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Assessments of environmental radioactivity level in St. Luke's hospital, Anua-Uyo

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ABSTRACT

This research work investigated and presents the level of ionizing radiation in St. Luke's Hospital Anua, Uyo. Inspector Alert Nuclear Radiation Meter (Manufactured by International Medcom with Model No. 33333) was used for these assessments. The meter was held at the abdominal level (about 1m above ground level) and readings were taken in $\mu Svhr^{-1}$ at different locations of the hospital and conversion factors were used to convert results into $mSvyr^{-1}$. The result obtained shows that health workers in the Old Reagent Room (ORR) are exposed to radiation level of $(0.5172 \pm 0.0062) mSvyr^{-1}$ equivalent dose rate, higher than that of unidentified reagent and it has a very high annual equivalent dose rate of $(24.0937 \pm 0.5622) mSvyr^{-1}$. This is an issue of great concern since the value is greater than $1 mSvyr^{-1}$ as stipulated by ICRP. The available data in the hospital gives a mean dose rate of $(0.1673 \pm 0.0028) mSvyr^{-1}$ except the waste bin data. Though these people (except those at reagent laboratory) are exposed to ionising radiation due to radioactivity, the dose rate is far less than the required annual equivalent dose rate set by ICRP.

Keywords: radioactivity, equivalent dose rate, Anua

INTRODUCTION

Due to the radioactivity processes occurring in the earth, man is exposed to different types and levels of ionizing radiations with or without his consent. And exposure to radiation leads to damage on different levels of the biological system of an organism. The clinical risk of radiation damage and the resulting radiation syndromes may vary to a great extent. This depends on exposure conditions like nature of radiation, time and affected organs [1]. Hospitals and other health facilities use radioactive material for a variety of functions, from examination to treatment. For example, radiation from ^{60}Co and powdered ^{137}Cs is used to sterilize blood and medical equipment, while ^{60}Co is also used to kill diseased brain tissue. Capsules of ^{137}Cs are implanted next to tumors to kill cancerous cells, and thin tubes of radioactive material are used to operate gauges and other diagnostic devices. However the International atomic Energy Agency (IAEA) estimates of dose contribution in the environment in the environment show that over 85% of the radiation dose received by man is derived from naturally occurring radionuclides while the remaining 15% is from cosmic rays and nuclear processes[2].

Secondly, the enormous global interest in the study and survey of naturally occurring radiation and environmental radioactivity had been essentially based on the importance of using the results from such studies for the assessment of public radiation exposure rates and the performance of epidemiological studies, as well as reference radiometric data relevant in studying the possible changes in environmental radioactivity due to nuclear, industrial and other human technology-related activities[3]. Again, it has been established that out of the total radiation dose that the world population receives, about 96.1% is from natural sources and the remainder is from human-made sources [4].

Following health risks associated with the exposure to indoor radiation, many governmental and international bodies such as the International Commission on Radiological Protection (ICRP), the World Health Organization (WHO), etc. have adopted strong measures aimed at minimizing such exposures. This is imperative because the most significant exposure as regards the radiation health burden is due to the isotopes of radon (222Ra and 224Ra) and are the members of the decay series of 238U and 232Th, (226Ra and 224Ra) and are members of the decay series of 238U and 238Th, respectively. Radon and its short-lived daughters are alpha emitters. They consequently become a major source of internal exposure of the respiratory tracts when inhaled [4-6], hence the call for the measurement and survey of environmental radioactivity levels [7-9].

Specifically, in Nigeria there is concerted effort towards determining the radionuclide concentration levels in the environment, different raw mineral and building materials [10-11] industrial wastes and by-products from some industries [12 – 24].

The present work was intended to add to and enhance the existing information on the survey of environmental radioactivity level in Nigeria with particular interest in St. Luke's Hospitals Annua which is one of the major hospitals in AkwaIbom.

Presently, there is no data existing on the survey of environmental radioactivity level in St. Luke's Hospital, AnuaUyo. The knowledge of radiation level in the environment is imperative; this study is therefore expected to yield data that will provide information that may be used to assess the health effects on the population in the study area. Part of the aims are to determine the level of radioactivity in all the Laboratories in the hospital; evaluate radiation dose equivalent from the count rates for different locations within the hospital and determine the possible dose impact of the research operations on the Laboratory workers and other member of the public.

