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# Radiation Exposure and the Justification of Computed Tomography Scanning in King Abdul-Aziz Specialist Hospital Emergency Department Taif City, KSA

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## Abstract

*Background: The dire consequences of unjustified exposure to radiation, mainly MDCT, for emergency patients are considered public health issues, so this study is conducted to determine the necessity of radiologist discussion and minimize unjustified exposure to MDCT. Material and Method: A total of 770 patients were retrospectively exposed to MDCT, and the effective dose (mSv)for each patient was calculated using DLP Multiplied by a tissue weighting factor, extending from (1 September to 31 December 2024). 128 slice CT systems (Siemens Medical System) King Abdul-Aziz Specialist Hospital (KAASH) in Ta'if City, the Kingdom of Saudi Arabia. Result: In this retrospective study, a total of 770 patients were referred to the radiology department from the emergency department for a MDCT 570 (74%) were male, and 200 (26%) were female. The results have observed that exposure to ionizing radiation was significantly higher in the male population (74%) than in the female population (26%). Based on age groups, the rate of exposure to ionizing radiation was 33.8%, 20.8%, 10.4%, 13%, 8.4%, and 13.6% for the age range 15-25 years, 26-35 years, 36-45 years, 46-55years 56 -65 years, and 66y and older respectively. According to statistical analysis, most cases requested directly by an ER resident with a specialist or consultant agreement to exposed to ionizing radiation (MDCT) were normal which, representing 470 (61%). In comparison, they were abnormal, representing 250 (32.5%), and the other findings were related to the patient's age, which represented 50 (6.5%). The brain was found to be the most frequent part exposed to ionizing radiation with an incidence of 295 (38.3%), followed by KUB with an incidence of 155 (20.1%), whole spine 78 (10.1 %), chest as well as the abdomen and pelvis represent 65(8.4%), facial bone 60 (7.8%) while the upper/lower extremities were the least region that exposed to MDCT which represents 52 (6.8%). The average effective radiation dose of each patient was still within the optimal range of the recommended dose as a result of the efficacy, effectiveness, and qualification of a technologist as well as the radiologist and medical physicist. Conclusion: The ALARA concept and radiologist discussion are essential to avoid unnecessary CT imaging, diminish or minimize unjustified CT requests, also Education for dose reduction programs is highly recommended.*

**Keywords:** *Emergency Patients, Unjustified CT Requests, Multi-Detector Computed Tomography, Effective Radiation Dose.*

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## Introduction

*Research Background*

Multi-detector Computed tomography (MDCT) is considered a non-invasive modality that offers a highly accurate diagnosis of disease and assessment of injury in traumatic patients. It is precious diagnostic equipment in emergency medicine. This is proven by a significant increase in recent years in the number of CT scans requested by physicians in emergency departments (ED) subsequently exposed to high radiation doses, which is considered a significant public health issue [1,2]

The high ionizing radiation associated with Subsequent utilization and exposure to MDCT may increase concern for the possibility of adverse effects, specifically radiation-induced cancers and multiple different aberrations on cellular DNA [3.4]. On the other hand, Ionizing radiation is considered a primary carcinogenic agent that can cause DNA destruction, chromosomal abnormalities, and mutation [5]. In 2007, there were around 29,000 radiation-induced cancers expected to have been caused by the 72 million CT exams performed in the United States [6], with around 2.0% of malignant tumors caused by CT procedures [7]. In addition to cancer risks, tissue reactions can be induced due to exposure to ionizing radiation (deterministic effects) above a specific threshold dose, such as cataracts, alopecia, and erythema [8].

They predicted that CT studies would cause a future risk of up to 2 % of all cancers in the USA [2]. Henceforth, the concern with CT imaging lies in the future; an exponential rise in the use of CT imaging modality on a growing populace may result in future public health concerns [2]. In agreement with Brenner's suggestions to diminish future risks by (1) avoiding unnecessary CT imaging through utilization of validated clinical decision rules, (2) reducing radiation dose to "as low as reasonably achievable," and (3) utilizing alternative imaging modalities such as ultrasound and magnetic resonance imaging (MRI) when possible [9].

