P-ISSN: 2709-6254	Journal of Development and Social Sciences	Jul-Sep 2022, Vol. 3, No. 3
O-ISSN:2709-6262	http://dx.doi.org/10.47205/jdss.2022(3-III)59	[619-625]

Journal of Development and Social Sciences
www.jdss.org.pk

RESEARCH PAPER

Comparative Analysis of Inpatient Ward Typologies for Space Program and Nurses' Walking Distance

[1]Muhammad Shakil [2]Usman Ali [3]Ubaid Ullah*

1. Master Student, Department of Architecture, University of Engineering & Technology Peshawar, Abbottabad Campus, KP, Pakistan
2. Master Student, Department of Architecture, University of Engineering & Technology Peshawar, Abbottabad Campus, KP, Pakistan
3. Lecturer, Department of Architecture, University of Engineering & Technology Peshawar, Abbottabad Campus, KP, Pakistan

***Corresponding Author:** drubaidullah@uetpeshawar.edu.pk

ABSTRACT

This study examines nurses' walking distance, and space programming for six plan typologies of the inpatient ward. As the design and spatial configuration play a vital role in the safety and well-being of patients and healthcare providers. This study adopted a case study and mixed method of research and designed inpatient wards in six different typologies. The measures of nurses' walking distance and space programming were calculated using AutoCAD and MS Excel software. The result shows that the compact square ward type on average offers minimum nurse's walking distance, maximum patient area, minimum gross area as well as minimum circulation area. Research suggests that nurses' responsibilities and roles are vital to meet the growing demand for high-quality patient care. There had been numerous studies that quantify the impact of nurse walking distance on patient outcomes, nurse performance, and overall efficiency.

KEYWORDS Inpatient Ward Typology, Nurses' Walking Distance, Space Programming, Spatial Arrangements, Ward Typologies

Introduction

The inpatient ward of a hospital is where patients get treatment from medical staff for a certain amount of time to be treated. A hospital ward's initial layout, known as the "Nightingale ward," consisted of a long space with several beds for patients on each side. Although this design makes it simple for nurses to monitor patients, it tends to rob patients of their privacy and raises the possibility of patient cross-infection (Hughes, 2000). To maintain privacy and lower infection and other dangers, hospital ward design currently provides more separate patient rooms and shifts towards having fewer beds per room for patients (Ulrich et al., 2008). However, Separate patient rooms in the ward may also need extra work from medical staff to undertake visual surveillance of the patients they are responsible for. In the design of an inpatient ward, many factors are taken into account such as the nurse's walking distance, patient area per bed, patients' experience of care, and circulation area that could ultimately have an impact on the process of healing and cure of patients. Research guides the design choices for how the facilities are laid up spatially, including the best ward layout. The results from many studies suggest that some layouts are preferable to others. For instance, the radial typology of the inpatient ward is considered best in terms of nurses' walking distance and high patient visibility (Pachilova & Sailer, 2020). On the other hand, there are factors, which were overlooked and not taken into consideration for the design of inpatient wards. This Research paper examines and evaluates the comparative analysis of space programming and nurses' walking distance, through the hypothetical design of different ward typologies and suggests a suitable unit design for the inpatient ward.

