EVALUATION OF BACKGROUND IONISING RADIATION LEVELS IN BENUE STATE UNIVERSITY TEACHING HOSPITAL MAKURDI NORTH CENTRAL NIGERIA.

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ABSTRACT

Measurement of background ionizing radiation levels in Benue State University Teaching Hospital Makurdi, North Central Nigeria was carried out using radalert 100 nuclear radiation monitor(with serial number S1170). Results obtained ranged from 0.24 ± 0.01 μSv/hr to 0.12± 0.01μSv/hr with an average of 0.175 ± 0.01μSv/hr for indoor measurement within X-ray Department,0.29± 0.01μSv/hr to 0.13± 0.01μSv/hr with an average of 0.198± 0.01μSv/hr for measurements in Departments and locations within the hospital. These values when compared to standard of 0.274 μSv/hr recommended as worldwide average natural dose of background ionizing radiation are within permissible value.

Keywords: *Background ionising radiation, Radalert 100, Hospital, Radiation sources, Makurdi.*

INTRODUCTION

Human activities like industrialization, environmental degradation and medical research are associated with the release of various forms of pollutants including radiation into the environment.

Admittedly, human exposure to ionizing radiation from natural sources is an unending and unpreventable phenomenon on earth. Human exposure to natural radiation exceeds that from all man-made sources (medical, weapons testing and nuclear technologies) put together[1]. The presence of natural background radiation is due to the distribution of radionuclides in the earth and it is responsible for exposure to living organisms. It has been noted that people who live in areas of higher altitude have higher exposure levels and this has been attributed to the contents of natural radionuclides as well as the thin layer of atmosphere in these regions[2,3].

Radiation in hospitals is known to come mainly from three principal sources; medical exposures, cosmic radiation and radioactivity from the background. Of these three, medical exposures constitute a significant percentage of indoor background ionizing radiation[4].

These radiations from hospitals and medical research institute have been of great concern because of the known effects of high dosages. Exposure to radiographic examination like computerized tomography, fluoroscopic procedures, conventional X-rays, dental diagnosis, radioisotope procedures and radiation therapy have contributed to increase in background radiation levels and radiation to patients and occupational workers[5].

It has been documented that chronic exposure at both high and prolonged low doses have the potential to cause injuries and clinical symptoms and these may include free radical formation, cancer induction, cell death, mutation, congenital anomaly and radiation carcinogenesis in human beings[6,7].

Background radiation levels in Nigeria and other developing worlds are lower than those of industrialized countries. This has been attributed to the greater access to medical imaging. Indeed, the radiation levels in countries like the US and Japan have been documented to be about four times the world average which is quoted to be 2.4 millisievert (mSv) per year[8].

Investigations of the dose from natural radiation and its effects on health are of great value as a reference when standard and regulatory control actions on radiation protection are to be undertaken. It is our hope that the result of this study will provide

a baseline data for future detailed estimation of background ionizing radiation within our hospital and also to determine whether these values so obtained are within tolerable limits as recommended by US nuclear radiation safety

MATERIALS AND METHODS.

Study Area.

Benue State University Teaching Hospital (BSUTH) Makurdi was chosen for this study. It is a 300 bed tertiary hospital which is located in Makurdi the capital of Benue State, Nigeria. The Hospital was commissioned on the 9th of March, 2012 with 23 clinical departments and 19 administrative departments[9]. It has units of a teaching hospital which contain radiation emitting devices and also ionizing radiation from terrestrial sources.

Methodology

A Radalert-100 (International Medcom) was used for the measurement and this was set to the total-count-mode and the total count was taken for a timed period of 10 minutes for every location. A timed total count was preferable in determining the average counts per minute over a period of time, since the number of counts detected by the Radalert-100 varies from minute to minute due to random nature of radioactivity. The monitor was held one meter (1m) above the ground throughout the study. Measurements was carried out in different areas of the hospital namely: Radiology Department, Pharmacy, General Outpatient Department, Accident and Emergency Unit, Academic Block, Laboratory Block, Eye clinic, Theatre, Administrative Block, Works and Maintenance Department, Physiotherapy Department, Staff Quarters, Laundry Unit, Dental unit, Staff Cafeteria, ARD canteen, Nurses Station, Information and Communications Technology (ICT) Unit, Library, generator house, hospital main gate and Mortuary. The reading was taken five times at each point and an average was recorded. The values was then converted to Sievert (Sv) using: 1CPM=0.01(Radalert-100 User's Manual 2007)

The mean exposure rates were entered into an Excel Sheet and processed using SPSS software version 22.0 (SPSS Inc. Chicago, Illinios, USA). The results are presented in the form of tables and figures.

