Evaluation of X-ray Exposure to Radiology Staff in Some Hospitals of Babylon Governorate

Zainab Hasan Hussein, Nihad Abdul Ameer and Eman Shakir

Abstract--- *After almost all hospitals use X-rays for medical diagnosis now it have become clear that expanded or repeated publicity to this radiation is considered a danger, so it was important to distinguish or measure radiation by devices to protect the medical staff from unnecessary radiation. The aim of this study was to measure the severity of X-ray on the radiologist and calculate the weekly and annual dose equivalent in an clinical imaging radiology department in different Babylon hospitals. Therefore, the purpose of this work is to limit the amount of ionization levels in workers and to identify the effects of different parameters on staff dosages. The measurements will be done at three different locations, before and after the protective barrier inside the examination unit and the third one is outside in the corridor at eight Hospitals within the province of Babylon. The distances from the X-ray tube were (0,20,40,60,80,100) cm to Radiologist position. Determinants of radiation risk include not only radiation dose levels but also clinical workforce ages, intercourse and their location. These elements can decrease or increase the hazard of publicity.*

Keywords--- *Radiation, Exposure, Imaging, Department-radiology, Babylon.*

I. INTRODUCTION

Radiology acting an critical role in contemporary medication. Many of the diagnostic and radiology departments techniques contain publicity to radiation [1]. Ionizing radiation is one of the main dangers affecting healthcare patients and workers wide-reaching. Exceptional interest ought to be paid to scientific body of workers near the radiological gadget by using measuring the radiation values, personal dosimeters are worn by worker [2]. The principles of radiation protection and radiological safety include protection of workers from the risky effects of publicity to ionizing radiation. [3] They are essentially based on the International Commission for Radiation Protection (ICRP) principles, which stipulate that no practice that causes or can cause radiation exposure shall take place unless the benefit to the exposed individuals or the society exposed to the radiation exceeds the radiation damage caused [4][5]. All radioactive sources and radiological installations should be equipped with the best possible safety and the lowest number of people should be exposed to radiation taking into account the economic and social factors known as the principle of “as low as reasonably achieved (ALARA) [6]. Furthermore, they should be legally authorized to perform the exercise involving a radioactive source of primary responsibility for radiological protection.

1In addition, the staff should be continuously trained and a culture of safety should be developed [7] [8]. All means and tools that help to ensure safety should be achieved through good management, periodic safety assessment, and lessons learned from others experience and previous radiological incidents [9]. These work is meant

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as a guide to the lows nearly possible dose for radiology of the Babylon Hospitals, interventional radiology department.

II. Materials and Methods

This study was carried out in eight major hospitals in Babil Governorate/Iraq, where it targeted the technicians and medical staff working in X-ray units.,[10] of different type:(Shimadzu/Villa/GE/Siemens) in the radiology and medical imaging departments.[11] The radiation dosages received by the medical personnel and X ray technicians running inside the radiology and medical imaging departments become measured via the Geiger counter (Inspector Exp), and after that the weekly dose equal and the annual dose equal had been calculated in µS/h gadgets for every of the 3 places so as to be referred to later. It is through the formulation below:

$$W.D.E= N; O * T* R(0)/3600 \quad (1)$$

$$A.D.E= N; O *T* R(0)* 52(week)/3600 \quad (2)$$

Where:

W.D.E represented the weekly dose equivalent

A.D.E represented the annual dose equivalent

N; O represented the number of exposure.

T represented the time of examination.

R(0) represented the reading at zero distance from the tube.

When radiological doses are measured, X ray technicians and scientific staff are of their recurring locations. The distances from these places to the X-ray tube have been determined to be (0,20,40,60,80,100)cm for medical group of workers and X-ray technician. The measurements will be carried out at three exclusive position:

1. Before the protective barrier inside the examination units.
2. After the protective barrier inside the examination units.
3. Outside the examination units in the corridor. [12] figure (1).

