

EFFICIENCY OF INPATIENT LAYOUT IN PRIVATE HOSPITAL (Case Study: Bhakti Asih Hospital, Brebes Central Java)

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Abstract

In the context of hospital building, inpatient care has large portion in comparasion of the other facility areas within hospitals related to efficiency, such as outpatient services, emergency room, diagnostic and especially inpatient function group services. Even though inpatient care group do not have specific requirements for detailed design and building equipment, it requires efficiency considerations related to correlation with room layout. It is expected that by considering the level of efficiency of service to patients, design can fulfill technical requirements of health and medical aspects.

Regarding designs for district-level private hospitals, demand optimization of placement and layout of inpatient care became main topic in this research. This is related to the value of investment in building area development and types of services provided according to inpatient services class. The method used is comparative study of two (2) private hospital design to find the mind factors that most influence of optimization of inpatient layout. The results of study can be used as a guide in architectural design process for designing hospital buildings especially related to design efficiency of inpatient layout so that the building can function sustainability because of optimal service.

Keywords: *Inpatient Care; Room Layout; Design Efficiency; Service Optimization*

Introduction

In the law number 44 years 2009 regarding hospital article 10 paragraph (2) mention, hospital building as referred to in paragraph (1) at least consists of room: b. Inpatient care. In the third part about Sri Hartuti Wahyuningrum, Mustika K. Wardhani

buildings, Article 9 point (b) mention that technical requirements of hospital building, according to function, comfort & ease to service delivery and protection and safety for all patient such as people with disabilities children, and elderly. Hospital layout and room built contributed to technical efficiency and work safety (*Facility Guidelines Institute [FGI], 2010, in Zadeh et al, 2012*).

..The size of the room is one variable that may be associated with the existing theoretical dimensions because it may signal the possibility of perceived control and the possibility of social support. In the literature, there is increasing emphasis on the concept of a right-sized room, one that meets needs for a patient-centered approach yet wastes no space. (<http://www.healthcare designmagazine.Com/article/increasing-patient-satisfaction-decreasingpatient-room-sizebalances efficiency>).

Safe and comfortable inpatient layout are main factors that can affect healing process for patients. Design of inpatient room with accommodating size is expected can be in accordance with requirements that support of healthy inpatient room, safe and comfortable for patients and also medical service units. With the different care class hierarchy, it becomes an opportunity to make efficiency, especially related to room size, layout configuration and supporting facilities related to inpatient care.

..Phychiatric facilities should enhance patients's dignity, self esteem and comfort as well as promoting autonomy and ensuring safety (Hoskins and Marshall, 2002)..

..Confusing layouts can add to patients'anxiety (Landro, 2014) and uncertainty in patient flows challenges strategic decision making in health care (Blumenthal, 2009)..

Appropriate design with an understanding of the facilities that should be available and area that fulfill requirements become dominant variable as basis for inpatient room *lay out* design in context of developing district-level private hospitals.

Constraints on land area limitations because both availability of site area and from investment context will cause need of efficiency in space area. In this condition, study of design efficiency of inpatient layout is needed which technically has relatively dominant portion of the overall hospital area.

This research can be reference for architects/professionals, *stake holder* (hospital owner) or institutions related to health services, especially in understanding the design concept of inpatient layout in hospital buildings that fulfill technical requirements and can accommodate service performance function.

Methods of Research

Method used in this research is descriptive analysis of main factor which has impact of optimization of two comparative design layout of inpatient room in private hospital. Whereas to find dominant factor that give an impact for optimization is to compare the design of existing room layouts by examining observational indicators one by one.

..Research on hospital rooms has focused on the impact of specific features of the physical environment (such as the view, Ulrich, 1984; or the occupancy/typology of the rooms, Shepley, Harris, & White, 2008); or on the effect of overall improvements (e.g., Rice, Ingram, & Mizan, 2008), most of them using correlational or quasi-experimental designs..

