Shapes and sizes to safety: labour delivery room design as case study of Malaysian hospitals.

Presented by
Assoc. Prof. Dr. Datin Norwina Mohd Nawawi
International Islamic University Malaysia
Winston Churchill did say that
"We shape our building and the building shape us..."

Kleeman in his book *The challenge of Interior Design* states, “there are those who assert that essentially the design of an interior space and its location not only can communicate with those who enter it but also controls their behaviour”
Outline of Content

Issue of SPACE and SHAPE on Safety
Safety in healthcare environment
How we practice
Case Study and findings
Recommendation
Conclusion
...the issue

- Does the **shape and size** of the space produce affect safety?
We pride ourselves on projects and design done but..

- Did designers ever ask oneself whether the projects and individual spaces derived through various decision making process is effective for the purported function once built?
- Were there any re-visit or assessment or evaluation done on the handiwork as it is used?.

Shapes & Sizes to Safety-31st UIA-PHG Seminar, Tokyo-NMN
Research objectives

- To uncover whether **Shape** and **Size** in designing healthcare spaces effect Safety
- To provide recommendations as design guideline on critical dimension for better and safe design
Issue of SPACE, Shape and Sizes on Safety

Why Space, Shape and Size to safety
What Standards and Guidelines states...
"Form and shape are areas or masses which define objects in space. Form and shape imply space; indeed they cannot exist without space. There are various ways to categorize form and shape. Form and shape can be thought of as either two dimensional or three dimensional. Two dimensional form has width and height. It can also create the illusion of three dimension objects. Three dimensional shape has depth as well as width and height. Form and shape can also be described as either organic or geometric."

Why Space, Shape and Size to safety

...architecture do not consist in the sum of width, length and height of structural elements which enclose space but the void itself, the enclosed or defined space which man lives and moves. No matter how beautiful the façades or walls of buildings are, they are merely containers, the content is the internal space”  (Barry (1993) p24).

Why Space, Shape and Size to safety

“...spaces relate directly to body size, its acuity, range or motion and intentions- i.e. ergonomics, will eventually dictate how we move through space as well as interacts with its geometric forms and sensory stimuli. This movement defines our realm in specific environment or place..” Crisp (1998)


Shapes & Sizes to Safety-31st UIA-PHG Seminar, Tokyo-NMN
Why Space, Shape and Size to safety?

- Micro level
- Human scale, anthropometric
- Ergonomics
- Deals direct with Man (patient, staff, other) and the environment
- Point of use and contact
- Determinant of area for activity and related immediate activities
- Circulation
- Ventilation/Air borne
- Close proximity
- Controlled environment
Chapter 3: Accommodation for patients. Patient room size.

63(1) Where only 1 bed is intended to be placed in a room, there shall be at least 10 square metres of net usable floor space with no wall of the room being less than 3 metres long except for floor to ceiling height.

63(2) Where two or more beds are intended to be placed in a room or ward, the beds shall be arranged to allow spacing of beds at 1.5 metres clear space between beds and shall at least 0.9 metre from any wall.

63(3) Notwithstanding subregulation (2), the spaces between the head of the bed and wall may not be 0.9 metre if adequate space for services at the head of the bed is provided.

63(4) There shall be adequate space for movement of beds in and out of the room or ward.
What Standards and Guidelines states on healthcare spaces

- These findings were drawn from the variability of these standards with regards to situation in which (i) standards was judge as necessary to be established and (ii) being different between societies and cultures for both space standards and environmental standards.

- These differences also applies within the cultures themselves depending upon the social context in which the facility is used such as sizes of tread and risers for stairs for domestic, ceremonial, fire, etc. Rapoport, Watson (1972)


Shapes & Sizes to Safety-31st UIA-PHG Seminar, Tokyo-NMN
Rapoport, Watson (1972) further stated that to some degree these standards have been derived from ergonomic and anthropometric studies carried out by building research organization in each country as well as unconsciously, through cultural processes.

Safety in healthcare environment

The Concept of Safety in Healthcare Built Environment

The concept of standardised space/room in architecture and healthcare
Reiling (2007) pg2 raised question in his book *Safe by Design* whether there is connection between error and facility design. In his discussion on James Reason and Lucian Leape’s model of error, he concluded, that if the conditions causing human error are minimised or eliminated in health care, the result should be less human error, leading to fewer adverse events and preventable medical deaths, improved patients outcomes, and lower costs.
Reiling (2007) pg 2 also discuss Architect Mau in his book Massive Change on importance of design where Mau states that, "for most of us, design is invisible. Until it fails...when system fail, we become temporarily conscious of the extraordinary force and power of design. Every accident provides a brief moment of awareness of real life, what is actually happening, and our dependence on the underlying systems of design"
Reiling (2007), pg3 summarised Reasons’ Cognitive Theory of Errors in man as two types of mental functioning i.e.

