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Ergonomic Risk Assessment of Nurses' Station in a Philippine Tertiary-Care Hospital

Adriana Feliz L. Yap-eo, Chelsea Ann C. Boado,
Justine Renzo O. Rivera and Eliezer Jethro D. Torrecer
Students, Industrial Engineering
School of Engineering and Architecture, Saint Louis University-Baguio City
Philippines
2226568@slu.edu.ph, 2004600@slu.edu.ph,
2220472@slu.edu.ph, 2213617@slu.edu.ph

Michelle S. Cariño-Adiwang
Professor and Head, Industrial Engineering
School of Engineering and Architecture, Saint Louis University-Baguio City,
Philippines
mcadiwang@slu.edu.ph

Abstract

This study evaluated the ergonomic analysis and evaluation of nursing stations in a Tertiary-Care Hospital in the Philippines, emphasizing lighting levels, noise, temperature, workstation design, and anthropometric measurements. A series of ergonomic assessments were conducted across five nursing stations (Obstetrics-Gynecology, Pediatrics, Surgical, Coronary, and Medical) utilizing digital light meters, digital sound level meters, digital thermometers, and anthropometric measuring devices.The findings recommend essential design improvements for more flexible workstations as the evaluation shows that there is nonadherence to ergonomic standards. The lighting was insufficient in some areas, with specific areas resulting in 13 lux. The noise levels were too high, reaching 73 to 80 dB, which is above the limit set by the WHO. The design of the workstations made it hard to move and feel comfortable from space limitations. While the temperature was within the optimum level of 23-25°C, busy areas resulted in temperature fluctuations. Additionally, the study found that the furniture in use was not adjustable for different body sizes. Making these changes is important to lower the risk of musculoskeletal disorders (MSDs), improve the well-being of nurses, and boost their efficiency. In general, the study highlights the need for designs that can be customized to create safer and more effective healthcare work environments, which will ultimately improve patient care. Consequently, poorly designed nurse workstations result in physical and psychological stress, increasing the risk of musculoskeletal disorders (MSDs) and lowering job satisfaction, which could ultimately affect healthcare performance.

Keywords
Anthropometry, Ergonomics, Nurses' Station, Musculoskeletal Disorders (MSDs), Workplace Improvement

1. Introduction
Filipino nurses are known to deliver high-quality healthcare services all over the world, with over 300,000 nurses scattered across the globe (Valdez et al. 2024). However, their journey in providing quality healthcare has some challenges, both physically and mentally. Nurses are frequently susceptible to musculoskeletal disorders (MSDs) as a result of the physical demands of their jobs, their comfort, productivity, and mental health. In the Philippines, research

indicates that 80% of nurses experience back discomfort or lower back diseases, and 40% report that nurses experience some form of injury (De Castro et al. 2009).

While partially caused by the physical demands of patient care, these injuries are also worsened by poorly built workstations significantly impacted by the more significant office environment, including lighting, noise levels, temperature, overall spatial organization, and a lack of ergonomic and environmental considerations. Healthcare professionals, particularly nurses, work long hours in settings where the surroundings directly impact their comfort and efficiency: several factors, including poor air quality, loud noises, crowded workstations, and inadequate illumination, cause nurses mental and physical strain. Poor environmental design can cause weariness, discomfort, and reduced productivity and ultimately result in decreased job satisfaction, which affects the standard of patient care (AlHazim et al. 2022). Therefore, the design of healthcare facilities, particularly nurse stations, is critical to the well-being and efficiency of nursing personnel (Gurses and Pronovost 2011). By focusing on the environmental design of nurse stations, this research aims to improve the physical and mental well-being of nurses, reducing work-related injuries and promoting a healthier work environment. This aligns with Sustainable Development Goal 3 (Good Health and Well-Being) by ensuring that healthcare workers are in optimal conditions, ultimately enhancing the quality of patient care. Moreover, by improving job satisfaction and productivity through better working conditions, the study also contributes to Sustainable Development Goal 8 (Decent Work and Economic Growth) by fostering a more sustainable and efficient healthcare workforce. This is particularly crucial in countries like the Philippines, where nurses face significant workplace challenges. These improvements can reduce turnover and ensure a more effective healthcare system.

The scope of this study evaluates the environmental design of nurse stations in healthcare settings, with particular attention to lighting, noise, temperature, spatial organization, and anthropometric measurements. By determining the effect of these elements on the comfort, effectiveness, and safety of nursing staff, this research will present recommendations regarding the creation of a better working environment, improving working conditions is essential to improving healthcare delivery, which is especially important in the Philippines, where many nurses suffer work-related injuries (De Castro et al. 2009).

