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DETERMINATION OF WORKLOAD AND USE FACTOR IN THE RADIOGRAPHY DEPARTMENT OF FEDERAL MEDICAL CENTRE (FMC) YOLA SOUTH, ADAMAWA STATE, NIGERIA

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ABSTRACT

Background: The workload and use factor are important parameters required to estimate correctly the amount of shielding needed to reduce x-ray intensity to recommended dose limit. Maintaining appropriate dose limits in the shielded region is important as it gives radiation workers a sense of security and also ensure that members of the public are not exposed to unnecessary radiation doses. More so, the number of patients coming to the general radiography room for radiological examinations have consistently increased over the years for demographic reasons.

Objective: The study investigated the radiographic workload and use factor in order to determine the workload pattern and distribution in the Radiology department of the Federal Medical Centre, Yola.

Methodology: The exposure factors (kVp and mAs) for each exposure were recorded manually for 6 weeks involving 506 patients. The use factor was also determined by recording the direction of the primary beam for each exposure. The kVp distribution of the workload was determined and normalized per patient for this room.

Results: Results show that the normalized workload per week for the general radiography room is 47.88 mAs per patient, while the average number of patients per week is 84 pats/week. This is less than the 240 mAs per week recommended by the NCRP report 147 of 2005. The workload spectrum ranged from 54kVp - 97kVp with the bulk of the workload occurring between70-78kVp. The use factor for the various barriers ranged from 0.19 to 0.36. These values are less than the 0.7 and 1 use factors for floor and other barriers, as proposed by Simpkin, and the National (American) Council for Radiation and Measurement (NCRP) Report 49 (1976).

Conclusion: This shielding barrier from our results computed shows near perfection to standard barriers required in setting a radiographic room.

BACKGROUND

X-ray, since its discovery by German Physicist Wilhelm Conrad Roentgen in 1895, has maintained a crucial role in medicine as a diagnostic and therapeutic tool. X-rays are short-wavelength electromagnetic radiations that can undergo various interactions with matter. They have invaluable applications in areas like industry, agriculture, scientific research, as well as security and safety. It is estimated that a significant proportion of crucial medical decisions and the early diagnosis of some diseases like cancer are dependent on x-ray examination [1]. However, x-rays must be shielded to allow for the protection of patients, radiologists as well as the general public from radiological health hazards that can arise from its use, as these rays can interact beyond the parts of the body for which they are intended [2,3]. X-rays, as ionizing radiations, can cause adverse biological effects such as cancer and leukemia. The three techniques for controlling external exposures from radiation sources include minimizing exposure time, maximizing distance from the radiation source and shielding the radiation source. Limiting the duration of an exposure significantly may not always be feasible, because a certain amount of time is usually required to perform a given task. Also, sometimes it might be required to work very close to a radiation source in which case distance as a means of protection also become non-feasible. Hence, shielding is considered to be the most preferred technique of radiation protection [4,5].

Essien *et al*., estimated radiographic workload and use factor in order to determine the workload pattern and distribution in a general radiography room of Ahmadu Bello University Teaching Hospital Zaria [6]. The exposure factors (kVp and mAs) where recorded manually for 12 weeks for 2281 patients. The use factor was also determined by determining the direction of the primary beam for each exposure. The results showed that the average number of patients per week N_{week} was 119 patients/week, which is higher than the 112 patients/week recommended by NCRP report 147. The total workload for the room was found to be 288.8mAmin week^{-1}, which is also higher than the 240mA min week^{-1} recommended by NCRP report 147. Using the workload from this study in estimating shielding thickness will therefore result in a shielding thickness greater than that which NCRP report 147 will present. However, they found that the normalized workload for the general radiography room was 1.5mAmin per patient. The workload spectrum for this radiographic facility ranged from 40kVp to 115kVp with the bulk of the spectrum occurring between 70kVp to 75kVp. The study also found that the primary beam was directed at the chest stand/erect bucky for 51% of the total workload, while 47% was directed at the floor and the remaining 2% at the other walls. The research concluded that the results obtained are reasonable and can be used by shield designers as any shielding thickness calculated from the total workload obtained will result in adequate protection for the facility.