Literature Review

Research suggests that nurses' responsibilities and roles are vital to meeting the growing demand for high-quality patient care. For the nurses' well-being as well as to ensure time for patient care, the inpatient ward design must be improved to cut down on walking distance and increase patient visibility. Physical arrangements that allow for easy access between patients and nurses continue to be crucial factors in hospital design for staff efficiency and high-quality patient care. The key component of the quality of healthcare services is the experience and satisfaction of the patient. In a study based on observation, nurses spent 34.5% of the time in a 12-hour shift, traveling between the nurse station and patient rooms (Acar and Butt, 2016). A nurse walks 2.4–3.4 miles during a daytime shift which might reach 6 miles (Hendrich *et al*., 2008; Shepley and Davies, 2003). Furthermore, because of issues with hospital layouts, it was discovered that nurses in hospitals spent more time walking than providing care (Ulrich *et al*., 2004). According to one research, walking took up 28.9% of nurses' free time, and travel time for nurses is directly proportional to the amount of time spent on patients care (Burgio *et al*., 1990), since it has an impact on the standard of patient care and outcomes, inpatient ward design is a crucial component of healthcare facility planning. Reduced falls, infections, and duration of hospital stay have been linked to shorter nurse walking distances and improved patient visibility (Hignett, 2018; Hua *et al.,* 2019). According to the literature, nurses spend less time on the bedsides of patients when they spend more time walking (Hendrich et al., 2008; Shepley and Davies, 2003; Ulrich et al., 2004). Therefore, it is essential to assess the layout of inpatient wards in order to spot potential improvements that could improve patient care and safety. Another significant factor that affects nurse workflow, communication, and patient safety is nurses' station design. According to studies the placement and design of nurses' stations can influence the amount of time nurses spend at the station, their capacity to monitor patients, and their response to alarms (Ozkaynak, Budak & Karabayir, 2019; Zborowsky, Berta & Kortes-Miller, 2020; Tzeng, Yin & Yang, 2021). The possibility to observe Patients from the nurses' station has been a crucial design factor for the effectiveness of patient care. The major components of an inpatient ward are the patient rooms, the nurses' station, and a few service spaces (such as a supply room, equipment room, doctor room, kitchen, nurse room, etc. In order for the nurses to work and monitor the patients, including monitoring them in the nighttime without disturbing their sleep, it is crucial that the ward's design enables them to be in "visual proximity with patients" (Reiling, Hughes & Murphy, 2008). The nurses' responsibility while working in a hospital ward includes regularly checking on patients' conditions. According to research, more patient visibility and observation results in higher performance. The increased visibility reduces nurse walking (Hendrich et al., 2008), and turns out to have more time in patient care. For this purpose to optimize proximity between direct patient care areas and support locations and to enable efficient use of nurses' time, physical facilities (inpatient care units) and operational procedures are always designed on consideration bases. The size of the unit footprint, or the area occupied by a physical unit, is an important factor that affects both optimum process design and physical design. Inpatient care unit footprints have significantly increased during the last few decades. According to a calculation, the departmental gross square feet of adult acute care units have increased by 118% over the previous 20 years (Latimer, Gutknecht, & Hardesty, 2008). Departmental Gross square feet are the total of all the spaces inside the centerline of the walls separating a department from adjoining areas, including internal walls and corridors. However, neither staffing nor unit size (number of beds) have changed along with the increase in floor area. Larger units (number of beds) have continued to be encouraged for maximizing departmental performance due to operational considerations (staffing efficiency).

Material and Methods

This study adopted a case study and mixed method of research and designed inpatient wards in six different typologies. Each ward type was afterward used to analyze

the nurse's walking distance, patient area, circulation area, staff area, gross area, net area, and grossing factor using AutoCAD and MS Excel software. The results were then tabulated and compared.

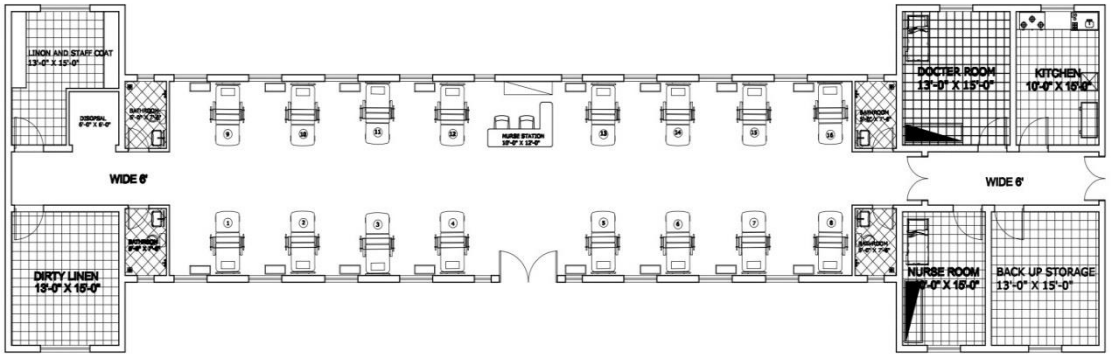

Figure 1: Case-I (1900: double-loaded)

