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Survey of Radiation Dose Levels in Patients in X-Ray Units of Some Selected Hospitals in Jos Metropolis

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ABSTRACT
The ionizing radiation is known to have hazardous incidences of cancers and health effects which have been reported to have risen on account of exposure to ionizing radiation like the x-rays. This study measured the radiation dose levels in patients in x-ray units of some selected Hospitals in Jos metropolis. These measurements were carried out in different locations of the x-ray units. The digital radiation detector Gamma Scout, a standard model with serial number A20 and 11829 meters was used to measure the radiation dose levels patients are exposed to during radiological examinations. The results showed increased in exposure and in some instances very high levels of unintentional exposure to radiation. From the study, a radiation dose value of between 2.31–7.72mSv/yr was measured at the radiology departments, which is beyond the prescribed limits of 1mSv/y for the general public. This study reports occupational exposure as well as exposure to the public and patients visiting the radiology department, of the selected Hospitals. The implication of these findings as seen in the plotted graphs showed that there is an obviously high health risk of radiation exposure for the exposed population visiting the radiology department of the three Hospitals selected.
Keywords: Health hazards, exposure, radiation, Dose rate, Dose level, Exposure factor

INTRODUCTION

X-rays are electromagnetic waves or photons not emitted from the nucleus of an atom but emitted by the energy changes in electrons. X-rays are radiation possessing high energy and penetrating power or capacity. They are classified as ionizing radiation, which are extensively used for industrial, medical diagnosis and therapeutic purposes. X-rays are categorised into hard and soft x-rays. Hard x-rays are radiations which have relatively high frequency, short wavelength, and high penetrating power with a little absorption to the skin. While soft x-rays have relatively low frequency, longer wavelength and low penetrating power with a greater absorption to the skin. It is a well known fact that radiation doses from the uses of ionizing radiation in medical diagnosis and treatment contributed to the collective dose from all man-made (artificial) sources of radiation, occupying about 15% of the total collection dose, rapidly increasing over the world due to their relatively high frequency (Park, 1998). Every body exposed to a variety of radiation, which range from visible to invisible (Jwanbot and Ike, 1999). Radiation is classified into two main categories depending on its ability to ionize matter. Non-ionizing radiation is a category of radiation that does not have enough energy to ionize atoms in the material it interact with, such as are microwaves, visible light, Radio waves, Tv waves and Ultraviolet radiation. Ionizing radiation has the ability to knock-off an electron from an atom (ie to ionize). These include alpha (α) particles, gamma (γ) rays, Beta (β) particles and x-rays (Giancoli, 2000).

Most health hazard of radiation to patients is reported to be arising on account of over exposure to ionizing radiation or high dose of radiation. Cancers, Leukemia, gene mutation, cataracts of the eye are some few health effects of radiation to patients on exposure to radiation. Equal exposure to different types of radiation expressed as gray does not necessarily produce the same or equal biological effects (UNSCEAR, 1998). Measurement of radiation dose to patients also provides essential information about radiographic facilities and techniques clearly where improvements are necessary which is important in the implementation of ALARA principle (Kathern, 1985).

The measurement of patients dose in various radiographic examinations has long been an issue of general interest to medical physicists as it forms a step towards a quantitative relation between the radiation and effect they produce (Greening, 1995). It is known that x-ray which is the most encountered radiation in diagnostic radiology have genetic effect, sterility and death on human beings which is due to high radiation doses. The knowledge of radiation exposure(x) expressed in units of milligray (mGy) of patients undergoing diagnostic examination is needed for the administration of radiation health. Such exposure may occur after the patient had been exposed or it may be necessary before radiation, in order to provide pre-irradiation knowledge of the dose to expect from a particular diagnostic procedure. This is particularly important in cases where the examination is complex requiring many cycles of irradiation. The effective dose expected to be delivered to the patients from the selected radiological parameter may require the measurement of exposure or exposure rate as a function of the tube voltage (V) in units of kilovolt peak (kvp).

The objective of this study is to establish and investigate the presence of radiation dose in different locations within the radiology department of some selected hospitals, to compare the radiation dose levels between these hospitals and also to delineate the level of occupational exposure of radiation to which the workers are exposed.