Simpkin (1996) carried out a survey to measure the workload and primary beam use factors used in diagnostic x-ray installations in comparison to those suggested in NCRP Report 49 [7]. The study investigated seven types of radiology facilities, including general radiographic rooms, general fluoroscopic and radiographic rooms, chest radiographic rooms, mammographic suites, and cardiac and peripheral angiographic suites. The radiologic technique (kVp and mAs) for each exposure performed on a total of 2396 patients was recorded either manually or by using commercially-available invasive electronic sensing system. The direction of the primary beam during the exposure was also recorded. The average workload per patient surveyed in each type of installation was found to be 2.5, 13, 1.5, 0.22, 6.7, 160, and 64 mA min per patient for the general radiographic rooms, general fluoroscopic and radiographic rooms, chest radiographic rooms, mammographic suites, and cardiac and peripheral angiographic suites respectively. For general radiographic rooms, it was observed that the primary beam was directed at the floor for 69% of the total workload, with the remaining 21.5%, 6.5% and 1.6% of the workload directed toward three different walls. By multiplying the average number of patients examined weekly by the average workload per patient in each type of installation, the mean weekly workloads for the general radiographic rooms, general fluoroscopic and radiographic rooms, chest radiographic rooms, mammographic suites, and cardiac and peripheral angiographic suites were found to be 270, 230, 35, 44, 320, 3100, and 1400 mA min respectively. The study concluded that the shielding designer should not rely blindly on the suggested workload and use factor information in the NCRP Report 49. Rather, values of workloads and use factors specific to a given installation should be utilized if they are available and that shielding requirement evaluation should consider the future use of the installation.

NCRP, (1976) has remained the primary guide for diagnostic x-ray structural shielding design. NCRP, (1976) proposed a design dose limit of 100mR/week (1mSv/week) for controlled areas and 10mR/week (0.1mSv/week) for uncontrolled areas [8]. This was based on the assumption that the entire workload in an installation is performed at a single kVp; for example, 1000mAmin wk^{-1} at 100kVp. NCRP, (1993) recently lowered these design values significantly [9]. Regarding occupational exposures, this report states that all new facilities and introduction of new practices should be designed to limit annual exposures to individuals to a fraction of the 10mSv per year limit implied by the cumulative dose limit and that radiation protection goal in such cases should be that no member of the public would exceed the 1mSv/year annual effective dose limit from all man-made sources and that a pregnant radiation worker should not be exposed to levels that result in greater than the monthly equivalent dose limit (H) of 0.5mSv to the worker's embryo or foetus. NCRP, (2005) while considering the design of new facilities and the pregnant radiation worker, recommends a fraction of one-half of the effective dose value or 5mSv per year and a weekly design dose limit (P) of 0.1mSv/week, dose for controlled areas and weekly design dose limit (P) of 0.02mSv/week dose (that is an annual effective dose of 1mSv) for uncontrolled areas [10]. The aim of this research is to determine the workload and use factor in the radiology department of F.M.C, Yola.

MATERIALS AND METHODS

Study Location

This work was carried out in the Radiology department of the Federal Medical Centre, Yola South Adamawa state, Nigeria. The operational area covered is conventional radiographic procedures comprising of ambulant patients that underwent all x –ray examinations during the period of the study: chest x-ray, abdominal x-ray, paranasal sinuses investigations, extremity x-rays, skull x-rays, vertebral column or spinal x-ray, and contrast or special investigations. Work process measurement in the department covered patient bookings/arrivals, patient waiting times, number of effective examination rooms/staff allocations, patient service times and staff utilization times.

MATERIALS AND EQUIPMENT

Facilities in the general radiographic room at Federal Medical Centre Yola, was used for the study. The room housing the general x-ray machine has an area of 5.30 x 4.70m, while the operator console in the room has an area of 1.65 x 1.70m and 1.83m high. The general x-ray machine is a Silhouette General X-ray machine manufactured by General Electric (GE) Medical Systems. It has a minimum inherent filtration of 1.5mmAl equivalent at 100kV. It has a leakage radiation of 0.876mGy/h dose (100 mR/h exposure) at 1m (150kVp, 3.3mA). The X-ray machine is shown in Figure 1 below.

