Frequency of Diagnostic Radiation Examination in the Kota Region

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Abstract:

Because of the explosive growth in the number of diagnostic medical examinations performed in recent years, particularly for imaging modalities like computed tomography and magnetic resonance imaging, There has been a rise in interest in interventional fluoroscopy, the population dose, and the potential health risks associated with medical exposure. Data on the promotion of high standard quality assurance programmes can be gleaned from the temporal trends over time for the population dose from diagnostic examinations. In this body of work, studies have been carried out to illustrate trends in the examination frequencies and effective doses of diagnostic examinations in Kota Region of Rajasthan from the year 2021. The time span covered is from 2021. The standard effective dose for each examination was calculated using information obtained from hospitals diagnostic centers surveys, data that was measured, and results that were published. For radiography, fluoroscopy, mammography, computed tomography, interventional fluoroscopy etc., estimates of the collective and per caput effective doses were developed. Estimates were also made regarding the likelihood of developing cancer as a result of medical exposure activity.

Key Words: Medical exposure, diagnostics, Medical examinations, effective doses, Collective dose

Introduction:

The population's exposure to ionising radiation as a result of medical procedures is an important public health issue. Diagnostic medical examinations can have a significant positive impact on a patient's health, but they also have the potential to have unintended consequences, such as the promotion of carcinogenesis [1]. In recent years, there has been a rapid increase in the frequency of examinations for several imaging modalities such as computed tomography (CT). As a result of this growth, the population dose and the health risk posed by medical exposure are becoming increasingly important topics in the field of radiation protection. The annual per capita effective dose from medical exposure before the year 2000 ranged from 0.05 to 1.1 mSv, as stated by the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) [2]. This was the case for populations living in regions with varying degrees of access to medical care. In Europe, this dose was found to be between 0.3 and 1.5 mSv for the year 2008 [3], while in the United States it was found to be 3.0 mSv for the year 2006 [4]. These data demonstrated an increase of 86 percent in Europe between the years 2002 and 2008 and a factor of 5.7 in the United States between the years 1980/1982 and 2006.

A global indicator for the quality of radiology practise is the amount of radiation that patients are exposed to during diagnostic medical examinations. The population dose received as a result of medical exposure varies greatly from one region of the world to another, primarily as a consequence of the myriad of distinct medical care delivery models, as well as the wide range of equipment and workforce capacities within radiology. This dose, which comes from a variety of imaging processes offers information that could be incorporated into the process of determining the dose guidance levels [5]. Determining the also proves to be beneficial. Priority in terms of dose reduction in order to maximize the protection provided to patients in a manner that minimises the amount of money spent. Data on the promotion of radiation protection issues and high standard quality assurance programmes can be derived from the temporal trends over time of the population dose from the various diagnostic examinations. Repeating surveys of the examination frequency and the average effective dose at regular intervals is necessary in order to keep up with the trends that emerge as a result of advances in technology and in clinical practises. In this body of work, studies have been carried out to illustrate trends in the examination frequencies and effective doses of diagnostic examinations in Kota Region of Rajasthan India from the years 2021 The time span covered is from 2021. Estimates of the collective and per caput effective doses were made for various medical modalities, such as radiography (RAD), fluoroscopy (FLU), mammography (MAM), computed tomography (CT), interventional fluoroscopy (IVF), and nuclear medicine. These modalities include: (NM). Following this, each modality was broken down even further into relevant classes based on the body part or organ system being treated. In 1997, this database contained information on 94.425 percent of Kota Regions population; in 2021 that number increased to 99.48 percent. Hospital surveys, measured data, and published results were used to derive the effective dose that was administered on average during each procedure. It was determined which diagnostic procedures were the primary contributors in terms of frequency and dose, and the percentages of those contributors' respective contributions were provided. In addition, the risks of cancer induction resulting from medical exposure were estimated using the risk coefficients recommended by the International Commission on Radiological Protection (ICRP) [6].

