Ergonomic Intervention for Radiology Department of Public Hospitals in Metro Manila

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Abstract

Radiologist now use filmless soft-copy Picture Archiving and Communication System (PACS) which needs ergonomic intervention on the different tasks it needs to perform on the radiology department. The four main objectives of the study were: (1) assess the current design of equipment and tools and check if the Musculoskeletal Disorder (MSD) exists in the workers of radiology department; (2) identify tasks that causes MSD which affects the performance of radiologist; (3) recommend the suitable ergonomic interventions or design in radiology department, and; (4) perform risk assessment on the different intervention in the Radiology Department. The study was conducted in public hospitals within Metro Manila with the same services for the patient like the X-ray, Ultrasound, MRI, and CT-scan. Using the CMDQ questionnaire, different MSDs were identified that affected their body while doing their tasks. Ergonomic principles such as RULA and anthropometry to determine if the equipment used in the task fit the workers. The highest prevalence of body pains are in the shoulders (93.75%), back (80.95), neck (75%), forearms (70%), and wrist (62.5%). Different ergonomic interventions were assigned on different task of the department and risk assessment was done on the different interventions.

Keywords
Radiologist, Musculoskeletal Disorder, Ergonomic Intervention

1. Introduction

One of the special medical doctors in the healthcare industry is the radiologist. Radiologist specializes in interpreting diagnostic imaging test and interventional procedures, they can explain the medical problems or symptom of the patient through the observation of images that are taken from different parts of the body (Goergen, 2015). Without the consultation of radiologist there was a 7.7% rate of significant discrepancy of interpretation. With a definitive diagnosis, the second opinion consultation was accurate in more than 84% of studies. Patient care benefits more with review of outside studies (Zan E. et al, 2010). Another scenario in the emergency department is when the radiologist is unavailable in interpreting the result, it can lead to 16% of plain films and 35% of cranial computed tomography being misread (Berner, 2008).

The doctor benefits from second opinion rendered by the radiologist. Service studies show doctors and patients benefits from second opinion services on radiology scans, including X-ray, ultrasound, CT scan, PET scan, and MRI. A second opinion requested by a patient or healthcare provider not only reduces the chances of a misdiagnosis or an unnecessary procedure resulting from an inaccurate reading, but allows the physician to focus on the most accurate and comprehensive diagnosis and treatment possible according to (Zan E. et al, 2010).

A survey conducted online in Australia ask the workers working on the ultrasound what type of task that they experience discomforts in their body. A total of 248 respondents were able to answer the survey and most of the workers answered having a problem of applying pressure with a response rate of 77.82% (Mason et al., 2014). Radiologist now are adapting in the filmless-based to a filmless soft-copy picture archiving and communication system (PACS) based environment has resulted in improved work flow as well as increased productivity, diagnostic accuracy, and job satisfaction (Harisinghani, 2004). Such access calls for either an ergonomically designed integrated single workstation with multitasking capabilities or multiple platforms that are ergonomically situated. Lack of attention to ergonomic design not only decreases efficiency and productivity but can actually cause harm in the form of repetitive stress injury, eye strain, backache, and shoulder and neck pain (Carter et al., 1994). The role of ergonomics in radiology is to ensure that working conditions are optimized in order to avoid injury and fatigue. Adequate workplace ergonomics can go a long way in increasing productivity, efficiency, and job satisfaction (Goyal et al., 2009)

2. Methods

2.1 Data collection

Descriptive research is the research design since the researcher evaluated all the gathered data and information. Factors were analyzed to determine the relationship of the different factors. The respondents of this study are the workers in the radiology department. Public hospital on tertiary level are the only focus for the respondents. The correspondents of the study are the workers working in the x-ray, ultrasound, CT-scan, and MRI. The research was conducted in Metro Manila since it has the most number of working radiologists in the Philippines. The research focused its study in a public hospital specifically the hospital that can provide the service. For this study, the research came up with a survey that helped analyze the different musculoskeletal disorder the radiologists are experiencing and came up with an intervention on improving the prevalence of MSD on the different tasks such as ultrasound, Ct-scan, MRI, and X-ray of the radiologist. CMDQ survey was used to know the factors of musculoskeletal disorders of radiologist. RULA assessment was used to determine the score of different postures of the workers in the different tasks. In order to gather data from the different public hospitals, the researcher prepared a request letter signed by the adviser in order to conduct interview and get the needed data. The researcher also examined the process on how the radiologists conduct x-ray to the patient and sonographers conduct test to patients. From the inspection, the researcher determined the causes of musculoskeletal disorder to the radiologists.