MATERIALS AND METHOD

The radiation level in this survey this study was carried out by measuring radiation dose in different locations of the radiology department. The radiation measurement was carried out on a single-phase x-ray machine at the x-ray units of the hospitals selected in *Jos* respectively. A typical voltage setting of 45-95KV was used for all adult patients. The exposure time(s), voltage (kV), and constant current (mA), for average size patients were chosen for different examinations. The measurement was taken in the x-ray room of three different hospitals using a digital radiation detector known as gamma scout calibrated across a wide range of 0.01μSv/hr to 100 μSv/hr. The radiation measurement was performed during the daytime between the hours of 9am-4pm. The background ionizing radiation (BIR) was measured for every location when the x-ray machine was switch on. The observed dose was taken during exposure of patient in an x-ray examination. The readings were read on the display screen of the device in microsieverts per hour and converted to millisieverts per year.

RESULTS AND DISCUSSION

The maximum radiation dose levels noted at seven location of the radiology for the purpose of statistical analysis. The results of the measurement obtained are given in the following tables:

Table 1 Radiation measurement for different locations of Hospital A

S/N	LOCATION	BIR µSv/hr	DOSE RATE µSv/hr	DOSE RATE mSv/yr
1	Exposure room	0.34	88.50	7.72
2	Cubicle	0.35	60.32	5.25
3	Darkroom	0.30	65.45	5.71
4	Corridor	0.24	32.36	2.81
5	Waiting room	0.21	63.33	5.53
6	At the door	0.36	83.98	7.33
7	Reception room	0.20	69.70	6.09

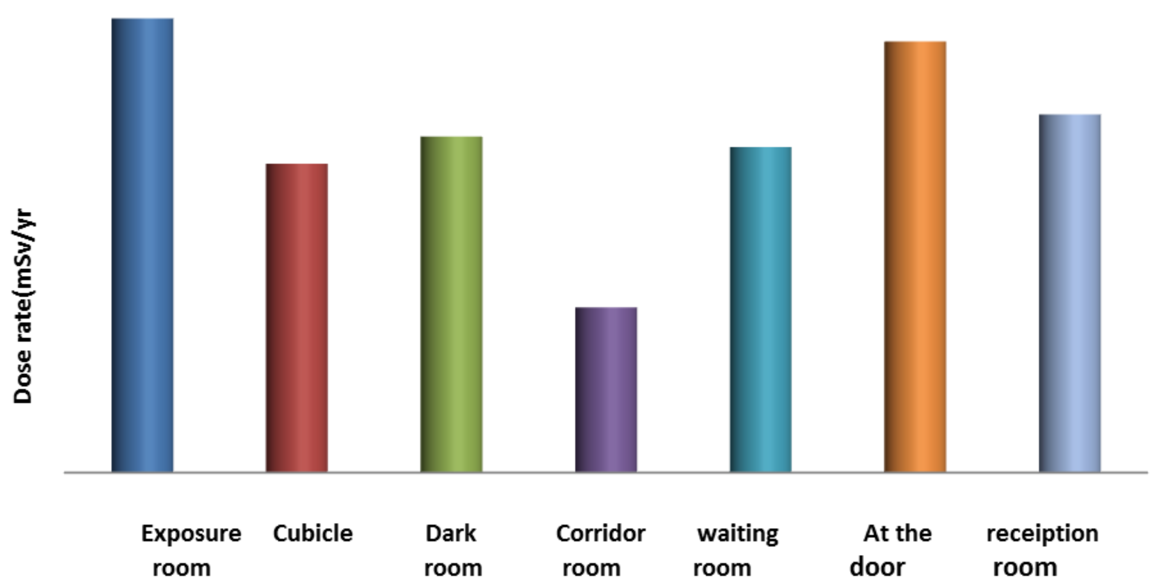

Figure 1: Dose rate vs location of Hospital A

Table 2 Radiation measurement for different locations of Hospital B

S/N	LOCATION	BIR µSv/hr	DOSE RATE µSv/hr	DOSE RATE mSv/yr
1	Exposure room	0.27	76.04	6.64
2	Cubicle	0.28	48.02	4.18
3	Darkroom	0.21	29.29	2.55
4	Corridor	0.22	26.56	2.31
5	Waiting room	0.20	32.48	2.83
6	At the door	0.30	40.28	3.50
7	Reception room	0.24	30.58	2.66

