Ultrasound Workstation Analysis of De La Salle University Medical Center

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ABSTRACT

This research study aims to identify the present and probable problems of the current ultrasound workstation being used at De La Salle University - Medical Center and provide improvements and recommendation to their current workstation to increase comfort and decrease pain. The current workstation was assessed and evaluated using different ergonomic tools. Data gathered were compared with the ergonomic standards to determine if the current workstation is fit for the radiologic technologists and safe from risks and injuries. The study focused on solving the problem regarding their posture while performing the ultrasound procedure. The RULA scores were 5.43 and 4.86 for the right hand (abdomen and thyroid) and 3.43 for the left hand, which indicates that further investigation and change on the current workstation is needed soon. The Postural Analysis showed that they stretch their wrist 65% of the time, their right elbow not assisted 80% of the time, and they raise their shoulder 81% of the time. While the Nordic questionnaire, focus group discussion, and comfort survey indicated that the participants experienced pain in their body parts specifically their right wrist, right shoulder, arm, and back.

Keywords: Ultrasound, Workstation, Radiologists, Rapid Upper Limb Assessment

1. Introduction

De La Salle University Medical Center (DLSUMC) is the first hospital in the Philippines to be awarded an ISO certification for its quality management system.

Radiologic Technologists use the ultrasound workstation to examine their patients. Six ultrasound workstations were evaluated in order to verify and validate whether the Radiologic Technologists are comfortable and satisfied with their working environment.

There are a total of 7 Radiologic Technologists in the department, which constitutes the population of study. An initial survey was distributed to the 7 Radiologic Technologists of DLSUMC to determine their demographic profile and other information related to the use of ultrasound machine. The main task of the radiologic technologists is to perform the ultrasound procedure. Moreover, they also examine the results of the ultrasound procedure and perform computer related tasks.

1.1. Participants’ Profile

Based on the survey, 57% of the radiologic technologists answered that they have been using the machine for one to five years while 29% of them have been using the machine for 12 years and up. The remaining 14% have just been using the machine for less than one year. Also, 71% are using ultrasound machine for 6-10 hours per day while 29% of them use the ultrasound machine for 1-5 hours per day. Their use of the ultrasound machine is dependent on the number of patients per day. The day starts at 8 AM and it usually ends around 7 PM.

The majority of the participants have 8-13 patients per day while some of them have 1-7 patients per day. There
is a difference on the number of patients per day on the Radiologic Technologists as the patients are given randomly to the Radiologic Technologists depending on their availability. Moreover, some patients take longer than other patients. The absenteeism of the participants were also noted and 29% of the Radiologic Technologists were absent for 1-5 days while 71% were absent for 6-10 days for the last 12 months. Whenever there is a Radiologic Technologist who is absent, the workload of the present Radiologic Technologists adds up since they are accepting the workload of the absent Radiologic Technologists.

1.2. Layout and Equipment
There are currently six ultrasound workstations separated by a curtain. The room also includes the office workstation that is mostly used by the Radiologists and administration employee.

![Actual Ultrasound Workstation](image)

Figure 1. Actual Ultrasound Workstation

Figure 1 shows the actual ultrasound workstation of the radiologic technologists. In every workstation, present are the ultrasound machine, chair, stairs, and bed. The area of one ultrasound workstation is 3.78 m². The bed is always located at the right part of the ultrasound machine as the radiologic technologists use their right hand in operating the probe and their left hand in operating the controls of the machine.

The study only focused on the transducers, which are being used for the abdomen and thyroid ultrasound procedure because these are the procedures most commonly done by the Radiologic Technologists.

Figure 2 shows the chair that is being used by the Radiologic Technologists of DLSUMC. The current chair does not have an armrest and backrest. The chair has a height of 27 inches and 12 inches for its seat pan depth and breadth.

![Chair](image)

Figure 2. Chair

Figure 3 shows the bed being used for the ultrasound procedure. The bed has a height, width and length of 33.5 inches, 24.75 inches, and 75 inches respectively. The height of the bed is fixed and cannot be adjusted.

![Bed](image)

Figure 3. Bed

2. Method

2.1 Workplace Assessment

The physical components of the workstation include the ultrasound machine, bed, chair, monitor, and keyboard. The environmental components that could also affect their work performance are illumination and noise, which are present.

In order for the current workplace to be properly evaluated, different standards were determined. The standards helped the group in analyzing the workstation as it can be assessed whether the current condition of the workstation is suitable for the workers using it. The different standards used are for illumination and noise.

Illumination

Having a well-lit workstation is very essential in
ensuring the health of employees at the work area that permits them to finish their tasks without any discomfort.

Table 1 - Safety and Health Standards

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<th>Hong Kong Occupational Safety and Health Branch – Labor Department (2008) &amp; Michigan Department of Licensing &amp; Regulatory Affairs (LARA)</th>
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<tr>
<td><strong>Illumination</strong></td>
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<td>Noise</td>
<td>European Agency for Occupational Safety and Health</td>
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Hong Kong Occupational Safety and Health Branch – Labor Department (2008) presented that the total area evaluated should be divided into a number of small equal squares in which the measurement of the illuminance was taken at the center of each divided square. The area of the room is 54.75 m², which indicates that the required number of minimum grids is 16 so the room was divided into 16 equal square grids. The measurement was done only once as there are no windows in the room therefore there is no sunlight affecting the lighting in the workplace. The data gathered was used to assess the lighting in the ultrasound workstation.

