Journal of Surgery and Trauma. 2027;15(1):xx-xx https://jsurgery.bums.ac.ir

Original Article

Open Access Publish Free

Evaluation of the Justification of Trauma-Related CT Scan Requests in a Referral Teaching Hospital of Birjand University of Medical Sciences

Hassan Zarghani[1], MohammadSajjad Roshandel[2], Mahyar Mohammadi Far[3], Sajjad Pandesh[4]✉

[1] Department of Medical Physics, School of Allied Medical Sciences, Sabzevar University of Medical Sciences, Sabzevar, Iran

[2] Student Research Committee, Birjand University of Medical Sciences, Birjand, Iran

[3] Department of Radiology, School of Medicine, Birjand University of Medical Sciences, Birjand, Iran

[4] Department of Radiology Technology, School of Allied Medicine, Birjand University of Medical Sciences, Birjand, Iran

✉**Corresponding Author:** Tel: +98 5632381606; Email: s_pandesh@yahoo.com

Received: July 04, 2025

Revised: June 14, 2026

Accepted: July 12, 2026

Citation: Zarghani H, Roshandel MS, Mohammadi Far M, Pandesh S. Evaluation of the Justification of Trauma-Related CT Scan Requests in a Referral Teaching Hospital of Birjand University of Medical Sciences. J Surg Trauma. 2027.;15(1):xx -xx. DOI:10.61882/jsurgtrauma.15.1.xx

Abstract

Introduction: Computed tomography (CT) has become an indispensable tool in the diagnostic workup of trauma patients. Nevertheless, the growing reliance on CT imaging has raised significant concerns about unnecessary exposure to ionizing radiation, particularly in cases where clinical justification is lacking. Despite the existence of well-established guidelines, such as those provided by the American College of Radiology and Advanced Trauma Life Support, a notable proportion of CT requests continue to fall outside recommended indications. Therefore, the present study seeks to assess the clinical justification of CT scan utilization in trauma settings, with an emphasis on both the appropriateness of imaging use and adherence to radiation protection principles.

Methods: This retrospective descriptive-analytical study was carried out at Imam Reza Hospital in Birjand, Iran, a leading trauma referral center in the region. Medical records of 400 trauma patients who underwent CT imaging were reviewed. The extracted data included patient demographics, types and frequencies of CT scans, the referring departments, and the presence or absence of traumatic injuries on imaging. Justification for each CT request was evaluated using clinical notes, radiological findings, and guideline-based criteria. Data analysis was performed using descriptive statistics and Pearson's chi-square tests to identify significant patterns.

Results: Out of 678 CT scan requests analyzed, 70% were classified as clinically justified. However, justification rates varied widely depending on the scan type and referring department. Whole-body CT (WBCT) scans showed the lowest rate of justification (28.69%), while abdominal CT scans exhibited the highest (81.36%). Thoracic and facial CTs also demonstrated high diagnostic yields. Neurosurgery departments submitted the most CT requests overall, whereas male orthopedic surgeons achieved the highest justification rates for WBCT. The financial assessment revealed over 600 million Iranian Rials (IRR) in direct losses due to unjustified imaging, alongside notable resource burdens in staff time and equipment depreciation. No statistically significant differences were observed between male and female patients in justification rates across anatomical regions (all $p>0.05$).

Conclusion: While the overall rate of justified CT use in trauma care was acceptable, a substantial portion, particularly WBCT requests, lacked adequate clinical indication. Strengthening clinical assessment protocols, promoting adherence to evidence-based imaging guidelines, and increasing physician awareness are essential strategies to prevent unnecessary CT usage. Such measures can enhance patient safety, conserve healthcare resources, and support more sustainable trauma imaging practices.

Key words: Computed Tomography, Diagnostic Imaging, Radiation Protection, Trauma

[Downloaded from jsurgery.bums.ac.ir on 2026-11-15]

Copyright © 2027, Journal of Surgery and Trauma. This is an open access article distributed under the terms of the Creative Commons Attribution License (CC-By-NC4.0: https://creativecommons.org/licenses/by-nc/4.0/legalcode.en), which permits use, distribution, and reproduction in any medium, provided the original work is properly cited and is not used for commercial purposes.

Introduction

In modern medicine, diagnostic imaging plays a pivotal role in clinical decision-making (1). A thorough clinical examination can optimize the use of imaging devices and mitigate potential harm (2).

Medical imaging plays a significant role in the management of trauma patients. Imaging modalities such as X-rays and computed tomography (CT) are commonly used to assess the extent and severity of injuries and guide treatment decisions (3). Referrals to emergency departments due to trauma are very common and require special attention. Trauma is a leading cause of death or disability in the community (4). While medical imaging is essential for accurate diagnosis and treatment, excessive or inappropriate use can lead to unjustified radiation exposure in patients, especially when imaging is unnecessary or the risks outweigh the benefits (5). Studies have shown a significant increase in the number of medical imaging requests in recent years, which can have adverse effects on both patients and healthcare systems (6).