Despite the significant role of MDCT in the emergency department (ED), which is considered the gold standard in patient evaluation, it rapidly and accurately helps to make a precise decision regarding a patient's condition. At the same time, there is still a risk, mainly due to the rising number of procedures that have not been requested. Hence, this study is conducted due to the lack of this type of research, especially in Taif City, and to determine the risk of requested unjustified CT scans for patients who were referred from ED in King Abdul-Aziz Specialist Hospital Taif City, KSA, also to determine the necessity of radiologist discussion to obtain an ideal examination that related to clinical history.

### Research Problem

A very precise non-invasive method for evaluating trauma patients' injuries and diagnosing illnesses is computed tomography (CT) scanning. The number of CT scans requested by physicians in emergency departments (ED) has significantly increased in recent years, demonstrating its importance as a diagnostic tool in emergency medicine. According to our observations, emergency department physicians worry that the requirement to take the lifetime risk of cancer into account will influence their decision to request a CT scan. Because of their specific training, radiologists are better able to assess a patient's radiation exposure and risk. However, they are frequently unable to assess whether the scans are clinically necessary or excessive in the absence of thorough clinical notes, as can be the case with trauma patients [10].

Recommendations for safeguarding against the negative effects of radiation during medical procedures are provided by the International Commission on Radiological Protection (ICRP). Justification for medical radiation exposure is a complex idea. In the case of trauma patients, it is made even more difficult by additional extenuating and conflicting circumstances. Faster clinical intervention after a CT scan, however, can be very beneficial to the patient, especially if the patient has multiple injuries [11]. This study compared the estimation of the lifetime risk of developing cancer with the trends in CT usage and radiation doses in the emergency department of our hospital.

We examined the justification principle, focusing on elements that will enhance patient outcomes.

## Aim & Objectives

The aim of this paper is to assess the risk of requesting unnecessary CT scans for patients who were referred from the emergency department at King Abdul-Aziz Specialist Hospital in Taif City, Saudi Arabia, and to assess whether consulting a radiologist is necessary to get the best examination and clinical history protocol.

### Secondary Objectives

This paper aims to achieve the following secondary objectives:

- Determine which anatomical areas are mostly requested and exposed to radiation.
- identify the Effective radiation dose.
- identify the final radiological report.
- identify the typical age and gender of people exposed to radiation.
- Determine the familiar physician degree who requested justified and unjustified CT scans.

### Research Significance

Diagnostic imaging, especially Computed Tomography (CT), is essential to clinical decision-making and emergency care in the modern healthcare system. But the growing use of CT scans has sparked worries about cumulative radiation exposure around the world, particularly when scans are ordered without rigorous adherence to clinical guidelines. With a focus on the potential consequences of radiation exposure, this study examines the justification procedures for CT scanning in the Emergency Department (ED) of King Abdul-Aziz Specialist Hospital (KAASH) in Taif City, Kingdom of Saudi Arabia (KSA). This study has many implications for public health, clinical practice, patient safety, and healthcare policy.

The study primarily tackles a critical patient safety concern. Ionizing radiation, which is used in CT imaging, can raise the risk of radiation-induced cancers when it is overused or misused, especially in susceptible groups like children and young adults. CT scans may be ordered as a preventative measure rather than as a clinically required intervention in the hectic setting of emergency medicine. Unnecessary radiation exposure may result from this. The study intends to identify practice gaps and encourage more prudent imaging use by assessing whether CT scan requests in the KAASH ED are consistently justified based on established clinical criteria.

Second, the results of this investigation will help the hospital's clinical practice. Healthcare professionals can learn more about their ordering patterns and pinpoint areas that need to be better aligned with evidence-based protocols, like the American College of Radiology's (ACR) Appropriateness Criteria or regional Saudi guidelines, by evaluating justification patterns. Teaching physicians' justification techniques promote a culture of accountability and ongoing quality improvement in addition to increasing diagnostic effectiveness.