- **Schemata** – established knowledge structures based on past experiences that we use to unconsciously perform routine activities in our brain or one is **automatic and unconscious**, e.g. Brushing teeth, dressing and drive to work...it is done rapidly and effortless,

- the other is **deliberate and conscious**, which is slow, sequential and laborious. These activities relate to problem solving, assessments, or observed errors based on unconscious mental functioning.
Built environment that causes or lead to Man’s error is classified as “latent conditions” as it lies dormant within the system for a long time and only becoming evident when they combine with other factors to breach the system’s defense such as poorly designed facilities including their technology, equipment, noise, lack of standardisation, inadequate policies……. and poor safety culture.

Errors made by physicians, nurses and other at point of service is classified as” active failures”.

Shapes & Sizes to Safety-31st UIA-PHG Seminar, Tokyo-NMN
Under the Concept of Quality in Health Care as envisaged by former Director General of Health Malaysia, Tan Sri Datuk (Dr) Abdul Khalid bin Sahan, former Director General of Health Malaysia, Malaysian Medical Association (2002). www.mma.org.my/info/4_quality_86.htm states that

“...Quality in health care is multi-dimensional, multi factorial and cannot to be judged out of context ... Safety is measured as relative risk and severity of an adverse outcome”

The concept of standardised space/room in architecture

Size and proportion are based on study of anthropometrics of man, women, age group, ethnic and others to fit the users

Space/room is based on an activity or related activities that take place sequentially or simultaneously with or without related tools, equipment, furniture, single or more users; and in control or natural environment.
Clinical Space configuration consideration of single space
The concept of standardised space/room in healthcare

Examples of typical spaces where guidelines indicate critical nett space/area required and critical clear width dimension as mandatory provision. Safety in terms of infection control, adequate space circulation and environment are considered.

Shapes & Sizes to Safety-31st UIA-PHG Seminar, Tokyo-NMN
 Healthcare facility structural grid and floor area

**Centre to centre (axis) dimension**
- Structural centred

**Spatial area**
- \( A \times B = AB1 \)

**Gross Area**
- Standard Grid
  - 6.6 x 6.6
  - 7.2 x 7.2
  - 8.1 x 8.1

**Clear dimension (outer skin of the wall)**
- Spatial centred

**Spatial area**
- \( A_1 \times B_1 = AB11 \) (smaller area than \( AB1 \))

**Nett Usable Area**
How we practice

Retrospect the way we practice
Retrospect the way develop the design
Designers led /Traditional procurement
Contractor led/Other procurement
Design Outcomes
Retrospect The Way We practice

How we were trained

Briefing Process
- Debrief & analysis, project brief and work out layout and spaces

Design Synthesis
- Master-plan
- Site Layout
- Preliminary Sketch Building Drawings based on space planning and zoning
- Room Data

Contract Documentation & Tender
- Final overall and detailed drawings, specification
- Bills of quantities

Construction
- Construction drawings
- Specification

Shapes & Sizes to Safety-31st UIA-PHG Seminar, Tokyo-NMN
Retrospect The Way We Develop the Design

- Design objective matrix

Needs and function
Cost, Buildability & Codes
Time & Technology
aesthetic

Design

Shapes & Sizes to Safety-31st UIA-PHG Seminar, Tokyo-NMN
Healthcare spaces, especially CRITICAL SPACES were initiated by FUNCTION first then form. Hence designers have to work back and forth putting the puzzles together to be held by a structure before an overall building form can be realised.
Design Activity Process

An Activity

Activities

Adjacent Space/Room/s

Department/Unit & intra dept circulation

Inter Dept Circulation

Overall Hospital/centre

Area of study
Aspects of safety is incorporated apart from ergonomics, circulation, equipment

Shapes & Sizes to Safety-31st UIA-PHG Seminar, Tokyo-NMN
Matrix in design development - macro

Healthcare Building Design

- Activity Flow and Circulation compliance
- Equipment compliance
- Structural Compliance
- Physical and Psychological Environmental Compliance
- Energy Conservation compliance
- Spatial & Floor Area compliance
- Zoning and Departmental Adjacencies Compliance
- Future Planning Compliance
- Safety and Security Compliance

Shapes & Sizes to Safety-31st UIA-PHG Seminar, Tokyo-NMN
Designers led/ Traditional procurement method

Briefing, sketch design, design development and construction drawing with client and users

Tender, construct

Commissioning and Defects liability period

Designers and users determine scope

Best Bidder/Contractor/builder wins the job

Designers and Contractors review job done with users
Contractor led/ Other procurement method

Briefing
- Client put up project brief and call for bidding from contractors

Bidding
- Contractor bid for project with inhouse/panel consultant (designers)

Evaluation
- Bidders proposal were evaluated technically and financially.