When dealing with ionizing radiation in medicine, it is essential to weigh the diagnostic or therapeutic benefits against the potential radiation-induced harm, and to compare the advantages and disadvantages of these imaging techniques with other methods (7). The International Commission on Radiological Protection emphasizes the principle of justification as a cornerstone of radiation protection in medicine. Studies have revealed that in some regions, 20-50% of radiographic examinations are considered unjustified (8). Based on the principle of justification, no activity involving ionizing radiation should be undertaken unless there is sufficient net benefit to the patient to outweigh the harm from the radiation exposure. Justification guidelines may need to be revised periodically considering new information and technologies. The justification for exposing a patient to ionizing radiation is determined through consultation between a radiologist and a referring physician, especially for pregnant and lactating women (9).

Directive 97/43/EURATOM of the European Commission, issued in June 1997, identified justification as a decade-long challenge for prescribers and physicians. A study by Helja Oikarinen et al. found that 77% of lumbar CT scans ordered by physicians were unjustified. Most of these images could have been replaced by alternative imaging methods such as MRI. Exposure to radiation at a young age, up to 35 years, increases the risk of death from cancer, as these individuals are expected to have a longer lifespan, faster cell division, and more sensitive organs. Therefore, reducing radiation dose in this age group is crucial (10).

For trauma patients, radiological investigations play a major role in diagnosing injuries, and radiology requests are common in this population (11). Studies have shown that less than 22% of CT scan requests demonstrate pathological findings, emphasizing the importance of managing imaging justification. Furthermore, CT scans may pose long-term radiation risks. Given that an increase in CT scans elevates the population risk of radiation-induced cancers, avoiding unnecessary imaging and maintaining appropriate radiation dose levels are crucial public health goals.

In trauma patients' population, a large number of individuals require various imaging procedures; however, less than 30% of CT scans are effective in managing these patients. Considering the costs and complications associated with these imaging procedures, careful monitoring by surgeons and radiologists is necessary to achieve the best possible outcome in the diagnosis and treatment of trauma. Other data show that up to 85% of X-ray examinations do not yield positive diagnostic findings (12-14).

The Advanced Trauma Life Support guidelines consider CT scans and even pelvic radiographs unnecessary in hemodynamically stable patients. Studies have shown that certain clinical signs can indicate the presence or absence of pelvic fractures, thus helping to prevent unnecessary radiographs and control the dose to personnel and patients (15).

Several strategies are currently used to minimize radiation exposure in trauma patients. These include the use of alternative imaging techniques such as ultrasound or magnetic resonance imaging (MRI) when necessary, the use of low-dose CT protocols that reduce radiation dose without compromising image quality and limiting the repetition of imaging studies to avoid unnecessary radiation exposure (16, 17).

However, despite these strategies, many trauma patients still receive high doses of radiation, especially those requiring multiple imaging studies. This is due to a lack of awareness among healthcare professionals of the potential harms of radiation exposure and the absence of standard protocols for radiation protection in trauma patients (18).

Accordingly, the present study was conducted to assess the clinical justification of CT scan requests in trauma patients and to analyze imaging utilization

[Downloaded from jsurgery.bums.ac.ir on 2026-11-15]

patterns across different anatomical regions, with the goal of reducing unnecessary radiation exposure and improving diagnostic efficiency.

Methods

Study Design

This retrospective descriptive-analytical study was conducted at Imam Reza Hospital in Birjand, the main trauma referral center in South Khorasan, Iran.

Participants

Data were collected from trauma patients who underwent CT imaging during the study period. All trauma patients with at least one CT scan request who presented to Imam Reza Hospital and subsequently underwent CT scans were included. No specific exclusion criteria were applied, as this research is aimed at comprehensively assessing CT utilization and justification patterns across all trauma cases.

Sample Size

The sample size was calculated using Cochran's formula. With a 95% confidence level (Z=1.96), an assumed proportion of 0.5 (p=q=0.5), and a margin of error of 0.05 (d), a minimum of 384 participants was required. Ultimately, a total of 400 patients were enrolled in the study to account for potential attrition.

Data sources/Measurement

The extracted data included patient demographic information (age and gender), type and frequency of CT scans, requesting hospital department, and corresponding CT scan results. All information was retrieved from the hospital's electronic health record system.

Each CT request was reviewed by a radiology expert based on clinical notes and radiological findings. Requests were categorized as justified when trauma-related findings were present on performed CT scans. Requests with no clinical indication or no trauma-related findings were classified as unjustified.

All CT scans were performed using a 16-slice Toshiba's Activion CT scanner (Japan) under standardized exposure protocols routinely applied at the hospital.

The study protocol was approved by the Research Ethics Committee of Birjand University of Medical Sciences (IR.BUMS.REC.1402.247).

Statistical Analysis

All collected data were analyzed using SPSS (version 26), and the graphs were drawn using GraphPad Prism 8. Descriptive statistics (frequency, mean, and standard deviation) were used to summarize demographic characteristics and imaging patterns. Statistical analysis was performed using the Chi-square test to compare the ratios of CT scan requests and justification rates among different hospital departments and anatomical regions. A P-value of < 0.05 was considered statistically significant.