1.1 Objectives

This study aims to conduct an ergonomic risk assessment of nurses' stations to improve their design, enhancing both job efficiency and overall well-being. The following objectives summarize the focus of the study:

1. To evaluate the design of nurse stations by evaluating environmental parameters such as lighting, noise levels, temperature, anthropometric measures, and workstation layout.
2. To determine how these elements affect nurses' job performance, well-being, and productivity.
3. To identify potential design flaws that reduce efficiency in operations and add to physical and psychological strain.
4. To propose design adjustments for the nurses' station based on the ergonomic assessment to improve the overall work environment and reduce the risk of musculoskeletal disorders and discomfort.

2. Literature Review

Musculoskeletal Disorders in Healthcare Environments

Healthcare occupations are known for their high physical and mental demands, and nurses are key workers contributing to a successful hospital operation. Nurse workloads consist of different repetitive tasks that can cause work-related musculoskeletal disorders (WMSDs), a significant occupational health challenge among nurses, with global prevalence rates ranging from 33% to 88% (Soylar and Ozer 2018). Lower back pain is the most commonly reported condition, affecting 49% to 84% of nurses, followed by shoulders, neck, and knee discomfort. These disorders are primarily attributed to repetitive tasks, cumulative trauma, and awkward postures, such as bending, stooping, and reaching, alongside physically demanding activities like lifting, transferring, and repositioning patients. Also, demographic and individual factors, including age, gender, and body mass index (BMI), amplify the risk of developing WMSDs.

Moreover, in a recent study of Filipino nurses, 99% of respondents reported exposure to similar ergonomic hazards, with 98% engaging in repetitive movements and 78% frequently lifting patients heavier than themselves (Felix and Villapando 2022). Alarmingly, inadequate ergonomic support was reported by 100 nurses, alongside widespread issues of insufficient rest (99%) and lack of regular exercise (97%), further exacerbating their vulnerability to

WMSDs. Regression analysis also identified significant predictors of lower back discomfort, including age, BMI, and inadequate ergonomic training, with 64 respondents experiencing severe pain. Similarly, Rezaee and Ghasemi (2015) identified frequent bending and patient handling as key contributors to acute and chronic low back pain (LBP), further aggravated by workplace violence. These findings underscore the critical need for systemic interventions, WSMDs are suffered by thousands of nurses worldwide and this high percentage shows that society is not giving these deserving people who faithfully work to provide high service a more comfortable environment to work in, especially after tending to patients without a break. To address these issues, ergonomic evaluation and redesign is a must to promote nurses' safety, health, and productivity.

Ergonomic Risks in Healthcare Environments

An ergonomic workstation promotes efficiency and productivity in the workplace as it addresses ergonomic issues that may indirectly affect one's performance, and a workstation that promotes safety and health should be adhered to in all occupations, especially those who are prone to WMSDs. Ergonomic redesign involves assessing the physical evaluation of the workplace environment and particularly in a stressful occupation like the healthcare industry. These ergonomic risks in the physical environment of the healthcare industry include noise, lighting, temperature, and workstation design. These variables significantly impact the health and performance of healthcare workers and a study by Bayaban et al. (2016) highlighted that noise levels in patient rooms often exceeded the WHO-recommended limits, contributing to stress and reduced focus, while inadequate lighting and poor temperature regulation further added to the discomfort. Similarly, a study by Gumasing et al. (2020) also found a strong correlation between high noise levels and temperature fluctuations with increased occupational risks, while poor illumination negatively affected healthcare workers' well-being. These findings emphasize the need for ergonomic interventions, such as adjustable furniture and optimal environmental conditions, to create a more safe and comfortable working station and also improve efficiency and job satisfaction.

Besides environmental factors, the physical demands of tasks such as lifting and transferring patients also contribute to musculoskeletal injuries. De Castro et al. (2009) reported that a significant proportion of Filipino nurses experience work-related injuries, particularly back pain, due to poorly designed workstations and inadequate facilities. This shows us the severity of the ergonomic condition in the healthcare industry. To address these risks, experts such as Cullinan and Wolf (2010) advocate for ergonomic design in healthcare settings, which includes flexible workstations and better environmental control to enhance the comfort and safety of healthcare workers. Addressing these ergonomic challenges is essential to fostering a healthier, more productive workforce and ensuring improved patient care outcomes.

3. Methods

This study utilizes an applied research design to provide a practical solution to the prevalent issue of increased work-related musculoskeletal disorders (WSMDs) in healthcare. It evaluates the ergonomic conditions of nursing stations in various hospital wards across the Philippines. The primary aim is to assess various environmental factors influencing nurses' physical well-being, work efficiency, and job satisfaction. Key factors under investigation include lighting, noise levels, temperature, anthropometric measurements, and overall workstation design. Quantitative and qualitative data collection methods will ensure a comprehensive evaluation. The research involves an ergonomic assessment of factors such as illumination, temperature, noise, anthropometric measurements, postural analysis, hazard identification, and the overall layout of five hospital nursing stations. These stations represent the Obstetrics-Gynecology, Pediatrics, Surgical, Coronary, and Medical Wards.