Award
- Based on condition of compliance to project brief and series of discussion with users on needs and technical requirements and financiers on budget bottom line

Budget, Scope and Scale ( & profit margin) remain as the determinant factor

Shapes & Sizes to Safety-31st UIA-PHG Seminar, Tokyo-NMN
Design process in Contractor-led projects

**Cost & time**

- Determine Space and Scope based on cost of overall project

**Design within the constraints of predetermined area**

**Adjustment to needs, review cost, services and structure**

**Determine technology and material based on cost**

**Detailed design based on frozen scope and area**

**Construction**

---

**Note:**
Whatever requirements not noted as mandatory in legislature or project brief or contract will not be entertained. Element of compromise is bound to happen.
Design outcome

- Architects design spaces for proposed facilities based on
  - Schedule of accommodation (SOA) accompanying the project brief, or
  - Drawings of spaces done by others on similar projects, or
  - Space standards illustrated in guidelines, or
  - Through cumulative experiences from past similar projects or
  - Intuitively through routine process
Design Outcomes

› Hence spaces were designed by decisions made based on
  • Overall estimated floor area to cost
  • Structural construct-ability to overall estimated area on defined footprint
  • Definite estimated volume of enclosure to cost and area

Without performing the design process of function before form that could give better estimate on spatial requirements including adequate circulation and support areas as well as adequate consideration to its site context.
Design Outcome

› Various conglomeration of spaces and environment based on various predetermined constraints of cost, area and structure
  • Both comply and compromise spaces
  • Basically comply on minimum nett usable area but not necessarily on space configuration to activity
CASE STUDY AND FINDINGS

Identify scope /area of study
Design Process
Operational Policies
The Brief
Selected Sites and projects from public Hospitals of Malaysia

LABOUR DELIVERY ROOMS (LDR)
Scope of Study

- Ambulance access
- Relative Waiting, reception and public toilet
- Patient Assessment and patient wait
- Changing/toilet
- Observation beds
- Doctors Office
- Sisters Office
- LDRs (high dependency and normal)
- Central Staff Base
- Baby Assessment Area
- Ensuite Toilets to LDRs
- Baby Resuscitation Area
- Sub staff base
- Clean Utility
- Dirty Utility
- Equipment Store
- General Store
- Change area
- Praying Room
- Linen
- Staff Rest
- Staff Change
- Trolley / Wheelchair park
- Seminar Room
- Access to Maternity OT
- Seminar Room
- Staff On Call +toilet
- Staff on call +toilet
- Linen
- Staff Rest
Design Process

- Project inception and debriefing
- Preliminary Design
- Detail Design and Room Data Session
- Construction and Commissioning
- Post construction Evaluation in Use
Operational policy (1990)

6.5.1 Individual room for patients are recommended for privacy. The assembly line concept is to be done away with for future planning.

6.5.2 This room should be at least a minimum of 10 x 13 feet in size.

6.5.3 2 rooms will share one toilet facility.

6.5.4 These should be one room for every 600 deliveries.

6.5.5 The ideal maximum number of deliveries per hospital should be limited to 10,000 per year.

6.5.6 One room is to be reserved for special care of ill patients that requires close monitoring and use of ventilators.

6.5.7 A VIP room is to be allocated within the Labour Unit with individual toilet facilities, separate entrance and waiting room.

6.5.8 Assisted deliveries will be conducted in the same room as well.
Operational Policy (2010)

- **Management at the labour ward is with specialist input (Std: 100%)**
  - **Standard** Procedures and activities in labour room / suite.

- **Intent of 9.2.2**
  - Labour room / suite is a specialize area, taking care of mothers in labour. To ensure optimum patient care and safety to mothers and their babies, appropriate guidelines shall be followed for all procedures and activities.

- 1. During intrapartum period / postnatal period, refer to protocols:
  - d. Vaginal examination: ‘Proses pemeriksaan faraj’

Ref: Operation Policy In Obstetrics and Gynaecology Services. Medical Services Division, Ministry of Health Malaysia, 2010
Operational Policy

2.8

To ensure that patient care in obstetrics and gynaecology ensures the highest order of patient safety, efficiency, justification for actions and meticulous treatment.