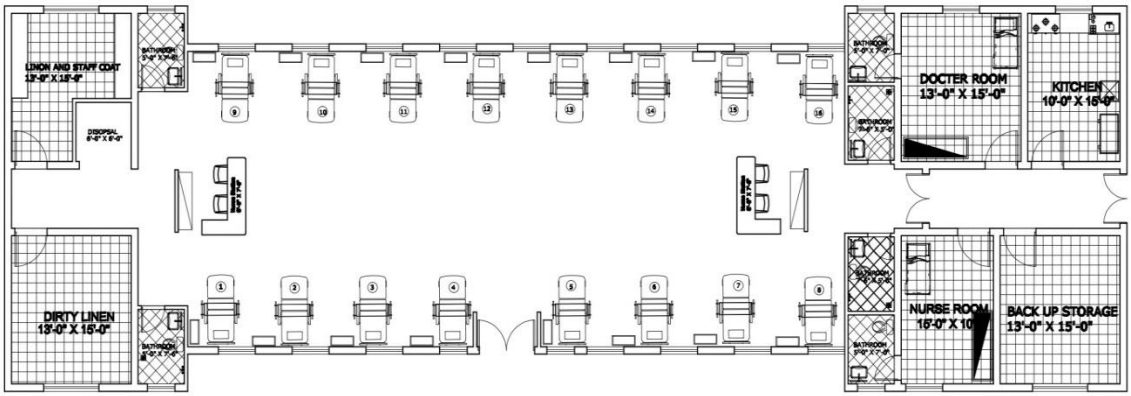

Figure 2: Case-II (1940s: race track)

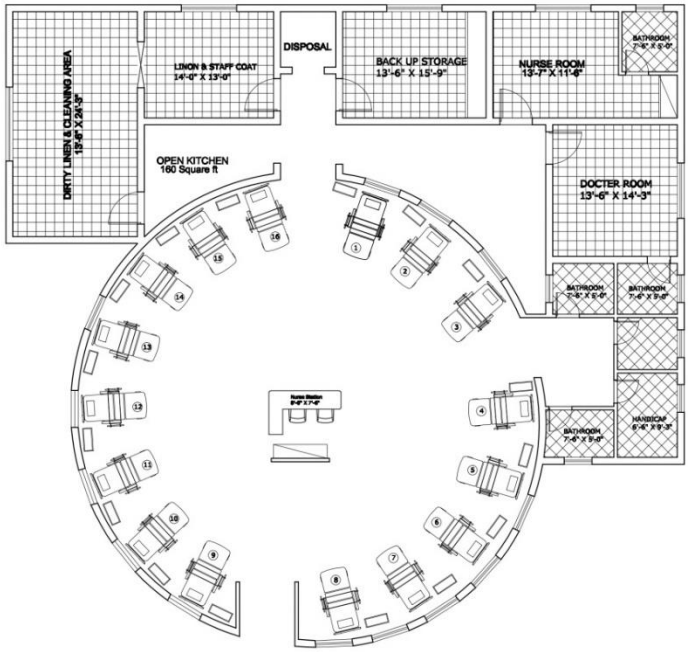

Figure 3: Case-III (1950s: compact circle)

