ASSESSMENT OF X-RAY RADIATION ON X-RAY WORKERS AND ASSOCIATED POTENTIAL HEALTH PROBLEMS IN OWERRI

By

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CERTIFICTION

This is to certify that this thesis on Assessment of X-RAY radiation on X-ray Workers and Associated Potential Health Problems in Owerri Imo State was carried out by Onyekaokwu Okeke Cyriacus (Reg. No: 20074677488) under the supervision of Prof. A.N. Amadi and has been read and approved as meeting the requirements for the award of Master Degree in Public Health.

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DEDICATION

This works is dedicated to God Almighty who has always been there for me throughout the period of this programme.

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ABSTRACT

A study on assessment of X-ray radiation among X-ray workers and associated potential health problems in Owerri was carried out with the thermolumolunescent dosimeter between 12th April to 30th December 2011. A total of 50 workers were used for the study. Comprising 24 male X-ray workers and 26 female X-ray workers. The mean X-ray dose below permissible doses is 9.4.7 the T-test is -4.29; the P-value is 0.000. The mean exposure factor is <100 is 88.52 and the standard deviation is 15.88, the standard error mean is 2.25, T-test is -5.11, P-value is 10.000 There is high doses above >20msv upto six test which involve 3 male x-ray workers and 3 female x-ray workers. The result of the study show high rate of hair loss, cancer, cataract, erthyma and sterility, each provide evidence of excess exposure of X-rays. Therefore it is recommended that workers should wear protective device e.g lead aprons, gonads cover during exposure to X-ray and also limit their exposure time.

CHAPTER ONE

2.0 INTRODUCTION

1.1 BACKGROUND OF THE STUDY

X-ray is electromagnetic radiation of short wave length produce when high speed electrons strike a solid target as defined by Walter Honda, Richard M. Sloe (2003). Is a radiation having wave length in the range of approximately 0.1 to 10mm. Sources: are environment (outer space and the earth, medical Imaging, x-ray tube, vacuum, CT scan.

Exposure routes are through medical imaging, fluoroscopy, chest radiography barium studies, Radiotherapy, x-ray astronomy, industrial radiography, Airport security, ionizing radiation, Air traveling.

Since shortly after the discovery of x-rays, it has known that repeated and prolonged exposure to irradiation produces deleterious changes in cells and tissues. We know that the absorption process of x radiation is a random one usually describe mathematically by an exponential function. This random process

of absorption varies with the composition of human tissue under consideration and this is public health concern.

Based on experiences and observation through the years, attempt have been made to establish safe limits which the x-ray workers can survive without experiencing unnecessary deleterious effects. An experience with the atomic bomb has indicated that acute, whole body exposure of 450-500 roentgen units of radiation at one time will result in death. Standard recommended by the National Council on Radiation Protection (NCRP) referred to as the "Maximum Permissible Dose" (PMD) are based on the accumulated dose over the life time of the individual. Efforts are made to maintain exposure levels below the maximum permissible levels, so that on detectable harmful effects are ever produced.

I am aware that over exposure to radiation will produce harmful effect, therefore it is imperative that basic precautions be established and safety rules be obeyed. Much of what has been learned has been published so that those x-ray workers utilizing

radiation for diagnostic and therapeutic purpose will be better prepared to protect the public when administering radiation in the performance of their duties. Today, radiographers the ever-increasing usage of ionizing radiation in Medicine is producing method knowledge about the effects of radiation as well as work from excessive amount of diagnosing disease are being disease found and employed.

Organ Dose-For a given entrance skin dose, it is possible to estimate individual organ dose for many common radiologic examinations. (Water Hunda and Richard M. Slone 2003).

Organ will be substantially less than the skin dose. Organs which are not in the direct field of view are only subject to scatter radiation and will generally receive very low radiation dose. For an anterior-posterior projection, the embryo dose will be between one third and one fourth of the entrance skin dose (in the direct beam). For a posterior-anterior projection the embryo dose will be about one six of the entrance skin dose (in the direct beam).

For a lateral projection, the embryo dose will be about one twentieth of the entrance skin dose (in the direct beam).

1.4 STATEMENT OF PROBLEM

There has been increment in x-ray exposures and physical demands that predispose the workers to distinct occupational health hazard like the hazards of accumulated radiation exposure have been know for years but unit recently the other potential risks have been ill defined and under appreciated. Day to day daily exposure to radiation by workers have increased these occupational health hazards which most of them try to ignore, afraid to know the truth or even worse to be pulled out of the laboratory as a result of the laboratory as result of excess monthly exposure have lead to increases in these occupational hazards.

To the best of my knowledge no work has been done in Owerri on Assessment of x-ray radiation among workers and its associated potential health problem. Therefore on x-ray situation

in Owerri which will be of immense value to policy makers on x-ray and health care delivery.

1.5 RESEARCH QUESTION

- Is the amount of x-ray radiation received by workers within normal
- Are there relationship between clinical ailments and x-ray exposure

1.4 RESEARCH HYPOTHESIS

Ho: There is no relationship between clinical ailment and x-ray exposures.

H1 there is a relationship between clinical ailment and x-ray exposure.

1.5. OBJECTIVES

- To determine the amount of x-ray radiation received by x-ray workers using themoluminscent dosimeters (TLD) per month.

- To find out the number of clinical ailments associated with the x-ray radiation.

1.6 SIGNIFICANCE OF STUDY

The knowledge obtained from this study will help in:

- Determining a permissible doses for x-ray workers
- Determining a permissible doses for pregnant female x-ray workers
- The findings will help to reduce morbidity and mortality among x-ray workers in Owerri. This is public health important of study.
- The benefits will include sanitizing the government and other stake holders on the needs to provide adequate protective device to x-ray workers for effective health care delivery. Minimize abortion among female x-ray workers.

1. 7. SCOPE AND DECLAMATION OF THE STUDY

The scope of this study is divided into:

- The implication of exceeding the permissible doses among x-ray workers
- The effect of absorbed dose to x-ray workers
- The health implication of not using protective devices and exceeding exposure factors 100.

Knowing the permissible dose, absorbed dose will help to determiner the two kinds of effect on x-ray workers. The two kinds of effects are somatic and genetic.

Somatic effects are readily discernable or visible. Examples include reddening of the skin, measurable changes in blood counts and damage of body tissues and organs occurring within a short period of time. Genetic effects occur to the reproductive organs; they are not readily apparent but become evident in future generation.

No level has been established s minimum dose below which x-ray will have no effect. Any level or grade or x-ray will cause some effect because of its ability to be absorbed dosage, in future generation excess of 25 reds to the whole body in one exposure will produce discernible temporary depression of the manufacture of white blood cells.

Exposure of the fetus to x-ray prior to the fourth month of gestation may result in termination of the pregnancy or in major birth defects. There is an increases risk of leukemia. The sensitive than the adult to all late somatic effect of x-ray. Lead is as useful as a protective barrier because of its absorption coefficient in comparison to concrete. Lead is very efficient shielding material at energies of <100kev. The photoelectric absorption coefficient of lead is forty times greater than concrete at 100kev. At higher energies the shielding properties of the material are independent of their atomic composition.

CHAPTER TWO

2.1 LITERATURE REVIEW

Walter Huda and Richard M. Slone (2003), in their work explain that X-ray are produce when electron with energies at 20 to 150 kilo electron volts (KEV) are stopped in matter, producing electromagnetic radiation in the from of X-rays belonged to class of radiation called "ionizing radiation" (along with gamma rays and cosmic rays). Ionizing radiation is any. Radiation capable of ionizing or stripping electrons from their respective atoms or molecules. In the process chemical bonds can lead to much different effect according to how many and which bonds are broken. Ionizing radiation can lead to cancer, burn, nervous system failure, shock, red blood cell production, and shut down, loss of hair.