Ref: Operation Policy In Obstetrics and Gynaecology Services. Medical Services Division. Ministry of Health Malaysia, 2010
The Project Brief -1

- Labour/delivery room
- X delivery rooms are required.
- The patient will be admitted into the room and go through the process of labour and delivery here. As much as possible, the room should have a non-clinical atmosphere and husband friendly so as to encourage the husband or a relative be with the patient during the entire delivery process.
The necessary clinical items for delivery should be kept on delivery trolley inside the room (one for each room). Two rooms shall be sharing an ensuite toilet. This toilet shall be used only by the patients. It shall have the vanity at the ante-lock and a 3-in-1 toilet/shower. Nurse call system shall be provided in the anteroom and toilet.

Space should allow for at least 2 staff managing the delivery, a bassinet, a cardiotocograph, a maneuvering trolley and one visitor’s chair. As well as resuscitation equipment in case of urgent resuscitation is required. Or else resuscitation is done at the resuscitation bay.
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Min 100sqft for LDR. 180 sq. ft for emergency. Min height 9ft (for obs light)</td>
<td>28 sq.m</td>
<td>Min 3.7m with min clear of at least 17sq.m exclusive of fixed or movable cupboard</td>
<td>Min clear 300sq.ft (27.87sq.m)</td>
</tr>
<tr>
<td>Clear 17ft 6in square (excluding equip/furniture)</td>
<td>Australasia 7x4.4 m (c/c)</td>
<td>For emergency 4.9m with at least 28 sq.m</td>
<td>For caesarian min clear 360sq.ft (33.45sq.m with min 16 ft (4.88) exld built ins etc.</td>
</tr>
<tr>
<td>Toilet/shower/dressing cubicle</td>
<td></td>
<td></td>
<td>Add 40sq.ft (3.72sq.m) for baby resus</td>
</tr>
<tr>
<td>Room door width 3ft 6in-4ft</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Mother in labour
Spouse is called in for support

Birthing process

Baby delivered and place on mother for xxx minute

Mother undergo suturing

Baby is taken from mother tag and send for assessment

while unbilical cord is cut and placenta delivered

Mother rest change and given refreshment

Mother and baby wheel to the ward

LDR undergo cleaning and ready for next patient

LDR
Listing the standard equipments and furniture required in the LDR at various stages

**GENERIC LIST**

Delivery bed and accessories  
Cardiac/overbed table  
Baby crib, baby weigh and scale eater  
Radiant heater  
Monitor (where relevant)  
CTG (when necessary)  
Dressing trolley  
Clinical wash basin  
Medication cabinet (for disposables e.g. gloves, mask)  
Visitor Chair (for spouse)  
Writing table (for staff)  
General Waste bin  
Clinical bin  
Sharps  
other
Identification of USERS of LDR

LDR

- Patient Mother (PM)
- Midwife/Community Nurse (MW)
- Housemen (H)
- O&G specialist
- Student Nurses (SN)
- Medical Office/Doctor (D)
- Staff Nurse (SN)
- Spouse
- baby
Framework & method of study

For each hospital,

- the physical measurement of LDR was conducted on all different designed rooms based on space configuration (L, B, Ht) + door size, window size, grid,
- All equipments and built-ins in LDR were measured. Name of product were noted as well as the equipment/furniture were indicated by definite location on each drawing drawn.
- observation of use (space utilisation factor) were based on cases available in the selected rooms at the time of visit ranging from 4-12 hrs of stay as well as mode of delivery – normal, forcep, vacuum. This include observation of circulation of various people involve in the process and the equipment use. The proceedings are captured by stages in sketches.
- Interviews were conducted at random using guided questionnaire to staff and patient

Safety issues are noted in the process based on observation and those related to standard practices.
Location of Case Studies

