# Measurement of exposure dose due to X- ray in Al-Sader medical city in Al-Najaf city

**Talib Abdulridha Abdulwahid**
**Hayder Hamza Hussain**
**Kufa university , science Faculty, physics Department.**
**E-mail: taliba.jabir@uokufa.edu.iq**
**E-mail: Hayder.alshibana@uokufa.edu.iq**

**Abstract :**

Many worker in radiation field are expose to different doses of ionization rays . one of this ray is X-ray . The instruments that produce X-ray are available in hospitals. In this project we measure exposure dose due to X-ray instrument in al-sader medical city in Al najaf city . Our measurements were done to determine the exposure dose by using RAD-CHECK$^{TM}$ PLUS equipment for different time intervals and different locations in the unit . The obtained results show the values of exposure dose for workers in X-ray unit and patients are within the permitted limits .

**Key words: X-ray, Exposure , normal limits, radiographic staff , Al-Najaf city.**

# قياس مقدار جرعة التعرض الناتجة عن الأشعة السينية في مدينة الصدر الطبية في مدينة النجف

**طالب عبد الرضا عبد الواحد حيدر حمزة حسين**

**الخلاصة :**

يتعرض العديد من العاملين في حقل الاشعاع الى جرع مختلفة من الاشعة المؤينة . احدى هذه الاشعة هي الاشعة السينية ، تتوفر بعدد كبير في المستشفيات الاجهزة التي تولد الاشعة السنية . تم في هذا البحث قياس جرعة التعرض الناتجة من استخدام الاشعة السينية في مدينة الصدر الطبية في محافظة النجف الاشرف . تم استخدام جهاز (RAD-CHECK$^{TM}$ PLUS) لقياس جرع التعرض لفترات زمنية مختلفة ولمواقع مختلفة في وحدة الاشعة في المدينة الطبية . بينت النتائج التي تم الحصول عليها ان قيم جرع التعرض للأشعة السينية للعاملين والمراجعين للمستشفى هي ضمن الحدود المسموح بها .

**كلمات مفتاحية: الاشعة السينية ، التعرض للأشعة ، جرعة التعرض ، مدينة النجف .**

**Introduction**:

X-rays have application in industry ,researches and medicine for diagnosis and for treatment of diseases .The objective of any diagnostic X-ray examination is to produce images of patients , in order to provide diagnostic information for a clinician to give suitable care for patients [1]. The widespread use of X- rays for medical diagnosis to make that worker in medical radiograph represents the most staff exposed to ionizing radiation in the hospital [2] . If the worker in therapy and diagnosis they are using X-rays randomly may lead to health hazards to patients and workers who are professional exposed to X-rays . The use of X-ray cannot be completely to except from medical practice hence the need for patient which gives a good information about the patient case [3] .

It has been estimated that over 70% of the world population is expose to medical X– rays annually [4]. The principal concern in radiographic protection is the reduction of unnecessary exposures [5] .

The bodily and genetic health risk associated with exposures to X – rays , these examinations should be done with minimum amount of radiation levels [6] .

Exposure (X) was introduced by the International Commission of Radiological Protection (ICRP) to provide a amount of ionization in air that occur by ionizing radiation then effect of radiation doses to tissues and organs that exposed to radiation [7] .

Radiation levels associated with radio-graphical procedures in hospitals has come under increasing examination , so that to observe radiation levels require quantitative monitoring and measurement [8].

This is necessary to ascertain whether the radiation levels in the hospitals are within the permissible dose limit set up by the guiding principles recommended by the International Commission on Radiation Protection (ICRP) for medical exposures [9] .

The amount of radiation received since over exposure could result in serious health problems like cancer and gene variation to workers that exposed to radiation for long time[10] .

**Methodology**

In our project we selected X-ray unit in al-sader medical city in al najaf city to take the measuring because a large number of patients are entered the examination in X-ray unit . X-ray unit contains four instruments producing X-rays . to measure exposure dose that produced from X-ray instruments we selected 32 locations to be covered the X-ray unit . those 32 locations are distributed as follow: 26 positions for different cases inside exam room(in door) represent by locations (1, 2, 3, 4) and 6 location outside exam room (out door) represented by locations (5, 6, 7,8 ,9 ,10) as shown in Figure (1) .