Figure 1: General X-ray machine and Its Operator Console at Federal Medical Centre Yola

Methodology

The study population includes patients of all ages, with different sex, at Federal Medical Centre, Yola. The kVp and mAs for every x-ray exposure in this room was recorded manually for 6 weeks. The workload at each kVp for all exposures was computed and then normalized by the number of patients surveyed in the room. By considering all the exposures in this room, a workload spectrum was achieved using the NCRP 147 theoretical model of workload distribution which is based on the number of patients seen in the room per week. For example, using the Simpkin approach [7], the total workload (in mA min/wk) will be the average workload per week in mA min/wk multiplied by number of patients/wk. The data for this research work was obtained from the receptionist and the radiology specialist, especially the ones that have to do with the radiographic units/machines for six (6) weeks.

WORKLOAD ANALYSIS

In order to determine the amount of shielding required, it is necessary to determine the amount of radiation (primary and secondary) that will be incident on the shielding barrier [11]. The amount of radiation depends directly on the amount of work an x-ray unit does per week, known as the workload of the x-ray unit. The workload for a given facility is defined as the total number of milli-amperes-minutes per week that the x-ray tube is in operation [6]. The average workload per patient is called the normalized workload, W_{norm}, and the total workload for a given installation is the product of the normalized workload and the weekly number of patients, N:

$W_{tot} = N \times W_{norm}$

The workload will be calculated using the formula above.

USE FACTOR

The use factor is the fraction of the time that the primary beam is directed towards a given primary barrier [12]. It is the fraction of the workload that is expended by the primary beam while directed at a particular barrier [7]. The value of U is dependent on the type of radiographic installations and the barrier of concern [10].

The use factor for each barrier in the room was determined by calculating the fraction of the total workload for which the primary beam was directed at that barrier. The barriers will be categorized as floor, primary and secondary barriers. The Simpkin approach will be used to determine the use factors for the different barriers.

Table 1: Proposed primary use factors for workload distribution models [13]

Barrier	Use Factor (Single KVp)	Use Factor Workload Distribution
Floor	0.70	1 (floor/other barriers)
Wall 1 (Chest Image Receptor)	0.25	1 (Chest Bucky)
Wall 3	0.10	0.1 (Floor/other barriers
Wall 4 (Control Boot)	0.05	0.05 (Floor/other barriers

Determination of Occupancy Factor (T)

The occupancy factor was determined using data derived from the site for which the shielding is being designed, taking into consideration the possibility of future changes in use of surrounding rooms. For example, an outdoor area that has benches where employees can eat lunch will have an occupancy factor influenced by the climate of the location. The NCRP report 147 gives suggested values ranging from 1 for adjacent offices and x-ray control areas, to 1/40 for outdoor areas such as car parks or internal areas such as stairwells and cleaner's cupboards.

General guidance values that may be utilized if more detailed information on occupancy is not available is shown in Table 2 below

Table 2: Suggested occupancy factors for use as a guide in planning where other occupancy data are not available (NCRP, 2005) [11]

Location	Occupancy Factor
Administrative or clerical offices; laboratory, pharmacies and other work area fully occupied by an individual; receptionist area, attended waiting room, children’s indoor play area adjacent x -ray room, film reading, nurse’s station, x-ray control room.	1
Room used for patient examinations and treatment.	½
Corridor, patient room, employees’ lounges, staff rest room.	1/5
Corridor door	1/6

Location	Occupancy Factor
Public toilets, unattended vending areas storage rooms, outdoor areas patient holding areas.	1/20
Outdoor areas with only transie nt pedestrians or vehicular traffic, unattended parking lots, vehicular drop off areas (unattended), attic stairway, unattended elevators, and janitor closets.	1/40

X-ray Shielding

When x- and gamma rays pass through material they are not totally absorbed by that material. Instead, they are attenuated (i.e. reduced in intensity). X-rays are attenuated exponentially when they pass through material. This attenuation can be represented mathematically by the following equation:

$R_x = R_o e^{-\mu x}$ 2.0

where R_x = Dose rate after passing through a shield of thickness x

R_o = Dose rate without shielding

x = Shield thickness

μ = A constant known as the linear absorption coefficient of the shielding material

The linear absorption coefficient depends on the type of shielding material used and also on the energy of the incident X-ray. It is usually given in units of cm^{-1} (i.e. the absorption per centimetre of shielding).

Although the equation can be used to give a value for the amount of shielding material required, in practice simpler methods are used. These methods used experimentally determined shielding quantities known as Half Value Layers and Tenth Value Layers.