The study may have an impact on regional radiological safety regulations from a wider public health standpoint. The demand for diagnostic imaging services in Saudi Arabia is rising, but there is currently a lack of national-level data on radiation doses and justification procedures. The findings of this study could be used as a basis for setting regional standards or providing information for national radiation safety initiatives. Furthermore, it can assist the Ministry of Health in creating uniform standards for imaging in emergency situations.

## Literature Review

The quantity of energy that the body absorbs from radiation interactions is known as the radiation dose. Measures of exposure (such as x-rays' capacity to ionize air, expressed in roentgens [or R]) and absorbed dose (such as energy absorption, initially expressed in radiation absorbed dose [or rad] and more recently in gray [Gy] or milligray [mGy] [1 Gy = 100 rad; 1 rad = 10 mGy or 0.01 Gy]) have supplanted the early nonquantitative measures of dose, which were based on skin erythema [12].

Different radiation types may have different biological effects, and the dose rate—the rate at which radiation is received—may affect how strong the effects are. One of the main determinants of the biological effects of a specific absorbed dose is the dose rate. For instance, the biologic effect of a given dose is typically diminished as the exposure time is prolonged and the dose rate is decreased. The sievert (Sv), a metric for biological equivalent dose that can be used to measure mixed types of radiation exposure, accounts for relative biological effectiveness, which indicates the ability of a given type of radiation to produce a specific biological outcome in comparison with x-rays or gamma rays. The effective dose, or the total dose of x-rays that would need to be administered to the entire body to have the same carcinogenic risk as the partial dose that was administered, is calculated by adding the equivalent doses to each exposed tissue and organ and multiplying the result by the appropriate tissue-weighting factor. This number makes comparing risks much easier and offers a simple way to evaluate overall risk. Effective dose is not measurable and cannot be used for assessing individual risk, despite the fact that it is emphasized in many surveys due to its association with the risk of carcinogenic effects [13].

According to the International Agency for Research on Cancer (IARC), ionizing radiation is a carcinogen and has long been known to raise the risk of developing cancer. The World Health Organization now officially lists it as a carcinogen (IARC list of carcinogens, 2011). However, there are a number of complicated issues that warrant more discussion regarding the precise relationship between dose exposure and cancer induction. First, the amount of radiation that is perceived to be related to medicine has historically been measured by comparing it to the background radiation that we all receive. It is important to remember that background radiation and radiation exposure from medical procedures are two different things. While low-energy x-rays are typically exposed during diagnostic medical procedures, background radiation exposure typically consists of mixed-energy particles (high and low LET-radiation) [14].

Compared to high-LET radiation, low-LET radiation is thought to be less harmful per radiation track and leaves less energy in the cell along the radiation path. X-rays and γ-rays (gamma rays), which are employed in medical imaging, are examples of low- LET radiation. High-LET radiation is more destructive per unit length and transfers more energy per unit length as it passes through a cell than low-LET radiation, which produces ionizations sparsely throughout the cell. However, it is now widely accepted that, of the 2.4 mSv total average background radiation of mixed LET, the total average annual population exposure worldwide due to low-LET radiation would generally be expected to be in the range of 0.2–1.0 mSv, with 0.9 mSv being the current estimate of the central value. This makes it difficult to quantify medical exposures (which are of mostly low-LET radiation) to background radiation (which are of mixed-LET radiation). The percentages of high-LET and low-LET background radiation worldwide are depicted in the pie chart below [15].