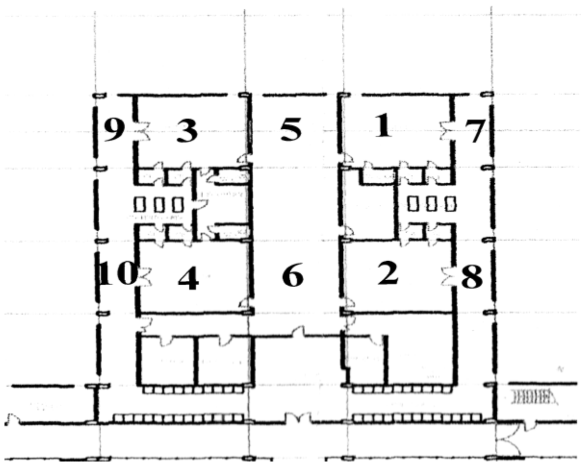



Figure (1): the distribution of measurement locations in X-ray unit .

The distance between the X-ray tube and patients is about (50-100) cm by depending on patient case . In the Different radiographic techniques were used to measure exposure dose (tube potential in kilovolt and tube current in milliampere ) representing different patients body size and different cases . Our measurements were done to determine the exposure dose by using RAD-CHECK$^{TM}$ PLUS instrument model 06-526. Our measurements were performed inside examination room(26 measuring) and the outside examination room (6 measuring).

## Results and discussion

It is necessary to keep the exposure dose of X-ray as low as is reasonably achievable to avoid health risk to radiographic staff those undergoing X-ray exposure . Exposure dose was measured in (mR) .

The exposure dose of X-ray (mR) was measured for inside and outside examination room relative to different locations that are applied during the examinations .

In general the measurements values of exposure dose outside the exam room (locations 5,6,7,8,9,10) show that there are no exposure dose due to X-ray (i.e. our device RAD-CHECKTM PLUS did not record any value) these locations represent the examiner standing (locations 5,6) and the patient pass through the corridor to enter the examining room (locations 7, 8, 9, 10) .

While in other locations our device record exposure dose values due to X-ray . these values are listed in table 1 as shown below with addition corresponding current and voltage values. From table (1) we note exposure dose values to vary from minimum value (0.00114 mR) and maximum value (0.01758 mR) and all values that we measured are in permitted limits that recommend International Commission on Radiation Protection(ICRP) .

Table-1: The exposure dose (mR) inside examination room locations (1, 2, 3, 4) relative to different cases that are applied during the examinations.

| No. | Tube voltage(KV.) | Tube current(mA) | Exposure (mR) |
|---|---|---|---|
| 1 | 50 | 2 | 0.00114 |
| 2 | 53 | 2.2 | 0.00136 |
| 3 | 55 | 2.5 | 0.00172 |
| 4 | 56 | 2.6 | 0.00187 |
| 5 | 59 | 3 | 0.00229 |
| 6 | 60 | 3.4 | 0.00275 |
| 7 | 61 | 3.5 | 0.00298 |
| 8 | 64 | 3.7 | 0.00344 |
| 9 | 67 | 4 | 0.00459 |
| 10 | 68 | 4.3 | 0.00465 |
| 11 | 70 | 4.5 | 0.00505 |
| 12 | 72 | 4.7 | 0.00559 |
| 13 | 73 | 5 | 0.00609 |
| 14 | 76 | 5.2 | 0.00689 |
| 15 | 79 | 5.4 | 0.00770 |
| 16 | 80 | 5.7 | 0.00827 |
| 17 | 83 | 6 | 0.00942 |
| 18 | 84 | 6.3 | 0.01011 |
| 19 | 86 | 6.5 | 0.01103 |
| 20 | 88 | 6.8 | 0.01206 |
| 21 | 90 | 7 | 0.01298 |
| 22 | 92 | 7.2 | 0.01379 |
| 23 | 94 | 7.4 | 0.01494 |
| 24 | 96 | 7.6 | 0.01609 |
| 25 | 97 | 7.8 | 0.01686 |
| 26 | 98 | 8 | 0.01758 |

Exposure dose values are distributed inside examination room for 26 positions for different cases inside exam room (in door) represent by locations (1, 2, 3, 4).