Methodology:

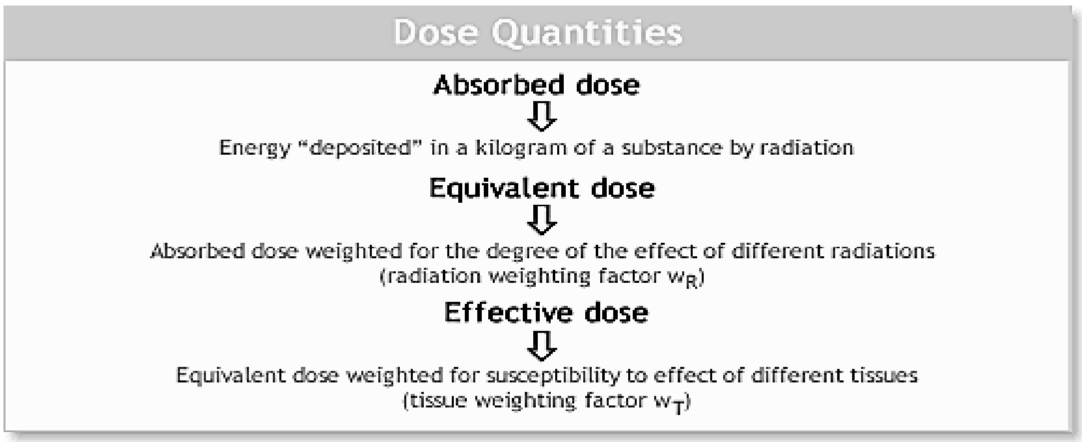
For the study of exposure activities, a questionnaire was designed, discussions with various doctors, and the assistance of various field literature Survey forms were deigned . Data from each diagnostic centre were collected for one month using the designed questionnaire. The root map of private and government hospitals/diagnostic centers was planned for data collection. Discussions were held with diagnostic centers/hospitals' concerned personnel.

Dose Calculation:

In the year 2021 information was gathered from a variety of public and civil hospitals, diagnostic centres, nursing homes, and body sites located in the Kota regions of Rajasthan regarding the total number of diagnostic procedures that were carried out using X-Ray examination, CT scan, Angiography, Mammography, Interventional radiology, Bone Densitometry, and other methods. All of the diagnostic X-ray examinations that were discussed earlier were included in this study, which was carried out in a retrospective manner. The survey of the Kota region has been completed to an extent of 80%. The total effective dose can be calculated with the help of the number of examinations that were performed. The term "collective effective dose" refers to the total amount that can be calculated by multiplying the "average effective dose" by the total number of people who were exposed to a specific source of ionising radiation. The systemic name for the Man Sievert is International (SI) (manSv). The effective dose is calculated by adding up the doses received by each organ in the irradiated volume and then weighting those doses based on how radiosensitive each organ is. The SI unit for this quantity is the milli Sievert. It is common practise to rely on published values from the literature when a country is unable to conduct extensive patient dose measurements and estimate nationally representative effective doses for all types of ionising radiation examinations. This is because such a country is unlikely to have the resources necessary to conduct such measurements. Patients undergoing the same examination can vary greatly from one nation to the next and even within the same nation; consequently, estimates of national mean doses derived solely from domestic or international data can never be relied upon to be accurate. The European Commission has, however, provided some sets of "typical" effective doses for those examinations that contribute significantly to collective dose in order to assist those nations that do not presently have the resources necessary to carry out extensive national patient dose surveys. These nations include those in the Middle East and Africa. As a consequence of this, and due to the fact that there has not been a study carried out in India (the region of Rajasthan known as Kota) to estimate the average effective dose per examination, the average effective dose per examination per body site that was calculated in this study was based on the values recommended by the European Commission.