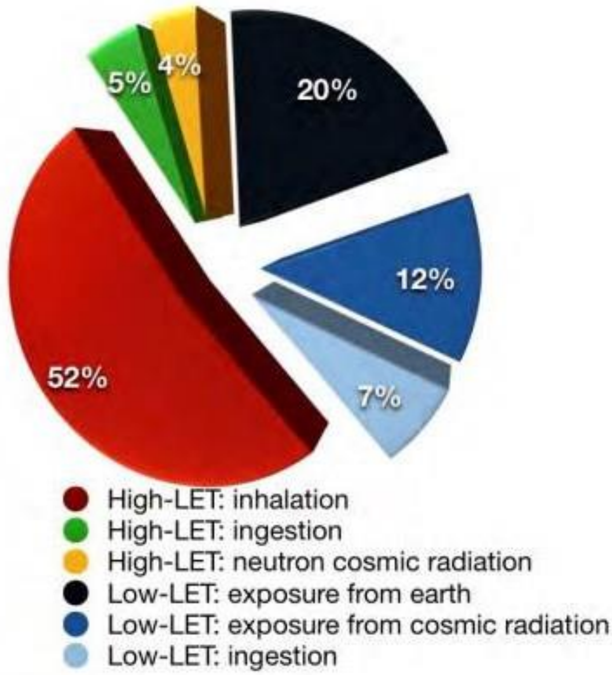


Figure (1): Pie Chart Showing the Global Background Radiation's High and Low LET Radiation Proportions

While there are certainly a number of benefits to medical imaging that uses ionizing radiation, it is important to remember that the best way to minimize radiation exposure is to avoid doing the investigation altogether. There is proof that CT is being overused in a number of clinical settings, which means that either unnecessary scans or incorrect examinations are being carried out without the proper justification. To guide or support an examination in accordance with a clinical scenario, it is customary to consult clinical guidelines or appropriateness criteria. The European Commission, the Royal College of Radiologists in the UK (RCR), and the American College of Radiology (ACR) have all released decision guidelines regarding the proper use of CT in various clinical situations [16].

A level I trauma center conducted a retrospective study to examine the appropriateness of scans [17]. It was discovered that if the guidelines had been strictly adhered to, 44% of the ordered studies would not have been indicated. Incorporating these guidelines into a computerized imaging order entry system is one recent creative solution to this problem. An institution that demonstrated a high deferral rate and a notable decline in CT and MRI use used preauthorization of CT exams in accordance with the ACR and RCR guidelines. CT annual performance rates dropped from 25.9 exams per 1,000 in 2000 to 17.3 exams per 1,000 in 2003 following the implementation of reauthorization

[18].

Even though these guidelines are evidence-based and suggested for routine clinical use, their general uptake is still low. ACR was used in a survey that examined how doctors choose which imaging test is best for their patients. When compared to other available resources, one institution's adoption of appropriate criteria was incredibly low (2.4%) [19]. Reducing the overall amount of radiation that the X-ray tube emits and cutting down on scanning time are the two main categories of CT dose reduction. ECG gating in cardiac studies or, for instance, raising the scanner's pitch are methods to shorten the scanning time [20]. X-ray beam filtration, X-ray beam collimation, X- ray tube current modulation and adaptation for patient body habitus (automatic exposure control), peak kilovoltage optimization, enhanced detection system efficiency, and low dose protocols for particular indications (e.g. CT KUB for renal stones) have all historically been used to lower the overall dose. Dose reduction in CTs has been attributed to several technological advancements since the 1980s, such as the use of solid-state scintillating detectors, electronic circuitry, multidetector arrays, more potent x-ray tubes, and beam-shaping filters [21]. The following are some of the more recent dose reduction methods that have become widely accepted.

One of the most crucial methods in clinical practice for lowering radiation dose without sacrificing image quality is automatic exposure control, or AEC. AEC is a general term that includes both figuring out and administering the "right" dose for every patient (from infants to obese people) in order to produce diagnostic quality images, as well as tube current modulation (to adjust to changes in patient attenuation). Similar to how fluoroscopic x-ray systems automatically modify exposure, CT systems can technologically modify the x-ray tube current in real-time in response to changes in x- ray intensity at the detector [22]. The modulation can combine pre-programming and a feedback loop, be entirely pre-programmed, or happen in almost real time through the use of a feedback mechanism. Depending on the patient's size, shape, and the resulting attenuation, longitudinal and/or angular modulation of the x-ray tube current is used to maintain a constant image noise level. This indicates that different scan lengths result in different tube currents. This contrasts with fixed tube current methods, which maintain a constant current throughout the scan length. This means that radiation is wasted in some areas because the diagnostic capability is not increased [23].