Observation variables used in identifying optimization of inpatient room design include: (X1) division of hierarchy class related to the number of bed in room; (X2) Total area of inpatient room related medical service activities (X3) type of medical services; (X4) and room facilities. Schematic of research flow can be seen in **Figure 1**:

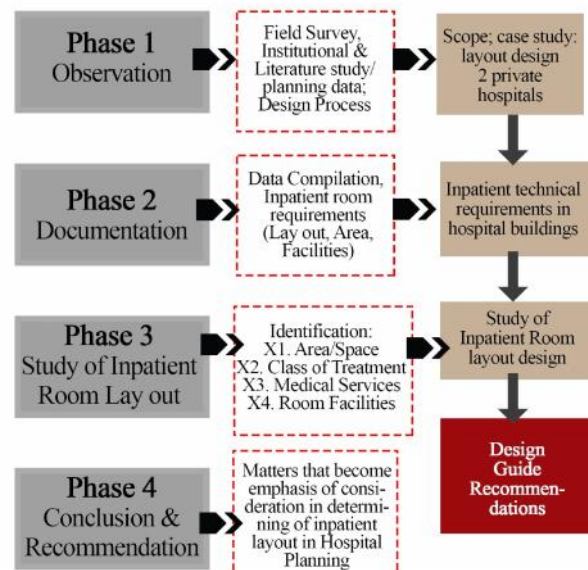


Figure 1. Flowchart of research stage (author, 2019)

Research phase consisted of observations, especially object of case study in this research is private hospital building (2 sample) followed by documentation, study of inpatient layout design according to latest literature and final stage leads to conclusion and recommendation compiled from results of analysis which form the basis of consideration used for inpatient room design .

Study Literature

1. Inpatient Room Design, Consists of (1) *Nursing Unit* which is service area for patients as hospital facilities, includes patient's bedroom, supporting room and staff room.

..Planning for efficient operation involving various plan types where patients were observed from the central nursing station (Kliment 2000)..

The location of nursing station should have proximity to inpatient room it serves, so the control of patients becomes more effective and efficient. So the function of control becomes main point for patients and nurses.

..A study of 6300 randomly selected nurses found that the highest risk of violence to staff was working in a nursing home/long-term care facility, followed by intensive care units, psychiatric units and emergency departments and that the risk of physical assault was highest when working with geriatric patients (Gerberich et al., 2004)..

Placement of inpatient care usually be one separate floor or being part of building wing in hospital area. Inpatient care can be one patient bed module or consist of several patient modules in one room depends on room class. Patient Module Requirements are understood as one health care unit for one or more patients served from one nurse station.

..The size of nursing units are determined according to how many patients can be cared by the certain number of personnel (Aydýn, 2004)..

Inpatient care should be separate from other medical public services, while the nurse station located at the easy point for control over patient, with minimum ratio of 1 nurse station for maximum of 35 patient beds. The area of inpatient care should be able to suffice its breadth for service of nurses and patient movement. Supporting facilities such as toilets easily accessed from inpatient room.

2. Activity Flow in Inpatient Room, The flow of activities in Inpatient building are shown in Figure 2 below:

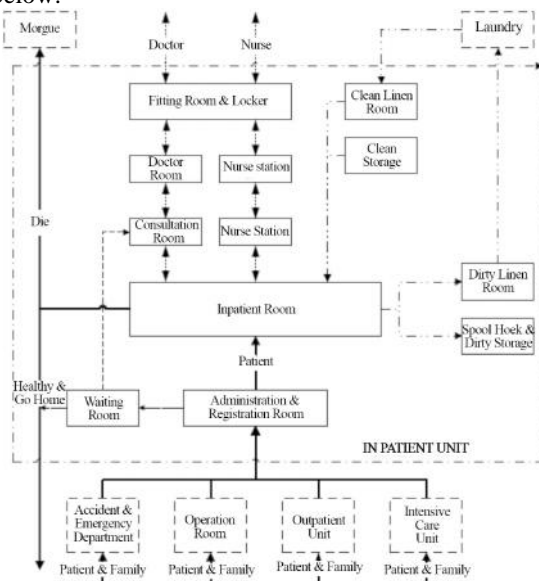


Figure 2. Re-draw Flowchart of Activities in Inpatient care (source: Directorate of Medical Support Services and Health Facilities, Indonesian Ministry of Health, 2012)

There are two activities in Inpatient room as follows below:

- Flow of Doctors, Nurses, and staff
 - (a) Preparation
 - (1) Doctor enters room to change clothes.