Half value and tenth value layers

The half-value layer (HVL) (also known as the half-value thickness), for a particular shielding material, is the thickness of a shielding material required to reduce the intensity of radiation to half its original value.

Equation 2.1 is similar to the radioactive decay equation ($A = A_0 e^{-\lambda T}$) and is used in a simpler form for shielding calculations using half value layers, in the same way that the radioactive decay equation is used in a simpler form using radiological half-lives. The simpler form of Equation 2.1 is therefore given by Equation 2.2 as follows:

$$R_x = \frac{R_0}{2^n} \quad (2.1)$$

where n = the thickness of the shielding in terms of the number of HVLs

R_x = Dose rate after passing through a shield of thickness x

R_o = Dose rate when unshielded

The actual thickness (x) of the shielding can be written in terms of Half Value Layers (HVL's) as shown in equation 2.3:

$$x = nHVL \quad (2.2)$$

The relationship between the linear absorption coefficient (μ) and the half value layer (HVL) is represented by Equation 2.4:

$$HVL = \frac{0.693}{\mu} \quad (2.3)$$

Another useful shielding value is known as the tenth value layer (TVL). This is defined as the thickness of a shielding material required to reduce the intensity of radiation to a tenth of its original value. Equation 2.5 can be used with tenth value layers:

$$R_x = \frac{R_0}{\mathbf{10}^n} \quad (2.4)$$

where n = the thickness of the shielding in terms of the number of Tenth Value Layers (TVLs)

R_o = Dose rate when unshielded

R_x = Dose rate after passing through a shield of thickness x

In this case, the actual thickness (x) of the shielding can be written in terms of Tenth Value Layers (TVL's) as shown in Equation 2.6:

$$x = nTVL \quad (2.5)$$

The relationship between the linear absorption coefficient (μ) and the tenth value layer (TVL) is represented by Equation 13.

$$TVL = \frac{2.303}{\mu} \quad (2.6)$$

X-ray shielding involves two geometrical conditions namely the narrow beam and the broad beam conditions.

Narrow Beam Condition: In narrow beam (also called good condition) geometry, every photon that interacts is either absorbed or scattered out of the primary beam such that those that reach the receptor have all of their original energy [14]. The attenuation of photons by various absorbing materials under ideal narrow beam conditions satisfy the relationship.

$$I(x) = I_0 e^{-\mu x} \quad (2.7)$$

Where I_0 is the initial photon intensity (usually expressed as a fluence or flux), *I(x)* is the photon intensity after passing through an absorber of thickness x in narrow-beam geometry, and μ (cm^{-1}) is the total attenuation coefficient, which accounts for all interaction processes, including scattering reactions, that remove photons from the beam. The attenuation coefficient μ is dependent on the particular absorber medium and the photon energy.

Broad Beam Condition: In poor geometry (also called broad-beam geometry), a significant fraction of scattered photons will also reach the receptor of interest, and the energy spectrum will be quite complex with multiple scattered photon energies in addition to unattenuated photons that retain all of their initial energy. Poor geometry exists in most practical conditions when tissue is exposed or a shield is used to attenuate a photon source, and it is necessary to account for these scattered photons [14].

The effect of scattered photons, in addition to unscattered primary photons, is taken into consideration by introducing a buildup factor B, which is greater than 1.0 to account for photons scattered towards the receptor from regions outside the primary beam. When buildup is included, the radiation intensity is

$$I(x) = I_0 B e^{-\mu x} \quad (2.8)$$

The buildup factor B is dependent on the absorbing medium, the photon energy and beam geometry, the attenuation coefficient for specific energy photons in the medium, and the absorber thickness x.

Estimation of Shielding Barriers

In measuring the shielding barrier, we intend to evaluate whether, appropriate shielding material, correct construction methods, and the shielding has been built according to design and is safe for use, verified by a qualified expert. The choice of shielding material is usually a compromise dictated by bulk, cost, and fabrication. The code, XRAYBARR was used to calculate the thickness of the barrier required to shield the diagnostic x-ray installations at federal medical centre Yola South, with the annual dose limit (P) and occupancy factor (T) to the area to be shielded specified. The program uses the workload in the room, use factor, distances to the occupied area and the x-ray tube information to calculate the barrier thickness required to reduce the total annual dose to P/T. The XRAYBARR calculation model is shown below in figure 2