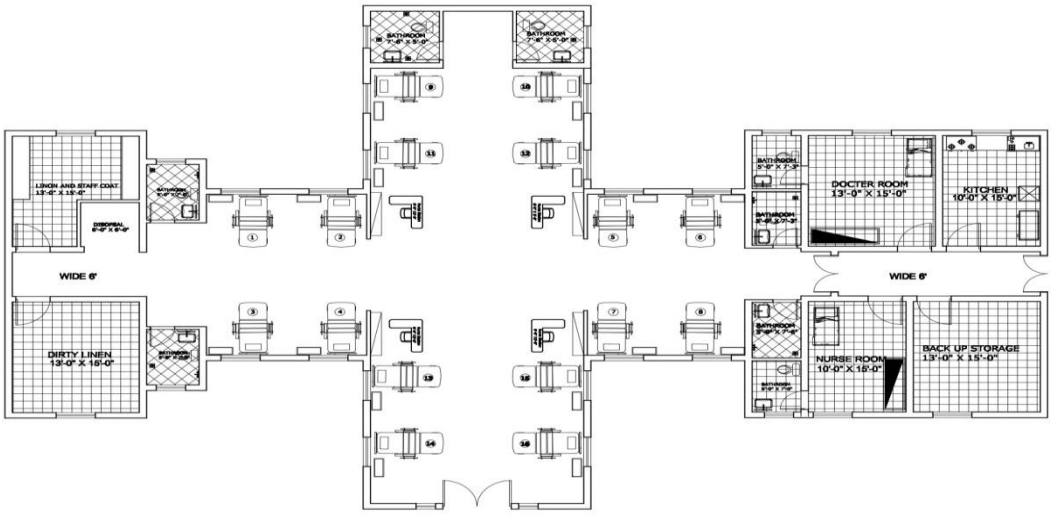

Figure 4**:** Case-IV (1930s to 1950s: cross shape)

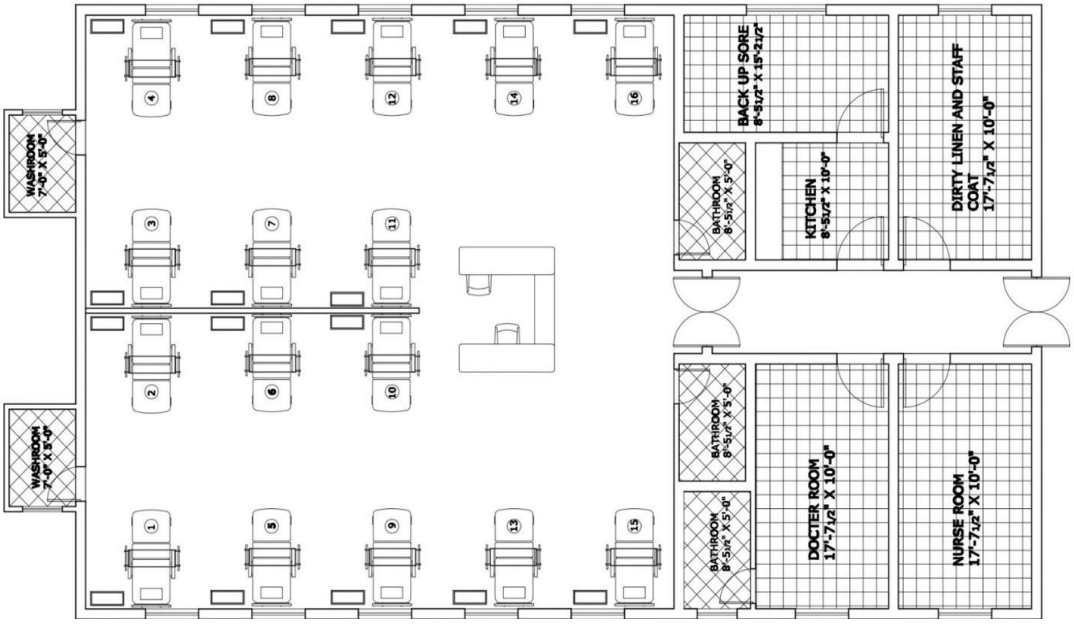

Figure 5**:** Case-V (1950s: compact square)