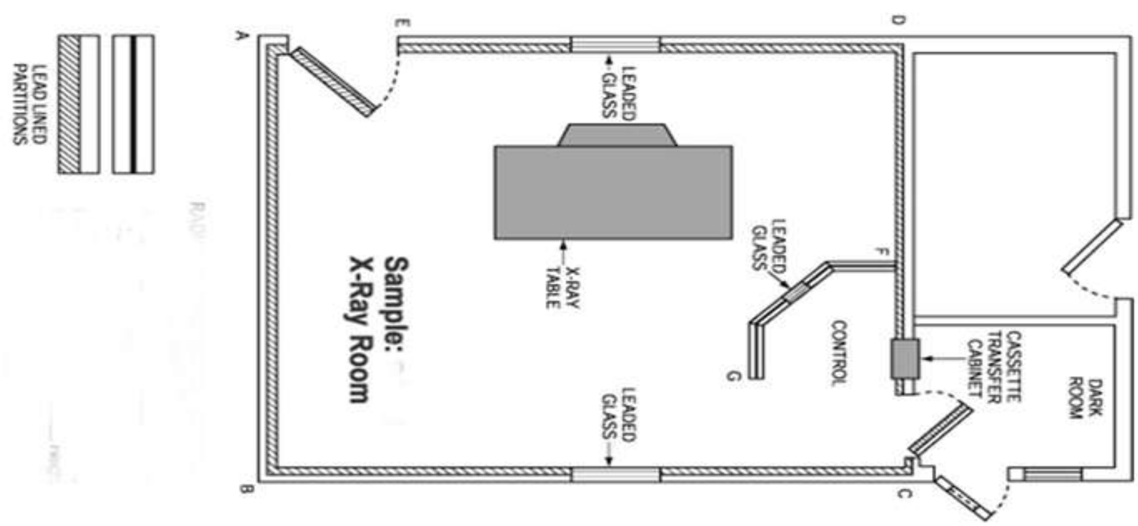

Figure 1: X-ray Room

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III. RESULTS

The statistics received for 3 distinctive places in eight specific hospitals, as a characteristic of distance from the X-ray tube, are presented in tables (1–10). The most dose is observed at beginning. When the distance from the X-ray tube increases, the radiation dose will decrease to the given location.[11].

In Figures (2-3) It is able to be determined that the values for the weekly dose equal and the annul dose equal range between the 8 hospitals, where the value will increase in health center A after which decreases in health center B, and so on for the rest of the hospitals; this is because the difference inside the wide variety of each day examinations of patients for every clinic where as the variety of day by day exam will increase for sufferers the number of radiological exposures will growth for the scientific team of workers and X-ray technicians inside the radiology departments and vice versa.

Table 1: Measured Radiation Dose as a Characteristic of Distances at X-ray Tube... Hospital Code (A)

Distance cm	*Before the barrier MS/h*			*After the barrier MS/h*			*In the corridor MS/h*		
	The Min dose	*The Max dose*	*The average*	*The Min dose*	*The Max dose*	*The average*	*The Min dose*	*The Max dose*	*The average*
0	1.180	1.190	1.185	0.766	0.774	0.77	0.107	0.113	0.11
20	1.175	1.180	1.177	0.740	0.752	0.746	0.101	0.106	0.103
40	1.170	1.178	1.174	0.722	0.732	0.727	0.095	0.098	0.096
60	1.156	1.168	1.162	0.718	0.720	0.715	0.081	0.088	0.084
80	1.071	1.077	1.074	0.702	0.712	0.707	0.062	0.075	0.068
100	1.062	1.068	1.065	0.692	0.680	0.686	0.055	0.061	0.058

Table 2: Measured Radiation Dose as a Characteristic of Distances at X-ray Tube… Hospital Code B

Distance cm	*Before the barrier MS/h*			*After the barrier MS/h*			*In the corridor MS/h*		
	The Min dose	*The Max dose*	*The average*	*The Min dose*	*The Max dose*	*The average*	*The Min dose*	*The Max dose*	*The average*
0	1.113	1.119	1.116	0.611	0.622	0.666	0.047	0.053	0.05
20	1.111	1.113	1.112	0.589	0.609	0.599	0.043	0.046	0.044
40	1.109	1.112	1.110	0.571	0.580	0.575	0.038	0.041	0.039
60	1.104	1.108	1.106	0.532	0.558	0.545	0.033	0.038	0.035
80	1.101	1.107	1.104	0.482	0.511	0.496	0.026	0.028	0.027
100	1.066	1.076	1.071	0.467	0.472	0.468	0.022	0.027	0.024

Table 3: Measured Radiation Dose as a Characteristic of Distances at X-ray Tube … Hospital Code (C)