**Noise**

To quantitatively measure the sound level of the workplace, a sound level meter was used. The locations for these sound level measurements were at the center of each workstation; the noise level was measured per workstation. The group measured from 8AM to 7PM since it is the operating hours of the ultrasound workstation. The measurements were then averaged in order to obtain the sound level measurements for the morning, afternoon, and evening.

**2.2. Postural Analysis**

The Rapid Upper Limb Assessment is an observation-based screening tool used to quickly assess an individual’s exposure to load factors due to posture, muscle function and forces they exert (Chen, Falkmer, Parsons, Buzzard, & Ciccarelli, 2014).

RULA can be used in analyzing the work postures of the Radiologic Technologists because they use their upper limb while performing the ultrasound procedure. A total of 7 radiologic technologists were studied; 6 female and 1 male which constitutes the population of the radiologic technologists. Their posture while performing the ultrasound procedure were observed and captured.

**2.3. Nordic Questionnaire**

The Nordic Questionnaire is a tool for measuring the musculoskeletal stress of a person. The questions are concentrated on the symptoms most often encountered in an occupational setting allowing comparison of lower back, neck, shoulder, and general complaints. The Nordic Questionnaire was chosen because it can evaluate whether the radiologic technologists feel any ache, pain, or discomfort found in the upper body.

**3. Results**

**3.1 Workplace Assessment**

To assess the illumination, the lux meter was placed at the center of each grid in order to determine the illuminance level in that area. Moreover, while measuring the illuminance level, the group ensured that there were no obstructions that would hinder in obtaining the actual measurement of the light that passes through the sensor. Shown in the figure below are the average illuminances reading for each square grid for the entire workplace.

![Figure 4. Illumination reading in the Radiologists workstations](image-url)

Based on the measurements of the illumination level per grid, the measurements averages from 25-63 lux. The illumination standard for the Diagnostic Section of Filming and Imaging for the healthcare sector is 20 lux which indicates that the workstation illumination meet the standards of Michigan Department of Licensing & Regulatory Affairs (LARA) Illumination (2004) for
Health Care facilities.

Proper illumination is essential as it promotes safe and efficient health care facilities, which promotes the wellbeing of the employees (Thorn, 2010). With that it is then important for the Radiologic Technologists to experience proper lighting while they are working in order for them to be able to clearly see the image that they are scanning and in order to promote safe and efficient working environment.

The average noise level for all the ultrasound workstations from morning to evening ranges from 58-60 dBA. The sources of noises were coming from the air conditioner, Radiologists and Radiologic Technologists consulting with patients, public announcement system, hospital bed wheeling, and music playing from the office.

However, after interviewing the radiologic technologists, they did not have any complaints regarding the noise. According to them, the noise level is just right for them and they have not received any complaints from the patients. Even if the noise level in the workstation is higher than the recommended, the noise level in the workplace is not considered a problem because the nature of the work of the Radiologic Technologists involves communicating with each other and with the patients.

3.2 Postural Analysis

The neck and trunk of the Radiologic technologists are mainly static while scanning while their upper lower arm and wrist are moving in a repetitive motion in order for them to obtain the desired image that they want for the patient. It was found that the grand RULA scores of the participants while performing the abdomen and thyroid procedure are 5.43 and 4.86 respectively while the grand RULA score for the left side is 3.43. Based on the grand RULA scores further investigation is needed and changes should be done.

3.3. Nordic Questionnaire

Based on the results of the Nordic Questionnaire, the participants experienced discomfort on their neck, shoulders, wrists, upper back, and lower back. All participants experienced pain in their shoulder, 6 of the participants experienced ache, pain, or discomfort in their right shoulder and 1 participant experienced it on both shoulders. Upon observing the participants during the ultrasound procedure, their shoulders were mostly raised which could be a reason why they were experiencing discomfort.

Moreover, the participants who experienced ache, pain, or discomfort in the right wrist were experiencing it because the use of ultrasound machine requires repetitive twisting of the right wrist.

The back, shoulders, and neck were the body parts in which they experienced discomfort and prevented them from working. Moreover, they experienced discomfort in the wrist because of the repetitive motions that they do while performing the ultrasound procedure.

During the last 7 days, 3 of the participants had trouble in their wrists/hands and shoulders. Having trouble while working could affect the productivity of the participants, as they are experiencing discomfort while doing the ultrasound procedure. The service time could increase because of the discomfort that they are experiencing.

4. Conclusion

Based on the ergonomic assessment, the current ultrasound workstation does not comply with the ergonomic standards obtaining a RULA score of 5.43 (abdomen procedure) and 4.86 (thyroid procedure). These results to pain and discomfort on their upper limbs, specifically, the wrist/ hand, upper arm, lower arm, and lower back which were being experienced by the participants based on the Nordic Questionnaire. The study aims to improve the existing workstation being used by the radiologic technologists of DLSUMC. This would be for their benefit in terms of their safety and comfort. This study could also benefit future hospitals in creating an ideal ultrasound workstation that could give them satisfaction and comfort while doing their task.

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