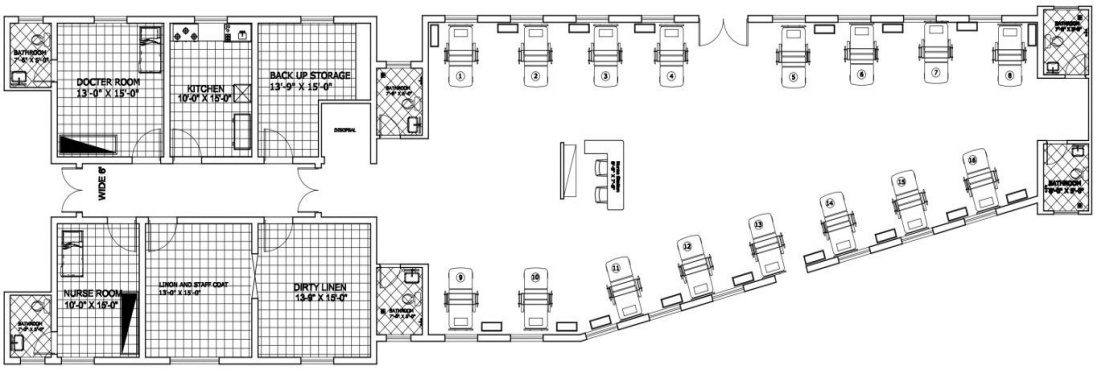

Figure 6**:** Case-VI (1970s: compact triangle)

Table 1
Patient area, circulation area, staff area and services area

S.NO	Ward Typology	Patient Area	Circulation Area	Staff Area	Services Area
1	1900s : Double-Loaded	31.0%	26.5%	11.0%	23.5%
2	1940s : Race Track	23.0%	34.5%	12.0%	23.0%
3	1950s : Compact Circle	26.0%	35.0%	11.0%	26.0%
4	1930s to 1950s: Cross Shape	22.0%	28.0%	13.5%	23.0%
5	1950s: Compact Square	31.0%	24.0%	13.0%	18.0%
6	1970s : Compact Triangle	24.0%	33.0%	10.0%	23.0%

Results and Discussion

The results of this study show that the maximum area for the patient is 31% in 1900s: Double Loaded and Compact Square, while 22% is the minimum in Cross shape. For patient facilitation and ease 1900s: Double Loaded and Compact Square were found more appropriate. While in the case of circulation area, it is found maximum in 1950s: Compact Circle, which is 35% and the minimum is 24% in 1950s: Compact Square. In terms of Staff area, it was observed that the maximum area utilized in 1930s to 1950s: Cross Shape, which is 35%, and the minimum is 24% in 1970s: Compact Triangle. The most efficient space usage in staff area is 1900s: Double Loaded, 23.5 % while the least utilization of space for services in 1950s: Compact Square, which is 18% of the total area as shown in table 2 below.

Table 2
Gross area, net area, departmental gross square feet, and grossing factor

S.NO	Ward Typologies	Gross Area Sqft	Net Area Sqft	D.G.S.F (Departmental Gross square feet) sqft/bed	Grossing Factor
1	1900s : Double Loaded	3725	3405	233	1.09
2	1940s : Race Track	4209	3824	263	1.10
3	1950s : Compact Circle	4116	3723	257	1.10
4	1930s to 1950s: Cross Shape	4302	3904	269	1.10
5	1950s: Compact Square	3298	2975	206	1.11
6	1970s : Compact Triangle	4281	3862	268	1.11

Analysis of ward typologies for the net area, gross area departmental gross square feet, and grossing factors are shown in table 2. It was observed that the minimum gross area for the same number of patient beds could be achieved in the 1950s: Compact Square (3298 Square feet), less among typologies due to its shape and configuration; Beds were arranged in four rows. 1950s: Cross Shape has maximum gross area because of the staff area and services which serves a greater area than other units. As discussed in the above analysis due to the spatial arrangement of 1950s: Compact Square, Departmental Gross Square feet (D.G.S.F) is 206 square feet per bed. Grossing Factor was found minimum in the case of 1900s: Double Loaded which is 1.09, and was observed maximum of 1.11 for 1950s compact square and 1970s compact triangle typologies.