TABLE 1: X-RAY DEPARTMENT OF THE HOSPITAL

S/N	LOCATIONS	DOSE RATE(μSv/hr)
1	Reception	0.23±0.01
2	Exposure Room 1	0.17±0.01
3	Exposure Room 2	0.14±0.01
4	Entrance	0.16±0.01
5	Dark room	0.15±0.01
6	Exposure cubicle 1	0.12±0.01
7	Exposure cubicle 2	0.12±0.01
8	Administrative office	0.24±0.01
9	Ultrasound room	0.20±0.01
10	Mammography room	0.17±0.01
11	Computer Tomography Room	0.16±0.01
12	Computer Tomography spa room	0.24±0.01
	MEAN	0.175±0.01

TABLE 2: DEPARTMENTS/UNITS AND LOCATIONS SAMPLED WITHIN THE HOSPITAL

S/N	LOCATIONS	DOSE RATE(μSv/hr)
1	ICT	0.14±0.01
2	ARD Canteen	0.20±0.01
3	Library	0.25±0.02
4	Physiotherapy	0.23±0.02
5	Laundry	0.20±0.01
6	GOPD Reception	0.13±0.01
7	Eye Clinic	0.19±0.01
8	Accident and Emergency	0.22±0.01
9	GOPD Consulting room 1	0.28±0.01
10	GOPD Consulting room 2	0.14±0.01
11	Nurses Station	0.14±0.01
12	Generator House	0.14±0.01
13	Laboratory	0.20±0.01
14	Maintenance	0.22±0.02
15	Mortuary	0.13±0.01
16	GOPD Pharmacy	0.16±0.01
17	Pharmacy Store	0.28±0.01
18	Staff Clinic	0.28±0.01
19	Dental Unit	0.21±0.01
20	Administrative Block	0.29±0.01
21	Theatre	0.20±0.01
22	Hospital Main	0.18±0.01