According to the X-ray worker at Federal Medical Centre Owerri, the extract effect depends on the magnitudes of the exposure. Every one receive a certain amount of radiation from "back ground exposure" for most people that amount to 100-300

Milliam of radiation. The background radiation is excluded from this study. To give you some idea what is the "mean fatal dose of full body exposure to ionizing radiation is approximately 500 to 600 Rems. Federal regulation permits radiographers to be exposed to a maximum of 50 Msv as explained by Satish K. Begergrave (2008) in their work. The annual scales of contrast media (CM) now represent 60 million doses and contrast Nephropathy (CN) has been their leading cause of hospital-acured acute renal failure. In this review article, physicochemical pharmacokinetic and pharmcodymic properties of CM are surveyed. The definition for CN is presented as well as the mechanics involved in the path pathogenesis.

SKIN

Owing to the radiosensitive of cells in the germinal layer of the epidermis. Rapid exposure of the skin to 6 SV or more produces erythematic in the exposure area, which typically appears within a day as observed at federal Medical Centre Owerri. After exposure lasts a few hours and is followed 2 to 4 weeks later by

one or more waves of deeper and more prolonged erythematic as well as epilating.

WHOLE-BODY RADIATION INJURY

Amadi a Nkaw 2011 un his work explained that if a major part of the body is exposure rapidly to more that ISV, the acute radiation syndrome is characterized by an initial pridomal stage involving malaise, anorexia, nausea and vomiting, an ensuring finally either recovery or death.

FLUOROSCOPY

Fluoroscopy allows real time, observation and imaging of dynamic activities such as barium moving through the gastrointestinal of the flow of contrast through blood flow vessels. (Walter Huda, Richard M. Slone 2013) in their work stated that is an overview, of the complete fluoroscopes imaging system modern fluoroscopic system also provide several options for image recording, including video spot film and film changers, cine and photo spot cameras and digital capture.

Fluoroscopy is performed at low doses, which means that relatively few. X-rays are used to produce the image and this result in high quantum mottle (noise) levels. Fluoroscopy tube currents are low between 1 and 5 ma, and X-ray tube voltages are normally between 70 and 90KV. The X-ray pulse width or duration can also be varied when pulsed exposure are used such as in cardiac cine fluoroscopy system are use girds to remove scatter radiation with a typical gird ration of 10.1 and used collimation to match the x-ray beam to the image intensifier size. Portable fluoroscopy systems are C arm devices with 18 and 23cm diameter image intensifier being most common.

AUTOMATIC BRIGHTNESS CONTROL

The automatic brightness control regulates the amount of radiation incident required to maintain a constant TV display. The amount of radiation is changed by adjusting the technique factors to maintain a constant light at the image intensifier output phosphor. Most modern systems use a combination tube current and voltage variability to control image brightness. The light

output of an image intensifier is proportional to the input area of the image intensifier. And the radiation exposure reducing the image intensifier size thus requires the radiation exposure to the increased of the image brightness is to be kept constant. A reduction of the image intensifier input from 25 to 18cm normally requires the radiation level to be nearly double (i.e. $25^2/18^2$ = 1.9). An ionizing chamber between the grid and cassette is used for taking spot films (photo+ming) spot films and photo-spot. Film spot refers to direct film cassette moved in front of ht image intensifier for the exposure. Fluoroscopy is interrupted during the exposure of the spot film, various films changes devices may be used for rapid acquisition of serial radiographers such as in vascular imaging. Photo spot films are a method of indirect image recording in which the output of an image intensifier is recorded onto 70 and 105mm roll film or onto 100mm cut film. A series of mirrors and lenses (100MR) per frame at the receptor, about five times lower than that required for conventional screen film combination other advantages of photo spot film include the following; there is no need to change the film as there would be

to change a cassette. The short exposure time (50 millisecond) reduces patient motion artifacts. Rapid sequence up to 12 frames per second is possible. The small size of photo spot films result in a substantial film cost saving (80%).

CINE FLOURGRAPH

A cine film is a series of photo spot images obtained in rapid sequence. Cine studies require the use of a grid-controlled X-ray tube, an optical distributor, and a synchronization circuit. Cine uses 35mm film and images are 18*24mm. the X-ray pulses and cine shutter are synchronized. Training frequency is in fraction or multiples of 30(15, 30, 60) or 90 per second; 30 frames per second is the most common. With total over framing, the film from fits within the image intensifier image is lost.

EXPOSURE RATE IN FLUOROSCOPY

Entrance skill exposure rates in fluoroscopy typically range from 10 to 100m Gy minute (1 to 10). Because fluoroscopy exposure times are much longer than in those in radiography, total patient radiation doses are much high in fluoroscopy. The U.S. maximum

legal limit for entrance skin exposure is generally 100MGY/minute (10R/minute). High-dose fluoroscopy can be performed to maintain image quality in large patients. High dose fluoroscopy options require special activation machines and visible/audible indicators to show that the option is being used. The maximum exposure rate in high-dse fluoroscopy is zoomGHY/minute (20R/minute). There are no regulatory exposure rate levels when a fluoroscopy images for diagnostic purpose (e.g cine imaging, DSA imaging, and digital photo spot acquisition). Indiscriminate use of high-dose fluoroscopy may result in very high dose and induce skin earthman epilating to the radiographers. This of public health significant.

HEALTH RISK OF X-RAY

Walter Huda and Richard Slone (2003) in there work explain that X-ray induced cancers.

Cancer induction is the main risk of exposure at doses normally encountered in radiology. Bone marrow, colon, lung and stomach

are the most susceptible to radiation-induced malignancy. The bladder, breast liver, esophagus, and thyroid are moderately radiosensitive. Cancer risks from X-ray can induce both benign and malignant tumors. Cancer induction has a latency of 5 to 10 years for leukemia but is measured in decades for solid tumors. X-ray used to treat acne and tonsillitis has been linked to thyroid cancer. X-ray induce thyroid cancer is more likely in children and women than in men. Evidence of the carcinogenic effects of radiation exposure has been observed in radium dial painters. Uranium miners and atomic bomb survivors.

CANCER RISK ESTIMATES

Grange and Allis (2003) in there work explain that x-ray risks have been provided by the U.S National academy of sciences committee on the Biological Effects of ionizing radiation (BEIR). In 1990. The BEIR V. committee introduced a linear response current radiation risks are based on a relative model for cancer induction, in which X-ray increases the natural incidence of cancer by a constant. Fraction previously, an absolute risk model

was used in which X-ray induce a given (absolute) member of cancers in the exposed population.

Radiological protection (ICRP) current estimates the fatal cancer V x-ray risk at 4% persevere (i.e. 0.04% per ram) for whole body exposure of a working population. The X-ray risk factor per sievert (0.5% per ram). Is higher because it includes children, who are more sensitive to radiation. Radiation cancer risk are factor of two higher if the doses are high compared with a high occupational exposure and delivered at a high dose rate (acute exposure). Quantitative x-ray risks from United Nations Scientific Committee on the Effect of Atomic Radiation (UNSCEAR) and bier are similar those of the ICRP.

GENETIC RISKS

Before, 1950 genetic effects were considered the most important risk of x-ray exposure (M. Slone Walter Huda and Richard 2003. Genetic effects (i.e effects on future generation because of chromosome mutation in germ cells) are the result of radiation exposure to the result of virtually no epidemiological evidence of

the genetic effects of radiation in humans, and current risk estimates are based on animal experiments. Genetic effects depend on the demographics of the exposed populations, for the same exposure. For workers, the risk of severe hereditary effects is 0.8% per. Sievert (i.e 0.008% per ram) of severe hereditary effect is 1.3% higher because of the inclusion of children.