MATERIALS AND METHODS

A typical portable Inspector Alert TM Nuclear Radiation Monitor was used to detect and measure the radiation equivalent dose. The survey meter, model GLR61-6AM6-9V, serial No. 33333. Quality 1, The Nuclear Radiation Monitor is made in USA by International Medcom. The Inspector AlertTM Handheld Nuclear Radiation Monitor improves safety in laboratories and in the field through quick analysis and determination of radiation levels. The handheld monitor measures alpha, beta, gamma and x-radiation. Its safety-first calibration feature can eliminate exposure for personnel. The Inspector Alert quickly notifies first responders to the presence of harmful levels of nuclear radiation. Easy to read digital display shows a wide variety of readings: mR/hr, CPM, CPS, or µSv/hr. But in this study, the measurement was expressed in micro Sievert per hour. The survey meter is run by one 9V battery.

This research was carried out at St.Luke's Hospital Anua, Uyo. The selected locations for the experiment were: the pathology laboratory area (PLA), pathology laboratory store (PLS), blood bank room (BBR), blood bank store (BBS), pathology laboratory washing area (PLWA), microbiology section (MS), waste dumping site (WDS), new reagents room (NRR), old reagents room(ORR), Tuberculosis room (TR), drugs store (DR), X-rays Machine room(XMA). Readings were recorded at intervals of 5 seconds for each monitoring area. Exposure rate was taken in $\mu Svhr^{-1}$, the quality factor was taken to be unit and conversion factor was used to convert it to $mSvyr^{-1}$ (Equation 1).

$$H = \frac{D \times \mu \times 24 \times 365}{1000} \qquad (1)$$

where H is the dose equivalent in $mSvyr^{-1}$, D absorbed dose in $Gyhr^{-1}$ and µ is the outdoor occupancy factor = 0.2[24]

EXPERIMENTAL PROCEDURE

At each laboratory, the survey meter was held about 0.03m away from laboratory instruments/equipment/chemicals/reagents. Since radioactivity measurement or process is statistical 100 readings were taken on each laboratory, average and error of the readings were obtained. The equivalent dose in from the survey meter was converted to the annual dose rate in for each of the location using the relations by [24]:

RESULTS

Table 1: Exposure rate in St. Luke's Hospita, Anua, Uyo

S/N	Locations/Code	Annual Equivalent Dose Rate (mSvyr-1
1	pathology laboratory area (PLA)	0.11057±0.0012
2	pathology laboratory store (PLS)	0.07826±0.00086
3	Blood bank room (BBR)	0.1204±0.00192
4	Blood bank room (BBS)0.10014±0.00126	
5	Pathology Laboratory Washing area PLWA	0.1165±0.0015
6	Microbiology Section (MS)	0.1057±0.0004
7	Waste dumping site (WDS)	0.11057±0.0010
8	New reagents room/store (NRR)	0.13172±0.0008
9	Old reagents room/store (ORR)	0.11057±0.0062
10	Tuberculosis room (TR)	0.12951±0.0015
11	Drugs store (DS)	0.1954±0.0092
12	X-rays room (XRR)	0.2797±0.0076