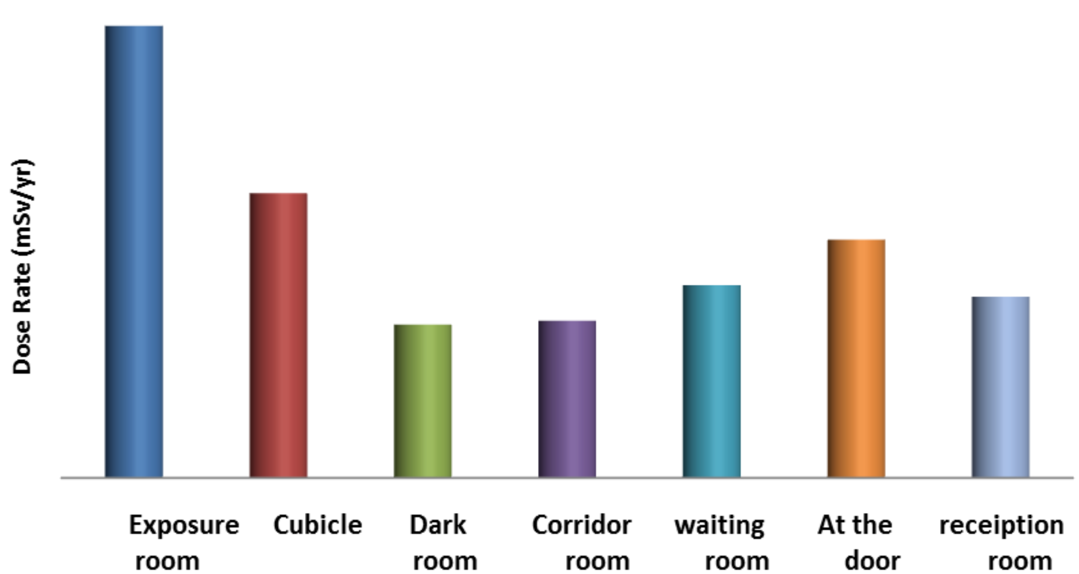

Figure 1 Dose rate against Locations of Hospital B

Table 3 Radiation measurement for different locations of Hospital C

S/N	LOCATION	BIR µSv/hr	DOSE RATE µSv/hr	DOSE RATE mSv/yr
1	Exposure room	0.24	70.20	6.13
2	Cubicle	0.23	66.66	5.82
3	Darkroom	0.25	30.70	2.67
4	Corridor	0.27	45.20	3.94
5	Waiting room	0.22	50.40	4.40
6	At the door	0.21	69.70	6.09
7	Reception room	0.20	60.70	5.29