4. Data Collection

4.1 Physical Environment Measurement

The physical environment measurements include illumination, noise, and temperature, using specialized devices to ensure accuracy. Illumination is measured with the UT383 digital light meter, which can display results in Lux or Foot-candles (Fc). The rooms are divided into a grid using a grid-based method, following the guidelines in ISO 8995-1:2002 for workplace lighting. The measurement point of illuminance was determined based on the room size, with measurement points spaced evenly to capture variations in light levels. Measurements are taken over a grid of points on the working plane or task areas, with the device positioned at a constant height from ceiling to surface. Noise levels are measured using the UT353 mini digital sound level meter, which operates within 30 to 130 decibels (dB) with an accuracy of ±1.5 dBA. Readings are taken during morning and night from a stationary location, with averages

calculated for final results. Temperature is measured with the WDKL-EWQ-004 non-contact infrared thermometer, calibrated in degrees Celsius (°C). The device is fixed at the patient's bedside, and readings are taken in the morning and night. These measurements provide comprehensive data on the physical environment, which is essential for assessing comfort and safety.

4.2 Anthropometric Measurement

The methodology for collecting body measurements followed standard guidelines to ensure accuracy and consistency in different body parts. The study included 20 participating nurses, with measurements taken in both standing and sitting positions. Measuring tapes, digital calipers, and anthropometers were used to get the body dimensions of the nurses. Each measurement was carefully recorded, with consistent body positioning to reduce errors. The data was then organized into a detailed dataset covering key measurements such as body mass index (BMI), waist width, hip width, and elbow rest height, along with their percentiles (5th, 50th, and 95th). This process allows for a clear view of the range of body size and shape within the subjects, which is essential in applying ergonomic design.

4.3 Workplace Evaluation

In the data collection process, the applications AutoCAD and SketchUp were used to evaluate the layout of the nursing stations. AutoCAD was employed to precisely determine and approximate the areas of the workstations, allowing for accurate spatial measurements. SketchUp was then utilized to generate 3D visual models of the workstation designs, providing a detailed and interactive representation of the physical layout for further ergonomic analysis.

5. Results and Discussion

5.1 Numerical Results

Illumination

According to the Department of Labor and Employment (2020), under Rule 1075 of the Occupational Safety and Health Standards, specific guidelines for workplace lighting are set to ensure that natural and artificial light is adequate for various tasks, supporting safety and productivity in different work settings. Lighting standards across different industries are established based on the precision required for specific tasks. A minimum illumination level of 100 lux is advisable for activities necessitating minimal detail recognition. In contrast, 300 lux is required for more accurate activities, including office tasks and medium-level inspections. Maintaining these lighting standards is crucial for enhancing productivity, minimizing errors, and ensuring safety in workplaces where accuracy and detail are key.

The recommended lighting level for a nurse station should range from 200 to 300 lux, depending on the specific area. This level of light is sufficient for essential tasks such as charting, reviewing patient records, and coordinating care, supporting staff efficiency and safety. Proper lighting in nurse stations is critical to maintaining a safe and effective work environment, especially in the fast-paced setting of a hospital.

Table 1 above displays the light levels across five nurses' stations. The illumination in several critical areas of the hospital is inadequate, not meeting the established guidelines, which has significant repercussions for both operational efficacy and safety. Critical locations, including nurse locker rooms, workspaces, and corridors throughout various wards, exhibit poor lighting, with corridor illumination levels recorded as low as 13 lux. This is well below the recommended 200-300 lux required for safe navigation, particularly during night shifts. Poor lighting in these areas may jeopardize staff productivity and patient safety, emphasizing the urgent need for improvements to the lighting systems.