- (2) Nurses, enter nurse's room to change clothes.

- (3) Staff, enter the staff room to change clothes

- (b) After completing jobs

- (1) Doctor, nurse, staff go out through same way

- Patient flow

- (a) Patients enters inpatient room

- (1) Patient enters inpatient room from emergency room/central operation theatre (COT)/Outpatient treatment through admission

- (2) Patients get medical record number

- (3) handover & orientation in nurse station

- (4) patients change their clothes

- (5) Patients further treated in inpatient room

- (b) Patient leaves inpatient room

- (1) Patient returns home after being healthy, or
- (2) Dead patient will be deliver to mortuary

3. Technical Requirements for Inpatient Room in Hospital Buildings

- (a) **Location,** inpatient buildings should be located in quiet location based on site analysis, safe and comfortable, but still has easy accessibility or proximity to supporting facilities. Inpatient building located far from landfill area, and away from engine/generator noise.

- (b) **Plan,** (1) Room grouping is based on similar activity groups so each activity doesn't mix and not confusing building users; (2) Room placement, especially as a whole should be space to space connected with priority scale that should be close and related; (3) proximity access to each block/room should be easy reached; (4) moving speed is one of keys to successful design, so the unit block should be designed with the concept of linearly circulated/straight (lengthways); (5) the amount of room needs should be adjusted with the number of patients that will be accommodated; (6) morning sunlight as much as possible enter the room; (7) flow of staff and visitors are separated; (8) the amount of room and room capacity should be able to fulfill minimum requirements as shown in table 1 (see table 1):

Table 1. Minimum space requirements in inpatient care (source: Directorate of Medical Support Services and Health Facilities, Indonesian Ministry of Health, 2012)

Nu mb er	Room Name	Area (+)	Unit
1	Inpatient Room:		
	VIP	18	m ² /bed
	Class I	12	m ² /bed
	Class II	10	m ² /bed
	Class III	7.2	m ² /bed
2	Nurse station	20	m ²
	Consultation room	12	m ²
	Operating room	24	m ²
	Administration room	9	m ²
	Doctor Room	20	m ²
	Nurse Station	20	m ²
	Fitting Room/ Locker	9	m ²
	Head of inpatient care room	12	m ²
	Clean linen room	18	m ²
	Dirty linen room	9	m ²
	<i>Spoelhoek</i> toilet	9	m ²
	Pantry	25	m ²
	Janitor	9	m ²
	Room/Service		
	Clean Storage	18	m ²
	Dirty Storage	18	m ²

- (c) Inpatient room type, consist of (1) inpatient room 1 bed each room (VIP); inpatient room 2 bed each room (class 1); inpatient room 4 bed each room (class 2); inpatient room 6 bed or more each room (class 3).
- (d) Specific patient requirements (isolation room), as: (1) patients suffering from infectious diseases; (2) Patients with treatment that causes stink (tumor disease, gangrene, diabetes); (3) Rowdy & uneasy patient (issued noise in room).

4. Rationale for Case Study Selection

Case studies are determined based on consideration of private hospitals requires efficiency studies in relation to savings operational costs of health services, especially in inpatient care. As private hospital, Bhakti Asih Brebes hospital has been operating in Brebes city (1) and Bhakti Asih Jatibarang hospital is currently still doing construction (2).

