Presented at the DLSU Research Congress 2016
De La Salle University, Manila, Philippines
March 7-9, 2016

An Ergonomic Assessment of a Philippine Hospital Patient Room

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Abstract: The study provides an ergonomic analysis and evaluation of a hospital patient room. Ergonomic standards are not only relevant to manufacturing applications but also to health care application. It is important to incorporate ergonomics in health care for patient room design to ensure patient safety and comfort as well as the nurse welfare. The methodology used in the evaluation includes layout analysis, anthropometry, postural and workstation analysis, and measurement of the physical environment. It also includes patient satisfaction survey to assess the current and proposed improvements. The main objective of the study is to propose a patient room design for a hospital with regard to standard ergonomic requirements on space, safety, comfort and satisfaction. The evaluation results showed that there are non-compliance to ergonomic standards in terms of space and physical environment, thus compromising the comfort, satisfaction, and safety of patients and nurses alike. The limitations of the study include: space constraints, furniture and equipment, plumbing works (bathroom fixtures) and electrical works imposed by the institution's engineering department.

Key Words: patient room; ergonomic evaluation; posture analysis; safety

1. INTRODUCTION

With healthcare spending in the Philippines continuously rising and currently at the fastest rate in history approximately 13.2% higher in 2011 than in 2010, it is important to ensure that people get the value for their money (Albert, 2013). One technique is by having well-designed patient rooms. Studies show that well-designed patient rooms diminishes the chance of infection, helps healthcare workers do their jobs efficiently, offers adequate spaces for members of the family to take part in the healing process of the patient (Reiling & Murphy, 2008), and helps ensure patient safety (Gurses & Pronovost, 2011). Rooms that promote a healing design and environment will result in higher patient satisfaction (Quan et al., 2012) and added assurance that patients will be safe during the duration of their hospital stay (Mazer, 2010).

According to Harris and Detke (2013), research evidence and statistics in hospital admission insinuates that patients in the hospital are at greater risk of falling, slipping, and tripping compared to the people in the community due to the unfamiliar environment. Common occurrences of falls occur in the following areas: in bathroom, from bed, from chair/wheelchair, from trolley/table, whilst walking/standing, and from toilet/commode. Hence, the physical environment must be ergonomically designed to prevent such patient accidents

The physical environment also plays an important role in the health and safety of staff. Ironically, healthcare workers are at higher risk of having occupational musculoskeletal disorder (MSD) compared to other professions. In the Philippines, 40% of Filipinos in the nursing profession experience at least one injury or illness, and 80% experienced back pain or low back disorders. Most causes of such injuries are thought to be due to physically

ISSN 2449-3309

demanding manual handling tasks done by these nurses such as lifting, transferring, and repositioning of patients, and the incidence with which the nurses are required to move them. These work-related injuries then resulted to compensation claims of nurses, which impacts the institution (de Castro et al., 2009). The design and functionality of patient rooms directly affects patients, families, hospital staff, and administration altogether (Cullinan and Wolf, 2010).

As stated by Cullinan and Wolf (2010), "from optimizing patient well-being and comfort, to saving administration money through strategic use of materials and space allocation during construction, the decisions made regarding the patient room are pertinent to every person in the healthcare environment." The impact of the physical environment in the design of healthcare facilities must always incorporate both patient and medical staff (Gurses & Pronovost, 2011).

The hospital under study has a plan to renovate the patient rooms and the hospital administration wants to incorporate ergonomic in the design of the new patient rooms. Thus, the main objective of the study is to propose a patient room design with regard to standard ergonomic requirements on space, safety, comfort and satisfaction. The limitations of the study are dependent on the hospital engineering department's renovation plan that includes space constraints, furniture and equipment, plumbing works (bathroom fixtures), electrical works.

2. METHODOLOGY

The study employed ergonomic measurement of the environment specifically illumination, temperature, noise, layout and space.

2.1 Illumination Measurement

First, the respective rooms and bathrooms are divided into grids. The number of grids is computed using the following formula (Webb, 2009).:

$$Room\ Index\ (k) = \frac{a \times b}{h(a+b)}$$

Where:
a and b = Dimensions of the area
h = Vertical distance between the horizontal reference plane and

For the illumination of the rooms and bathrooms, the photometer is positioned at a constant height from ceiling to surface for each location.

2.2 Noise Measurement

Measurements of the noise levels in each of the patient rooms are measured using a Sound Level Meter (SLM) set at lvl 50-100. Readings (in dBA) during three different times of the day: morning, afternoon and night. The SLM is positioned at a single, stationary location, specifically the patient bed, for the entire duration of the measuring process. Three readings are taken for each of the conditions and their averages are taken as the final measurement.

2.3 Temperature Measurements

Temperature measurements are done with the use of Hygrotherm set to measure surrounding temperature in degrees Celsius (°C). The Hygrotherm is positioned at a single, stationary location, specifically the patient bed, throughout the measuring process. Temperature readings are then taken during three different times of the day: morning, afternoon, and night; with two different conditions: with the air-conditioning turned off and with the air-conditioning turned on.