Table 1. Illumination Levels in Various Hospital Wards and Areas

Ward	*Area*	*Average Daytime Lighting (lux)*	*Average Nighttime Lighting (lux)*
Medical Ward	Locker Room	126.67-128.11	120-120.89
	Working Area	100.56-102.22	90.89-91.67
	Medicine Preparation Area	67.89- 69	70.22-70.56
	Linen Room	163.44-164.89	139.56 - 140.44
	Hallways	31.33-33.56	43.22-44
OB	Working Area	110.22-111.44	92.67-94.67
	Kitchen Area	216.11-218.33	163.22-163.44
	Medicine Preparation Area	230.11-232.44	143.89-144.44
Coronary Ward	Locker Room	92.33-99.11	104-105
	Working Area A	99.22-101.22	85-85.78
	Working Area B	131.56-135.67	123.56-124.22
	Medicine Preparation Area/Kitchen	71.56-75.11	71.78-73.89
	Linen Room	129.67-131.78	130.67-131.11
	Hallways	81.33-85.44	85.67-87
Pediatric Ward	Locker Room	148.11-153.9	147.67-162.44
	Working Area	118.11-122.11	108.33-118.78
	Medicine Preparation Area/Kitchen	105.78-111.11	70.44-77.11
	Linen Room	92.78-94.67	106.22-112.22
	Hallways	113.89-120.33	94.56-98.56
Surgical Ward	Locker Room	86.3-92.3	58.6-60.6
	Working Area A	139.1-151.4	155.7-165.7
	Working Area B	99.1-99.9	106.2-108.2
	Medicine Preparation Area/Kitchen	126-134.3	65.8-76.2
	Hallways	90.2-92.9	91.3-94.8

Noise

Association of American Medical Colleges (2023) states that the WHO International Noise Council and Environmental Protection Agency standard for noise limits for hospitals should range from 35-45 dB (morning) and 20-35 dB (night). With this data, some hospitals still exceed the limit. For this study, the standards given by the World Health Organization (WHO) will be followed and used as the basis. The advised maximum level of ambient noise is 70 dB, as prolonged exposure to sounds exceeding this threshold may pose health risks. In occupational and recreational contexts, noise levels between 120 dB and 140 dB are deemed highly hazardous, particularly for children and adults.

Table 2. Noise Levels in Different Wards and Work Areas

Ward	Average Noise Level (dBA)	Remarks
Medical Ward	61.99	Open spaces with noise from discussions, doors, and surrounding areas.
Obstetrics-Gynecology	53.75	Open windows, front desk, and elevator areas influence noise.
Coronary Ward	58.32	Central location with multiple noise sources, including doors and staff.
Pediatric Ward	56.23	Noise from nearby areas, open workstations, and elevators.
Surgical Ward	54.21	Noise from windows, open areas, and central locations near elevators.

Table 2 above displays the noise levels across the five nurses' stations; it exceeds the standard noise level ranging from 35 to 45 dBA (Harris and Detke 2013), which can contribute to ergonomic risks such as stress, fatigue, and impaired communication among staff. These results showed similarity with the study conducted in another hospital in the Philippines, resulting in 58-68 dBA ((Bayaban et al. 2016). From the results, the Medical Ward, with an average noise level of 60.99 dBA, experiences disruptions from open spaces and surrounding activity. In the Obstetrics-Gynecology Ward, noise averages 53.08 dBA, with areas like the Kitchen and Medicine Preparation Area registering moderate levels. At the same time, the Working Area often reaches higher levels due to its proximity to elevators. The Coronary Ward averages 57.81 dBA, with quieter areas like the Linen Room contrasting with noisier Working Areas due to increased staffing and activity. The Pediatric Ward, averaging 56.59 dBA, and the Surgical Ward, at 55.01

dBA, demonstrate heightened noise in Working Areas, influenced by elevated activity and staff interactions, compared to quieter spaces like the Hallway and Locker Room.

Temperature

To optimize the working environment for healthcare professionals, it is recommended to establish a consistent temperature range of 23°C to 25°C across all nurse stations. This range is generally comfortable and conducive to patient care. Regularly monitoring temperatures, especially during peak activity hours in the morning and night, is essential. (Lomas and Giridharan 2011).

Table 3. Temperature Measurements in Nurse Stations Across Wards

Ward	***Average Temperature Measurements Reading (°C)***	
	Morning	***Night***
Medical Ward	23.13	24.39
Obstetrics-Gynecology Ward	22.84	23.72
Coronary Ward	25.16	25.20
Pediatric Ward	24.91	25.06
Surgical Unit	24.48	25.16

The table above displays the average temperature reading across the five nurses' stations. Temperature readings in all wards and areas range from 22°C to 25.5°C, which is optimal for the comfort and effectiveness of healthcare professionals. However, it is important to note that the measurements were taken during the colder season in a tropical country, and the results may vary during the summer months. The stations in the hospital do not have proper air conditioning against the heat. Higher temperatures, increased humidity, and changes in activity levels could affect staff's comfort and efficiency, requiring temperature adjustment.

Anthropometric Measurements

The Table below displays the anthropometric measurements of 20 nurses. The anthropometric data gathered emphasizes the critical role of ergonomic design in preventing musculoskeletal disorders (MSDs) by considering the varied physical dimensions of healthcare professionals. The disparity in body size, represented by the 5th, 50th, and 95th percentiles, highlights the necessity for adaptable workstations that cater to an extensive range of body types.