Figure (2) shows relation between measured exposure dose and tube current of X-ray device . We note the exposure dose values are proportion with current as shown in figure (2).

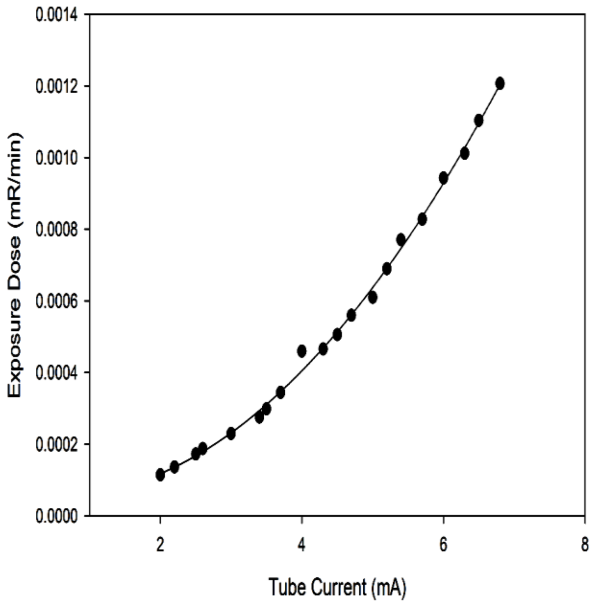



Figure (2): The relation between exposure and tube current .

Figure (3) represent the relation between the measured exposure dose with tube voltage of X-ray device. From the figure we note the exposure dose values are proportion with tube voltage as shown in figure (3).

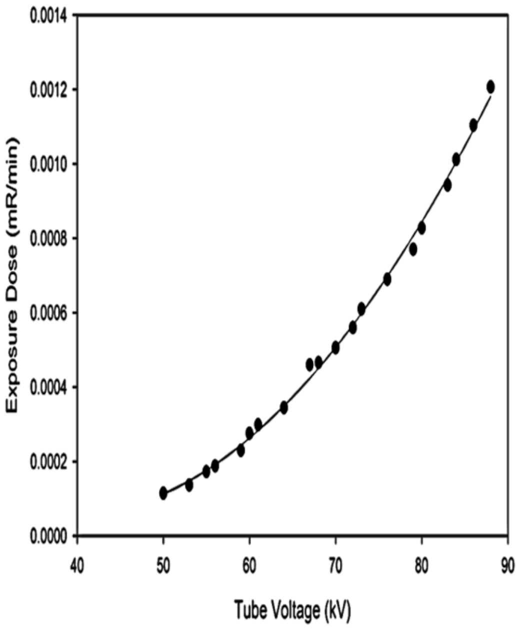



Figure (3): The relation between exposure and tube voltage.

When we compare between figures 1 and 2 we notice the exposure dose values are proportion with tube voltage larger than tube current i.e. exposure dose are increased with increasing tube voltage discord increasing tube current where the increasing in exposure dose are small .

Figure (4) show the cantory distribution for exposure dose values with tube current and tube voltage in same time . We notice the increasing in tube current and tube voltage cause increase in exposure dose values.