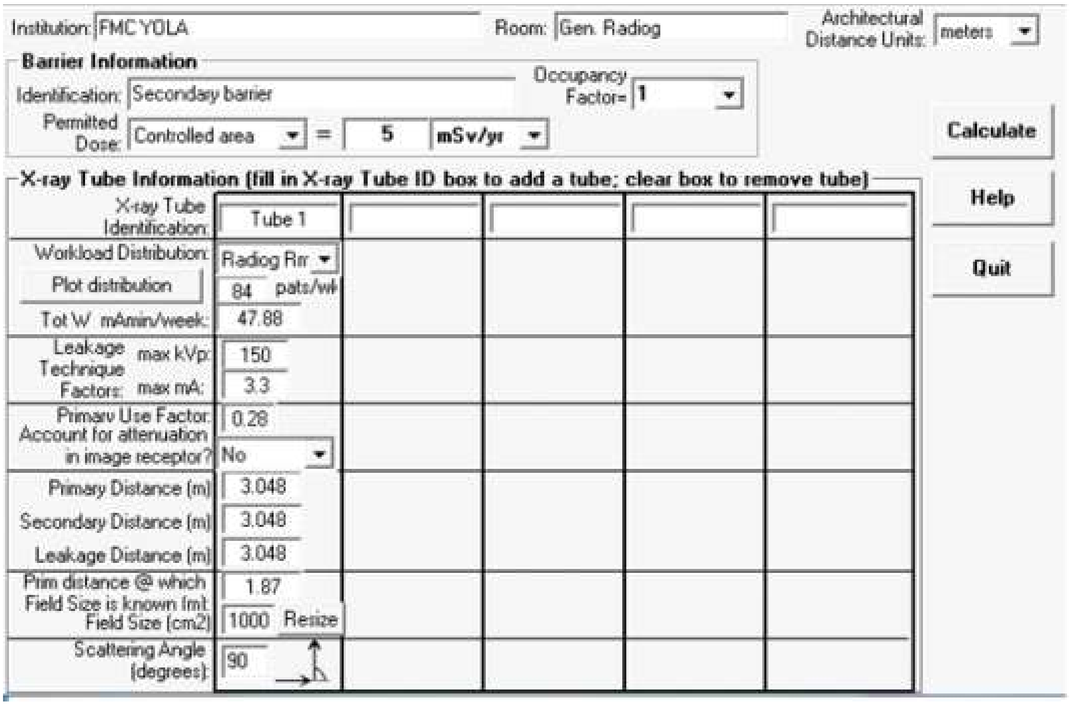


Figure 2: The XRAYBARR Calculation Model

Upon inputting the type of barrier and x-ray tube information and clicking the calculate button, the program presents the required minimum shielding thickness in (mm and inches) and the details of the calculated unshielded and shielded primary, scatter and leakage dose generated by the x-ray tube. The program uses equations 2.3, 2.4, 2.5, 2.6 and 2.7 to calculate the unshielded and shielded primary, scatter, leakage radiation and the thickness of barrier required.

RESULTS

The results are collected and computed for the entire period of six weeks.

Workload Spectrum

Tables 3, 4 and 5 show the results of workload calculated using data obtained from the general radiography room of the Federal Medical Centre (FMC) Yola.

Table 3: Workload Spectrum for Soft Tissue (>60kVp)

weeks	N	W_t (mAs)	W_n (mAs)	kVp
1	30	287.0	9.56	54.70
2	35	308.4	8.81	57.74
3	44	425.3	9.67	59.33
4	43	362.8	8.43	55.74
5	53	423.0	7.98	54.65
6	23	175.5	7.63	52.56

Table 4: Workload Spectrum for Hard Tissues (>60 – 150kVp)

Weeks	N	W_t (mAs)	W_n (mAs)	kVp
1	46	2920	63.48	70.75
2	31	2838	91.54	93.82
3	62	5936	95.74	97.35
4	57	4706	82.56	87.50
5	59	3828	64.88	89.70
6	23	2018	87.74	78.50

Table 5: General Workload Spectrum

Weeks	N	W_t (mAs)	W_n(mAs)	kVp
1	76	3207.0	42.20	62.73
2	66	3146.4	47.67	75.78
3	106	6361.3	60.01	78.34
4	100	5068.8	50.69	71.62
5	112	4251.0	37.96	72.18
6	46	2193.5	47.68	65.53