Table 4. Percentile Table with Standard Deviations in Meters (5th, 50th, 95th and SD)

Name					
Sitting Eye Height					
Popliteal Height	0.39	0.02	0.37	0.39	0.42
Buttock Popliteal Length	0.41	0.04	0.37	0.42	0.45

The table outlines seven key anthropometric measurements used to design an ergonomic chair that ensures comfort and suitability for nurses working at the stations. The measurements such as popliteal height, hip breadth, and buttock-popliteal length guide the chair's seat height, width, and depth, while sitting shoulder height and elbow rest height determine backrest and armrest placement.

The popliteal height at the 5th percentile (0.39 meters) determines the seat height, indicating that the nurses are, on average, shorter, so the chair must be designed to allow them to sit comfortably with their feet flat on the floor. The hip breadth at the 95th percentile (0.43 meters) helps set the seat width, ensuring that more prominent individuals can sit comfortably. The buttock-popliteal length at the 5th percentile (0.37 meters) decides the seat depth, preventing pressure on the back of the knees during extended sitting. The sitting shoulder height determines the height of the upper backrest, providing adequate support for both the lower and upper back. Finally, the elbow rest height at the 5th percentile (0.17 meters) defines the armrest height, ensuring that shorter users can rest their arms comfortably. These body measurements are essential for creating a safe and comfortable chair and help reduce the risk of body strain.

Workstation Evaluation

The nurse workstations in the hospital were assessed based on required standard space, ease of passage, and adjacency of furniture and fixtures. This assessment was based on ergonomic design principles and hospital design standards and focused on patient safety, staff efficiency, and workplace ergonomics (Gurses and Pronovost 2011).

1. Space Requirement

According to the Health Facilities and Services Regulatory Bureau (HFSRB) of the Department of Health (DOH 2023), hospitals and healthcare facilities must be designed to meet specific functional requirements and comply with P.O. 1096 – the National Building Code of the Philippines and its Revised Implementing Rules and Regulations. These standards ensure that healthcare environments are safe, accessible, and operationally efficient. This study evaluated the dimensions of the nurse stations across different floors.

Table 5. Total Area per Nurse Station

Floor	Total Area (m^2)
4th Floor (Medical Ward)	30.23
5th Floor (OB Ward)	18.97
6th Floor (Coronary Ward)	42.76
7th Floor (Pediatrics)	30.79
7th Floor (Surgical)	30.23

The Table 5 displays the total area per nurse station, and each nurse station accommodates around 2 to 4 nurses per shift. Still, clinical groups of 10 student nurses also occasionally use the stations as part of their training. According to the regulations set by the Health Facilities and Services Regulatory Bureau, a minimum of 5.02 square meters per staff member is required to ensure adequate space for staff to work efficiently and comfortably. For the station to comfortably use the amenities, each station has to accommodate only a specific number of workers, depending on the total area of the station.

2. Flow of Movement and Placement of Furniture

It has been found that the amount of equipment and supplies in nurse stations exceeds the available space, restricting movement and reducing efficiency. This limited space leads to congestion, especially during busy times, making it hard for staff to move freely and perform their tasks effectively. Besides hindering productivity, this overcrowding increases the risk of accidents or delays in patient care. First, many of the nurse stations were found to have equipment and furniture placed in a way that created obstacles and restricted the flow of movement. This made it difficult to access necessary tools quickly and contributed to a cluttered, stressful environment, especially during peak hours when multiple nurses worked simultaneously.

Research by Singh et al. (2023), highlights the importance of a clutter-free, well-organized workspace in minimizing physical strain and improving staff efficiency. The layout also affects the ergonomics of the workspace. Many stations had furniture positioned in ways that required nurses to adopt awkward postures, such as leaning forward or reaching excessively for items. This can lead to discomfort and increase the risk of musculoskeletal disorders (MSDs) over time. Adjustable desks, chairs, and workstations are essential to accommodate the diverse body types of healthcare workers. Still, many of the stations lacked sufficient flexibility in their design to support different postures. According to Septiani et al. (2024), ergonomic workplace design that allows for adjustable furniture and workspaces can help mitigate the risk of MSDs among healthcare professionals.