3. Results

A total of 55 radiologists were surveyed and interviewed for this study in three different Tertiary Hospital. This radiologist is the once who conduct test in making the required image by the patients. The age of the participants ranges from 23 to 45 with mean average of 32.89. The average height of all the participants is 161.84cm. The average weight of the participants is 64.49 kg and the average BMI is 24.78.

From the result obtained on the different equipment assessment, there are different equipment dimensions that does not fit the workers. In table 1, it shows the different assessment in the different Body Dimensions versus the Workplace measurements. Some of the Workplace Measurements are acceptable since it's within the limits of the Anthropometric Measurements done for each body dimension.

Table 1. Equipment assessment on the different tasks

Dimension	Body Dimension	Workplace measurements	Anthropometric measurements	Assessment
		X-ray		
X-ray Tube	Overhead reach	185cm (average)	185.34cm - 216.39cm	Acceptable
X-ray table	Waist Height	80cm(average)	78.10cm - 91.16cm	Does not accommodate 5th percentile female
Wall chest stand	Shoulder Height	100 - 145cm (average) adjustable	120.55cm - 140.71cm	Acceptable
		Ultrasound		
Chair Height	Popliteal Height	35cm-40cm	36.93cm- 43cm	Does not accommodate 95^{th} male
Chair seat	Hip Breadth	45cm	36.21cm-	Acceptable

width			44.51cm	
Ultrasound holders	Popliteal Height + Thigh clearance	90cm	49.58cm- 57.62cm	Acceptable
Ultrasound Monitor	Sitting Eye height	110cm-130cm	40 + 68.68cm - 81.98cm	Does not accommodate 5th female
Ultrasound Keyboard	Popliteal Height + Thigh clearance	90cm	49.58cm- 57.62cm	Acceptable
Bed height	Popliteal Height + Thigh clearance	50cm	49.58cm - 57.62cm	Does not accommodate 95th male and female
CT-scan				
Chair height	Popliteal Height	35cm-40cm	36.93cm - 43cm	Does not accommodate 95th male
Workstation table	Popliteal Height + Thigh clearance	60cm	49.58cm - 57.62cm	Acceptable
Chair arm rest	Sitting elbow height	16cm	17.10cm - 20.64	Does not accommodate 95th male
Chair seat width	Hip Breadth	45cm	36.21cm - 44.51cm	Acceptable
MRI				
Chair height	Popliteal Height	35-40cm	36.93cm - 43cm	Does not accommodate 95th male
Workstation table	Popliteal Height + Thigh clearance	60cm	49.58cm - 57.62cm	Acceptable
Chair arm rest	Sitting elbow height	16cm	17.10cm - 20.64	Does not accommodate 95th male
Chair seat width	Hip Breadth	45cm	36.21cm - 44.51cm	Acceptable

In Figure 1, the result of the CMDQ survey shows which body part is commonly affected for the different tasks.

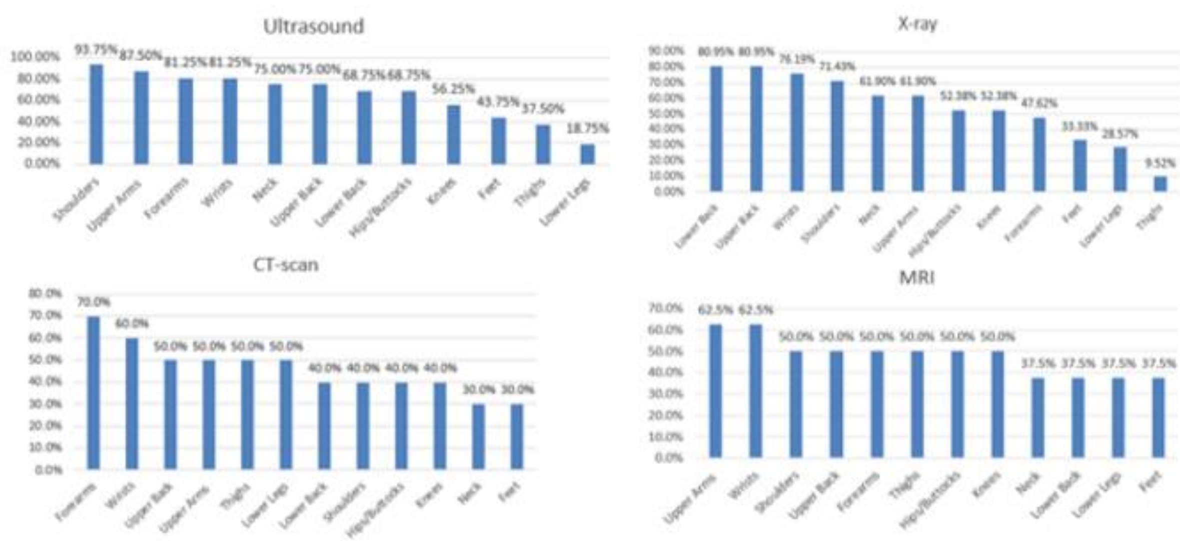

Figure 1 Frequency of MSD on different tasks

Table 2 shows the different RULA score for the different tasks of the radiologist. Different positions were assessed to compute for the RULA scores for the different tasks within the scope of radiology Department.