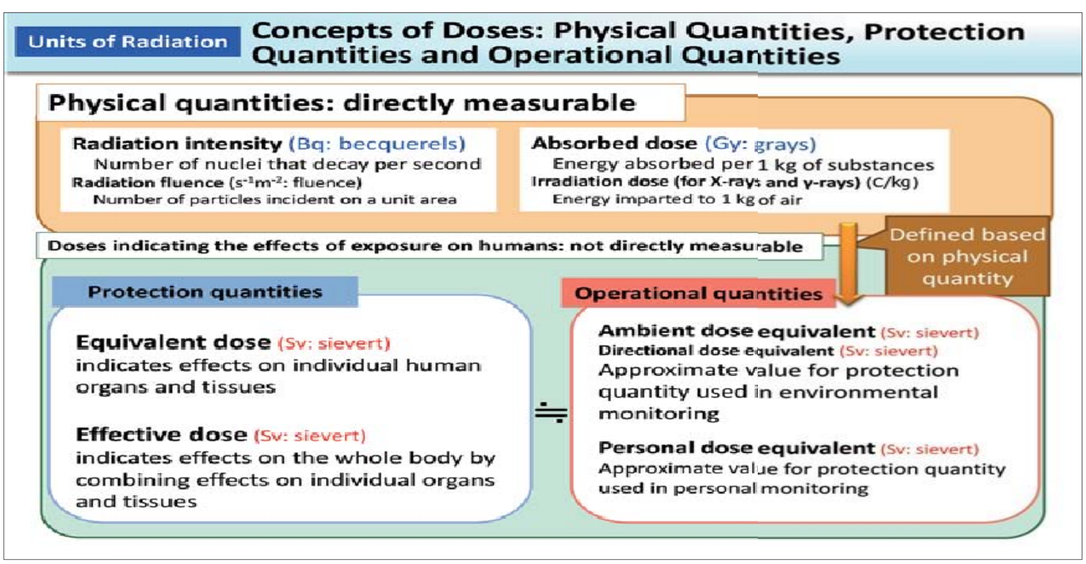
Radiation dose:

Ionizing radiation deposits energy when it penetrates the human body or an object. A dose is the amount of energy absorbed as a result of radiation exposure. There are three types of radiation dose quantities: absorbed, equivalent, and effective.



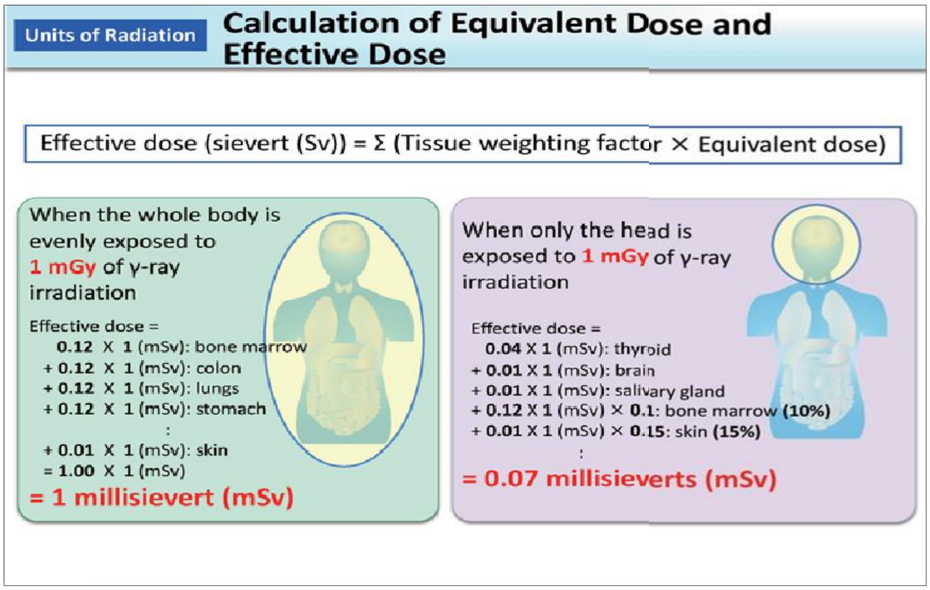
Absorbed dose:

The absorbed dose is the amount of energy deposited in a substance (for example, human tissue). The absorbed dose is expressed in grey units (Gy). A grey dose is one unit of energy (joule) deposited in one kilogramme of a substance.