FETAL RISKS

The fetal risk when exposing pregnant female x-ray workers radiographer depends on the gestation period. The most likely result of a major first x-ray exposure during the first 10 days after conception is early intrautennie death. The fetus is most vulnerable to radiation induced the first trimester, specifically, 20 to 40 days after conception. Radiation induced microcephaly is the most likely abnormality occurring at 50 to 70 days after conception. Growth and mental retardation occur at 70 to 150 days after conception. The greatest effect after 150 days after conception is an increased risk of childhood malignancies. Occurs in approximately 5% of live births, which makes the difficult to

evaluate at dose greater than 0.1 GY (10 rad), increases. An abortion to avoid the possibility of radiation induced congenital annualized is considered only when doses exceed 0.1gy (10 rad) second or third trimester of gestation, the risk of childhood leukemia may be increased by as much as 40% childhood leukemia is relatively rare disease and therefore the absolute risk of x-ray induced childhood leukemia is low.

DOSE LIMITS

Radiation protection organizations the ICRP was found in 1928 and issues periodic recommendations on radiation protection. ICRP publication 60 (1990) is the latest recommendation for radiation workers and members of the public. The international commission radiological units and measurement (ICRU) advises on issue such as measurement unit in radiology. In the United States, the foremost radiation protection and measurements (NCRP). The NCRP advises Federal and State regulatory commission (NRC) is responsible, nuclear materials. Some states are known as agreement, state and arrange with the NRC to self-

regulate medically related licensing and inspection requirements for nuclear materials. Other state (i.e non agreement states) is regulated directly by the NRC. Each state is responsible for regulation pertaining to x-ray imaging equipment. States coordinate their x-ray protection activities through the conference of radiation control. Program director (CRCPS), which meets annually.

2.2 OCCUPATIONAL EXPOSURE

Important goals of radiation protection are the prevention of the occurrence of deterministic effects and minimizing stochastic effects of radiation. Dos limits can refer to individual organs or to uniform whole body irradiation organ dose limits include doses to the eye lens extremities and other tissues. Controlled areas have significant does equivalent exposure rates and safety officers.

In the United State, the legal (regulatory) whole-body dose limits for radiation workers are currently 50ms/year. (5ram/year) the US dose limits for workers are likely to be reduced in the future to the 20mv/year (2ram/year) as recommended by the

ICRP and NCRP. Occupational dose limits exclude exposure from medical procedures and natural background. People who are occupationally exposed to radiation should be monitored using personnel dosimeters, such as film badges. Actual exposures to radiology department staff are relatively low. The typical annual effective dose equivalent exposure is approximately 0.2msv (20m ram) for x-ray technologist annual. Dose to radiation therapy technologists are about 1.5msv (1.50m ram) and to nuclear medicine technologists are about 2msv (200mram). Doses to the most highly exposed radiation workers (interventional radiologist and nuclear power operators) are unlikely to exceed 5msv/year (500mram/year).

PREGNANT WORKERS

Grainger and Allison's (2003)

In their work for radiation protection purpose the fetus is normally considered to be a member of the public by the ICRP in normally considered to be a member of the public by the ICRP in the United State, however, the dose limit for the fetus of a

radiation workers (5msv) higher than that of member of the public (1msv) Walt, Huda and Richard M Slone (2003), this higher fetus legal dose limits permits women of reproductive capacity to seek employment radiation workers (i.e. nuclear medicine technologists).

Table 1:

Recommended international commission on radiological protection dose limits for workers

Parameter	**Dose limit**
Whole body	20msv/year (2ram/year)
Lens of the eye	150msv/year (15ram/year)
Extremities (hand)	500msv/year (150ram/year)
Life time whole body	<0.8sv (<80ram)
Fetus (9mo)	1msv (100mram)

Setting the fetal dose limits at 1msv would have deprived women of reproductive capacity employment as radiation workers. The fetus of radiation workers should not exceed a dose of

0.5msv/month (50mram/month). The limitation on the rate at which the fetus is exposed helps to ensure that any radiation risks to the fetus is kept to a minimum. Pregnant radiation works are monitored by a dosimeter worm on the abdomen to ensure fetal dose limits are not exceeded the dose to the fetus is normally taken to be half the skin dose to account for attenuation by soft, tissues between the fetus and skin surface. The public generally receives negligible dose from radiological activities.

X-RAY WORKERS SHIELDING

Lead is an effective protective barrier (i.e. it has a high efficient because of its high density and high atomic number). Lead apron used in diagnostic radiology should have 0.25mm lead apron reduced radiation exposure by at least a factor 10. Individual organs not by protected by lead aprons, such as the eye lens thyroid, can receive much high doses during fluoroscopy. Leaded glass can significantly reduce the dose to the thyroid protective gloved should have a lead equivalence of 0.25mm.

2.3 PRINCIPLES OF RADIATION, PROTECTION AND LEGISLATION

The aim of radiation protection practice is to restrict radiation dose so that with the exception of staff, patients and public remain below the level at which deterministic effect occur and the probability of stochastic effect occurring is limited to an acceptable low level. (Granger and Allison's 2008). To achieve this aim, ICRP recommends the application of three principles: justification, optimization and limitation.

Justification implies that no practice resulting in ex-exposure to ironing radiation should be adopted unless it results in sufficient net benefit to expose individual or society to offset the determinant. The use of radiation in healthcare is a justified practice.

Optimization requires that the individual dose, the number of people exposed and the likelihood of inadvertent exposure should be kept as low as reasonably achievable (ALARP, economic

and social factor). Being taken into account In UK, legislation is translated into a low as reasonably practicable (ALARP).

Limitation – the exposure of individuals should be subject to dose limits designed to ensure that no individual is exposed to an unacceptable radiation risk. It is possible to give only a short summary of the major point of UK legislation covering the safety of patients, employees, the public and the environment. The legislation is based on ICRP recommendation and subsequent European directives.

The dose to the fetus during the declared term of pregnancy (i.e after the employer has been in formed in writing) should be less than 1MSV. For those receiving exposure to diagnostic X-rays, this is equivalent to about 2MSV to the surface of the abdomen. An individual risk assessment must be carried out for the pregnant employee. The evidence available indicates that there should be no need for change in work patterns except perhaps for staff who are involved in a heavy interventional radiology work load or working with high activity unsealed

sources (e.g in the radio pharmacy). In these cases, it may be advisable to change work schedules or to limit the number of procedure performed and to offer additional monitoring. However, it should be stressed that such measure are often mainly to give peace of mind to the staff concerned.

2.3.1 THE MISSION OF THE INTERNATIONAL ATOMIC ENERGY AGENCY IS SAFETY AND SECURITY (IAEA)

It helps countries to upgrade their infrastructure for nuclear and radiation safety and security and to prepare for and respond to emergencies. The aim is to protect people and the environment from the harmful effects of exposure to ionizing radiation.

2.3.2 LEGISLATIVE FRAMEWORK

Law making to support a radiation protection infrastructure presents a significant challenge. Some developing nations have limited experience in legislative processes and little expertise in nuclear sciences. To spur progress in this area, the IAEA produced a set of model legislations and regulation. Sample law and related procedures that support the requirements set out in

the international basic safety standards for protection against ionizing radiation and the safety of radiation sources (BSS).

2.3.4 REGULATORY INFRASTRUCTURE

The first step is to establish legislation that allows beneficially justified uses of ionizing, radiation and provides for adequate protection of this legislation must also provide a mechanism that achieves this aim through the establishment of a regulatory body or authorities entrusted with an appropriate range of function and responsibilities and provides with adequate human and financial resources. In Nigeria, Nigerian nuclear Regulatory Control Authority is responsible for radiation control. The legislation also provides enforcements instruments to address non-compliance. regulation provide further detailed on the application of the laws. One of the most important tasks of the regulatory authority is to have a system of notification, authorization, inspection and enforcement. This includes the creation and maintenance of an all radiation sources.

