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Short Communication

RADIATION SAFETY STUDY OF X-RAY IRRADIATION FACILITIES AT THREE HOSPITALS IN PORT HARCOURT

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ABSTRACT

A Radiation safety study of X-ray Irradiation facilities was carried out at three Hospitals in Port Harcourt, Rivers State. This study employed the use of a specialized Geiger Muller counter, the Radalert-100, to take measurements of the levels of radiation emissions and extent of scatter radiation to the surrounding environment. A pocket dosimeter was also used to measure the absorbed doses. The background radiation in and around the radiation rooms were measured and found to range from 0.08 to 1.60μSv which are within the normal range of 0.09 to 1.70 μSv. However some technical and engineering regulations would have to be strictly followed to maintain standards.

Keywords: X-ray, irradiation, safety, absorbed dose, exposure, radiation facility.

INTRODUCTION

Radiation is one subject that is likely to cause people to become nervous and worried. Most people have undergone one form of medical X-Ray exposure/Gamma therapy or have been exposed intentionally or otherwise to one form of radiation or the other. Ionizing radiation sources can be found in a wide range of occupational settings including health care facilities, research institutions and various manufacturing facilities (Morgan and Turner, 1967). A high radiation dose given at a low rate over a period of years might have a different (probably smaller) effect from the same dose given in a short time, although the very use of a total dose summed over a long time period, of the order of a lifetime implies that the difference is unlikely to be large (Shilnikova *et al*., 1996). Children in the age group 0 – 8 yrs seem to develop leukemia naturally at a greater probability than those a little older (Stewart and Kneale, 1970). Studies (Stewart, 1970) showed that one X-ray exposure during pregnancy increased the chance of cancer in the child. Two questions of interest in this work are: how safe are the radiation emitting facilities (CT scanning inclusive), and are patients repeatedly exposed or over exposed in the course of getting good results? Although radiographers know that a smaller body mass means that lower doses can be used, the relationship of dose to image quality causes radiographers to increase the dose for higher quality (Khan, 1984). Medical patients receiving radiation treatments in Radiotherapy often experience acute effects, because they are receiving relatively high "bursts" of radiation during treatment (Rema, 2004). There is no firm basis for setting a "safe" level of exposure above background for stochastic effects. Any increase in radiation exposure is accompanied by an increased risk of stochastic effects (Kondo, 1993). The type of radiation to which the person is exposed and the pathway by which they are exposed influence health effects. Health physicists generally agree on limiting a person's exposure beyond background radiation to about 100 mrem per year from all sources. Exceptions are occupational, medical or accidental exposures. (Medical X-rays generally deliver less than 10 mrem). Regulatory Agencies generally limit exposures from specific source to the public to levels well under 100 mrem (BEIR III, 1980). This is far below the exposure levels that cause acute health effects.

MATERIALS AND METHODS

Experimental

Three Health Institutions in Port Harcourt, Nigeria were used for the study. Background radiation measurements were carried out inside the diagnostic room before and after the radiation emitting machine was put on but before use to ascertain if there were leakages. Specific radiation doses administered to patients for a number of investigations were recorded. On the average between fifteen (15) and fifty (50) patients were seen daily at the hospitals.

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The hospitals investigated had one or more of the following radiation facilities:

1. Static Rotating Anode conventional X-ray Machines of high capacity in the range of 300 mA /600 mA, 150 kV/175 kV peak and time range of (0.06 – 4) s/ (0.001 to 5) s.
2. Mobile X-ray machines of capacities 300 mA, 120 kV and time range of .06 to 4 seconds.
3. Computerized Tomography (CT) Machine of enormous radiation emission capacity.
4. Fluoroscopic X-ray machines for real time medical imaging screening, with a considerable amount of radiation emitted each time they are in use and incidentally they are often used.
5. Magnetic Resonance Imaging [MRI] Machine of capacity 0.23Tesla.
6. Mammography machine for breast screening with a considerable though low level radiation emission.

This study employed the use of a specialized Geiger Muller counter, the Radalert-100, to take measurements of the levels of radiation emissions and extent of scatter radiation to the surrounding environment. A pocket dosimeter was used to measure the absorbed doses.

Data from radiation monitoring was taken at various points in and around the exposure rooms (as displayed on Table 1).