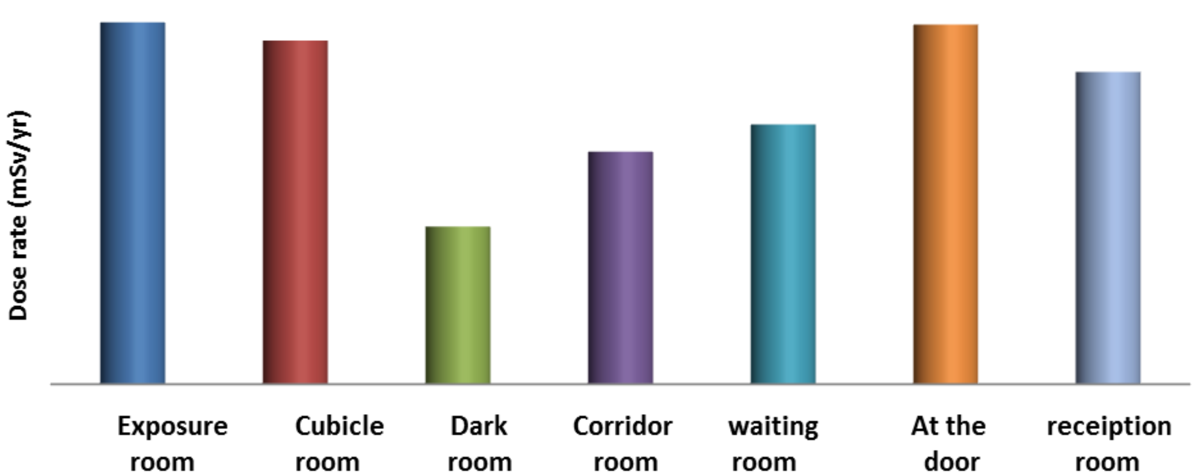

Figure 3 Dose rate against Locations of Hospital C

Table 4. Radiation Measurement of patient's examinations of Hospital A

S/N	TYPE OF EXAMINATION	LOCATION	VOLTAGE (kV)	CURRENT (mA)	TIME (s)	DOSE ATE (μSv/hr)	DOSE ATE (mSv/yr)
1	Chest	Cubicle	85	60	0.02	60.32	5.28
2	Chest	Exposure Room	85	60	0.03	63.33	5.54
3	Chest	Exposure Room	85	60	0.04	65.45	5.73
4	Chest	Exposure Room	85	60	0.05	69.70	6.10
5	Chest	Corridor	85	60	0.06	72.36	6.33
6	Abdomen	Exposure Room	85	60	0.70	77.02	6.74
7	Knee (AP)	Cubicle	85	60	0.08	79.54	6.96
8	Hand	Cubicle	85	60	0.09	81.64	7.15
9	Abdomen	At the door	95	70	0.10	83.98	7.35
10	Pelvic	Cubicle	125	70	0.11	88.50	7.75

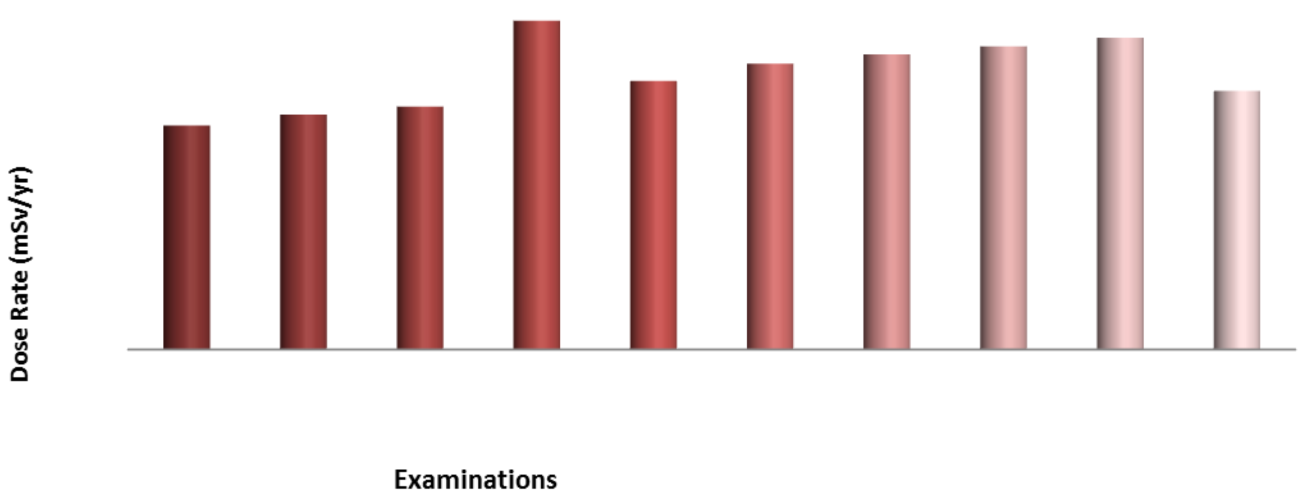

Figure 4 Dose rate (mSv/yr) against different examination of Hospital A

Table 5 Radiation Measurement of patient's examinations of Hospital B

S/N	TYPE OF EXAMINATION	LOCATION	VOLTAGE (kV)	CURRENT (mA)	TIME (s)	DOSE RATE (µSv/hr)	DOSE ATE (mSv/yr)
1	Chest	Corridor	94	77	1.10	26.56	2.32
2	HSG	Darkroom	94	77	1.20	29.29	2.56
3	Chest	Waiting Room	94	77	1.30	30.58	2.67
4	Hip	Waiting Room	94	77	1.40	32.48	2.84
5	Chest	Exposure Room	94	77	1.50	40.28	3.52
6	Pelvic	Cubicle	94	77	1.60	48.02	4.20
7	Hand	Exposure Room	94	77	1.70	62.40	5.46
8	Chest	Exposure Room	94	77	1.80	69.32	6.07
9	Chest	Exposure Room	94	77	1.90	74.04	6.48
10	Ankle	EX. Room	94	77	1.95	76.04	6.66