5.2 Proposed Improvements

Illumination

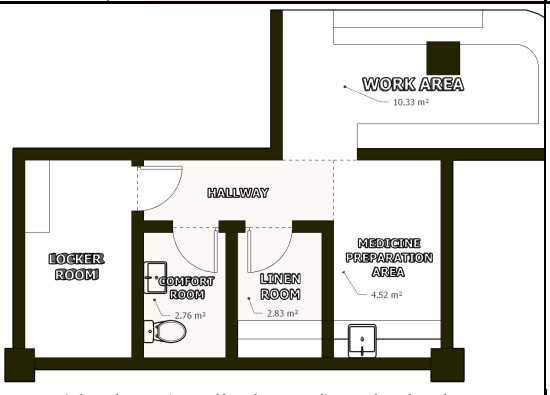
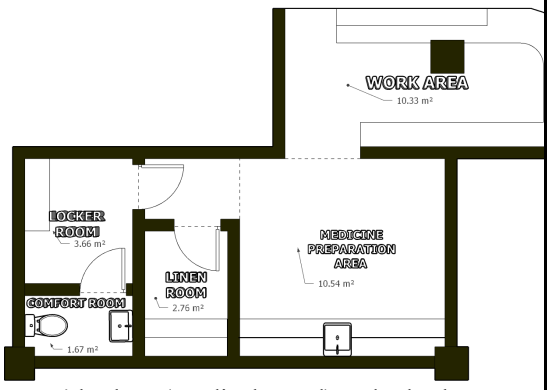
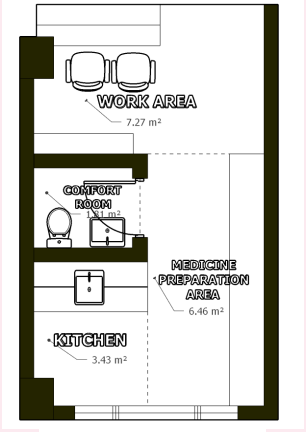
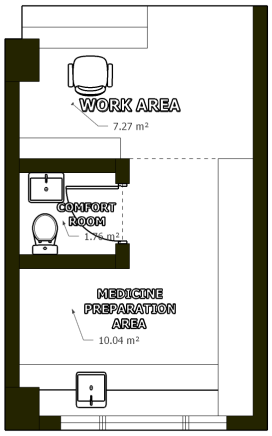
Illumination in several areas, such as hallways, working areas, and storage rooms, fell below the standard lighting levels. It is recommended that lighting intensity in these areas be increased to at least 200 to 300 lux, especially in high-traffic areas, and that 150 lux should be maintained in locker rooms. Installing high-intensity LED lights would help ensure that illumination in all workstations meets suggested standards.

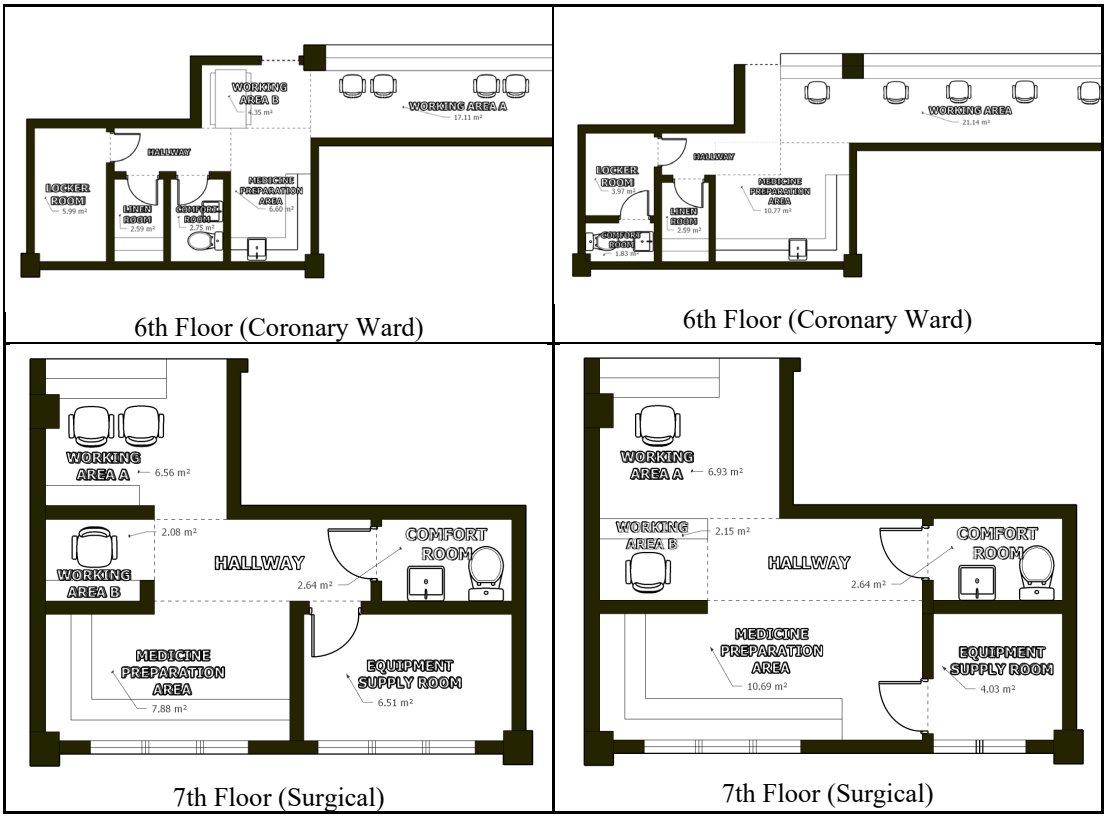
Noise
Noise levels at several stations exceeded WHO standards. Therefore, installing soundproofing elements such as sound-absorbing ceiling tiles and wall panels is recommended, as is using quieter equipment alternatives if possible. These improvements would reduce auditory strain and help create a quieter, more focused workspace.