2.4 AUTHORIZATION, INSPECTION AND ENFORCEMENT

In its broadest sense, regulation encompasses the introduction and conduct of any practice involving sources of radiation. It is a

task that can only be fulfilled by defining process parameters in many different areas such as:-

- Establishing notification procedure for individuals and organizations wishing to acquire radiation sources of having the intention to carry out a practice.
- Granting authorization for such sources and practice.
- Performing inspection to ensure that practices are carried out and sources are used in accordance with the requirements of relevant regulation and with any authorization condition.
- Enforcing legislation and regulations to correct non-compliance r revoking of licenses of the regulatory body that can no longer conclude that operations are unlikely to be safe.

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 AREA OF STUDY

The areas of study were selected hospitals and laboratories in Owerri that have x-ray machines. These include Federal Medical Centre Owerri in Owerri Municipal L.G.A., Amanda Hospital plot 412-415 works layout in Owerri Municipal L.G.A., O.C medical Centre and X-ray number 3 works layout Owerri in Owerri Municipal L.G.A., KEN/KON Medical Diagnosis plot 267 Ikenegbu layout Owerri in Owerri Municipal Local Government Area, Dalzon Medical diagnosis plot 271 Ikenegbu layout Owerri in Owerri Municipal Local Government Area, Umezuruike Hospital number 21 Umezuruike Street Owerri in Owerri Municipal Local Government Area, Nigerian Police Medical service State police Amakohia Owerri in Owerri North Local Government Areas, Imo State specialist Hospital Owerri in Owerri West Local Government Area, Holy Rosary Hospital Emekuku in Owerri North L.G.A and

Christiana Specialist Hospital Egbu in Owerri North Local Government

Geographically, Owerri is in Imo State located in the South-eastern part of Nigeria between latitude $4^{o}45^{1}$ and 7^{o} North and longitude $6^{o}50^{1}$ and $7^{o}25^{1}$ east, (Wikipedia 2010).

3.2 SAMPLING POPULATION SIZE AND SELECTION

The population sizes for this study were 50 X-ray workers being members of staff of hospitals and laboratory selected from hospitals and laboratories that have X-ray machine in Owerri.

The following criteria were used to select the population size.

- The X-ray worker selected must be a staff of selected hospitals and laboratory that have X-ray machine in Owerri. The following X-ray worker should not have any health problem in the past that may complicate with X-ray induced.
- The female X-ray worker selected must not have encountered accidental exposure to X-ray.

3.2.1 SAMPLE AND SAMPLING TECHNIQUE:- a systematic

Sampling technique was adopted in order not to introduce bias among patients and X-ray workers. A total number of 50 questionnaires were distributed among X-ray workers in Owerri

3.2.2 INSTRUMENT FOR DATA COLLECTION:

Data were Collected using questionnaire, oral interview and by using thermolumniscent Dosimeter (TLD).

3.3. QUESTIONNAIRE

Distribution of questionnaire to both male and female X-ray workers as the main source of data collection. The variables in the questionnaire drafted were 10 in number as introductory informed consent. 50 questionnaires were distributed to the X-ray workers.

3.4. RESEARCH DESIGN

Across sectional study design was used for this study.

3.5. VALIDATIONA AND RELIABILITY OF INSTRUMENT

All instruments adopted for this work were adequately and specifically design and validated by my supervisor, and X-ray workers from each respective hospital and laboratory that have x-ray machine in Owerri for the objective of the research.

3.6. METHOD FOR DATA COLLECTION:- The instruments were administered by X-ray workers.

3.7. STATISTICAL ANALYSIS:- Data were analyzed using higher

statistical test (inferential and descriptive statistics) such as student T-Test, Bar Chart, and Pie Chart.

3.7.1 PROTECTIVE SURVEILLANCE

This involves observation/inspection of environment from the environmental health points of view to ensure the protection and other physical features/characteristics of a good protective environmental health under protective surveillance, a survey of

possible pollution sources were determined. The instruments adopted include interviews and direct observation.

3.8 ETHICAL CONSIDERATION:- Respondents were assured to co-operate and prompt assistance in providing answers that best represent their opinion. Their response will be treated confidentially and will not be used against them. Ethical approval was gotten from Ken/Kon ethical committee.

3.9 LIMITATION OF STUDY

The survey was particularly limited by the following factors:

- **Time constraints**: A lot of time was wasted in trying to get ethical approved from hospital and laboratories that have x-ray machine in Owerri.
- **Financial problems**: A lot of money was needed to get reliable TLDs for the study.
- Hazardous nature of the study

CHAPTER FOUR

4.1. RESULTS

A total of 50 questionnaires were administered to X-ray workers in selected hospital and laboratories in Owerri that have X-ray machines. The whole 50 were returned given response rate of 100%. The results of the study were recoded as follows.

TABLE 2: FEDERAL MEDICAL CENTRE OWERRI IN OWERRI MUNICIPAL L.G.A.

Age in years	sex	Marriage	KV	MA	MAS	DOSE(µsv)	Time in yrs	Permissible dose µsv	BM^1	$BSAm^2$	Effect
40.00	M	Married	120.00	320.00	32.00	63.696	32.00	20.00	25.00	1.63	Cardiovascular Intervention
50.00	F	Separated	120.00	320.00	32.00	71.17	32.00	20.00	26.00	1.52	Cancer
30.00	F	Not married	75.00	320.00	32.00	2.6960	5.00	20.00	31.00	1.72	--------
25.00	M	Not Married	85.00	31.00	31.00	5.5839	2.00	20.00	28.00	27.	----------
30.00	M	Not Married	70.00	322.00	32.00	2.5399	2.00	20.00	27.00	1.64	----------

TABLE 3: AMANDA HOSPITAL PLOT 412-415 WORKS LAYOUT OWERRI, IN OWERRI MUNICIPAL L.G.A.

Age in years	sex	Marriage	KV	MA	MAS	DOSE(µsv)	Time in yrs	Permissible dose µsv	BM[1]	BSAm[2]	Effect
70.00	M	Married	100.00	320.00	32.00	71.00	40.00	20.00	29.00	1.72	Erythma
30.00	F	Not married	75.00	32.00	12.00	2.5480	2.00	20.00	25.00	1.60	--------
35.00	F	Married	70.00	32.00	12.00	2.4400	3.00	20.00	27.00	1.41	----------
21.00	F	Not Married	70.00	31.00	12.00	5.3888	2.00	20.00	26.00	1.60	----------
22.00	F	Not Married	90.00	32.00		7.1656	1.00	20.00	25.00	1.70	----------

TABLE 4: KEN/KON MEDICAL DIAGNOSIS PLOT 267 IKENEGBU LAYOUT PLOT 27 IKENEGBU OWERRI, IN OWERRI L.G.A

Age in years	sex	Marriage	KV	MA	MAS	DOSE(µsv)	Time in yrs	Permissible dose µsv	BM[1]	BSAm[2]	Effect
60.00	M	Married	120.00	200.00	32. 00	65.88	32.00	20.00	26.00	1.52	Redness of skin
30.00	F	Not married	90.00	320.00	27.00	7.1654	2.00	20.00	25.00	1.63	--------
55.00	F	Not Married	75.00	320.00	16.00	7.1645	1.00	20.00	21.00	1.41	----------
21	F	Not Married	90.00	320.00	13.00	5.9547	1.00	20.00	26.00	1.7	----------
25	M	Not Married	85.00	320.00	12.00	2.4367	2.00	20.00	27.00	1.8	---------