Equivalent dose:

A biological effect may be observed when radiation is absorbed by living matter. However, equal absorbed doses do not always result in equal biological effects. The effect is determined by the type of radiation (alpha, beta, gamma, etc.) and the tissue or organ that receives the radiation. 1 Gy of alpha radiation, for example, is more damaging to tissue than 1 Gy of beta radiation. A radiation weighting factor (wR) is used to compare the biological effectiveness of various types of radiation. This weighted absorbed quantity is known as the equivalent dose, and it is measured in sieverts (Sv). That is, one Sv of alpha radiation has the same biological effect as one Sv of beta radiation. Because worker and public doses are so low, most reporting and dose measurements use millisievert (mSv) and microsievert (Sv), which are 1/1000 and 1/1000000 of a sievert, respectively. These smaller sievert units are easier to use in occupational and public settings. The absorbed dose is multiplied by a specified radiation weighting factor to obtain the equivalent dose (wR). The equivalent dose is a single unit that accounts for the degree of harm caused by various types of radiation.



Effective dose:

Radiation sensitivity varies between tissues and organs. Bone marrow, for example, is far more radiosensitive than muscle or nerve tissue. To get an idea of how exposure can affect overall health, multiply the equivalent dose by a factor related to the risk for a specific tissue or organ. The effective dose absorbed by the body is determined by this multiplication. The sievert is also the unit of effective dose. Methods for calculating an effective dose when the entire body is evenly exposed to 1 mGy of y-ray irradiation are compared, as are methods for calculating an effective dose when only the head is exposed to 1 mGy of y-ray irradiation. Because the radiation weighting factor (WR) for y-rays is 1, being evenly exposed to 1 mGy means being evenly exposed to 1 mSv (1 grey 1 (WR) = 1 millisievert). That is, equivalent doses for all organs and tissues are 1 mSv. To calculate effective doses, multiply the equivalent doses for each tissue by their respective tissue weighting factors and add the results. Because these organs are at high risk of radiation-induced fatal cancer, the bone marrow, colon, lungs, stomach, and breasts are given a high factor of 0.12. The skin on the entire body is given a factor of 0.01. When the equivalent doses for all organs and tissues are multiplied by their respective tissue weighting factors and the products are added together, the result is a millisievert effective dose. If only the head is exposed to 1 mGy during radiation inspection, the organs and tissues in the head, such as the thyroid, brain, and salivary gland, are completely exposed to radiation, so the equivalent doses for all of these organs and tissues are 1 mSv. Equivalent doses are calculated for organs and tissues that are only partially present in the head, such as bone marrow and skin, by multiplying the ratios of their areas exposed to radiation (bone marrow: 10%; skin: 15%). When their equivalent doses are multiplied by their respective tissue weighting factors and the results are added up, the effective dose is 0.07 mSv. (Related to p.36 of Vol. 1, "Unit Relationships") The above data were analyzed to deduce the temporal trends, to evaluate the population dose, and to identify the major contributing examinations. The cancer risk of medical exposure was also estimated.

Results and Discussions:

Kota has approximately 175 diagnostic centers/clinics/hospitals/nursing homes with a facility of ionising radiation-based medical tools, of which 80% have been surveyed. Table 6.1 and Figure 6.1 show the overall results. The effect of using different ICRP tissue-weighting factors in estimating the total collective effective dose is small (approximately 5%), but for some specific modalities (eg, mammography, interventional radiology, and dental radiography), the use of newer tissue-weighting factors increases the effective dose per procedure by more than two-fold. Table-1 depicts the percentages of 2020 collective doses for various modalities.

Table : 1 : Study of collective effective dose in Kota Region from Various ionizing medical examinations

Type of diagnostic radiography	No. of Examinations	Collective Effective Dose(mSv)
Plain Radiography/X-ray		
3. LUMBAR SPINE, AP	989	692.3
LUMBAR SPINE, LAT.	971	291.3
5. THORACIC SPINE, AP	475	190
THORAIC SPINE, LAT.	397	119.1
6. CURVICAL SPINE, AP	617	123.4
7. SKULL, AP	268	8.04
SKULL, LAT.	248	2.48
8. ABDOMEN, AP	425	297.5
9. PELVIS	454	317.8
10. CHEST, PA	6747	134.94
CHEST, LAT.	174	6.96
11. EXTREMITIES	277	2.77
12. HIP JOINT, AP	596	357.6
13. SHOULDER, AP	697	6.97
14. OTHER JOINTS	2096	10.48
15. I.V.P., NO. OF FILM PER STUDY	167	417.5
16. BARIUM SWALLOW, NO OF FILMS PER STUDY	127	190.5
17. BARIUM MEAL, NO. OF FILMS PER STUDY	131	393