It can be seen from the tables that the higher the peak kilovolt used in the radiography room, the higher the workload for the installation. From Table 5, Week 3 has the highest workload of 60.01mAs with the input Potential voltage of 78.34kVp. Also, most of the radiography diagnosis carried out for the six weeks of this study involved hard tissues, and this contributed significantly to the total workload of the radiographic installation.
Similarly, from table 5, we can see that the normalized workload per week of the radiographic installation of Federal Medical Centre Yola is 47.88 mAs per patient. While the average number of patients per week is 84 pats/week. Figures 3 to 8 shows the variation of the workload with the peak kilovolt for soft tissues and hard tissues and the general normalized workload with the peak kilovolt.

Figure 3: Workload spectrum for Soft Tissues

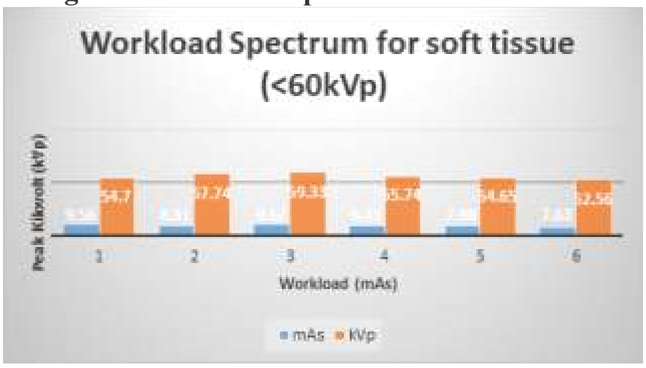


Figure 4: Graph of Peak Kilovolt with Workload for Soft tissues

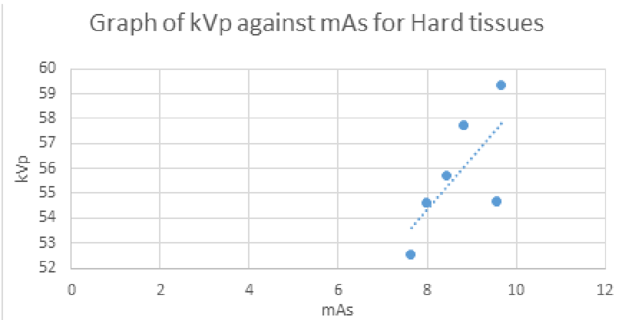


Figure 5: Workload spectrum for Hard Tissues

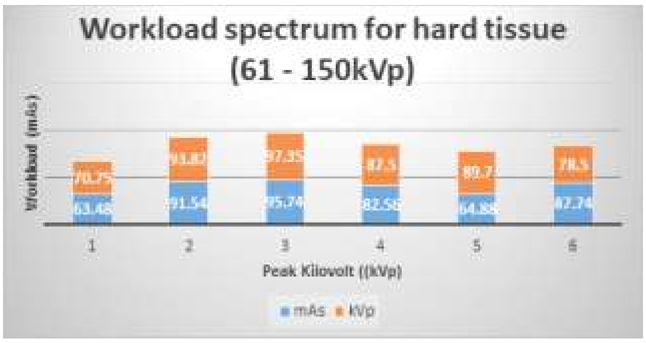


Figure 6: Graph of Peak Kilovolt with Workload for Hard Tissues

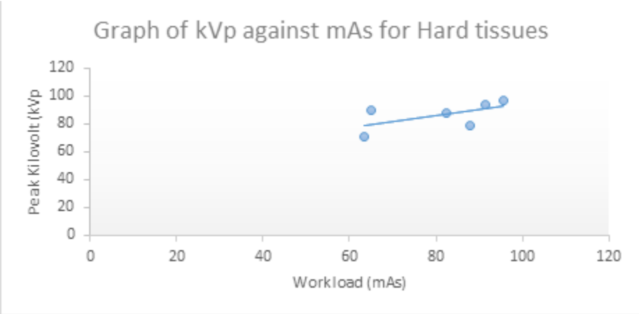


Figure 7: General Workload Spectrum

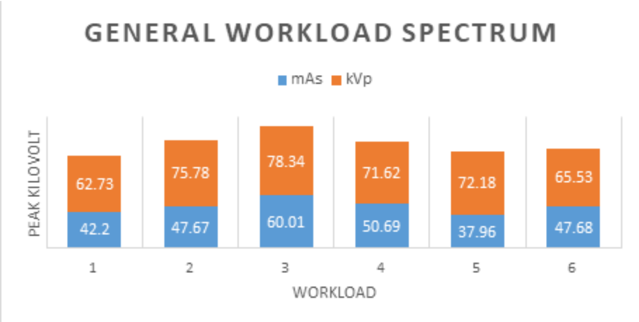
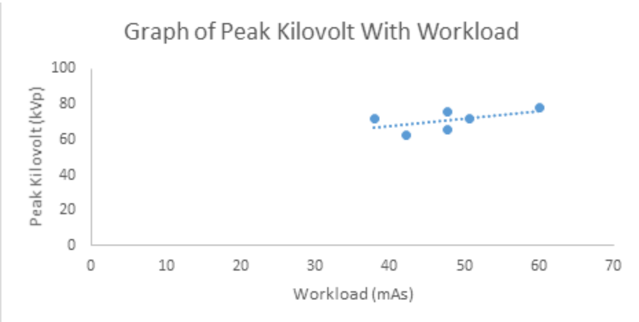


Figure 8: Graph of The General Peak Kilovolt with General workload



Use Factor

The use factor is the fraction of the time that the primary beam is directed towards a given primary barrier [9]. It is the fraction of the workload that is expended by the primary beam while directed at a particular barrier (Simpkin, 1996). The use factor for the radiography room of Federal Medical Centre Yola is shown on Table 6 below

Table 6: Use Factor for The X – ray Installation in The Radiography Room

Weeks	N	Use Factor
1	76	0.26
2	66	0.28
3	106	0.36
4	100	0.31
5	112	0.29
6	46	0.19

From Table 6, the use factor of the radiography room of Federal Medical Centre Yola for the various barriers ranges between 0.19 at week VI, to 0.36 at week III. These values are less than the use factor of 0.7 for floor and other barriers, as proposed primary use factors for workload distribution models by Simpkin, and that recommended by The National (American) Council for Radiation and Measurement (NCRP) Report 49 (1976) of U=1.