TABLE 5: DAL ZON MEDICAL DIAGNOSIS PLOT 271 IKENEGBU LAYOUT OWERRI, IN OWERRI MUNICIPAL L.G.A

Age in years	sex	Marriage	KV	MA	MAS	DOSE(µsv)	Time in yrs	Permissible dose µsv	BM^1	$BSAm^2$	Effect
30.00	M	Not Married	70.00	210.00	20.00	2.9286	2.00	20.00	31.00	1.82	--------
35.00	F	Married	85.00	320.00	25.00	2.4424	1.00	20.00	21.00	1.61	--------
25.00	F	Not Married	90.00	320.00	27.00	4.5985	2.00	20.00	30.00	1.91	----------
35.00	M	Not Married	85.00	320.00	20.00	23.8708	2.00	20.00	26.00	1.71	----------
25.00	F	Not Married	70.00	32.00	20.00	2.9725	2.00	20.00	27.00	1.60	----------

TABLE 6: UMEZURUIKE HOSPITAL NUMBER 21 UMEZURUIKE STREET OWERRI, IN OWERRI MUNICIPAL L.G.A

Age in years	sex	Marriage	KV	MA	MAS	DOSE(µsv)	Time in yrs	Permissible dose µsv	BM^1	$BSAm^2$	Effect
21.00	F	Not Married	120.00	200.00	22.00	4.1628	50.00	20.00	69.00	1.52	--------
40.00	M	married	90.00	320.00	25.00	2.7898	50.00	20.00	29.00	1.72	--------
30.00	M	Not Married	85.00	320.00	12.00	21.4767	50.00	20.00	25.00	1.93	----------
35.00	F	Married	90.00	310.00	12.00	3.5318	50.00	20.00	30.00	1.80	----------
21.00	F	Not Married	90.00	320.00	12.00	1.9018	50.00	20.00	26.00	1.72	----------

TABLE 7: O.C. MEDICAL CENTRE AND X-RAYS NUMBER 3 WORKS LAYOUT OWERRI, IN OWERRI MUNICIPAL L.G.A

Age in years	sex	Marriage	KV	MA	MAS	DOSE(µsv)	Time in yrs	Permissible dose µsv	BM[1]	BSAm[2]	Effect
60.00	M	Married	100.00	320.00	27.00	4.5530	40.00	20.00	25.00	1.37	
26.00	F	Not Married	70.00	320.00	10.00	2.3188	1.00	20.00	23.00	1.61	---------
30.00	F	Not married	90.00	320.00	12.2	4.3514	2.00	20.00	26.00	1.51	--------
30.00	M	Not Married	85.00	320.00	12.1	2.3481	2.00	20.00	25.00	1.62	---------
21	F	Not Married	70.00	320.00	12.2	3.9091	1.00	20.00	25.00	1.51	---------

TABLE 8: NIGERIA POLICE MEDICAL SERVICE STATE POLICE AMAKOHIA OWERRI, IN OWERRI NORTH L.G.A

Age in years	sex	Marriage	KV	MA	MAS	DOSE(µ sv)	Time in yrs	Permissible dose µsv	BM[1]	BSAm[2]	Effect
50.00	M	Married	120.00	200.00	12.00	65.00	30.00	20.00	26.00	1.52	Erythma
40.00	M	Married	90.00	320.00	25.00	2.3871	20.00	20.00	29.00	1.72	--------
30.00	M	Not Married	85.00	320.00	12.00	5.0864	10.00	20.00	25.00	1.93	----------
35.00	F	Married	90.00	310.00	12.00	2.1627	5.00	20.00	30.00	1.80	----------
21.00	F	Not married	90.00	310.00	12.00	5.1969	1.00	20.00	27.00	1.60	----------

TABLE 9: IMO STATE SPECIALIST HOSPITAL OWERRI, IN OWERRI WEST L.G.A

Age in years	sex	Marriage	KV	MA	MAS	DOSE(µsv)	Time in yrs	Permissible Dose	BM[1]	BSAm[2]	Effect
40.00	M	Married	100.00	200.00	12.00	3.1318	4.00	20.00	26.00	1.52	--------
35.00	M	Married	90.00	320.00	25.00	2.2895	2.00	20.00	29.00	1.72	--------
30.00	M	Not married	85.00	320.00	12.00	4.8457	1.00	20.00	25.00	1.93	--------

35.00	**F**	**Married**	**90.00**	**310.00**	**21.00**	3.3355	**3.00**	**20.00**	**30.00**	**1.80**	**----------**
40.00	**F**	**Married**	**85.00**	**320.00**	**21.00**	5.0506	**3.00**	**20.00**	**26.00**	**1.8**	**----------**

TABLE 10: HOLY ROSARY HOSPITAL EMEKUKU IN OWERRI NORTH L.G.A

Age in years	sex	Marriage	KV	MA	MAS	DOSE(µsv)	Time in yrs	Permissible dose µsv	BM^1	$BSAm^2$	Effect
40.00	**M**	**Married**	**100.00**	**200.00**	**12.00**	**3.2229**	**4.00**	**20.00**	**26.00**	**1.82**	**---------**
40.00	**M**	**Not Married**	**90.00**	**320.00**	**25.00**	**4.6668**	**2.00**	**20.00**	**29.00**	**1.72**	**---------**
30.00	**F**	**Not married**	**85.00**	**320.00**	**12.00**	**2.0684**	**1.00**	**20.00**	**25.00**	**1.93**	**--------**
35.00	**F**	**Married**	**90.00**	**310.00**	**12.00**	**2.2050**	**3.00**	**20.00**	**30.00**	**1.80**	**---------**
30.00	**M**	**Not Married**	**90.00**	**320.00**	**12.00**	**4.5985**	**2.00**	**20.00**	**26.00**	**1.71**	**---------**

TABLE 11: CHRISTIANA SPECIALIST HOSPITAL EGBU IN OWERRI NORTH L.G.A

Age in years	sex	Marriage	KV	MA	MAS	DOSE(µsv)	Time in yrs	Permissible dose µsv	BM^1	$BSAm^2$	Effect
25.00	F	Married	120.00	200.00	12.00	69.00	2.00	20.00	26.00	1.82	Erythma
40.00	M	Married	90.00	320.00	25.00	3.0630	2.00	20.00	29.00	1.72	-------
30.00	F	Not married	85.00	320.00	12.00	5.20	1.00	20.00	25.00	1.93	--------
23.00	F	Not Married	90.00	310.00	11.00	3.8734	3.00	20.00	30.00	1.80	----------
35.00	F	Married	85.00	320.00	21.00	2.6960	3.00	20.00	26.00	1.8	----------

TABLE 12: FREQUENCY DISTRIBUTION OF DOSES AS RECORDED BY THE THERMOLUMNISCENT DOSIMETERS TLD OF X-RAY WORKER THAT HAVE X-RAY MACHININE IN OWERRI FROM SELECTED HOSPITALS LABORATORIES THAT HAVE X-RAY IN OWERRI

Doses	Counts	Frequency	Sex	Age
1-10	IIII IIII IIII IIII IIII IIII IIII IIII IIII	44	21male/23female	21-50
11-20	_____	0		40-50
21-30	II	2	1Female/1male	
31-40	_____	0		

41-50	**_____**	**0**		
51-60	**_____**	**0**		
61-70	**II**	**2**	**1male/1female**	**35-50**
71-80	**II**	**2**	**1male/1female**	**35-50**