Depending on patient size and attenuation, the fundamental goal of the longitudinal (z- axis) modulation (AutomA) technique is to provide consistent image quality in order to obtain a trustworthy diagnosis with the least amount of radiation required. This is carried out along the longitudinal axis of the patient, which runs from the shoulders to the pelvis. The user prescribes a particular parameter (known as the noise index, or NI) to specify the desired image quality for a particular patient anatomy and diagnostic task [24]. This parameter represents the average noise in the center of an image of a uniform water phantom. While a 5% increase in NI reduces radiation dose by about 10%, a 5% decrease in NI necessitates a 10% increase in radiation [25]. As a result, choosing the right NI is essential to managing the ratio of radiation dose to image quality. This is frequently suggested by a combination of clinical experience and manufacturer recommendations. The type of scan that is done also affects this. Regardless of patient size and attenuation, the Autom A automatically modifies the x-ray tube current in the scan with a given NI to maintain the same noise level in all images. According to earlier research, a radiation dose reduction of 16.6–53.3% is achieved in abdominal CT studies when an NI of 10.5–15 is used instead of a constant x-ray tube current [25,26].

## Material and Method

### Research Design

An analytical retrospective study was conducted on 770 patients who referred from emergency department to the radiology department for MDCT between 1 September to 31 December 2024 at King Abdulaziz Specialist Hospital (KAASH) in Ta'if City, with ages ranging from 15 to more than 66 years old including both gender (male, female) and effective radiation dose was calculated based on this formula (DLP X Tissue weighting factor) and the unit was measured in millisieverts (mSv). The data was analyzed skillfully using Excel version 16 and the statistical program Statistical Package for the Social Sciences (SPSS) version 23 and presented as a table and appropriate diagrams.

Inclusion & Exclusion criteria:

*Inclusion criteria:*

- ✓ Patients who are exposed to ionizing radiation only from CT scans.
- ✓ Patients' ages ranged from 15 years to >66 years.
- ✓ Only optimization CT protocol.
- ✓ Demographic features include (age and gender).

*Exclusion criteria:*

- All other patients.
- Repeated CT for technical issues or artifacts.
- Non-optimization CT protocol.

Preparation of the patient and technique or protocols:

*Patient preparation*

No specific preparation is needed because the data will be obtained from the selected hospital's Picture Archiving and Communication System (PACS).

*Technique and protocol:*

- All optimization CT protocols used in selected hospital
- Effective Radiation dose is calculated based on this formula (Dose length product multiplied by tissue weighting factor)
- the unit is measured in millisieverts (mSv).

**Data Analysis**

The data was analyzed professionally using Excel version 16 and the statistical program Statistical Package for the Social Sciences (SPSS) version 23. It was then presented as a table and suitable charts.

**Ethical Considerations:**

- This research was done effectively and scientifically, and the final results were published to share beneficial information.
- Consent and acceptance were taken before data collection.

## Results

In this retrospective study, a total of 770 patients were referred to the radiology department from the emergency department for a CT scan 570 (74%) were male, and 200(26% ) were female. The results have observed that exposure to ionizing radiation was significantly higher in the male population (74%) than in the female population (26%). Based on age groups, the rate of exposure to ionizing radiation was 33.8%, 20.8%, 10.4%, 13%, 8.4%, and 13.6% for the age range 15-25 years, 26-35 years, 36- 45 years, 46-55years 56 -65 years, and 66y and older respectively. (see table1)

| **Variable** | | **Frequency** | **Percent %** |
|---|---|---|---|
| | Males | 570 | 74 % |
| **Gender** | Females | 200 | 26 % |
| | 15-25 y | 260 | 33.8 % |
| | 26-35 y | 160 | 20.8 % |
| | 36-45 y | 80 | 10.4 % |
| **Age range (years)** | 46 -55 y | 100 | 13 % |
| | 56-65 y | 65 | 8.4% |
| | 66> | 105 | 13.6% |

Table1: Distribution of the Study Sample According to Gender and Age

According to statistical analysis, most cases ordered directly by an ER physician (resident, specialist, or consultant agreement) to exposed to ionizing radiation from a CT scan and the final result as radiologist approved via the report which demonstrates most of the cases were normal which represent 470 (61%). In comparison, they were abnormal, representing 250 (32.5%), and the other findings were related to the patient's age, representing 50 (6.5%) more details, as shown in (Table 2).