Estimation of X –ray Shielding

Barrier: Secondary barrier

Minimum barrier thickness required

	mm	inches
Lead :	0.840	1 / 30.3
Concrete :	69.9	2.75
Gypsum :	222	8.76
Steel :	6.60	0.260
Plate Glass :	82.9	3.26
Wood :	679	26.7

Table 7: Shielding Barrier Thickness Required Calculated from XRAYBARR for General Radiography Room of Federal Medical Centre Yola.

Awareness of Patients and Medical Imaging Personnel on the Health Risks of X-ray Exposure

A total of 244 participants including 222 patients and 22 medical imaging personnel were surveyed to ascertain the level of awareness on the risks of X-ray exposures. The results are shown in table 8.

Table 8: Awareness of Patients and Imaging Personnel on Health Risks of X-ray Exposures

AWARENESS OF PATIENTS ON THE HEALTH RISKS OF X-RAYS	YES	NO	YES (%)	NO (%)
Exposure to x-rays can damage the cells	36	186	16.2	83.8
Exposure to x-rays can cause cancer	18	204	8.1	91.9
Chronic exposure to x-ray increases the chance of contracting radiation induced cancer	24	198	10.8	89.2

AWARENESS OF PATIENTS ON THE HEALTH RISKS OF X-RAYS	YES	NO	YES (%)	NO (%)
Some radiation induced symptoms may not manifest until 10 to 15 years after exposure	18	204	8.1	91.9
Chronic exposure to x-ray can reduce lifespan	36	186	16.2	83.8
X-ray exposure is dangerous to the fetus during pregnancy	108	114	48.6	51.4
MEDICAL IMAGING PERSONNELS				
I have received training on radiation protection	18	4	81.8	18.2
I ensure that all exposures to x-rays are reasonably justified	21	1	95.5	4.5
I inform patients of the risks of x-rays before they undergo any examination procedures	14	8	63.6	36.4
The risks of cancer from exposure to x-rays has increased	17	5	77.3	22.7
Routine checks are carried out to ensure shielding and other radiation protection measures are not compromised	14	8	63.6	36.4

DISCUSSIONS

Tables 3, 4, and 5 show the results of workload calculated using data obtained from the general radiography room of the Federal Medical Centre (FMC) Yola.