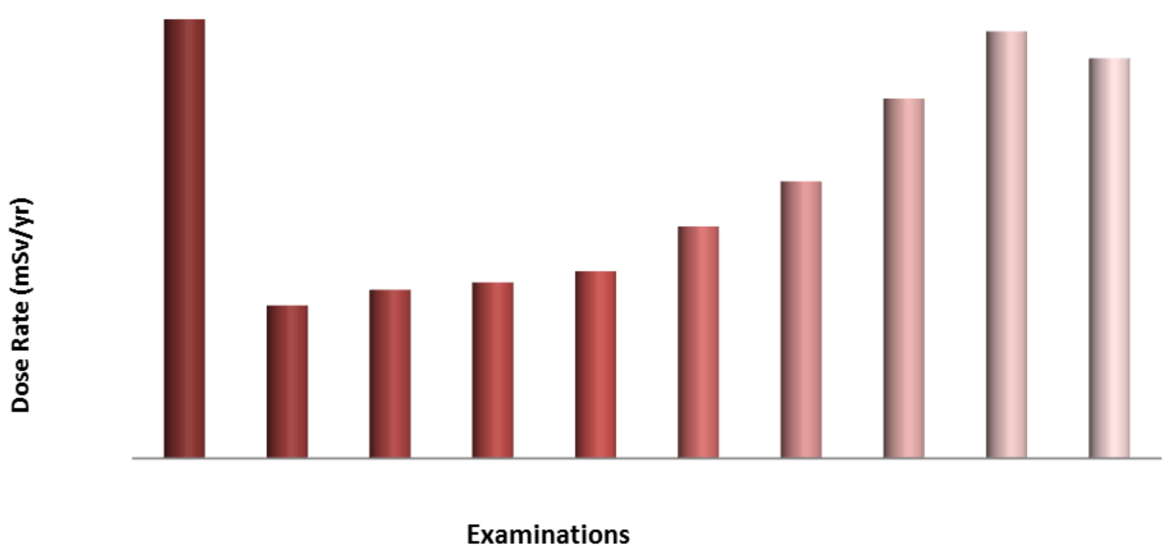

Figure 5: Dose rate against different examination of Hospital B

Table 6 Radiation Measurement of patient's examinations of Hospital C

S/N	TYPE OF EXAMINATION	LOCATION	VOLTAGE (kV)	CURRENT (mA)	TIME (s)	DOSE RATE (μSv/hr)	DOSE RATE (mSv/yr)
1	Chest	Exposure Room	45	8	0.20	66.66	5.83
2	Chest	Exposure Room	45	8	0.30	69.70	6.10
3	Chest	Exposure Room	50	8	0.40	70.20	6.14
4	Chest	Exposure Room	50	8	0.50	72.64	6.36
5	Chest	Exposure Room	55	8	0.60	76.80	6.72
6	Chest	Exposure Room	55	8	0.70	78.20	6.85
7	Chest	At the Door	60	8	0.80	80.40	7.04
8	Pelvic	At the Door	60	8	0.90	82.88	7.26
9	Leg	Exposure Room	65	8	1.00	86.90	7.61
10	Hand	Exposure Room	65	8	1.10	89.10	7.80