Table 2. RULA Assessment for the different tasks

RULA Assessment for Ultrasound			
Position	Wrist arm score:	Neck, Trunk and Leg score	Final RULA score:
Assist the patient in lying down the bed	6	6	7
Looking at the monitor while sitting down	5	7	7
Using the keyboard while sitting down	6	4	6
Assist the patient getting off the bed	5	5	6
RULA Assessment for X-ray			
One Worker Lifting the Patient from the wheel chair to the bed	5	6	7
One Worker Lifting the Patient from the bed to the wheel chair	5	6	7
RULA Assessment for CT-scan			
Radiologist positioning the patient in the table	3	2	2
Radiologist working on the computer	4	3	3
RULA Assessment for MRI			
Radiologist positioning the patient in the table	3	2	2
Radiologist working on the computer	4	3	3

Table 3 shows the statistical treatment of the radiologist. Having a p-value of less than the significance level of 0.05 defines that the factor (age, weight, and height) being compared have a significant difference between the response variable (CMDQ score). The smallest height surveyed in the ultrasound is 148 cm and the tallest is 172cm. The youngest age surveyed in the x-ray is 23 years old and the oldest age recorded is 45 years old.

Table 3. One-way ANOVA: Total CMDQ Score versus different factors for all task

	Ultrasound		**X-ray**		**CT-scan**		**MRI**	
Variable	**P-Value**	**Significant difference**	**P-Value**	**Significant difference**	**P-Value**	**Significant difference**	**P-Value**	**Significant difference**
Age	0.399	Not significant	0.034	Significant	0.454	Not significant	0.362	Not significant
Weight	0.441	Not significant	0.284	Not significant	0.905	Not significant	0.492	Not significant
Height	0.044	Significant	0.397	Not significant	0.528	Not significant	0.852	Not significant

4. Discussion

The four tasks in the Radiology department were considered in the study the x-ray, ultrasound, CT-scan, and MRI. Using the RULA the different position were scored and it shows that what are the tasks needed to be investigate or change. The different measurements for the equipment used in the x-ray were compared with the current anthropometric measurements of the workers. The height of the x-ray table does not accommodate the 5th percentile female workers. The different measurements for the equipment used in the ultrasound were compared with the current anthropometric measurements of the workers. The problems identified based on the measurement are the height of the ultrasound monitor, chair height and the bed height. The equipment being used in the CT-scan task are the following: the computer, chair, computer table and the CT-scan machine. Since the scanning of the patient is being operated on the computer, the workers are doing its task there. The problem that were identified are the chair height and the height of the arm rest. The task for the MRI is identical with the CT-scan task that is why the measurement for the different parts are almost identical. The problem identified are the height of the arm rest and height of the chair. Through survey, the demand of the radiologist were identified. Based on the result of the survey the most important need is the comfortability in the workplace. Different ergonomic interventions were suggested such as ergonomically design chair that is suitable for the workers, vertical arm support, Electronic bed, Electronic x-ray table, and cushion. After implementing the ergonomic interventions in the radiology department, Failure Mode and Effect Analysis was used to determine and evaluate the different potential failures of the product that could cause a risk to the users. It was a procedure to help identify every possible failure mode of the chair, vertical arm support, electronic bed, cushion, mobile hoist and electronic table.

5. Conclusion

The following tools were used to determine if MSD exists in the task of the radiologist, the RULA and anthropometric measurement were able to identify which of the following task in the department MSD exist. Through the use of RULA, the researcher was able to identify which task affects their performance. In the x-ray task, the workers scored 7 when it lifts the patient to the table. In the ultrasound the workers scored 7 when looking at the monitor while sitting down. 5 when examining the patient using the transducer, and 6 while the radiologist is using the keyboard of the machine while sitting down. Both in the task of MRI and CT-scan had a RULA score of 3 when they are using the computer in examining the patient. From the result of the CMDQ survey and RULA analysis, wrist, forearm, shoulders, back, and neck are the most affected parts of the body of the radiologist. The researcher came up with an intervention that helped lessen the discomfort the workers feeling on their task. Interventions such as vertical arm support, cushion, mobile hoist, electronic bed, ergonomic chair and electronic table proves lessens the discomfort the workers feels on their task. The different risks on the intervention and new design chair in the radiology department were assessed using the FMEA tool. The different causes of the risk were determined and what are the effects of it. Contingency plans were made on the different risks that may arise on the new interventions.

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