Table No??
Nurse's walking distance from nurses' station to patient bed

Bed No.	1900s Double Loaded	1940s Race Track	1950s Compact Circle	1930s to 1950s Cross Shape	1950s Compact Square	1970s Compact Triangle
1	40'-3''	13'-9''	22'-9''	24'-4''	25'-7''	24'-2''
2	31'-3''	15'-6''	22'-5''	19'-3''	33'-0''	18'-5''
3	23'-0''	21'-3''	22'-6''	25'-6''	31'-4''	16'-3''
4	15'-6''	29'-4''	22'-9''	24'-2''	32'-6''	18'-0''
5	10'-6''	24'-9''	22'-10''	22'-10''	23'-6''	27'-11''

6	15’-6’’	18’-6’’	22’-11’’	27’-4’’	24’-6’’	36’-0’’
7	23’-0’’	14’-7’’	23’-0’’	18’-9’’	23’-3’’	44’-10’’
8	31’-3’’	16’-1’’	24’-4’’	23’-9’’	23’-3’’	53’-8’’
9	40’-3’’	13’-3’’	24’-4’’	23’-9’’	17’-9’’	23’-7’’
10	37’-0’’	16’-8’’	23’-4’’	23’-6’’	9’-4’’	17’-9’’
11	30’-9’’	23’-3’’	23’-5’’	8’-2’’	9’-2’’	14’-5’’
12	22’-0’’	32’-10’’	23’-6’’	18’-0’’	17’-5’’	16’-3’’
13	11’-5’’	24’-0’’	23’-6’’	20’-0’’	15’-6’’	23’-9’’
14	11’-5’’	16’-9’’	23’-5’’	21’-2’’	15’-2’’	31’-9’’
15	22’-0’’	12’-8’’	23’-4’’	2’-6’’	18’-3’’	39’-4’’
16	30’-9’’	14’-0’’	23’-4’’	25’-0’’	17’-11’’	48’-2’’
Average	24’-9’’	19’-3’’	18’-9’’	20’-6’’	18’-10’’	28’-5’’

This study calculated nurse's walking distance by drawing lines to each bed from the nurses' station from bed number 1 to bed number 16 as shown in table 3. Double Loaded had nurses' walking distance of 396 feet while Race Track had a total of 305 feet, Compact Circle had 278 feet, Cross Shape has 328 feet, Compact Square 337 feet and 6 inches, Compact triangle has a total of 455 feet nurse's walking distance. To examine the most efficient ward on the basis of nurse's walking distance among six typologies of wards, Compact circle was found the most efficient based on nurses' walking distance of 278 feet, while compact triangle was found the least effective in terms of 455 feet of nurse's walking distance. In terms of average distance per unit, the 1950s compact circle was found with the least average walking distance of 18 feet and 9 inches of distance per bed. The maximum average nurse walking distance was observed in the case of the 1970s compact triangle with an average distance of 28 feet and 5 inches per bed.

Conclusion

The design and spatial configuration of the inpatient ward had undergone prominent changes over the last years, for the improvement of patient care, nurses' performance, and overall efficiency. Nurses' walking distance and spatial configuration are critical factors that affect the quality of care provided in inpatient ward design. However, on the other side, not much attention had been given to the other factors, which play a key role in the design process. From examination and analysis, it could be concluded that for each different category different ward typologies offer different performance matrices such as nurse walking distance and programming and gross area of the unit. It was found that compact circle had the minimum walking distance of 18 feet and 9 inches per bed compared to the maximum found in compact triangle type with a 28 feet and 5 inches average walking distance per bed. Although in the case of gross area compact circle stand at third position as the minimum area required for the same number of beds is for compact square and double loaded type units but at the same time both of these typologies stands at second and fifth position. Based on the above it could be concluded that the compact square type offer in the best performance in terms of nurse's walking distance, maximum patient area, minimum circulation area, and the least gross area among the above-mentioned six typologies.