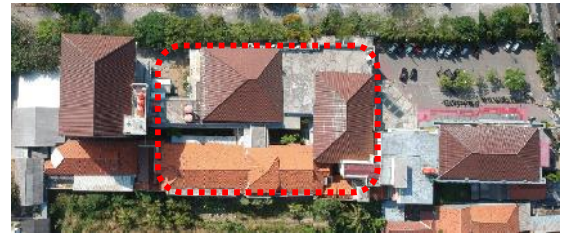


Figure 3. Inpatient building block Bhakti Asih Hospital Brebes

Inpatient care in Bhakti Asih Brebes Hospital as follows (see table 2):

Table 2. Layout plan comparison of inpatient care (2nd & 3rd floor) Bhakti Asih hospital Brebes (author, 2019)

2 nd Floor Plan	3 rd Floor Plan

The building mass in form of letter L, nurse station position is in the middle (at a bend angle), *modular trave* room with variant of 3,5 m & 4 m, central corridor – corridor width 2,5 m (*double loaded*), combination of room classes, vertical access by elevator.

While inpatient building at Bhakti Asih Jatibarang Hospital located in the back of building block, which is 3-storey building with inpatient area in 2nd & 3rd floor connected to other service buildings on each floor.

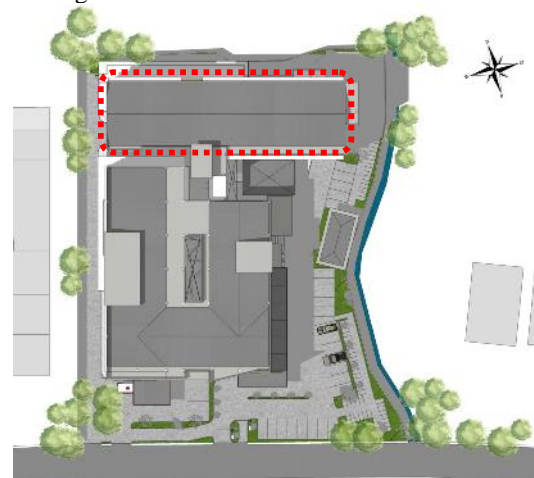




Figure 4. Inpatient Building Block, Bhakti Asih Hospital Jatibarang

The inpatient lay out room as follows (see **table 3**):

Table 3. Comparasion of inpatient layout 2nd & 3rd floor Bhakti Asih hospital Jatibarang (Author, 2019)

2 nd Floor Plan	3 rd Floor Plan
	
<p>The mass form is letter I, the nurse station's position in the middle (near arrival area), <i>modular space trave</i> 4 m, central corridor – corridor width 2,8 m (<i>double loaded</i>), combination of classes, vertical access with elevators.</p>	

Analysis

The analysis in this research using a scientific method which is considered as a set of methods to prove or disprove one or more hypothesis. Hypothesis is an explanation proposed to see the phenomenon that occurs. This phenomenon is generally collected through observation of two observed objects or experiment which in this research is layout design. This was explained according to (Castillo, 2013):

.. The scientific method is better thought of as a set of "methods" or different techniques used to prove or disprove 1 or more hypotheses.

A hypothesis is a proposed explanation for observed phenomena. These phenomena are, in general, empirical—that is, they are gathered by observation and/or experimentation...



Concerned with spatial configuration and technical requirements in supporting special medical services especially regarding procedures for patient services related to lay out and inpatient care services. Inpatient layout indicator will determine efficiency of its services related to:

- (1) Shape and size of building mass of inpatient care
- (2) Placement of *nurse station* as service area to patients in inpatient care (ease of service access, controlling and service proximity) .
- (3) Bed layout in each inpatient room.