2.4 Postural Measurement

Ovako Working Posture Analysis System (OWAS) is commonly used to evaluate postures for trunk arms, lower body and neck in a standing position. The nurses are usually in awkward standing position thus, OWAS was used to evaluate the postural problems of the nurses while treating the patients.

2.5 Patient Satisfaction Survey

The patient survey was formulated to assess current and proposed satisfaction with regard to the following aspects of the patient rooms and bathrooms: space and layout, physical environment, facilities, and overall satisfaction. Patient questionnaires are provided in English and Filipino. Pilot tests were conducted before the survey was given to 13 patients and 24 nurses.

3. RESULTS AND DISCUSSION

3.1 Illumination

The general illumination for patient rooms is at 300 lux. For examinations and treatments by the bedside, 1000 lux is needed for complex ones and 300 for

ISSN 2449-3309

simple ones. Patient care at night merely requires 5 lux (Kunz, 2004). Furthermore, the standard illumination for bathrooms for patients is just 200 lux (Kunz, 2004). The illumination results are shown in Table 1 for the patient room and Table 2 for patient room's bathroom illumination.

Table 1 Average Illumination Results

	Morning	Afternoon
Minimum to maximum values	46.53-167.56	38.40-162.67

The results showed that for the whole day, illumination is below the standard illumination level of 300. Considering the different time of the day with blinds up and light on, the illumination is below the standard which can pose difficulty in doing examinations / treatments with the patient. For the bathroom, it is below the standard of 200 lux which can pose some difficulty with patients doing normal bathroom activities, especially if there are some medication required done in the bathroom.

Table 2: Patient Room's Average Bathroom Illumination Result (in lux)

	Morning	afternoon	Evening
Minimum to Maximum Values	69.0-143.67	55.50-150.83	19.33-76.11

3.2 Noise

The noise levels in the room ranges from 58-68 dBA. The noise levels for hospital patient rooms are well above the recommended 30-35dBA (Harris & Detke, 2013). The sources of uncontrollable noise are traffic noise outside the hospital, cars in the parking lot, nurse station activity related noise and from the air-conditioning unit.

3.3 Temperature

The temperature readings taken in the room generally do not exceed the recommended thermal condition of 20 to 26 degrees Celsius (Bolden-Barrett, 2008). Sometimes the patient feels cold because of the air-conditioning unit position that is directly facing the patient bed.

3.4 Layout and Space

The patient rooms and bathrooms were assessed based on space requirements, ease of transit, doors, doorways, doorknobs, and placement of furniture and fixtures using concept in methods engineering taking into consideration patient safety and comfort (Joseph et. al., 2012 and Gurses & Pronovost 2011). The table below summarizes the findings.

Table 3 Layout and Space Analysis

Room space Barely has any space for additional equipment (i.e. baby cart, wheelchair, oxygen tanks, etc.) and guests. There is a clear violation of the universal guidelines for wheelchairs, which is a clear floor space of 30" x 48" and a 36" width for a 180-degree turn (Openshaw and Taylor, 2006). Special bed for patient transfer does not fit in the room. During emergencies, nurses and doctors have to take turns in going inside the room. Equipment is stationed along the corridor.
Bathroom Transit The three steps to traverse are not uniform with the 2nd and 3rd steps being irregular. All the steps deviate from the standard since the minimum width is 11 inches and the heights (Openshaw & Taylor, 2006).
Doors, Doorways and Doorknobs Both doorways pass the universal guidelines for wheelchairs, which is a doorway clearance of 36 inches. The main door has a tendency to hit the chair, IV stand, cabinet door (and the person opening the cabinet), and overbed table. The doorknobs in all the doors (main door, bathroom door, and balcony door- for deluxe only) are the standard doorknobs.
Placement of Furniture and Fixtures The air-conditioning unit is directly above the bench. There is no minimum clearance space of at least 36 inches from any wall or fixed obstruction for the foot and sides of the bed. For the nurses to be able to adjust the bed, they have to tilt the bed to separate it from the drawer or pillar. Nurses are forced into awkward postures.
Bathroom The bathroom door can hit the baby cart, wheelchair, and chair when opened. People who exceed 65 inches will end up overextending their arms as well due to the irregular elevation. There is no handrail that can aid patients in getting up from the toilet.

3.5 Postural Analysis

ISSN 2449-3309

OWAS results are shown in Table 4 (Karwowski & Marras, 1999).