References

Acar, I., & Butt, S. E. (2016). Modeling nurse-patient assignments considering patient acuity and travel distance metrics. *Journal of biomedical informatics, 64*, 192-206.

Burgio, L. D., Engel, B. T., Hawkins, A., McCormick, K., & Scheve, A. (1990). A descriptive analysis of nursing staff behaviors in a teaching nursing home: Differences among NAs, LPNs, and RNs. *The Gerontologist, 30*(1), 107-112.

Hendrich, A., Chow, M., Skierczynski, B. A., & Lu, Z. (2008). A 36-hospital time and motion study: how do medical-surgical nurses spend their time? *The Permanente Journal, 12(3), 25–34. https://doi.org/10.7812/tpp/08-021*

Hignett, S. (2018). The importance of ward design and layout for the delivery of acute care: a review of the literature. *International Journal of Nursing Studies, 82*, 129–146.

Hua, X., Chau, P. Y. K., & Wong, K. K. Y. (2019). Hospital design and healthcare-associated infections: A systematic review and meta-analysis. *Journal of Hospital Infection, 101*(4), 428–439.

Hughes, J. (2000). The "matchbox on a muffin": the design of hospitals in the early NHS. *Medical History, 44*(1), 21-56.

Latimer, H. S., Gutknecht, H., & Hardesty, K. (2008). Analysis of hospital facility growth: Are we super-sizing healthcare?. *Health Environments Research & Design Journal, 1*(4), 70-88.

Ozkaynak, M., Budak, E., & Karabayir, O. (2019). Impact of nurse station design on nursing workflow: A literature review. *Health Environments Research & Design Journal, 12*(2), 60

Pachilova, R., & Sailer, K. (2020). Providing care quality by design: a new measure to assess hospital ward layouts. *Journal of Architecture, 25*(2), 186-202.

Pati, D., Harvey Jr, T. E., & Thurston, T. (2012). Estimating design impact on waste reduction: Examining decentralized nursing. *The Journal of Nursing Administration, 42*(11), 513.

Reiling, J., Hughes, R. G., & Murphy, M. R. (2008). *The impact of facility design on patient safety. Patient safety and quality: An evidence-based handbook for nurses*. Agency for Healthcare Research and Quality (US).

Shepley, M. M., & Davies, K. (2003). Nursing unit configuration and its relationship to noise and nurse walking behavior: An AIDS/HIV unit case study. *AIA Academy Journal, 6*, 12-14.

Tzeng, H.-M., Yin, C.-Y., & Yang, C.-H. (2021). The effect of nurse station design on nursing workflow: An experimental study. *Journal of Nursing Management, 29*(2), 164–172.

Ulrich, R. S., Zimring, C., Zhu, X., DuBose, J., Seo, H. B., Choi, Y. S., ... & Joseph, A. (2008). A review of the research literature on evidence-based healthcare design. *Health Environments Research & Design Journal, 1*(3), 61-125.

Ulrich, R., Zimring, C., Quan, X., Joseph, A., & Choudhary, R. (2004). *The role of the physical environment in the hospital of the 21st century: A once-in-a-lifetime opportunity.* Concord, CA: The Center for Health Design

Van Wijk, J. J. (2005). The Value of Visualization. Visualization. In VIS 05. IEEE.

Zborowsky, T., Berta, W., & Kortes-Miller, K. (2020). Supporting patient and family engagement in healthcare: A qualitative study of ward design features. *Health Expectations, 23*(6), 1546–1555.