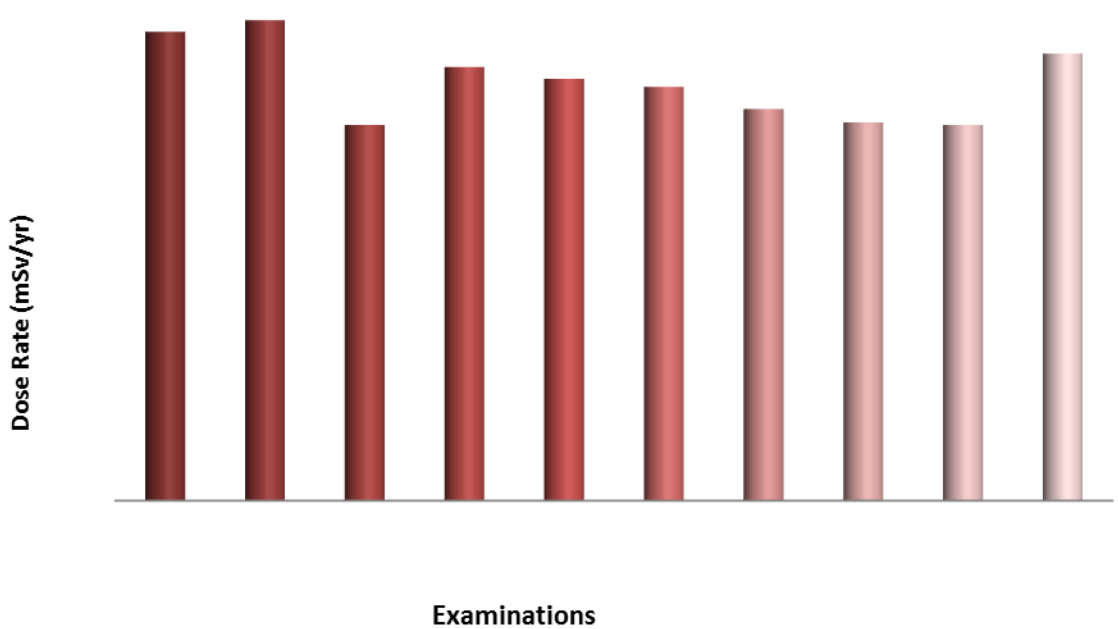

Figure 6: Dose rate against different examination of Hospital C

DISCUSSION

The results presented in table 1-3 were collected in radiology department of three hospitals and were converted from microsieverts per hour to millisieverts per year. It's is very clear from the results obtained, that the radiation dose measured in the exposure room of the three hospitals has the highest values of dose rate 7.72mSv, 6.64mSv/yr and 6.13mSv/yr. This is simply because radiation obeys the inverse square of intensity. Table 1 of Hospital A has the highest values of radiation dose rate in mSv/yr in all the locations than hospital B and C. This could be linked with the materials used in building the department, which was found to contain some radioisotope substances. According to ICRP-IAEA recommendations (1997) the annual average dose should not exceed 20mSv/yr for occupational exposure and 1mSv/yr for general public. The instrument used in the measurement was suitable to detect and measure x-rays or gamma rays because these impart energy to charge particles, which cause ionization (Kaplan, 1998).

CONCLUSION

The radiation measured at the radiology department of the hospitals were beyond the prescribe limits of 1mSv/yr for general public exposure. Radiation values of between 2.31 to 7.72 mSv/yr were found in the various location of the hospital as in table 1 and 2. The graph plotted shows that there is an obviously high health risk of radiation exposure for the exposed population visiting the radiation department of the three hospitals selected.

This study showed that there is higher level of harmful ionization radiation within the vicinity of hospitals measured especially to the operators of the x-ray machine. With the evaluation of dose rate that have been done for the three hospitals, we wish to recommend that, radiation profiles for different hospitals in Jos should be in line with the standard limits in order to assess health risk to which general public are exposed in a subsequent work, we intend to survey the radiation measurement profile for the entire hospitals in Jos metropolis.

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REFERENCES

Bjorn Washtreoem. Radiation, Health and society Finland, International Atomic Energy Agency (IAEA, 1997)

Giancoli D.C (2000). Physics for scientists and Engineers with modern physics volume 11, 3rd edition published by prentice hall. U.S.A.

Greening J.R. (1995). Fundamental of radiation Dosimeter. Churchill Robert University, Aberden Living Stone Press.

ICRP-Radiation Protection 1997 recommendation the International commission on Radiation, protection, preganon press, Oxford.

Jwanbot and Ike,1999. Measurement of permissible levels in mineral, processing plants in Jos and environs *Journal of Environmental science* 2 (1):2-8

Kaplan Irving. Nuclear physics, second edition, India, Norosa publishing house, 1998.

Kathern R.L. (1985). Radiation protection and Control measures.

Katmandu University (2007).Measurement of Radiation. *Journal of science, Engineering and Technology*.**1**, (IV).

Knoll GF. (1989). Radiation detection and measurement, 2nd ed., Wiley, New York, ISBN: 0-471-49545-X, 95-103 (1989)

Owolabi LF, Shehu MY, Fadere J, Shehu MN,et al. (2005).Patient around an x-ray diagnostic machine. *Nigeria Journal of physics volume 175.pp2-6*

UNSCEAR, United Nations Scientific Committee on the Effects of Atomic Radiation, 1998. Sources effects and Risks of Ionizing Radiation, report to the general assembly, United Nations New York.