Distance cm	*Before the barrier MS/h*			*After the barrier MS/h*			*In the corridor MS/h*		
	The Min dose	*The Max dose*	*The average*	*The Min dose*	*The Max dose*	*The average*	*The Min dose*	*The Max dose*	*The average*
0	1.163	1.166	1.164	0.259	0.287	0.273	0.074	0.081	0.077
20	1.156	1.161	1.158	0.246	0.253	0.249	0.066	0.071	0.068
40	1.137	1.143	1.14	0.232	0.241	0.236	0.046	0.053	0.049
60	1.126	1.132	1.129	0.181	0.212	0.196	0.035	0.042	0.038
80	1.119	1.121	1.12	0.155	0.168	0.161	0.022	0.029	0.025
100	1.105	1.112	1.108	0.125	0.145	0.135	0.012	0.019	0.015

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Table 4: Measured Radiation Dose as a Characteristic of Distances at X-ray Tube … Hospital Code D

Distance cm	*Before the barrier MS/h*			*After the barrier MS/h*			*In the corridor MS/h*		
	The Min dose	*The Max dose*	*The average*	*The Min dose*	*The Max dose*	*The average*	*The Min dose*	*The Max dose*	*The average*
0	1.074	1.084	1.079	0.113	0.119	0.116	0.053	0.057	0.055
20	1.051	1.069	1.06	0.101	0.107	0.104	0.046	0.051	0.048
40	1.022	1.038	1.03	0.091	0.099	0.095	0.038	0.042	0.04
60	0.958	0.964	0.961	0.083	0.089	0.086	0.031	0.035	0.033
80	0.932	0.943	0.937	0.071	0.078	0.074	0.022	0.028	0.025
100	0.912	0.929	0.920	0.066	0.069	0.067	0.018	0.021	0.019

Table 5: Measured Radiation Dose as a Characteristic of Distances at X-ray Tube Hospital Code (E)

Distance cm	*Before the barrier MS/h*			*After the barrier MS/h*			*In the corridor MS/h*		
	The Min dose	*The Max dose*	*The average*	*The Min dose*	*The Max dose*	*The average*	*The Min dose*	*The Max dose*	*The average*
0	1.177	1.180	1.178	0.621	0.634	0.627	0.056	0.061	0.058
20	1.167	1.174	1.170	0.604	0.612	0.608	0.049	0.052	0.050
40	1.151	1.162	1.156	0.581	0.592	0.586	0.032	0.044	0.038
60	1.133	1.143	1.138	0.552	0.571	0.561	0.024	0.029	0.026
80	1.113	1.124	1.118	0.499	0.538	0.518	0.019	0.021	0.02
100	1.101	1.106	1.103	0.477	0.481	0.479	0.012	0.016	0.014

Table 6: Measured Radiation Dose as a Characteristic of Distances at X-ray Tube Hospital Code (F)

Distance cm	*Before the barrier MS/h*			*After the barrier MS/h*			*In the corridor MS/h*		
	The Min dose	*The Max dose*	*The average*	*The Min dose*	*The Max dose*	*The average*	*The Min dose*	*The Max dose*	*The average*
0	1.151	1.157	1.154	0.341	0.343	0.342	0.073	0.081	0.077
20	1.138	1.143	1.140	0.328	0.335	0.331	0.066	0.072	0.069
40	1.131	1.133	1.132	0.314	0.322	0.318	0.052	0.057	0.054
60	1.119	1.125	1.122	0.292	0.298	0.295	0.035	0.043	0.039
80	1.113	1.116	1.114	0.261	0.276	0.268	0.022	0.028	0.025
100	1.101	1.106	1.103	0.251	0.258	0.254	0.013	0.017	0.015

Table 7: Measured Radiation Dose as a Characteristic of Distances at X-ray Tube … Hospital Code (G)

Distance cm	*Before the barrier MS/h*			*After the barrier MS/h*			*In the corridor MS/h*		
	The Min dose	*The Max dose*	*The average*	*The Min dose*	*The Max dose*	*The average*	*The Min dose*	*The Max dose*	*The average*
0	1.190	1.192	1.191	0.550	0.557	0.553	0.064	0.072	0.068
20	1.181	1.188	1.184	0.543	0.546	0.544	0.057	0.061	0.059
40	1.175	1.180	1.177	0.536	0.541	0.538	0.044	0.052	0.048
60	1.166	1.172	1.169	0.527	0.533	0.53	0.036	0.041	0.038
80	1.154	1.163	1.158	0.517	0.520	0.518	0.022	0.028	0.025
100	1.144	1.147	1.145	0.509	0.511	0.51	0.017	0.019	0.018