FIGURE 1: BAR CHART SHOWING THE FREQUENCY OF DISTRIBUTION OF X-RAY DOSES

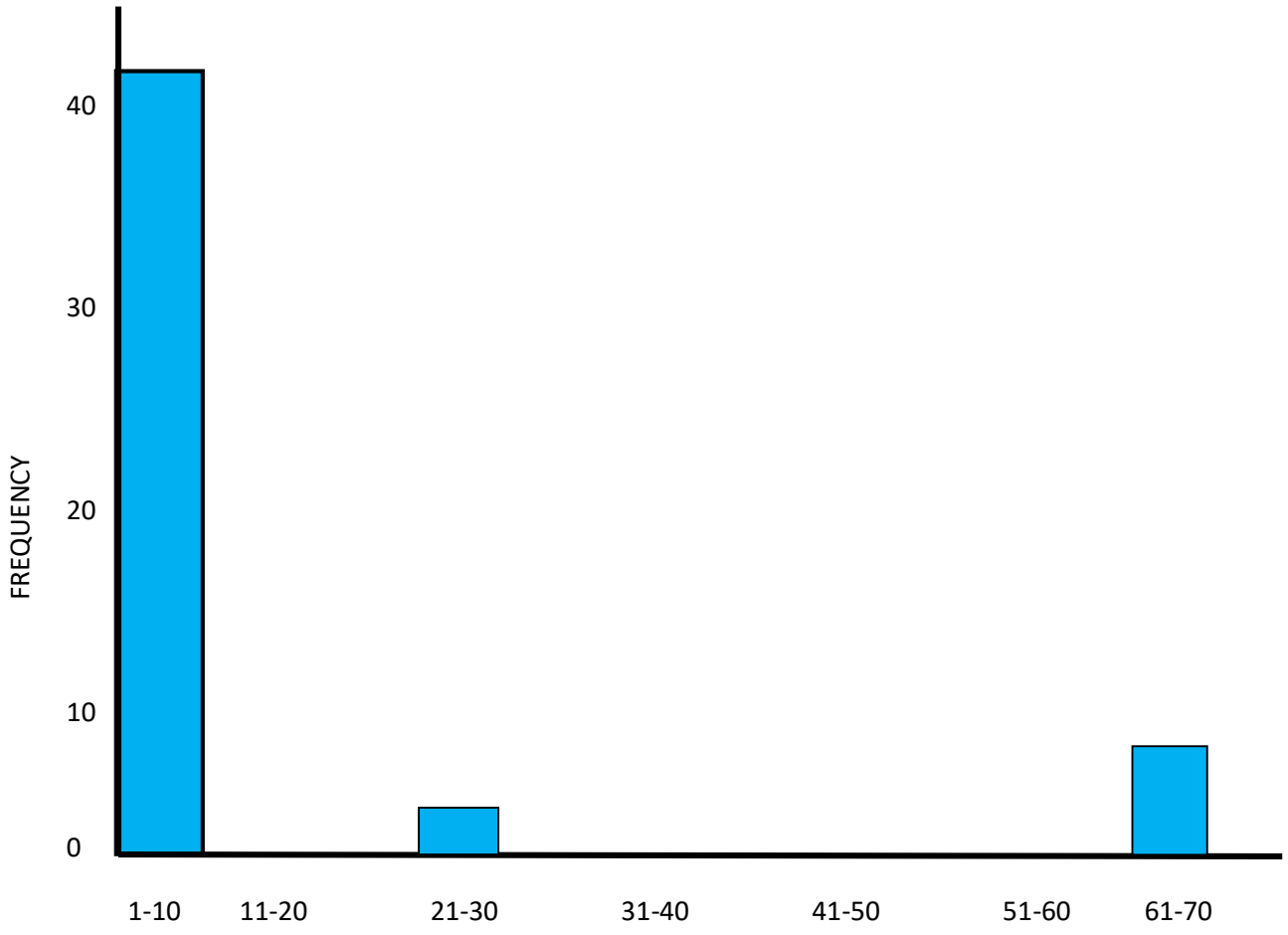
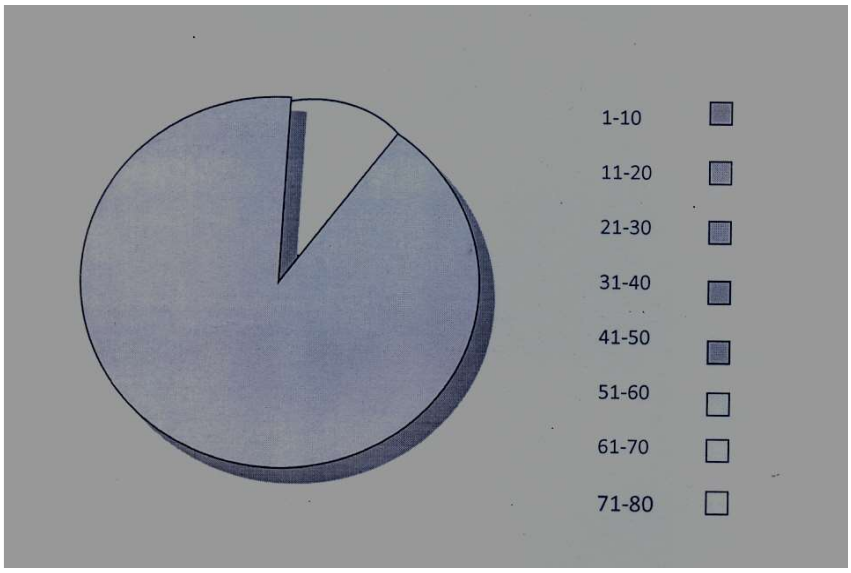


Figure 2

Show the frequency distribution where of doses of number of x-ray workers who didn't wear protective devices or exposure facto >100. They are liable to clinical ailment according to D.A. Clerk, (2008), x-ray workers are Amanda Hospital, Federal Medical Center Owerri. Nigerian Police Medical Service State Police Amakohia Specialist, Hospital Owerri, Holy Rosary Hospital Owerri, Holy Rosary Hospital Emekuku Owerri and Daizon Medical Diagnosis Plot 271 Ikenegbu in Owerri.

Figure 2: Pie chart showing the frequency distribution of doses of x-ray workers in hospitals and laboratory that have x-ray machine in Owerri.



FREQUENCY DISTRIBUTION OF DOSES

From the pie chart, I observed that the x-ray workers frequency distribution of doses fall within 21-30, 61 to70. Do not put on protective devices. Or exposure factor is >100. They are liable to clinical ailment, according to D.A. Clerk (2008), X-ray workers at FMC Owerri, O.C medical center and x-ray Owerri, Imo State Specialist Hospital Owerri and Christiana specialist hospital Egbu Owerri while those ≤20чsv are not liable to clinical ailment as

explain by this x-ray workers in all the hospitals and laboratories above. The result student of T test analysis for using protective device to achieve permissible does or not achieving permissible does when the exposure factor is at ≤ 100Kv or >100, and its clinical ailment.

Table 4:

SUMMARY OF THE RESULT OF T TEST ANALYSIS OF THE DOSES OF X-RAY OF 50 WORKERS AS RECORDED BY THERMOLUMNISCENT DOSIMETER TLDS AND ASSOCIATED POTENTIAL HEALTH PROBLEMS AMONG X-RAY WORKERS IN HOSPIAS AND LABORATOEIS THAT HAVE X-RAY MACHINE IN OWERRI

Variable	N	Means	Standard deviation	Standard mean error	t-test value	P-value	Effect
Energy > 100kva due to over exposure in attempt to get clearer picture e.g test on skull. Not covering the extremities with protective device	50	88.52	15.88	2.25	-5.11	0.00	Erythema by Vanoe C, also at FMC, Owerri, Amanda Hospital Owerri, Nigerian medical service police Amakohia Owerri

Energy <100 KV failure to cover extremities with led protectors	50	8.852	15.88	2.25	-5.11	0.00	Cataract, cancer since is > 20 usv according to Clerk DA 2008, also at Holy Rosary Owerri, Umezuruike Hospital Owerri, OC Medical center Owerri, According to Stish K.B (2008), Kenkon diagnosis Owerri, Doses >20, causes a lot of clinical ailmate like cardiovascular intervention, redness of skin.
Doses >20	50	9.47	17.37	2.46	-4.29	1.000	
Does <20	50	9.47	17.37	2.46	-4.29	0.00	This is below permissible doses, there is no noticeable clinical ailments

Table: Confidence intervals of the students T-Test of all the 50 X-ray workers in hospitals and laboratories that have X-ray machine in Owerri.