Temperature
Most temperature readings in nurse stations were within the recommended range of 23-25°C. However, fluctuations occur during high-activity periods and the year's season. To address this, it is recommended that regular monitoring and maintenance of the facility's HVAC systems be conducted to ensure consistent temperature throughout all work shifts. Moreover, installing or using localized cooling systems like electric fans in areas prone to temperature variability will help ensure that workstations remain comfortable and within ergonomic standards.

Workstation Layout and Anthropometry
The evaluation of the workstations found that the space per nurse at several stations was below 5.02 square meters, which is the DOH-recommended area per staff member. To address this, declutter high-use areas, reorganize storage for essential items, strategically place equipment, and redesign layouts with more open pathways. These configurations lead to the avoidance of overcrowding and more open pathways, enhancing the flow of operations and minimizing risks associated with tight and obstructed spaces (Table 6).

Table 6. Current and Proposed Nurse Station Layout

Current Layout	Proposed Layout
 4th Floor (Medical Ward) and 7th Floor (Pediatrics)	 4th Floor (Medical Ward) and 7th Floor (Pediatrics)
 5th Floor (OB Ward)	 5th Floor (OB Ward)



The proposed layouts are based on the National Building Code of the Philippines (NBCP), assuring that the design complies with the minimum area requirements for every space of the nurse station. If the maximum capacity of the nurse station exceeds, the hospital needs to expand the nurse station or provide additional stations for the excess nurses. The Working Areas and Medicine Preparation Areas (MPA) have been enlarged to accommodate the maximum number of nurses on duty per shift, having a minimum requirement area of 5.02 m2/staff. The MPA has been enlarged in the Medical Ward, Pediatric ward, and Coronary ward by combining the locker rooms and comfort rooms into one space while still meeting the standard adequate area (2.32 m2). MPAs can only accommodate two staff nurses at a time in the proposed layouts. While the MPA is entirely occupied, other nurses can work on different tasks in the working area. Nurses are encouraged to rotate tasks in this workstation design to maximize the limited space. Moreover, job rotation is a straightforward task distribution method that helps reduce muscular fatigue (Keir et al. 2011).

In the proposed layout of the OB Ward, the Kitchen Area found near the MPA has been removed. Removing the Kitchen is necessary to reduce the contamination risks among hospital inpatients and nurse staff. According to Banna et al. (2022), hospital kitchens are recognized as one of the primary sources of contamination that, through cross-contamination, can lead to foodborne illness outbreaks. To compensate for removing the kitchen area, the hospital should provide a designated space where nurses can eat and prepare food during their break.

Figure 1. Proposed Counter and Desk Design

Figure 1 shows the proposed counter and desk design changes based on ergonomic principles to improve comfort and usability. The design features adjustable desk heights to accommodate various working postures, helping nurses work without unnecessary strain. It also offers enough legroom and easy reach, reducing the need for excessive bending or stretching. Furthermore, the spacing between desks is adjusted for easy movement and better accessibility. These changes aim to create a more efficient and comfortable work setting, reducing physical discomfort and fatigue while enhancing productivity. The measurements used are based on the guidelines provided in *Human Dimension & Interior Spaces* (Panero and Zelnik 2014).

Table 7. Anthropometric Measurements for the Proposed Office Chair

Chair Specification	Anthropometric Measurements	Percentile	Dimensions (meters)
Seat Height	Popliteal height + Shoe Allowance	5th Percentile	0.39
Seat Width	Hip Breadth + Clothing Allowance	95th Percentile	0.43
Seat Depth	Buttock popliteal length	5th Percentile	0.37
Backrest Width	Hip breadth	95th Percentile	0.38
Upper Seat Backrest Height	Sitting shoulder height – popliteal height	Average	0.58
Armrest Height/Lower	Elbow rest height	5th percentile	0.17

Table 7 presents the anthropometric dimensions used to design an ergonomic office chair for nurses. The design is based on key anthropometric data such as popliteal height, hip breadth, buttock-popliteal length, and elbow rest height, ensuring that the chair accommodates a wide range of users. The percentile values indicate that the design caters to smaller and more prominent individuals, promoting comfort and reducing the risk of MSDs

Figure 2. 3D Perspective of Proposed Ergonomic Chair Based on The Anthropometric Data of Nurses

Figure 2 shows the ergonomic chair design based on the anthropometric data in Table 7. The chair has a backrest shaped to support the spine, helping to maintain good posture. It includes an adjustable seat height to fit nurses of different sizes. The armrests are placed at a height that helps reduce shoulder strain. The chair also has a stable base with wheels, making it easy to move around. These features are designed to make the chair more comfortable and functional for use in a healthcare setting.

