Radiation Protection Measures Taken In Designing Of The X-Ray Room And Installation Of The X-Ray Machines At The Departments Of Radiography Of Private Hospitals In The Municipal Area Of Kandy-Sri Lanka

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Abstract- Ionizing radiation is used in medical examinations. It causes microscopic damage to living tissue. Radiation protection in medical radiography provides vital information on radiation protection. The general objectives of this study were to describe the measures taken for radiation protection in the x-ray rooms at the departments of radiography of selected private hospitals in the municipal area of Kandy and the specific objectives were to find out the details of room designing with relevance to radiation protection and to compare above with the standard guidelines. This was a descriptive study.Three departments of x-ray of the private hospitals of the Kandy municipal area were selected as the sample of the study. Measurements were taken by using standard measuring tape. Data collection was done in a quantitative manner. Data analysis was done by comparing the measurements which were taken in hospitals with the AEA(Atomic Energy Authority, Sri Lanka) standards. Some of the major noncompliance was: x-ray room situated in high occupancy area at Hospital 1 ,Inadequate wall thickness of the x-ray room at Hospital 1 and Hospital 2,Entrance door opening to the occupancy area at Hospital 1,Interlock system or warning indicator was not attached to the door at three departments,Inadequate wall thickness of the control panel at Hospital 1,Incorrect construction material of the wall of the control panel was at Hospital 1,Erect bucky fixed as primary beam directed towards the occupied area at Hospital 2 and Hospital 3,Patient waiting area is provided in front of the entrance door at Hospital 2 etc. Compatible measurements with AEA standards at the three departments of radiography under study were:Room dimension was compatible with AEA standards,Material of the wall of the x-ray room,Type of the door,Lead thickness of the door,Number of doors kept minimum as described by the AEA standards,Lead glass thickness of the control panel. Radiation protection measures taken in designing of the x-ray room and installation of the x-ray machines at the departments of radiography of private hospitals in the municipal area of Kandy revealed that some important measurements in the departments under study are incompatible with AEA standards and most of them are compatible with AEA standards.
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Index Terms- Ionizing radiation,x-ray room,radiation protection,AEA

I. Introduction

Radiation is a process where energy emitted by one body traveling in a straight line through a medium or through space.
Radiation comes from the sun, nuclear reactors, microwave ovens, radio antennas, X-ray machines, and power lines, to name a few. Radiation can be classified as either ionizing or non-ionizing.[1][2]
Ionizing radiation is used in medical examinations such as Plain radiography, Computed tomography, Nuclear medicine and Mammography.Ionizing radition can cause biological damage to living tissue at high exposures and statistically elevated risks of cancer, tumors and genetic damage at low exposure for longer period of time.[3]
Radiation protection is the science of protecting people and the environment from the harmful effects of ionizing radiations. [4][5]Radiation protection can be divided into three categories. One is occupational radiation protection, which is the protection of radiation workers. Second one is medical radiation protection, which is the protection of patients and the third one is public radiation protection, which is protection of individual members of the public and of the population as a whole.[6]

II. Material and Method

The study was carried out at the three departments of x-ray of the private hospitals of the Kandy municipal area, Sri lanka. This was a descriptive study. Questionnaire was used to record the data. The study was carried out at the three departments of x-ray of the private hospitals of the Kandy municipal area. Location of the x.ray room, Room dimension(length,width),shielding of the

entrance door, Construction of the wall of the x.ray room, Lead glass thickness of control panel, Location of the erect bucky, Patient waiting area were checked for this study. Measurements were taken by using standard measuring tape. Data analysis was done by comparing the measurements which were taken in hospitals with the AEA standards.

III. RESULTS

Below table, contain the variable measurements of three x-ray departments

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Table 1. Location of the room in the hospital under study

Hospital	**High occupancy area**	
	Yes	**No**
Hospital 1	✓	
Hospital 2		✓
Hospital 3		✓

Table 2.Room dimensions in the hospitals under study

Measurement	**Hospital 1**	**Hospital 2**	**Hospital 3**	**AEA standards**
Length	5.7m	5.64m	6m	5m
Width	3.4m	5.05m	3.4m	4m
Room size	$19.4m^2$	$28.5m^2$	$20.4m^2$	$20m^2$

Table 3.Construction of the wall in the hospitals under study

Measurement	Hospital 1	Hospital 2	Hospital 3	AEA	
Material	Brick	Brick	Brick	Brick	Concrete
Thickness	28cm	26cm	32cm	30cm	20cm

Table 4.Control panel

Measurement	Hospital 1	Hospital 2	Hospital 3	AEA
Dimension of the viewing glass	36x46cm^2	65x32cm^2	20x20cm^2	30x30cm^2
Lead glass thickness of control panel	1.5mm	2.5mm	1.5mm	1.5mm
Material of the wall	Brick	concrete	lead	20cm thick concrete wall or 1.5mm lead sheet

Table 5.Location of the erect bucky

According to AEA standard, the erect bucky should be fixed to ensure that the primary beam is directed to less occupied area.