CHAPTER FIVE

5.1. DISCUSSION

The result of this study showed that there is a significant level of doses above permissible level for x-ray workers relating with the findings in objective 1. Which is to determining the amount of x-ray radiation received by x-ray workers using thermolumniscent dosimeters TLD? The amount of x-ray received when not using protective device at all, the T-test is -5.11, the P-value 0.000.The mean exposure factor is 8.52, number in this study is 50, the standard deviation is 15.88 and the standard error mean is 2.25 and the T. test is -5.11 P value is 0.000. When the exposure factor is ≤ 100 permissible doses is achieved using protective device like lead apron or gonads cover to prevent sterility of clinical ailments. The number in this study is 50 the mean is 88.52 standard deviation. Dev 15.88 standard error mean is 2.25 The student T. test is -5.11 the P. value is 0.000 When the doses of x-ray received by x-ray workers in this study is ≤ 20 it means that x-ray work was covered by protective attire that is the

reason he or she achieved permissible doses he or she will not have any clinical ailments as mentioned in objective number 2 in this study, the number of such x-ray workers is 50, the mean is 9.47, the St dev is 17.37 SE mean is 2.46, the student t test is -4.29, the P. value is 0.000. This is the result from Christiana specialist Hospital Egbu and Umezuruike Hospital Owerri.

5.2. CONCLUSION

The result of this work has shown that the assessment of x-ray on x-ray workers at the Hospitals and laboratories that have x-ray machine in Owerri. Though government provided protective devices to Government Hospitals in Owerri, from the study I can observe the some x-ray workers don't even care to be on protective attire, as explain at FMC Owerri hence receiving high doses of x-ray > 20Msv. these doses above permissible doses as a cording to Clark D.A (2008) causes' clinical ailment to x-ray workers. From the study almost all these clinical ailment, could be prevented by put on protective devices while working an x-ray room. Improved protective device could reduce clinical ailment by

2/3 accelerate economic and social development in Owerri. Where x-ray is a major causes of lost of work because of clinical ailments. This study may be an important working tool for policy markers in Owerri, Imo State and Nigeria in general.

5.3 RECOMMENDATION

Based on the above findings, it is recommended; government should provide protective devices to all the x-ray workers in Owerri, Imo State and Nigeria in general.

- Nigeria nuclear regulatory authority (NNRA), Environmental health officers should revisit the issue of radiology inspection.
- Electronic dosimeters which absorbed x-ray radiation entering the body of x-ray workers and give instant reading. This will help the x-ray workers to monitor the doses of x-rays entering their body per month easily.
- The hospitals management board should make it a law that every x-ray workers must wear protective device while working in an x-ray room.

- The regulatory bodies should make it a law that every x-ray female workers must wear protective devices at her abdomen while both male and female x-ray workers must wear gonad's cover.
- In an x-ray room if you have received more than the usual amount of radiation from while doing diagnostic x-ray, such as abdominal or pelvic, CT or fluoroscope, discuss the possible risks with your doctor.
- If you are pregnant or think you may be, tells your doctor before doing another x-ray test, it may be possible to change you with another person for that test.
- If you must do an x-ray test, tell your doctor about any similar x-ray test you have done recently, you may not do such test till further notice.
- If you think you may be pregnant have a pregnancy test before doing an x-ray test in an x-ray room.
- If you are pregnant wear protective measures, such as using lead apron while doing a test in x-ray room.

APPENDIX

Sample faction SF is gotten by SF No in the sample to population

For exposure factor above 100kv

$$\frac{100}{50} = \frac{2}{1}$$

Viswesware Rao, (2009)

For exposure factor below 1- KV

100 KV

$$\frac{100KV}{50} = 2$$

This means that 2kv. Out of every person out of exposure factor above 100 is selected and 100 out of every 50 person from exposure factor below 100kv are selected.

Test of statistical hypothesis on exposure protection and students T-test was used to test the hypothesis.

Ho: There is no statistical; difference in the methods and use of lead protectors and effect of x-rays on x-ray works in Hospital and Laboratories at Owerri.

Ho: There is a statistical difference in the use of lead protector and effect of x-rays on x-ray works in Owerri, Imo State.

Level of significance: 95.0% level of significance test statistics of choice; T-test.

$T = X1 - X2$

Where X1 = mean of exposure above factor

X2 = mean of exposure for below 100KV at

$Df = N1+N2 - 2$

$$SE\ (X1-X2) = \frac{S12}{N1} + \frac{S22}{N2}$$

Where; Sdf = Degree of freedom

S = Standard error of mean

S = Standard Deviation

N = No of X-ray works

SCHOOL OF POST GRADUATE STUDIES

DEPARTMENT OF PUBLIC HEALTH TECHNOLOGY FEDERAL UNIVERSITY OF TECHNOLOGY OWERRI, IMO STATE.

Dear Respondent,

I am a student of the above named school carrying a research on assessment of effect of X-rays radiation on X-ray workers in Owerri Imo State.

I solicit for co-operate and prompt assistance in providing answers that best represents your opinion. The response will be treated confidentially and will not be used against you.

Section A: Bio-data

Instruction: Tick from the given option

1) Age: 21-25 ☐, 26-30 ☐, 31-35 ☐, 36-40 ☐ >40 ☐
2) Sex: M ☐, F ☐
3) Marital status: single ☐, Married ☐, Divorce
4) Rank in the profession: Intern ☐,Basic

Senior/principle ☐, Asst./chief and above ☐

5) Experience in clinical practices < years ☐, 6-10 ☐

11-15 ☐ , 16-20 ☐ >21

SECTION B: BACKGROUND OF STUDY

6) How long do you work in the x-ray room? < hour per day

1-2hours per day ☐ 2-4hours per day ☐ 4-6hours

per day ☐, 6-8hours per day ☐ 8hours per day ☐

7) While working, do you put on protective device? Yes ☐

No ☐ .

8) If yes, is it for all patients you attend to? Yes ☐, No ☐

9) As a professional, do you know the implication of not using protective device while working in x-ray room? Yes ☐ No ☐

10) Do you have any health problem in the past that your may think is x-ray induced? Yes ☐, No ☐

11) Do you suffer from any of these illnesses in the past? Epithermal ☐, cataract ☐, tumor ☐, sterility

12) If you are a female x-ray worker, have you been pregnant before wile? Yes ☐, No ☐