RESULTS AND DISCUSSION

These measurements were on single exposures. An exposure lasted between 0.06ms to 4s depending on body part under investigation. The duration of CT scanning and other high dose techniques was between five minutes to an hour depending on the investigation in progress. There was need for concern when exposures were repeated. Reasons for repeat were usually to confirm diagnosis, poor radiographic positioning, poor processing and handling, and loss. Figure1 shows the levels of radiation at various points within and outside the diagnostic rooms.

The background radiation in and around the radiation rooms were within normal range of between 0.09 and 1.70μSv (ICRP, 1992). The X-ray machines were in good shape. It was observed that the older the X-ray machine the higher the amount of radiation required to achieve a particular result. This was evident by the recording of variable doses of radiation for chest X-ray exposures and other radiological investigations. This was of concern as increasing the radiation dose increases the possibility of harm because there was always cell death at every level of radiation exposure was also a great concern exists when the radiation exposures are repeated. It was discovered that some collimators especially in older X-ray machines were ineffective as some radiation escaped even when the collimators were closed which was an anomaly. Patients' waiting area, which should be free of radiation,

Table 1. Radiation levels at selected locations and times, and within and outside diagnostic rooms.

Investigation	Hospital 1 μSv	Hospital 2 μSv	Hospital 3 μSv
Background within hospital premises	0.011	0.011	0.008
Background within the radiology diagnostic rooms	0.014	0.014	0.014
Radiation detected when the machine was put on but not in use	0.014	0.014	0.014
Radiation detected when the collimator was closed	-	0.600	0.600
Radiation detected at the entrance door when the door is open and exposure was in progress	0.940	0.940	0.890
Radiation detected during chest X-ray exposures	20.000	30.000	30.000
Radiation detected during skull X-ray exposures	160.000	170.000	170.000
Radiation absorbed by patients waiting outside the radiation room when the radiation entrance door is closed	0.800	1.600	1.600
Radiation absorbed by patients waiting outside the radiation room when the radiation room entrance door is open	9.400	9.400	9.400
Radiation exposure in adjoining offices and corridors adjacent to diagnostic rooms	0.600	0.600	0.600
Radiation exposure in adjoining offices and corridors opposite diagnostic rooms	0.340	0.342	0.342
Radiation absorbed by a patient's relation holding the patient but not wearing lead apron	60.000	60.000	60.000
Radiation absorbed by areas covered by lead apron of a patient's relation holding the patient and wearing lead apron	0.900	0.900	0.900

