioning team](Source: WHO, 1998)

The end-users will involve actively during the stage of commissioning. The end-users also will be required to test and verify the services, processes (such as patient information system and
communication system), equipment, structures, water and electrical supply at this stage to ensure the functionality when the hospital operates (WHO, 1998).

### 3.1.6 Post-occupancy evaluation stage

At this stage, the end-users will have an active role to evaluate the newly operated facility. Post-occupancy evaluation (POE) is where the end-users assess the built environment, that may reveal defects in operation of the hospital, which might be overcome by changing equipment, relocating activities or redirecting traffic (WHO, 1998). In terms of the end-users perspective, it provide answers on how the building actually work in technical, social, and management terms (Aliyu & Muhammad, 2016).

### 3.2 Human resource planning

A well-designed hospital cannot operate at its best without a proper human resource planning. As such, adequate staffing is a must to enable the benefits of well-designed health care facilities (Reiling et al., 2008). This is because, a study showed that there are fewer adverse events when appropriate nurse staffing levels are met, thus lowering rates of adverse events and ultimately making the operational costs are lower (Davidson et al., 2008). End-users may suggest on how many staffs are needed in respective job categories and departments to optimally run the services.

### 3.3 Equipment planning

Equipment planning process is a major part of project planning process, which constituting about 40% of total project cost (Mohd Hanafiah, 2016). It is an integration of clinical experience, design knowledge, and experience with medical equipment. There are basically five parties responsible for equipment planning, which are shown in the Table 3.

<table>
<thead>
<tr>
<th>No</th>
<th>Party</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hospital and clinic managers, or the end-users</td>
<td>to determine all the items of equipment necessary.</td>
</tr>
<tr>
<td>2</td>
<td>Architects</td>
<td>needed most for built-in equipment</td>
</tr>
<tr>
<td>3</td>
<td>Engineers</td>
<td>responsible for mechanical and engineering equipment, information and communication technologies (ICT) related equipment (fixed building equipment)</td>
</tr>
<tr>
<td>4</td>
<td>Equipment Planners</td>
<td>to determine medical and non-medical equipment</td>
</tr>
<tr>
<td>5</td>
<td>Medical Planner</td>
<td>to determine space required in clinical areas</td>
</tr>
</tbody>
</table>

Equipment planning is an ongoing process simultaneous with hospital facility planning. Medical equipment can be broadly classified into (i) fixed medical equipment such as dental chairs, OT light and table, and CT scan machine and (ii) loose medical equipment (plug and play equipment) such as ultrasound machine, ventilator, electrocardiography (ECG) machine,
medical furniture and surgical instrument (Mohd Hanafiah, 2016). In design brief, end-users will decide on all equipment that are deemed necessary for the operational of the new facility. Their perspective may take into account equipment with latest technology, equipment specification, any incorporation of ICT requirement and estimation of cost. In testing and commissioning (T&C) stage, end-users will actively involve in it (WHO, 1998). They will make sure all medical instruments are functioning as outlined and agreed earlier.

Healthcare providers sometimes needed an equipment or software that catered specific for their needs to provide a better healthcare service. Products, equipment, or software that are developed by clinicians can cater to the need of their professions on the ground level. For example, a study done in four ICU in United States of America on a novel electronic medical record (EMR) dashboard called AWARE (Ambient Warning and Response Evaluation) designed by clinicians showed improved efficiency and ease of clinical data management compared to the standard EMR (Kilickaya et al., 2015).

3.4 Hospital planning challenges from the end-users’ perspective

The roles of hospitals are ever changing, and planning may be able to control these changes. Among the health trends affecting future hospital planning are the demographic shift towards an ageing population and increase in non-communicable diseases, increasing client demands, advancement in medical technology, and the emphasis towards shortened hospital stays (Zulfiqar, 2019). These changing trends lead to several uncertainties for hospital planners such as estimating demands in the future, approximating patients’ length of stay, innovating human resource management, flexible hospital planning, and weighing the need for sub-specialisation against accessibility (Edwards & Harrison, 1999).

Future hospitals are geared towards more patient centred and disease-based services. A more sustainable hospital requires hospital planners to balance between accessibility, feasible construction, functional aspects, supplies, technology (information technology and medical equipment), waste management, cultural perspectives, demographics, models of care, patient-centred approach, and financing (Pantzartzis, Edum-Fotwe, & Price, 2017). Consulting end-users throughout the planning process may enable this balance to be achieved, however, these group of stakeholders often do not have the capacity in decision making which may lead to dissatisfaction with the end-product (Pemsel, Widén & Hansson, 2010). In terms of design for hospitals of the future, they would have an emphasis on the conservation of (electrical) energy, for example by using building materials that could optimise the indoor temperature and humidity, the interior design would also be cleaner, cosier and less institutionalized-looking (Pan American Health Organization, 2017).

Quality from the patients’ perspective include the optimal physical structure of the hospital, quality of services offered by the hospital, and the positive interaction with care providers (Goel, Sharma, Bahaguna, Raj, & Singh, 2014). In addition, the rise of chronic diseases presents a challenge in the delivery of quality services with regards to maintaining cost-effective levels of care (Tsekleves & Cooper, 2017). The paradox of aiming for shortened hospitalisations whilst working towards improving inpatient services exists in hospital planning. Optimally performing hospitals provide individualised settings based on the different patients’ conditions and profiles (Dovjak, Shukuya, & Krainer, 2018) which becomes a major challenge to negotiate as more resources need to be considered.
For the hospital workforce, quality services and ideal work environment are the desired outcome of hospital planning. The hospital in the future will utilise more information technology, the internet-of-things and artificial intelligence to improve the quality of services. These technologies come at a high price and they evolve at such a fast pace that planning (acquisition) process is unable to catch up to the latest iteration demanded by the users (Barlow & Köberle-Gaiser, 2008). Working space and the quality of indoor environment are also features important to the hospital workers. Deficiencies in the work environment may lead to personnel attrition and difficulty in recruitment of new employees (Naccarella et al., 2016). Apart from the work environment, poor resource planning leads to lowered employees’ morale especially when it leads to increasing workload (WHO, 2018).

As described above, the challenges in hospital planning are not limited to the process of planning, designing and constructing a hospital project but encompasses systemic, demographic, political, and social aspects involving all stakeholders.

4.0 Conclusion

Hospital planning is a very complex process and involves multitude of people from different discipline. It must be carefully correlated with the real needs of the community. The process must be organised well to make sure the needs and perspectives of the end-users are considered and translated well into the final product. Thus, the end-user’s involvement either actively or consultatively in every stage along the hospital planning process are very important.

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Declaration

The authors have no conflict of interest to declare.
Authors contribution

Author 1: Main researcher for information gathering, preparation and editing of manuscript
Author 2: Main researcher for information gathering, preparation and editing of manuscript
Author 3: Main researcher for information gathering, preparation and editing of manuscript
Author 4: Concept initiation and final review of manuscript

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