18. BARIUM ENEMA, NO. OF FILMS PER STUDY	79	553
19. C.T. SCAN		
HEAD	555	1110
NECK	121	363
CHEST	58	464
ABDOMEN	59	590
PELVIS	16	160
SPINE	22	132
20. ANGIOGRAPHY (All)		
Cerebral	5	37.5
Coronary	160	3200
Pulmonary	1	5
Lymph vessel	1	19.4
Extremity	5	

The Because the clinic/institution/etc. was unwilling to provide data, it was assessed as reliable, reasonably reliable, or suspect. Data reliability was the null hypothesis. Avoiding unnecessary or wasteful X-rays, CT scans, angiography, mammography, interventional radiology, bone densitometry, etc. is one of the greatest ways to reduce radiation exposure. Appropriate radiography lowers patient exposure. X-rays provide optimal diagnostic information with minimal diagnostic exposure. Rare earth screens. Rare earth intensifying screens reduce exposure time while maintaining clinically meaningful picture quality.

Britain and 14 other wealthy nations' annual diagnostic x-rays indicated this risk. Diagnostic x-rays may cause 0.6% of UK cancers up to 75. 700 cancer cases occur year. Japan had the greatest projected yearly exposure frequency; hence its risk was over 3%. 0.6%–1.8% for the other 13 industrialized nations. Replacing amplifying screens with rare earth screens reduces ionising radiation exposure and cancer treatment costs. Radiation dosage reduction reduces cancer and prolongs X-ray tubes. Rare earth screens are faster due to shorter exposure durations. The tube's cumulative radiation quality lowers dose and extends life by 60%. India can switch to digital computed radiography cheaply using rare earth screens. Finally, large-scale research on all Indian hospitals should start with existing data (Kota region). Diagnostic ionising radiation may overexpose patients. Because the clinic/institution/etc. was unwilling to provide data, it was assessed as reliable, reasonably reliable, or suspect. Avoiding unnecessary or wasteful X-rays, CT scans, angiography, mammography, interventional radiology, bone densitometry, etc. is one of the greatest ways to reduce radiation exposure. Appropriate radiography lowers patient exposure. X-rays provide optimal diagnostic information with minimal diagnostic exposure. Rare earth screens. Rare earth intensifying screens reduce exposure time while maintaining clinically meaningful picture quality. Britain and 14 other wealthy nations' annual diagnostic x-rays indicated this risk. Diagnostic x-rays may cause 0.6% of UK cancers up to 75. 700 cancer cases occur year. Japan had the greatest projected yearly exposure frequency, hence its risk was over 3%. 0.6%–1.8% for the other 13 industrialised nations. Replacing amplifying screens with rare earth screens reduces ionising radiation exposure and cancer treatment costs. Radiation dosage reduction reduces cancer and prolongs X-ray tubes. Rare earth screens are faster due to shorter exposure durations. The tube's cumulative radiation quality lowers dose and extends life by 60%. Rare earth screens can be used for a cost-effective transition to digital computed radiography in poor countries like India. Finally, we recommend leveraging the available data to conduct large-scale investigations of all Indian hospitals (Kota,Region). Modern medicine allows diagnostic ionizing radiation, yet patients may be overexposed.

Conclusion:

It is helpful to maintain diagnostic imaging tests justified and optimal by conducting continuous monitoring of the medical exposure that the population receives. It is expected that the increased focus on quality assurance for medical practises in recent years, such as the implementation of dose guideline levels, will contribute to a reduction in the amount of cancer risk that may be attributed to medical exposure. The fast expanding trends of CT and IVF treatments should draw greater attention from rule-making authorities and the general public, according to research that looked at trends in the examination frequency and effective dose. These studies showed that these procedures are becoming more common.

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