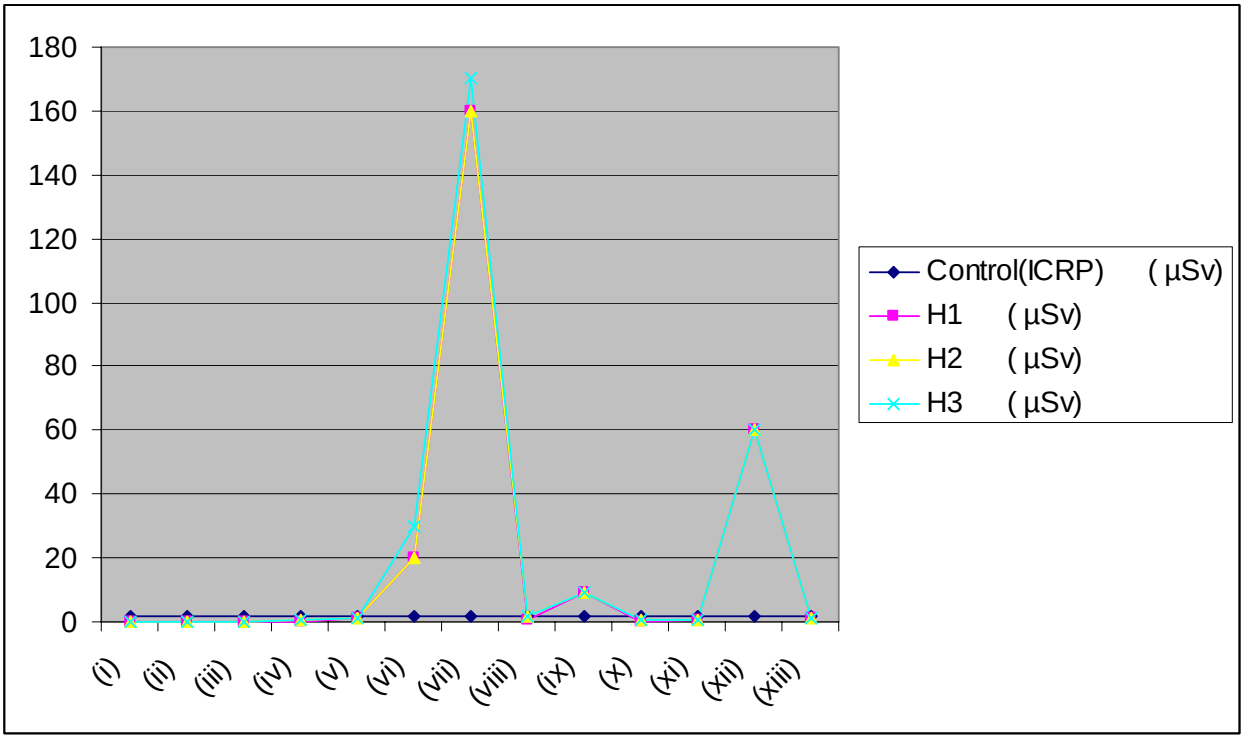

Fig. 1. Background radiation levels at the three hospitals (coded H1, H2 and H3).

Key:

within hospital premises
within the radiology diagnostic rooms
when the machine was put on but not in use
when the collimator was closed
at the entrance door when the door is open and exposure was in progress
during chest X-ray exposures
during skull X-ray exposures
by patients waiting outside the radiation room when the radiation entrance door is closed
by patients waiting outside the radiation room when the radiation room entrance door is open
in adjoining offices and corridors adjacent to diagnostic rooms
in adjoining offices and corridors opposite diagnostic rooms
by a patient's relation holding the patient but not wearing lead apron
by areas covered by lead apron of a patient's relation holding the patient and wearing lead apron

showed a significant reading of radiation. This was observed to worsen when the doors of the X- ray rooms were opened and posed a health risk for patients or staff who may stray into the diagnostic room or loiter around the corridors of the radiation room. Offices and toilets very close to the radiation rooms showed significant reading of radiation measurement.

There was also a great concern when the radiation exposures are repeated. A tangible number of repeated radiological investigations were due to technical fault and handling/packaging of the X-Ray results. Repeated radiological investigations were a sure way of increasing radiation exposures to patients and to an extent the workers. Efforts should be made to avoid/reduce repeated investigations.

Radiation workers should as a matter of routine explain every procedure to patients prior to exposures. This would help allay fears on the part of patients and get full cooperation which would help reduce repeated investigations by way of movement or failure to carry out instructions. Radiation workers should also protect every part of the patient not intended to be exposed to radiation by the application of proper coning/beam delineation and collimation. This would ensure that only areas of interest are exposed to radiation. Workers should provide lead gloves and aprons for patients to wear and protect the areas not to be exposed to radiation. Ten-day and 28-day rules should be strictly obeyed by radiation workers while attending to females of the child bearing age, pregnant or breast feeding mothers to prevent exposure of foetus or bodily contamination with radiation (Philip, 1991).

Children should be given special attention and protection as a good number of patients admitted that this was hardly the practice.

CONCLUSION

There is an urgent need for a quantitative non-destructive method for defining the extent of the field of a clinically significant radiation exposure early after its occurrence. There is also need for radiation workers to be given introductory seminars on radiation safety before they start working with radiation. The radiation workers should as a matter of practice strictly implement rules and guidelines in radiation protection. They should also ensure the calibration of their machines/ standardization of their processing chemicals. They should ensure that all accessories for X-ray machines are working properly and within safety limits. Government should as a matter of urgency overhaul all existing Health and Safety Inspection Agencies charged with regulation or accreditation of radiation workers streamlining:

1. The policies and procedures of training all Radiation workers must receive before employment.
2. Procedures for Teaching, General and Private Hospitals monitor and implement radiation safety guidelines.
3. Periodic and regular inspection and monitoring using thermo luminescence detectors, pocket dosimeters and Geiger-Mueller counters.
4. The use of film badges or their equivalents by radiation workers.

Patients/general public should on their part be self-informed and sensitized about radiation and radiation

Specific qualified persons should have the responsibility for assuring proper maintenance of the x-ray machines in line with Preventive and Corrective Maintenance Programs for X-ray machines as detailed by the International Atomic Energy Agency, IAEA. The radiation rooms should be adequately lead-lined in line with regulation. Lead-lined gloves and aprons are to be worn by staff, patients and helpers in the direct X-ray field.

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