Table 4 OWAS Analysis with Category 3

Actual Posture While Performing Duty	OWAS Code				Action Category
	Back	Arm	Leg	Load	
Duty: Monitoring of Vital Signs					
Checking of Temperature	*2*	*3*	*3*	*1*	*3*
Duty: Artery-Blood Test					
Rubbing of Alcohol	*2*	*1*	*5*	*1*	*3*
First Injection	*2*	*1*	*5*	*1*	*3*
Placing of Mark on the Injected Part	*2*	*1*	*5*	*1*	*3*
Looking for Vein	*2*	*1*	*5*	*1*	*3*
Second Injection	*2*	*1*	*5*	*1*	*3*

Based on these postural score, action category 3 poses immediate action be done as the nurse is prone to musculoskeletal disorders while attending to the needs of the patient. These awkward postures are due to the limited space and the placement of furniture and fixtures.

3.6 Proposed Recommendations

The proposed recommendations incorporate the standards used for occupational ergonomics in a health care environment (Salvendy, 1997, Joseph & Ulrich, 2007, Karwowski & Marras 2006, DOLE 2013), as presented in Table 5 below.

Table 5 Ergonomic Recommendations for the Patient Rooms

Wall color : Green or blue are suggested.
Illumination: Illumination should generally be 300 lux. Illumination for bedside examination and treatment depends on the complexity: 300 lux for simple tasks and 1000 lux for complex tasks. Illumination for the toilet and bath facility: 200 lux. Illumination for patient care at night: 5 lux
Temperature: Maintenance of room temperature within the range of 20 to 26 degrees Celsius should be maintained.
Noise: Sound-absorbing ceiling tiles can be installed (Joseph & Ulrich, 2007).
Bathroom Transit: Steps or any unnecessary elevations should be avoided for they are hazards to safety.
Doors, Doorways and Doorknobs The doorknobs in all the doors (main door, bathroom door, and balcony door – for deluxe only) will be the L-shaped handles. The main door should go towards the wall and will not hit any object in the room. The bathroom door does not hit any object in the room.

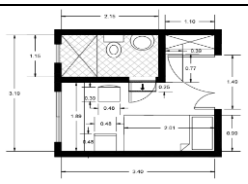
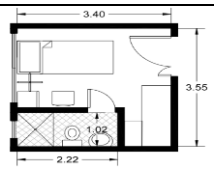
The need for safe, efficient, and effective care that still meets productivity standards is also important to consider in patient room design (Caixeta & Fabricio, 2013 and Novicoff, 2013). Adequate access space are needed for appropriate for proper bending and lifting, thus, improving the poor posture in OWAS from Category 3 to 2 (Hedge, 2005). By considering the nurses' posture can lead to higher staff morale and productivity. Ergonomic interventions in patient rooms ensure that patients receive better care, allow them to sleep better, reduce their hospital stay, and increase comfort and satisfaction (Boardman & Forbes, 2007). The physical design of healthcare facilities and environments is vital in ensuring and securing patient safety (Gurses & Pronovost, 2011). The proposed recommendation is tabulated in Table 6 below considering Filipino anthropometric data (Del Prado-Lu, 2007). The proposed layout is shown in Table 7.

Table 6 Proposed Recommendations on Space

Room Space: Area is 12.07 m^2, which exceeds the minimum Department of Health (DOH) standard of 7.43 m^2. Special bed for patient transfer fits in the room. During emergencies, all the nurses, doctors, and equipment fit inside the room. Bed adjustment does not require tilting of the bed. There is a minimum

clearance space of at least 36 inches from any wall or fixed obstruction for the sides of the bed and the foot of the bed.
Bathroom: The bathroom area is 2.26 m², which exceeds the minimum DOH standard of 1.67 m². The toilet is 15 inches away from the wall. There are no obstructions to the path. The shower area will have slightly sloping flooring so that all the water will be directed to the drain. Provide a handrail can also aid the patient when taking a shower.
Bathroom Transit. There are no steps/slight incline to traverse.

Table 7: Current and Proposed Patient Room Layout

	
Current Layout	Proposed Layout

3.7 Patient Satisfaction Survey

The patient survey contains a 7 rating scale with 7 as highly satisfied and 1 as the least satisfied. The survey was conducted for the current and proposed room layout through a mockup. The patient satisfaction had an average improvement of 35.71% for the overall room and bathroom. The contributing factor was the space and layout improvement considering patient safety and comfort.

Table 10: Patient Satisfaction Survey Results

	Before	After	Percentage Improvement
Room	5.00	6.40	28.00%
Bathroom	4.40	6.31	43.41%

4. CONCLUSIONS

The studied showed that the current patient room design was non-compliant to ergonomic standards and poor posture for the nurses. With the proposed recommendations, ergonomic problems with respect to space were resolved and posture of the nurses was also improved. Better patient environment conditions were established for patient safety, comfort and satisfaction.

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5. ACKNOWLEDGMENTS

We would like to thank the President, Mr. Raul Pagdanganan, and the administration of the hospital for letting us conduct an ergonomic study on their patient rooms. Thank you to Engr. Dan Cuevas and his staff, Ms. Ofelia Hernando and all the nurses who participated. Thank you to Engr. Jimmy Bartolo and Spes Construction Inc. for the mock-up construction.

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