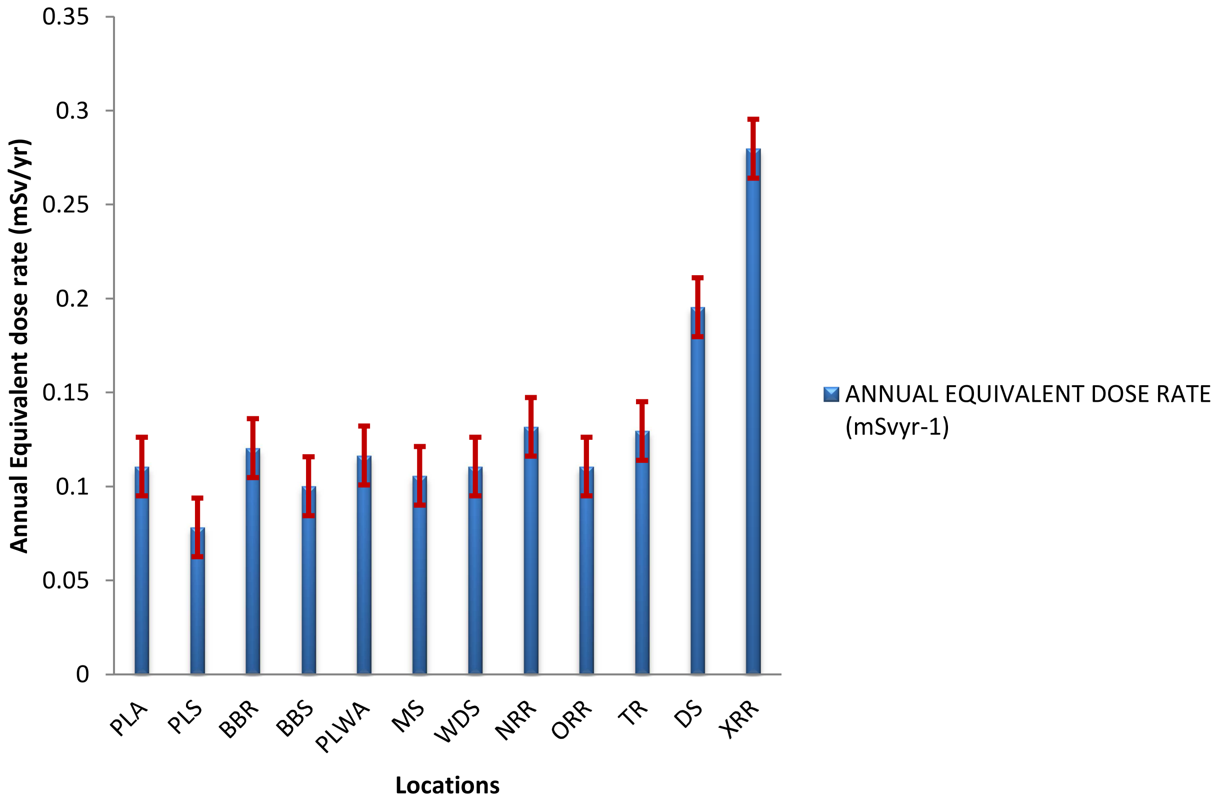

Figure 1: Distribution of annual dose equivalent dose rate on the locations

DISCUSSION

The results are presented in Table1. From the results obtained, old reagent room/store have high equivalent dose rate exposure of (0.5172±0.0062)mSvyr^{-1} due to the presence of radioactive ^{40}K in potassium iodate solution (KIO_2) found at that location. Eyebiokun et al.[28] in Ondo state measured the activity concentrations of ^{40}K absorbed dose equivalent of commonly consumed vegetables. A reagent waste bin found at this location contains some unidentified reagent and it has a very high annual equivalent dose rate of (24.09365±0.5662) mSvyr^{-1} (Fig1). This is an issue of great concern since the value is greater than 1 mSvyr^{-1} permissible limit as stipulated by ICRP standard [29].

Also, followed by X-ray room with (0.27976±0.0076) mSvyr^{-1}.Tizhe and Ike [30] carried out a detailed research work on the detection and measurement of the permissible radiation levels of diagnostic X-rays unit in some selected seven hospitals in Northern Nigeria, using a radiation monitor. The levels of radiation from the hospitals monitored ranges from 0.025rem/week to 0.029 rem/wk. These values are significantly less than the international recommended maximum permissible radiation level of 0.1rem/week by the International Commission on Radiological Protection [29]. Other locations had low equivalent dose rate exposure, which may be causedby the building materials used. Also, Aulay and Colgan[31] in Ireland determined gamma activity of some building materials and obtained a mean dose rate of (0.2 – 18.0) x 10^{-8}Gy/hr.Furthermore, Bou – Rabee et al [32] analysed various building construction materials in Kuwait for radioactivity the result showed that ^{232}Th was predominant in all the building materials. Similar experiment was investigated in Poland and computed a dose rate 2.0 x 10^{-8}Gy/hr. Measurements indicated that the values were still within the safety limits [29].

CONCLUSION

The available data gives a mean annual dose rate of 0.1673±0.0028 mSvyr^{-1}(exception of the waste bin exposure rate at Old reagent room). Though the existence of ionizing radiation due to radioactivity is established in St. Luke's hospital, Anua, there are insignificant health hazards of 1 mSvyr^{-1} equivalent dose rate for public exposure and 20mSvyr^{-1} for radiation workers. Ionizing radiation (due to radioactivity) safety, monitoring and assessment have become issues of great concern environments), since at high doses, ionizing radiation is carcinogenic.

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