| **Requested physician/ Radiologist report** | **Resident** | | **Resident with specialist agreement** | | **Resident with consultant agreement** | |
|---|---|---|---|---|---|---|
| | **No.** | **Percent** | **No.** | **Percent** | **No.** | **Percent** |
| **Normal finding** | 470 | (61%) | 250 | (53.2%) | 220 | (46.8%) |
| **Abnormal finding** | 250 | (32.5%) | 103 | (41%) | 147 | (59%) |
| **Age-related changes** | 50 | (6.5%) | 23 | (46%) | 27 | (54%) |

Table 2: Distribution of the Study Sample According to Radiologist Reports and Requested Physician

Depending on the statistical analysis, the brain was found to be the most frequent part exposed to ionizing radiation with an incidence of 295 (38.3%), followed by KUB with an in50cidence of 155(20.1%), whole spine 78 (10.1 %), Chest as well as the abdomen and pelvis represent 65(8.4%), Facial bone 60 (7.8%) while the upper/lower extremities were the least region that exposed to MDCT which represents 52 (6.8%) of study sample (see table 3).

| **Radiologist report**<br>**Exposed part** | Normal | Abnormal | Age-related changes | Totally |
|---|---|---|---|---|
| **Brain** | 193 | 63 | 39 | 295 |
| **Facial bone** | 25 | 35 | - | 60 |
| **Whole spine** | 42 | 25 | 11 | 78 |
| **Chest** | 30 | 35 | - | 65 |
| **Abdomen and pelvis** | 30 | 35 | - | 65 |
| **KUB** | 125 | 30 | - | 155 |
| **Upper and lower Extremities** | 25 | 27 | - | 52 |

Table 3: Distribution of Study Sample According to the Common Part That is Undergoing CT Scan and Radiologist Report

The average of effective radiation dose of each patient based on a statistical analysis of the current study was still within the optimal range of the recommended dose limit International Commission on Radiological Protection (ICRP) and American Association of Physicists in Medicine (AAPM), as a result of efficacy, effectiveness and qualified of a technologist as well as the radiologist and medical physicist in the study area. (see table 4)

| | | |
|---|---|---|
| **Exposed part** | Average of effective radiation dose for adult | |
| **Brain** | 2mSv | Should not excessed 2mSv |
| **Spine** | 5.5 mSv | Should not excessed 6mSv |
| **Chest** | 5.7mSv | Should not excessed 7mSv |
| **Abdomen** | 6.2mSv | Should not excessed 8mSv |
| **Pelvis** | 5.7mSv | Should not excessed 6mSv |

Table 4: Distribution of the Study Sample According to the Effective Radiation Dose.

The present study demonstrates frequent causes for ordering CT scans as follows:

- *CT Brain frequent indication*

The common causes for the brain were Head trauma 36%, Loss or Decrease level of consciousness 22%, Dizziness 18.6%, Weakness 17%, Headache 10.2%, Seizure and cerebrovascular accident CVA 8.5%, Confusion, slurred speech and mouth deviation

6.8 %, High blood pressure and Syncope attack 5.1%, Blurred vision1.7% respectively.

- *CT Chest frequent indication*

The common causes for chest CT that referred from ED were chest trauma 62%, pulmonary embolism (PE) 23.1%, chest pain 18.5%, and the last one was shortness of breath 7.7%.

- *Frequent indication for CT Abdomen/pelvis*

ER physicians were requested for a CT abdomen pelvis due to abdomen trauma 67.8

%, abdominal pain 21.5 %, and also to rule out mesenteric ischemia 10.7%.

- *Frequent indication of MSK cases*

The common causes of CT scans of the Upper and lower extremities were Trauma (96%), post-reduction (10%), and fracture (19%).

- *CT Spine frequent indication*

In the current study, Trauma 100 % was the common and frequent cause for requesting a CT scan of the spine (cervical, dorsal, lumber, and sacral).

- *CT Facial bone frequent indication*

Trauma was the frequent cause for requesting CT facial bone 100 %.