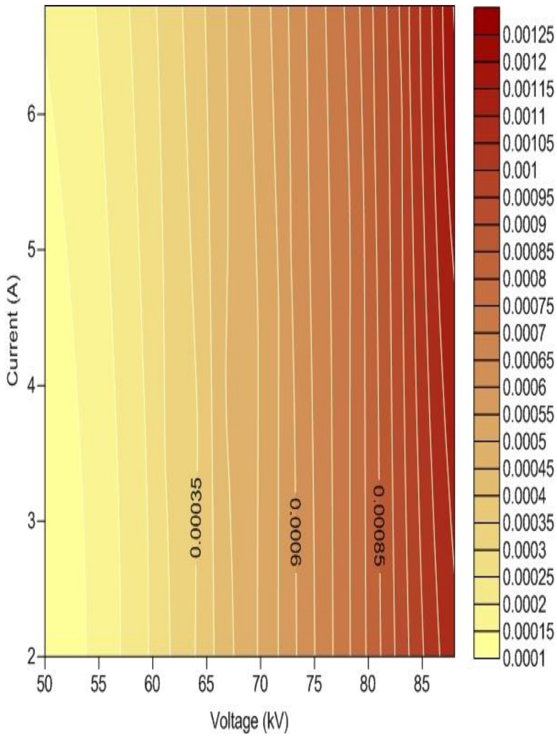
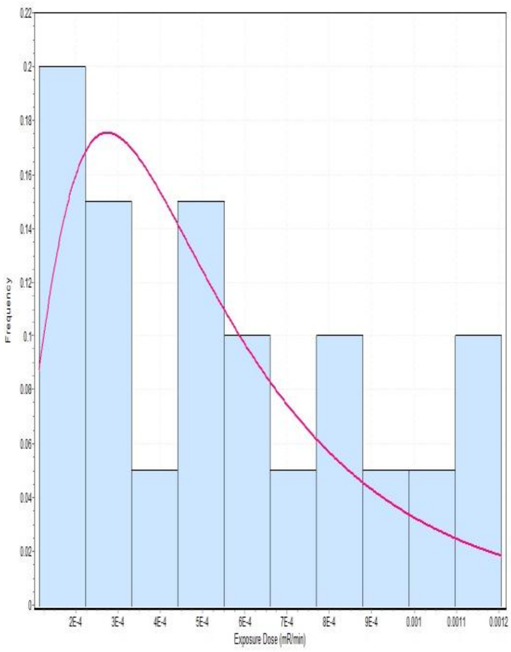



Figure (4) : The relation between tube voltage , tube current and exposure.

Figure (5) show the recurrence distribution for exposure dose values . From this figure we notice the lowest values of exposure dose are more recurrence in measurement




Figure(5): the recurrence distribution for exposure dose values

Table (2) show the Statistical Description. This table give us statistical information about the measured samples . From the statistical table we notice standard deviation and standard Error . they are small values because approach values for exposure dose and there are no irregular values in measurement due to error in measurement .

Table (2) show the Statistical Description

| Statistic | Value |
|---|---|
| Sample Size | 26 |
| Range | 0.0109 |
| Mean | 5.4500E-3 |
| Std. Deviation | 3.3936E-3 |
| Std. Error | 7.5883E-4 |
| Min. | 1.1400E-3 |
| Max. | 0.0171 |

## Conclusion

From the previous we can conclude the following :

1- The results in this project showed low exposure dose levels relative to the time of exposure inside examining room and outside examining room to which the patients and workers in hospital are exposed to X-ray and this guided to the radiation workers and patients are in safety conditions in X-ray unit .
2- It was observed that there was a wide variation in exposure dose that reflect different radiographic techniques. i.e. exposure dose proportion with tube voltage and tube currents .
3- The exposure time must be minimum as much as possible to avoid the cumulative dose from X-ray source for the workers in the hospital.
4- The measurements of exposure dose by using RAD-CHECKTM PLUS instrument in Al- Sader medical city in X-ray unit . Our measurements are in agreement with literatures in the world .
5- The result are in harmony with safety condition of International Commission on radiation Protection(ICRP) [9 ] where the measured data listed in table (1) are in permitted limits that International Commission on Radiation Protection recommend it .
6- X-ray unit in Al- Sader medical city has high quality from shielding and this prevent the X-ray from flowing out of X-ray unit .

## Recommendations:

1- To determine the maximum permissible dose (MPD) in (rem) yearly for radiation worker especially the staff who are exposed for long time to X-ray , We suggest using the following formula MPD=5(N-18) [11] N is the age in year.
2- We recommended that staff must be in work at maximum five days every week , four hours every day .
3- The medical staff that work in X-ray diagnosis must do the medical examination ( blood test , skin test, eye test, chest test ) every six months .
4- The medical staff that work in X-ray diagnosis especially that exposed to X-ray radiation for long time must take vacation one month for every year .

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