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Table 8: Measured Radiation Dose as a Characteristic of Distances at X-ray Tube … Hospital Code (H)

Distance cm	*Before the barrier MS/h*			*After the barrier MS/h*			*In the corridor MS/h*		
	The Min dose	*The Max dose*	*The average*	*The Min dose*	*The Max dose*	*The average*	*The Min dose*	*The Max dose*	*The average*
0	1.171	1.177	1.174	0.752	0.766	0.759	0.056	0.067	0.061
20	1.154	1.167	1.160	0.736	0.743	0.739	0.044	0.051	0.047
40	1.071	1.073	1.072	0.718	0.720	0.719	0.033	0.037	0.035
60	1.062	1.069	1.065	0.703	0.711	0.707	0.021	0.031	0.026
80	1.047	1.055	1.051	0.674	0.689	0.681	0.016	0.018	0.017
100	1.028	1.041	1.034	0.639	0.652	0.645	0.011	0.014	0.012

Table 9: Weekly Dose Equivalent

The codes	***The weekly dose equivalent before the barrier MS***	***The weekly dose equivalent after the barrier MS***	***The weekly dose equivalent in the corridor MS***
A	0.09875	0.02695	0.00916
B	0.0868	0.02368	0.00388
C	0.04075	0.02275	0.00271
D	0.01678	0.00258	0.00085
E	0.01145	0.00610	0.00056
F	0.01897	0.00266	0.00059
G	0.01736	0.00807	0.00099
H	0.01547	0.00354	0.00028

Table 10: Annual Dose Equivalent

The codes	***The annual dose equivalent before the barrier MS***	***The annual dose equivalent after the barrier MS***	***The annual dose equivalent in the corridor MS***
A	5.135	1.401	0.476
B	4.513	1.231	0.202
C	2.119	1.183	0.141
D	0.872	0.693	0.044
E	0.595	0.317	0.029
F	0.466	0.138	0.031
G	0.903	0.419	0.051
H	0.284	0.184	0.014

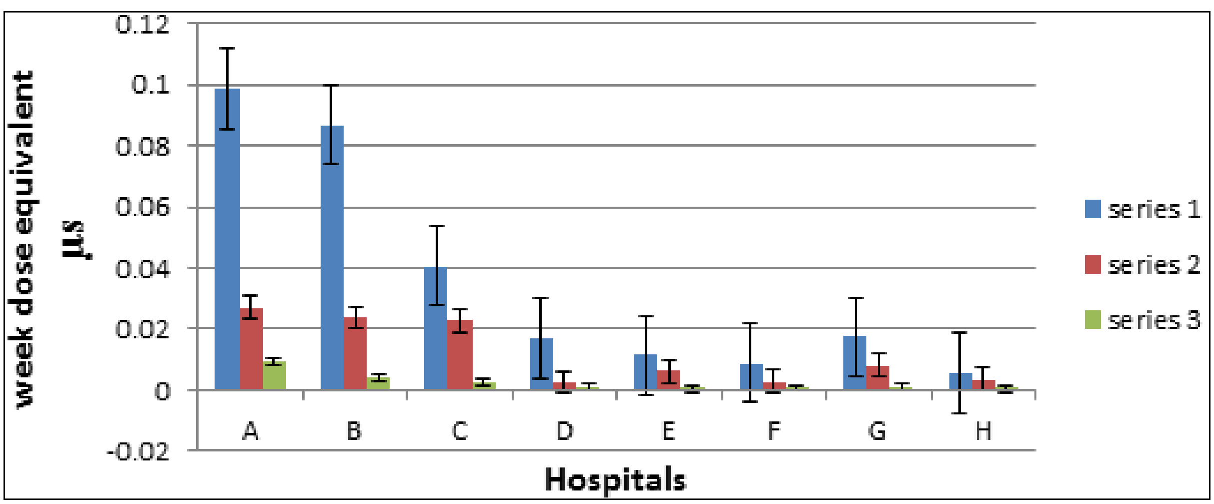

Figure 2

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Figure (2) average weekly dose equivalent in the various hospitals. When category A represents the first hospital as the first blue column represents the weekly dose equivalent before the barrier and the second red color column represents the dose equivalent after the barrier and the third green color represents the dose equivalent in the corridor and so for the categories B,C,D,E,F,G and H.