1. Analysis of Mass Shape in Inpatient Building

Building mass shape analysis of inpatient care will be explained in **Table 4** below:

Table 4. Analysis of Inpatient Layout in Building Mass From (Author, 2019)

Number	Inpatient Building Mass RS Bhakti Asih Brebes	Inpatient Building Mass RS Bhakti Asih Jatibarang
1	Inpatient Building Mass Block 	Inpatient Building Mass Block 
2	The form of mass = L shape	The form of mass = I shape
3	Total length of building block: 52 m	Total length of building block: 43 m
4	Inpatient room total : 21 unit	Inpatient room total : 13 unit
5	Wider area, so building block's mass capacity become more, however the length of services requires more distance calculated from nurse station point position & also because letter L shape so even though the distance between nurse station positions to each end is relatively same, but there was areas with less control in corridor	Building mass area is smaller, thus also less capacity, nurse station will be easier to serve because less patient, I-shape also have benefit because controlling from nurse station point position in corridor to be optimal

2. Placement of Nurse Station in Inpatient Block



The nurse station point in reaching patients is the main internal circulation in inpatient corridor so the traffic intensity is included in high criteria. According to (Bailey, 1956):

..Internal traffic means the movement of human beings and different materials in hospital. In general, spaces with high traffic in intensity should

be close to each other while ones with low traffic can be far away; however, such factors as urgency, destination convenience may change configurations..

Proximity should be close to one another. The urgency and comfort factor can change layout configuration, as long as it remains in the realm of intense patient quality control. The placement of Nurse Station can be seen in **Table 5** below:



Table 5. Nurse station placement in inpatient care RS Bhakti Asih Jatibarang (author, 2019)

Nu mb er	Nurse Station in Inpatient Care Bhakti Asih Hospital Brebes	Nurse Station in Inpatient Care Bhakti Asih Hospital Jatibarang
1		
2	Position at the angle of building mass	Position in the middle of building's length
3	Controlling over longer corridors, and one side is not well monitored	Controlling over shorter corridors, same length & well monitored
4	More service, number of beds= (37 bed unit)	Less service, number of beds= (34 bed unit)
5	Entrance area, one is not monitored (there was 2 entrance), lift area is easily accessible and monitored	Entrance area easily monitored (1 entrance), lift area is easily monitored because it become one with entrance area

3. Bed Lay Out In Inpatient Room

Lay out bed in each inpatient room for same class, which in this case selected for class I with capacity of 2 beds each for class I. For class II Bhakti Asih Jatibarang hospital is not in same block and for class III with 6 beds in Bhakti Asih Brebes hospital placed in different mass blocks and for VIP class (1 beds) in principle almost same. The analysis of bed layout can be seen in **Table 6** below:

Table 6. Bed layout analysis in Inpatient care (Author, 2019)

Nu mb er	Bed layout analysis in inpatient room (Bhakti Asih Brebes Hospital)	Bed layout analysis in inpatient room (Bhakti Asih Jatibarang Hospital)
1		
2	Inpatient room class I: capacity of each room = 2 beds	Inpatient room class I: capacity of each room = 2 beds
3	Room size : 4x6 m ² toilet include (2x2 m ²)	Room size : 4x6,2 m ² toilet include (2x2 m ²)
4	Toilet zone near corridor (ease of maintenance that does not disturb patient rooms)	Varian toilet zone: (1) near corridor (ease of maintenance that does not disturb patient rooms); (2) near, out of building (less maintenance access and there was interference to patient's room)
5	Bed configuration: in line (standard) and fulfill criteria for ease of access, including proximity to main entrance. Smaller inpatient room (less comfort and privacy), including adequate view out & not blocked by toilet area	Bed configuration: in line (standard) & fulfill criteria of ease of access, including proximity to main entrance. Wider patient room (more patient comfort and privacy), including adequate view out & not blocked by toilet area

Conclusion

Conclusions conducted after the results of analysis in the form of understanding and study which significant with inpatient room. Indicators of room optimization consist of: building mass shape, nurse station placement and inpatient room lay out are each reviewed in terms of discussion context. Conclusions of study can be explained into results (see **Table 7**) as follows :

Table 7. Conclusions and results of research (author, 2019)