Tables 3 and 4 shows that most of the radiography diagnosis carried out for the six weeks of this study involved hard tissues, and this contributed significantly to the total workload of the radiographic installation.

It can be seen also be seen from the tables that the higher the peak kilovolt used in the radiography room of Federal Medical Centre, the higher the workload for the installation. From Table 5, Week 3 has the highest workload of 60.01mAs with the input Peak kilovolt of 78.34kVp.

It was found from the research that the average workload per week of the radiographic installation of Federal Medical Centre Yola is 47.88 mAs. This is less than the 240 mAs recommended by the NCRP report 147 of 2005.

From Table 5, 506 patients undergo X-ray examinations at the Medical centre over a period of six weeks. This implies that the average number of patients per week for the radiography installation is 84 Pats/week. This value is less than the 112 patients per week recommended by the NCRP report 147 of 2005.

From Table 6, the use factor of the radiography room of Federal Medical Centre Yola for the various barriers ranges between 0.19 at week VI, to 0.36 at week III. The average use factor utilized for all barriers over a period of six weeks is 0.28. This value is less than the use factor of 0.7 for floor and other barriers, as proposed primary use factors for workload distribution models by Simpkin, and that recommended by The National (American) Council for Radiation and Measurement (NCRP) Report 49 (1976) of U=1.

Table 7, shows the shielding barrier thickness required to shield the radiography room of Federal Medical Centre Yola, calculated from XRAYBARR is 0.84mm for lead, 69.9mm for concrete, 222mm for Gypsum, 6.6mm for steel, 82.9mm for plate glass and 679mm for wood respectively.

The Malaysian Standard code of practice for radiation protection recommended that the shield of a radiographic room should have a minimum thickness of 1mm lead equivalent and dimension of at least 1m wide and 2m in height. While The office of radiation safety, Ministry of health, New Zealand Government as reviewed in 2010, states that, the acceptable secondary barrier required for general diagnostic room should include; 1mm lead, one sheet of barite board, concrete, solid concrete block having a total thickness of 75mm, and 1mm lead equivalence or lead glass for a viewing window.

By comparing the shielding barrier required for Federal Medical centre Yola, calculated from the XRAYBARR with the standard shielding barrier required for general radiography room, one can say that the Federal Medical Centre Yola is properly shielded.

From table 8, The result shows that they is generally low level of awareness on the health risks associated with the use of x-rays among patients.

Less than 20% of the patients sampled showed awareness on the tendency of x-rays to damage cells and cause cancer. Most (91.9%) of the patients were not aware some radiation induced symptoms may not manifest until 10 to 15 years after exposure. However, about half of the patients showed awareness on the danger associated with x-ray exposures during pregnancy.

Most medical imaging personnel surveyed showed good awareness of radiation risks, as well as radiation protection and safety. 81.8% have been trained on radiation protection and 95.5% said they ensure all exposures to x-rays are justified. Most imaging personnel (63.3%) also agreed they carry out routine checks to ensure shielding and other radiation protection measures are not compromised. This shows there is a good knowledge of radiation risk and safety among imaging personnel but a low level of awareness among patients.

CONCLUSION

The results shows that the potential parameters of interest such as shielding dose limit, risk estimation of radiation to both personnel and patients are within the limit of NCRP standard, estimation of the workload and use factor has shown that results obtained is in line with the Malaysian standard code of practice and the New Zealand ministry of health. But within the limit of accuracy, a shortfall of less than 0.2mm computed for lead thickness for the general diagnostic room and less than 5.0mm shortfall in solid concrete block. This shielding barrier from our results computed shows near perfection to standard barriers required in setting a radiographic room.

RECOMMENDATION

1. This work can be extended by using TLD chips to obtain the scattered radiations in the whole department to ensure proper shielding of the department.
2. Similar research work should be carried out in the department to ensure average workload and use factor is maintained to avoid over load of the radiographic installation.
3. Quality control tests should be done periodically to ensure the x-ray equipment is functioning properly with time.
4. Because the level of awareness of the general public to the deleterious effect of X-ray is very low, public seminars should be organized by the Radiology department of the Medical Centre Yola to keep the public abreast of the risks involved in X-ray radiations

Conflict of interest: Nil

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