13) Did you encounter accidental exposure to x-rays? Yes ☐

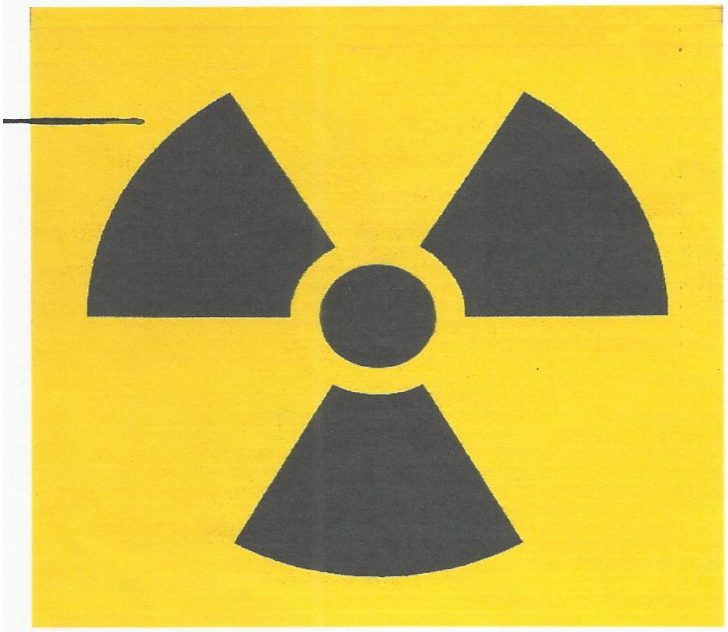
No ☐

14) If yes, do you think IT have an effect on your unborn child negatively? Yes ☐ No ☐. Thanks

THE FOLLOWING ARE THE DOSES OF X-RAY RECEIVED BY 50 X-RAY WORKERS WHILE DOING THE TEST AS RECORDED BY THERMOLUMNISCENT DOSIMETERS

2.6960	5.5839	2.5399	2.5480
2.4400	5.3888	7.1656	7.1654
7.1645	71.5839	63.746	65.888
5.9547	2.4367	2.9286	2.4424
4.5985	23.8708	2.9725	69.2057
4.1628	2.7898	21.4767	3.5318
1.9018	4.5530	2.3188	4.3514
2.3481	3.9091	2.1269	4.0001
2.2590	3.9644	2.3871	5.0864
2.1627	5.1969	3.1318	2.2895
4.8457	3.3355	5.0506	3.2229
4.6668	2.0684	2.2050	4.5985
3.0630	3.8734		

Plate 1

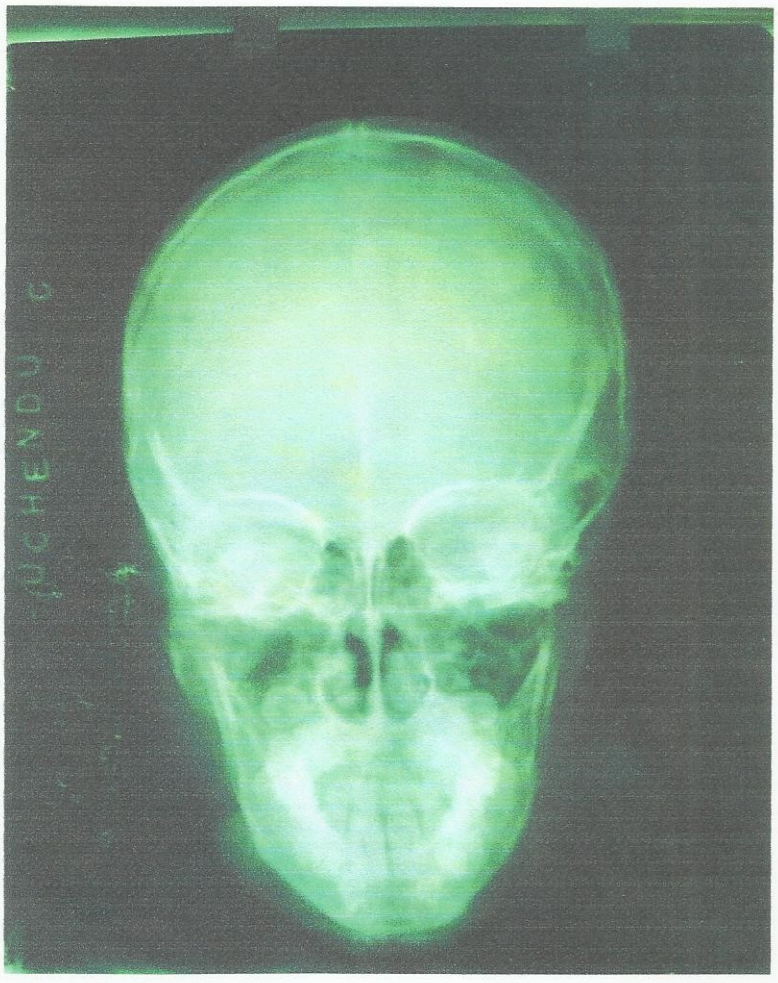


RADIATION WARNING SYMBOL

Plate 2

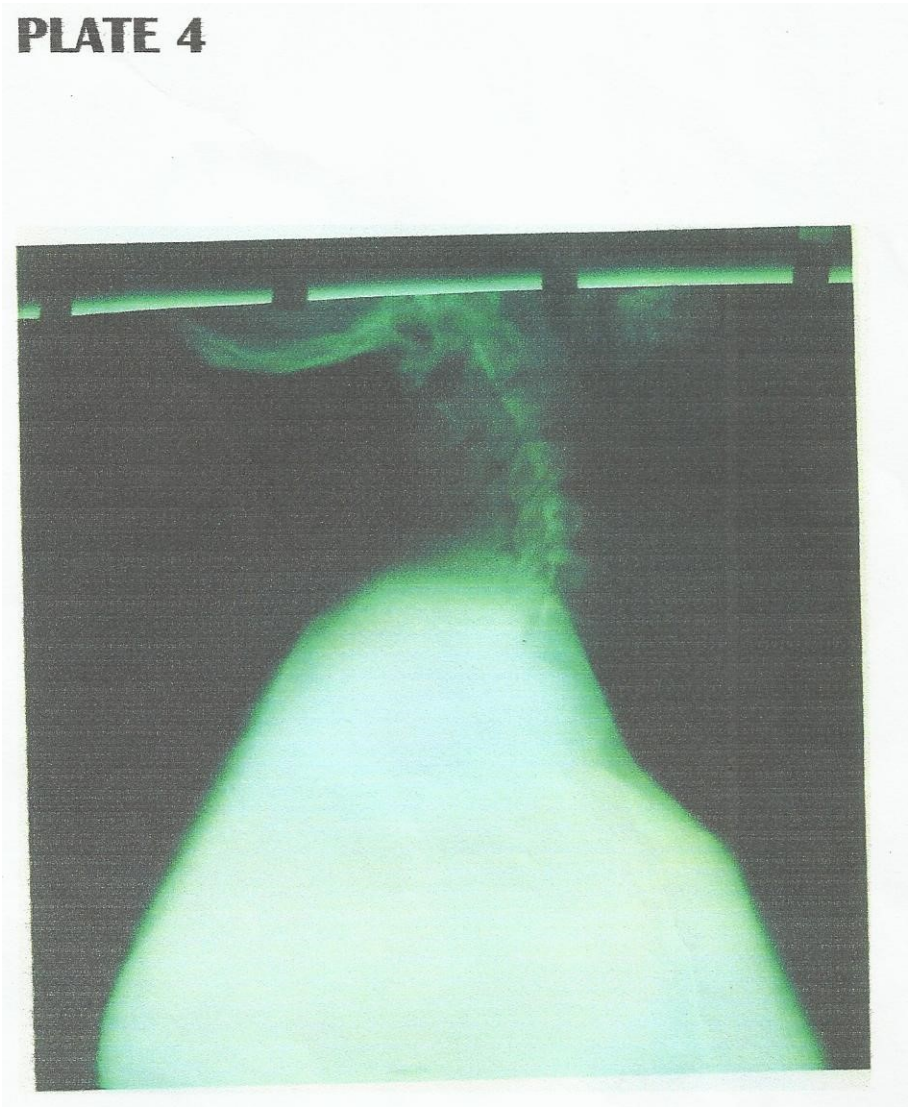
STATIC X-RAY MACHINE

PLATE 3



X-RAY OF THE SKULL

PLATE 4



X-RAY OF THE CER VICAL SCAN

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