Number	Bhakti Asih Hospital Brebes	Bhakti Asih Hospital Jatibarang	Conclusion
1. Study of Mass Forms in Inpatient Room Buildings			
	Building mass= Letter L	Building mass= Letter I	Building mass with letter I is more efficient Because it's easier to reach from <i>nurse station</i> nya placement point & easy for monitoring because of simplicity shape, the number of service units can also be optimized (related to number of beds per service floor)
	Total length of building block mass: 52m	Total length of building block mass: 43m	
	Amount of inpatient room: 21 unit	Amount of inpatient room: 13 unit	
	Wider area, so building block's mass capacity become more, however the length of services requires more distance calculated from <i>nurse station</i> point position & also because <i>letter L</i> shape so even though the distance between nurse station positions to each end is relatively same, but there was areas with less control in corridor	Building mass area is smaller, thus also less capacity, nurse station will be easier to serve because less patient, letter I shape also have benefit because controlling from nurse station point position in corridor to be optimal	
2. Nurse Station Placement Study in Inpatient Room			
	Position: angle of building mass	Position: in middle of building mass	with <i>I</i> -shape, nurse station's placement easier and can be controlled for farthest service
	Controlling over longer corridors, and	Controlling over shorter corridors,	

one side is not well monitored More service, number of beds= (37 bed unit) Entrance area, one is not monitored (there was 2 entrance), lift area is easily accessible and monitored	same length & well monitored Less service, number of beds= (34 bed unit) Entrance area easily monitored (1 <i>entrance</i>), lift area is easily monitored because it become one with entrance area	distance and controlling to all corridors become easier. Thus, service to patients more efficient (effective amount of beds, distance to patient's room is closer so it's more efficient)
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3. Study of Bed Lay Out in Inpatient Room			
	Inpatient room class I: capacity of each room = 2 beds	Inpatient room class I: capacity of each room = 2 beds	For <i>lay out</i> study in Inpatient room class I (capacity of 2 patient beds/room), Bhakti Asih Jatibarang hospital's patients get a larger room area so better for patient's comfort and privacy, for layout in principle there are no significant differences so the service is quite efficient (patient's bed position are fulfil requirement)

3. Study of Bed Lay Out in Inpatient Room		
	Room size: 4x6 m ² +	Room size: 4x6,2 m ² +

toilet include (2x2m ²) Toilet zone near corridor (ease of maintenance & does not disturb patient rooms)	toilet include (2x2m ²) Toilet zone near corridor (ease of maintenance & does not disturb patient rooms) are near outside edge of building (less maintenance access & disturb patient room)	
Bed configuration: in line (standard) and fulfill criteria for ease of access, including proximity to main entrance.	Bed configuration: in line (standard) & fulfill criteria of ease access, including proximity to main entrance.	
Smaller inpatient room (less comfort and privacy), including adequate view out & not blocked by toilet area	Wider patient room (more patient comfort and privacy), including adequate view out & not blocked by toilet area	

Based on analysis of all variables used and analysis, significant influential factor in inpatient layout efficiency is inpatient **Room Facility (X4)** which consists of the building mass shape and service proximity to nurse station, (room where the nurses standby) in context of large portion in service to patients, as follow:

1. Easy access to services to each patient's room
2. Effective proximity from nurse station to each patient room
3. Ease for monitoring to the corridor, so patient feels safe and comfortable
4. For inpatient layout with same area and number of patient beds, even though have different configurations, it's not provide significant

contribution to aspect of service efficiency, but more specific to context of comfort and privacy of patient room.

Recommendation

Research result can be recommended as design guide for lay out of inpatient room. Especially in variable = (X4) Inpatient Room Facilities to obtain optimal layout results in terms of service to patients, hospital layout designs especially layout in inpatient room should be :

1. Considering the character of building mass & form (simpler shape of building mass is more optimal for room layout configuration).
2. Considering the placement of nurse station in building mass related to proximity of services, easy access & monitoring.
3. Considering area and layout of inpatient rooms according to hospital design technical requirement especially in private hospital.

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