- *Frequent indication for CT KUB (kidney, ureter, urinary bladder)*

ER physician commonly requested CT KUB due to flank pain at 65%, Frank hematuria at 23%, dysuria at 16%, renal stone at 13%, and severe suprapubic pain at 6.4%. (see table 5).

| | | | | | |
|---|---|---|---|---|---|
| **Brain frequent indication** | **Frequency (n)** | **Percentage (%)** | **Chest frequent indication** | **Frequency (n)** | **Percentage (%)** |
| Head trauma | 105 | 36% | Pulmonary embolism PE | 15 | 23.1% |
| Decrease or Loss of consciousness | 65 | 22% | Shortness of breath | 5 | 7.7% |
| Dizziness | 55 | 18.6% | Chest trauma | 40 | 62% |
| Blurred vision | 5 | 1.7% | Chest pain | 12 | 18.5% |
| High blood pressure | 15 | 5.1% | **Frequent indication of Abdomen and pelvis** | **Frequency (n)** | **Percentage (%)** |
| Weakness | 50 | 17% | | | |
| Syncope attack | 15 | 5.1% | | | |
| Headache | 30 | 10.2% | | | |
| Confusion, slurred speech, mouth deviation | 20 | 6.8% | Query mesenteric ischemia | 7 | 10.7% |
| CVA | 25 | 8.5% | Pain | 14 | 21.5% |
| Seizure | 25 | 8.5% | Trauma | 44 | 67.8% |
| **Frequent indication of KUB** | **Frequency (n)** | **Percentage (%)** | **Upper/lower extremities frequent indication** | **Frequency (n)** | **Percentage (%)** |
| Dysuria | 25 | 16 % | Trauma | 50 | 96 % |
| flank pain | 100 | 65 % | | | |
| Frank hematuria | 35 | 23 % | Post reduction | 5 | 10 % |
| | | | Fractures | 10 | 19 % |
| SEVER SUPRABUPIC PAIN | 10 | 6.4 % | **Spine frequent indication** | **Frequency (n)** | **Percentage (%)** |
| Renal stone | 20 | 13 % | Trauma | 78 | 100 % |
| | | | **Facial bone frequent indication** | **Frequency (n)** | **Percentage (%)** |
| | | | Trauma | 60 | 100 % |

Table 5: Distribution of Study Sample According to the Common Indication for CT Scan

## Discussion

MDCT is one of the preferred imaging modalities for many pathologies in most cases that present to the emergency department for diagnosis and management. It assists ER physicians in making faster and more accurate decisions regarding a patient's condition [27-30]. In cases of pulmonary embolism [31], renal colic [32], and cervical spine trauma [33, 34], CT has replaced prior imaging modalities as the initial diagnostic study of choice because of its superior diagnostic accuracy [3].

Furthermore, Patient and physician concerns for an accurate and prompt diagnosis, as well as increasing presentation acuity and Trauma triage [35,36], have led to increased CT utilization in agreement with the present study. So that is why A retrospective study, was conducted on total of 770 patients exposed to CT scan referred from ED were included between September to December 2024 and the male population 570 (74%), was higher than female 200 (26%) with male to female ratio 2.9, that indicate the significant increasement of CT utilization in agreement with other studies [37,38].

While the Most cases that ordered directly by ER resident in agreement with specialist or consultant to undergoing to CT scan and the final result as radiologist approved via the report which clearly demonstrate most of the cases were normal which represent 470 (61%) whereas the other cases were abnormal which represent 250 (32.5%) and the rest findings were related to the patients age which represent 50 (6.5%) Moreover, the 470 cases were Normal which is directly diagnosed clinically and ordered for CT by ER resident in agreement of ER consultant was represent 220 and rest of these cases were in agreement with ER specialist that represent 250 case. Additionally, in cases related to patients' age, they were clinically diagnosed and referred for a CT scan; 23 cases were from residents with the specialist agreement, and 27 cases were from residents with consultant agreement.

Based on that, poor or inappropriate clinical diagnosis is indicated in agreement with another study [39]. On the other hand, Radiological examinations that do not meet diagnostic appropriateness criteria are almost a third of all investigations performed [40-42], which is consistent with the present study. As the latest European data show, exposing patients to inappropriate diagnostic investigations and an unjustified risk increases public health costs and concomitant growth in waiting lists for the same radiological procedures [29].