6. Conclusion

The ergonomic assessment of nurse stations in this study reveals essential areas for improvement to support nursing staff's well-being, efficiency, and safety. Current lighting, noise, temperature control, spatial layout, and furniture arrangements at the nurse stations significantly differ from established ergonomic standards. Low lighting in some parts of the hospital makes it difficult to perform specific tasks; high noise levels, fluctuating temperatures, lack of space, and inadequate furniture design lead to physical stress, reduced work output, and a higher likelihood of MSDs among nursing professionals.

Improvements in lighting intensity, noise reduction measures, temperature stability, adjustable furniture, and optimized workstation layouts are all recommended to address these issues. These changes would go beyond improving the comfort and efficiency of the nurses to benefit patient care by making the nurses' work safer and more effective. Hospitals that ergonomically align nurse stations will reduce occupational health risks to workers and promote increased job satisfaction among healthcare workers. Ultimately, this commitment to ergonomic improvements will help grow a healthy, safe, and productive work culture for staff and patients in the long run.

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Biographies

Michelle S. Cariño-Adiwang is currently serving as the Department Head of Industrial Engineering at Saint Louis University. With 25 years of academic and professional experience, Professor Cariño-Adiwang has established herself as a Human Factors/Ergonomics enthusiast. As a dedicated educator, Professor Cariño-Adiwang has taught a variety of courses in the Industrial Engineering Program, including Ergonomics, Methods of Research, Basic Occupational Health and Safety, Organizational Behavior, and Personnel Management; in the Graduate Program, she has taught Industrial Productivity and Factory Practice. Also, she has mentored numerous students in their academic and career pursuits. In addition to their role as department head, Professor Cariño-Adiwang is actively involved in extra-curricular school-based activities.

Adriana Feliz Yap-eo is a fourth-year university student at Saint Louis University where she is taking a Bachelor of Science in Industrial Engineering. She is a certified Safety Officer 2 and one of the founding members of the Saint Louis University Industrial Engineering Safety Committee, where she actively promotes safety standards within the university. Additionally, she holds a Lean Six Sigma Yellow Belt certification, equipping her with foundational knowledge in statistical concepts, data collection, and data analysis techniques. She is also a dedicated member of the Philippine Institute of Industrial Engineers - SLU Student Chapter under the Research and Development Committee. Her commitment to workplace organization is demonstrated through her experience in overseeing and conducting comprehensive 5S audits, where she has managed the audit process, evaluated compliance, and provided actionable recommendations for improvements.

Chelsea Ann Boado is a fourth-year college student in Saint Louis University, taking a Bachelor of Science in Industrial Engineering. She is a certified Safety Officer 2, a certified Six Sigma Yellow Belt, and is an active core member of the university's Safety Committee. She is also a member of the Philippine Institute of Industrial Engineers - SLU Student Chapter under the Outreach Committee. Additionally, she is also a member of the 5S team that conducted the pre-audit within the university to improve organizational efficiency and safety. Her focus lies in integrating safety and process improvement strategies to enhance both workplace safety and operational performance.

Justine Renzo O. Rivera is a fourth-year college student in Saint Louis University, taking Bachelor of Science in Industrial Engineering. He is a certified Safety Officer 2 and one of the pioneers of Saint Louis University Industrial Engineering Safety Committee, where he actively contributes to promoting safety standards within the university. He is also a member of the Philippine Institute of Industrial Engineers - SLU Student Chapter under the Events Committee and he acts as the Secretary General of the School of Engineering and Architecture Guild of Minds and Arts, the theater resident of the School of Engineering and Architecture. Additionally, he is also one of the 5S team that conducted the pre-audit within the university to improve the efficiency and to ensure the safety and the standard of university is followed.

Eliezer Jethro D. Torrecer is a fourth-year college student at Saint Louis University, taking Bachelor of Science in Industrial Engineering. He is a certified Safety Officer 2 and one of the members of Saint Louis University Industrial Engineering Safety Committee. He is also a member of the Philippine Institute of Industrial Engineers - SLU Student Chapter under the Social Media Committee. Additionally, he is a member of the Extension Committee of the Philippine Institute of Industrial Engineers - SLU Student Chapter that conducts 5S audits in the facilities of a barangay's multi-purpose hall to improve the efficiency of the processes as well as the safety of stakeholders.