Legend

H - Hospital
A-L – Hospital code name

SKETCH MAP OF PENINSULA MALAYSIA
## Background data of case studies

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Type</th>
<th>No of LDR</th>
</tr>
</thead>
<tbody>
<tr>
<td>A, Kedah</td>
<td>Specialist (T)</td>
<td>14</td>
</tr>
<tr>
<td>B, Selangor</td>
<td>Specialist (R)</td>
<td></td>
</tr>
<tr>
<td>C, Selangor</td>
<td>Specialist (R,T)</td>
<td></td>
</tr>
<tr>
<td>D, Selangor</td>
<td>Specialist (R)</td>
<td></td>
</tr>
<tr>
<td>E, Pahang</td>
<td>Specialist</td>
<td>10</td>
</tr>
<tr>
<td>F, Kuala Lumpur</td>
<td>Specialist</td>
<td>20</td>
</tr>
<tr>
<td>G, Selangor</td>
<td>Specialist</td>
<td>18</td>
</tr>
<tr>
<td>J, Melaka</td>
<td>Specialist</td>
<td></td>
</tr>
<tr>
<td>K, Johor</td>
<td>Specialist</td>
<td></td>
</tr>
<tr>
<td>L, Johor</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Shapes & Sizes to Safety - 31st UIA-PHG Seminar, Tokyo-NMN
Labour Delivery Room - Hospital A
Views of typical Labour Room Hosp A

Room without windows (LDR)
LDR A-room  Observation on sequence of use during birthing
Hospital B – Labour Unit
Labour Delivery Room - Hospital B
Views of typical Labour Room Hosp B
Hospital C – Labour Unit
Labour Delivery Room - Hospital C
Observation process
LDR Hospital K

Room 15

Room 10

Shapes & Sizes to Safety-31st UIA-PHG Seminar, Tokyo-NMN
Other LDRS observed
# Shapes and Sizes of LDR

<table>
<thead>
<tr>
<th>Hospital</th>
<th>LDR Shape</th>
<th>LDR Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>A, Kedah</td>
<td><img src="image" alt="Shape" /></td>
<td>18 sq m</td>
</tr>
<tr>
<td>B, Selangor</td>
<td><img src="image" alt="Shape" /></td>
<td></td>
</tr>
<tr>
<td>C, Selangor</td>
<td><img src="image" alt="Shape" /></td>
<td></td>
</tr>
<tr>
<td>D, Selangor</td>
<td><img src="image" alt="Shape" /></td>
<td></td>
</tr>
<tr>
<td>E, Pahang</td>
<td><img src="image" alt="Shape" /></td>
<td></td>
</tr>
</tbody>
</table>

Shapes & Sizes to Safety - 31st UIA-PHG Seminar, Tokyo - NMN
Sizes vary accordingly by hospital

Grid and column location determined size configuration and thence shape of the space

Mirror image of spaces

Location of equipment and fitting generally standard and typical in all rooms, mirror image room will mirror certain equipment but location of fittings are tried very much to be in unison to activity

Location of column and size of column in the space affect positing of fittings and hence affect behaviour circulation

Use of space varies by person

Number of person involve varies if hospital is assigned as teaching when it was not designed to be for teaching and learning (space capacity)

other
Findings

- Architects work backward from determined overall space to detail spaces and thus need to compromise configuration of certain spaces so as to fit in with the determined area.

- Structural grid setting determined based on certain design criteria is taken cover overall and those results in compromising space area and affect its configuration.
Ministry of Health Malaysia

“There are many variations in the design, location, facilities, support services and the presence or absence of subspeciality services in the hospitals managed by the Ministry of Health. There are also variations in human resources managing the obstetric and gynaecological services located in these hospitals in terms of numbers, experience levels, training and capability. There are numerous factors accounting for these variations, many of which are beyond the control of the Ministry of Health. These variable facilities and resources dictate that the same practices cannot be carried out in all hospitals at the current time.”

Ref: Operation Policy In Obstetrics and Gynaecology Services. Medical Services Division. Ministry of Health Malaysia, 2010
Recommendations

- Matrix of checklist on each stages of design as safety filter
- Reorganise traditional design process by integrating safety culture as mandatory part of facility design process
No.7: Use good hospital design principles.
Follow evidence based principles for hospital design to improve patient safety and quality.
Prevent patient falls by providing well-designed patient rooms and bathrooms and creating decentralized nurses' stations that allow easy access to patients.
Reduce infections by offering single bed rooms, improving air filtration systems, and providing multiple convenient locations for hand washing.
Prevent medication errors by offering pharmacists well-lit, quiet, private spaces so they can fill prescriptions without distractions.

Conclusion

- Healthcare facilities as part of the built environment and very much part of healthcare services are expected to provide CARE and not to HARM those laid in their lair. Although to “Err is Human…” at all cost it should be avoided.

- Latent failures only unearth when reacted with other failures or errors.. and thus we need to keep abreast with POE studies to be relevant in making spaces in the healthcare built environment SAFE.
Conclusion

Thank You

Arigato Kuzaimas

Shapes & Sizes to Safety-31st UIA-PHG Seminar, Tokyo-NMN
references

- Health Care Facilities at http://www.wbdg.org/design/health_care.php
references