According to the statistical analysis of the current study, the brain was most frequently exposed to ionizing radiation, with an incidence of 295 (38.3%). The normal finding was higher than abnormal and patient age-related changes 193,63 39, respectively. This was followed by KUB with an incidence of 155(20.1%); the normal finding was higher than the abnormal 125 and 30, respectively. , then the whole spine is 78 (10.1 %), with normal 42 while abnormal 25, the chest, as well as the abdomen/pelvis, represents 65(8.4%), with normal 35 while abnormal 30, facial bone is 60 (7.8%) normal 25 while abnormal 35 and finally the upper/lower extremities were the least region that exposed to CT scan which represents 52 (6.8%) of the study sample the abnormal finding was higher than Normal 27,25 respectively.so that highly indicated for lack information regarding dire consequences of radiation exposure and insufficient awareness about ALARA concept (as low as reasonably achievable) in which is consistent with the study of [43]. Numerous studies have shown that the principle of justification and precaution is not followed scrupulously and that 20 to 50% of medical imaging examinations are considered inappropriate [29].

Despite the significant advantages of MDCT in the diagnosis of emergency cases still, there is a higher risk of being exposed to ionizing radiation with high or low doses, and that might associated with an increase in the risk of cardiovascular disease and some other non-cancer diseases [44-46] add to that most of the study sample that exposed to ionizing radiation was higher in younger patients first and second decay with their age range 15-25 y, 26-35 y which represent 260,160 cases respectively and that undoubtedly indicate for poor justification and absence of radiologist discussion which is essential to select proper examination. On the other hand, most cases that validated clinically to undergoing a CT scan without radiologist discussion were Normal, as shown in table3,4 in the present study. Consequently, effective communication and discussion with the radiologist is necessary to obtain ideal and proper examination and protocol related to clinical history and to reduce unjustified requests.

According to statistical analysis of the current study, the average effective radiation dose, even with a skyrocket in CT utilization, was still within the optimal range of recommended dose limits due to the qualified, efficacious, and effective technologist, radiologist, and medical physicist in the study area.

## Conclusion and Recommendations

### Conclusion

The ALARA concept and radiologist discussion are essential to avoid unnecessary CT imaging, diminish or minimize unjustified CT requests, and reduce the possible dire consequences of radiation exposure. Alternative procedures such as ultrasound and magnetic resonance imaging should be considered if they are appropriate clinically. Education for dose reduction programs and safe training for technologists, radiologists, and medical physicists should be periodically applied. Growing awareness of the risks associated with radiation has prompted recent efforts in the medical community to reduce doses. The population's risk increases with the number of imaging procedures we do.

According to trends, this is growing at a rate that is nearly exponential. Thankfully, the medical community has advanced significantly in both the use of new technologies and the analysis of existing practices. Certain enhancements can be put into effect immediately with minimal expense and effort, but they depend on following established protocols and decision-making processes. Others rely on the use of new technologies that should help clinicians reduce or optimize doses while also making it easier to accurately monitor the dose given to the patient. It's likely that medical imaging and personalized medicine will eventually become so entwined that every patient will receive the right test at the right dosage level based on their unique characteristics. Instead of using a one-size-fits-all approach, it should become standard practice to customize an investigation for each patient. Future developments in medical physics and engineering, new tube design, computational power, and novel detectors will probably overcome existing constraints, which can only be advantageous.

### Recommendation

For radiologists and technologists to become more proficient in the field of medical imaging, a methodical procedure and evaluation of diagnostic referencing are required, as well as additional training and specialized programs. In order to support and actively participate in dose regulation efforts, radiologists must be knowledgeable about and adept at using data management software, which will enable radiology departments' main argument for low achievable doses and decreased radiation exposure.

- One limitation is the lack of this type of research in KSA, mainly in TA'if city. The large sample helps determine the accuracy of the dire consequences of radiation.

- ER cases exposed to unjustified CT should be classified, documented, and discussed to avoid increased public health costs and concomitant growth in waiting lists.

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