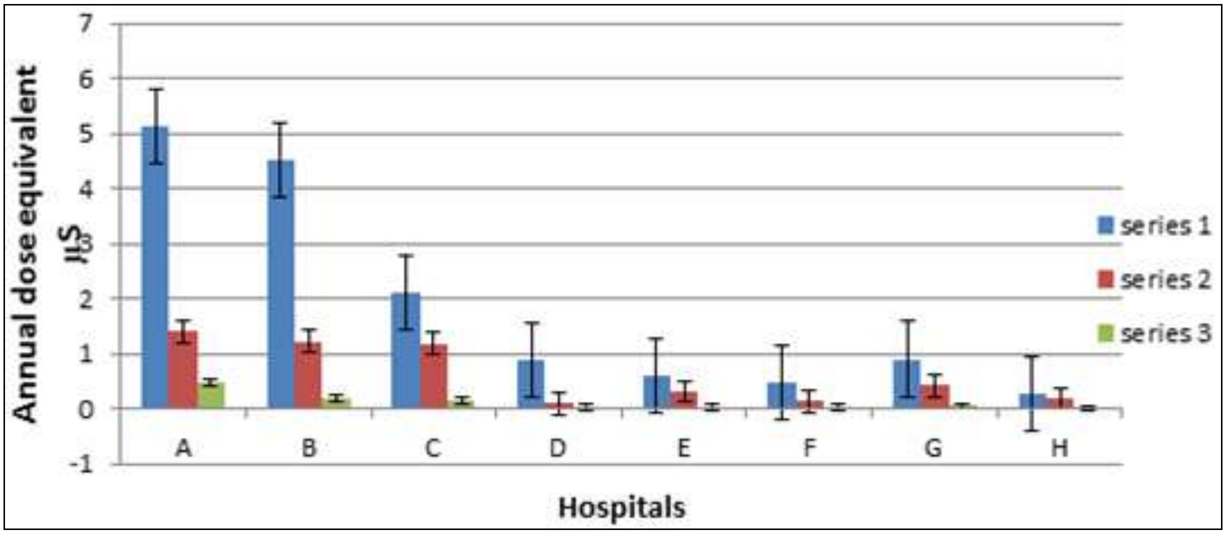

Figure 3

Figure (3) average annual dose equivalent in the various hospitals. When category A represents the first hospital as the first blue column represents the annual dose equivalent before the barrier and the second red color column represents the dose equivalent after the barrier and the third green color represents the dose equivalent in the corridor and so for the categories B,C,D,E,F,G and H.

IV. Discussion

Measuring the radiation level in the work environment (radiology and medical imaging departments) in hospitals is an essential part of the radiation protection program in order to ensure that the medical staff working in these departments are not exposed to radiation doses that exceed the annual exposure limit, this procedures should be applied in safely and accurately in order to maximally reduce the stochastic effects and deterministic[13][16]

The study conducted in this research concerned with the above, as all the measurements taken in the three locations mentioned in the tables (1-8) were significantly below the annual occupational limit (This means that the protection and shielding methods are good and highly efficient in the radiation units).[12]

But the medical workforce have to be cautious because of the cancer danger associated with radiation exposure.[15]Whereas, the more exposure to radiation, the greater the possibility of health risks for workers in the radiation field. Also, if there is a leak in the radiation source or in the of X-ray equipment, the biological risks of the medical staff and X-ray technicians will be more severe. [11]

Therefore, when designing an X-ray room, consideration must be given to the application of the ALARA principle, that is, the design and shielding of doors, walls, ceilings and the barrier must be very ideal [14].

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V. CONCLUSION

1. The radiation recorded before the barrier is more than both agencies(one after the barrier and one after the unit) and it is within the across the world permissible values and this is recorded in all hospitals(safety is ideal)
2. The choice of distance points should be far from the tube to avoid X-rays, as the areas near it are highly exposed.
3. It is necessary to protect the unexamined parts of the patient's body since the X-ray is before the barrier with high concentrations.
4. All scientific imaging units that use radiology should have neighborhood comments, The medical staff and technicians must commit to standing behind the protective barrier while examining a patient, wear an anti-radiation bullet proof vest, also carry personal dose scale (film badge) and continuously perform regular medical checks. All of these recommendations in order to protect themselves.

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