Hospitals	Primary beam direction	
	Towards occupied area	Towards unoccupied area
Hospital 1		✓
Hospital 2	✓	
Hospital 3	✓	

Table 6. Patient waiting area

Patient waiting areas must be provided outside the x-ray room according to AEA standard.

Hospitals	Outside from the x-ray room	
	Yes	No
Hospital 1	✓	

Hospital 2	✓ But in front of the entrance door	
Hospital 3	✓	

IV. DISCUSSION

According to AEA standards, the room location should be as far away as feasible from area of high occupancy and general traffic such as maternity and pediatric wards and other departments of the hospital that are not related to radiation and its use**.** The x-ray room location of one hospital is directly related with high occupancy area. It is not compatible with AEA(Atomic Energy Authority) standards.

The dimension of the room in an x-ray department should aim at providing integrated facilities so that handling of X-ray equipment and related operation can be conveniently performed with adequate protection. The minimum room dimensions of a standard x-ray room are as follows

Width of the room 4m
Length of the room 5m
Dimension of the room 20m^2

The dimensions of all the x-ray rooms are acceptable with standard values.

The walls of the x–ray room should have additional shielding, especially in relation to radiation protection of members of the general public. If it is concrete, thickness should be 20cm and Brick should be 30cm. The thickness of wall of the one hospital has adequate shielding by comparing AEA standards. The thicknesses of wall of the others have less shielding.

The number of the doors for entry to the X –ray room should be kept as minimum and shielding should be provided. Doors and door frames leading to x-ray should be lined with 1.5mm of lead to protect from leakage and scatter radiation main entrance door should be opened to high occupancy area. Shielding of the entrance door of three hospitals is acceptable with AEA standards.

The operators control station for all radiography procedures should be either in a separate room or in a protected booth or behind a fixed shield which will intercept the primary x –ray beam and scatter radiation .Cubicle should be made either with 20cm thick concrete walls or 1.5mm lead sheets.1.5mm lead equivalent glass should be fitted to the control panel to observe the patient .Window frames must have same lead equivalent of lead sheet in contact with the lead glass and must have an overlap of at least1cm.The minimum dimensions of the viewing window is 30x30cm.

Control panel of the Hospital 3 is located inside the x-ray room cubicle is made up of 3mm thickness of lead sheet. Control panel of the Hospital 1 is attached to the x-ray room. Cubicle is made up of 28cm thickness of brick wall. Control panel of the Hospital 2 is inside the x-ray room. Cubicle is made up of 26cm thickness of concrete wall. Wall thickness of the control panel of Hospital 3 and Hospital 2 are compatible with the AEA standards. But wall thickness of the control panel of Hospital 1 is slightly below the AEA standards

Dimension of the viewing windows of Hospital 3 control panel, Hospital 1 control panel and Hospital 2 control panel are 20x 20cm, 36x 46 cm, 65x32 cm. Hospital 1 and Hospital 2 both have acceptable value for dimension of the viewing window as describe by the AEA standards. But Hospital 3 has fewer dimensions for the viewing window.

And all three hospitals have 1.5mm thickness of lead in viewing window as described by the AEA standards.

The erect bucky of the Hospital 3 and Hospital 2 are fixed that the primary beam is focused on occupied area. The erect bucky of the Hospital 1 is fixed that the primary beam is focused on unoccupied area. Location of the erect bucky of the Hospital 1 x-ray room is only acceptable to AEA standards.

Patient waiting area of the three hospitals is provided outside the x-ray room. But waiting area of the Hospital 2 is located in front of the entrance door. That door has space between door panels. Therefore patients can get exposed. Patient waiting area of the Hospital 1 and Hospital 3 are compatible with AEA standards.

V.CONCLUSION

Radiation protection measures taken in designing of the x-ray room and installation of the x-ray machines at the departments of radiography of private hospitals in the municipal area of Kandy revealed that some important measurements in the departments under study are incompatible with AEA standards and most of them are compatible with AEA standards.

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