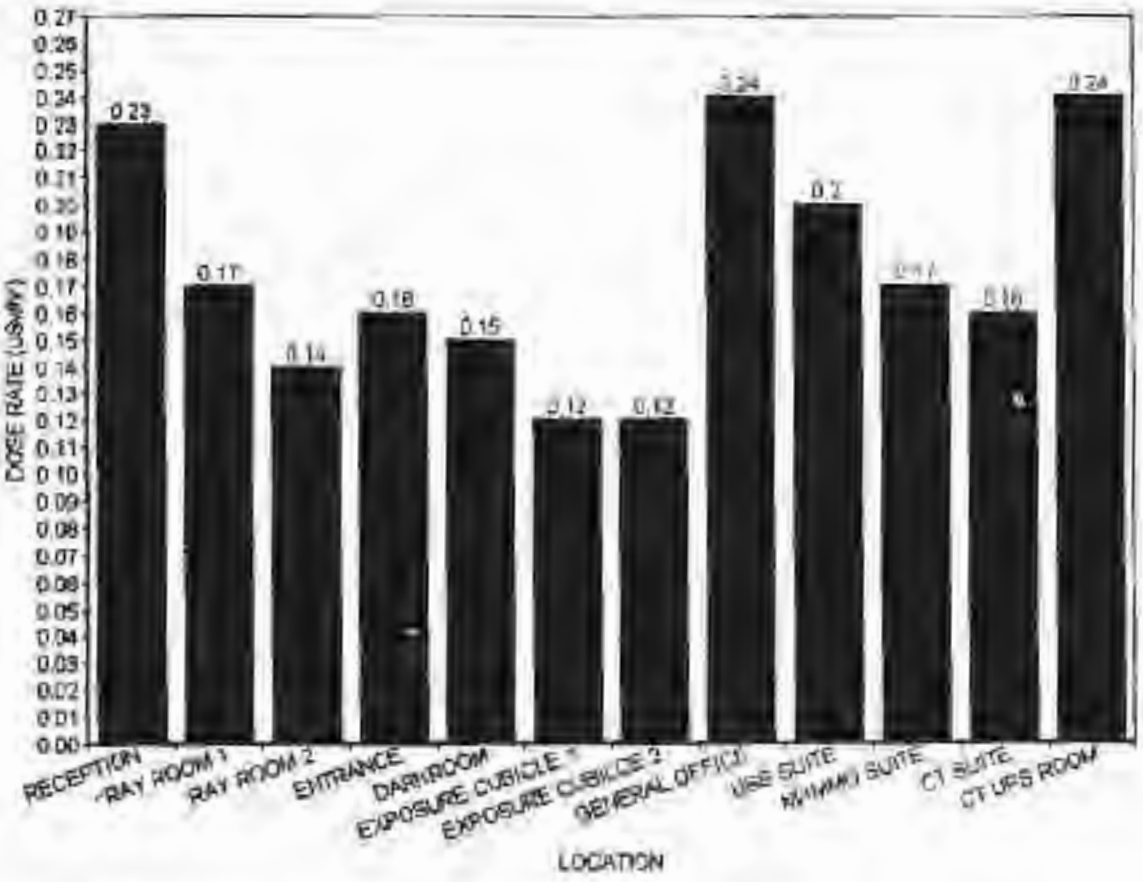

Fig. 1: Dose rates values compared to standard for X-ray department

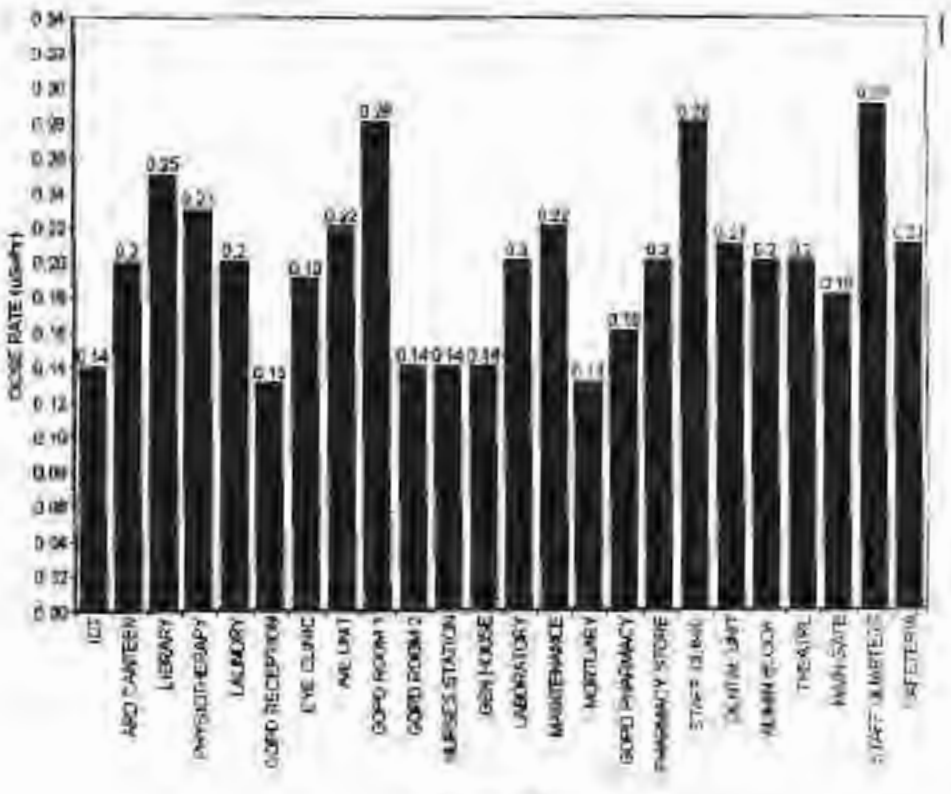

Fig. 2: Dose rates in departments/units compared to standard

RESULTS AND DISCUSSION

The results of the various sites ranged from 0.14 ± 0.01μSv/hr and 0.13±0.01μSv/hr to 0.29 ±0.01μSv/hr respectively as presented in tables 1 and 2.

Assessment of background ionizing radiation is important so that exposure to individuals, particularly health workers should be known. There is a general consensus among medical physicists that a person's exposure to radiation level should not exceed 100mrem/year from all sources (Background and medical sources).

Our study shows that the background ionizing radiation in Radiology department is highest in the administrative office with a value of 0.24±0.01μSv/hr. This maybe attributed the fact that the room is in close proximity to areas of numerous sources of radiation emitting devices. The room was not actually meant to be used as such, but because of space constraint, the place was turned to be a temporary office. Similarly, high doses was also noted from the room were the UPS of the CT is housed.

The maximum value of background ionizing radiation in the hospital was observed in the staff quarters with a value of 0.29 ±0.01μSv/hr. The possible explanation for the high radiation values in these areas could be building materials used in the construction of the hospital by the different companies who handled the hospital project. Indoor background ionizing radiation profiles for a building are, therefore, crucial since they enable us to assess the level of risk of exposure to the regular users of such buildings and the general population. It has been established that chronic exposure to an even low dose and a low dose rate of nuclear radiations from an irradiated building has the potential to induce cytogenetic damage in human beings, gene mutation, destruction of bone and cancer, cataract and a host of others[10]. The Staff quarters of the hospital are located close to the bank of River Benue. It is also possible that the high background radiation noted in our study maybe from industrial waste that have been deposited in the River from industries that are located upstream. The minimum and maximum radiation levels indicate that the background radiation was not evenly distributed in all points of measurement. Our findings support the observation by Jwanbot *et al*.[11] who demonstrated this in a study of two different hospitals in Jos, north central Nigeria.

Mettler *et al*.,[12] from united States of America, in New Mexico veterans Administration on Healthcare System, Department of Radiology and Nuclear Medicine, reviewed that the mean background ionizing radiation level is 0.342μSv/hr. The global average natural dose of background ionizing radiation to humans is about 0.274μSv/hr (**UNSCEAR,2008**), of which eighty percent (80%) comes from nature, while the remaining 20% results from exposure to man-made radiation sources, primarily from medical imaging. The average background ionizing radiation exposure is much higher in developed countries, mostly due to numerous industrial and medical activities. The mean value of background ionizing radiation from our study supports this assertion.

In conclusion, the background ionizing radiation levels in our hospital is within the permissible value as stipulated by United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR, 2008).

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