Results

This descriptive-analytical study collected and analyzed data from 400 trauma patients admitted to Imam Reza Hospital over a 6-month period. The mean age of the patients was 30.15 years (SD=18.78). The participants were predominantly male (n=298, 74.5%), with females comprising 25.5% (n=102) of the sample.

As demonstrated in Figure 1, the highest and lowest frequency of patients was observed in the 20-29 (n=102) and 80-90 (n=4) year age groups, respectively.

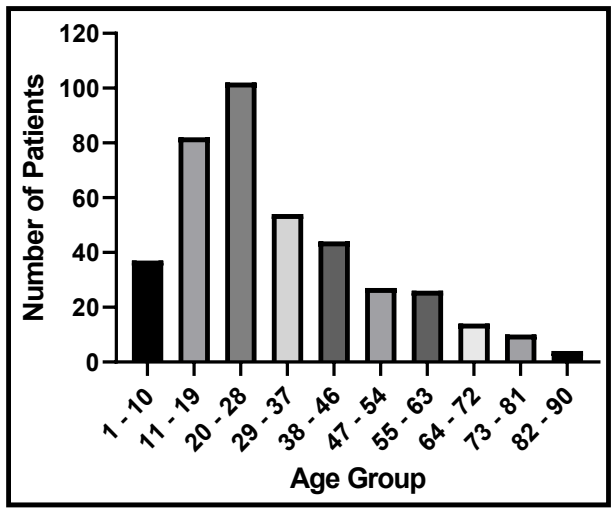


Figure 1. Age distribution of the patients. The highest and lowest frequency was in the 20-29 years (n=102) and 82–90 years (n=4) age groups, respectively.

In the present study, we evaluated the justification of CT scan requests by specialists across various hospital departments by examining all inpatient wards. As presented in Table 1 and Figure 2, comprehensive data are provided regarding: (1) the number of CT scans ordered for inpatients in each department, (2) their percentage relative to total patients, and (3) the justification rate of reviewed CT scans. This study allowed us to gain

[Downloaded from jsurgery.bums.ac.ir on 2026-11-15]

a better understanding of the CT scan justification request in different hospital departments.

This study defined whole-body CT (WBCT) as CT imaging encompassing more than three anatomical regions. Within our study population, the maximum number of regions scanned per patient was eight (brain, head & neck, chest, shoulder, thoracic spine, pelvis, and ankle).

The analysis revealed a clinically significant proportion of negative WBCT examinations. Among 122 trauma patients undergoing WBCT (88 male, 34 female), pathological findings were identified in only 28.69% of cases (28.41% of males vs. 29.41% of females). In this study, WBCT examinations that showed no traumatic findings in any of the scanned anatomical regions were classified as unjustified. Therefore, the justification rate was determined based on the presence of trauma-related pathological findings across the examined regions. Notably, 71.31% of scans demonstrated no pathological findings (71.59% male vs. 70.59% female patients). Comprehensive data are presented in Table 2.

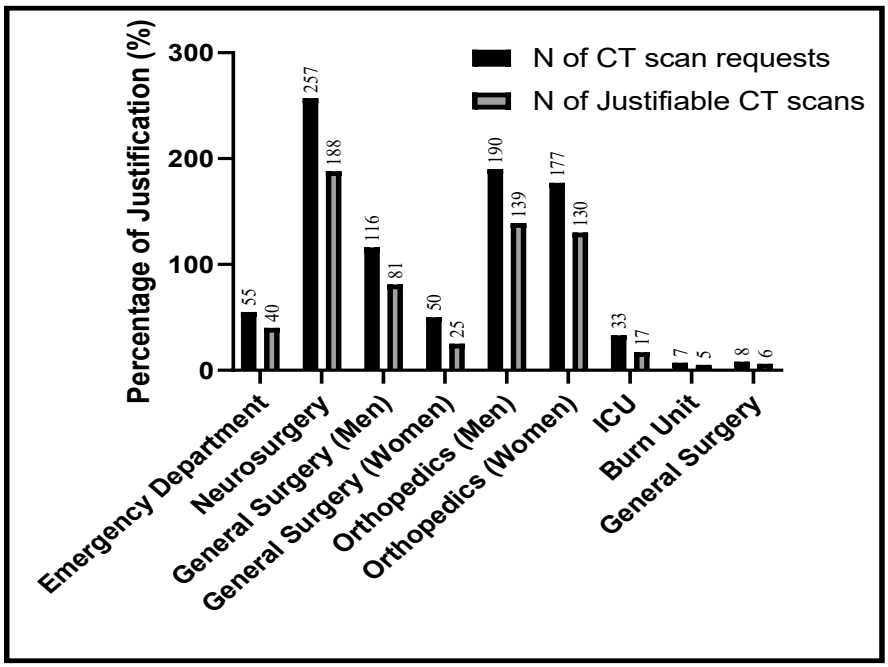


Figure 2. Frequency distribution of reported CT scan requests and the number of justified requests stratified by hospital departments

Table 1. Percentage of justifications for CT scan requests in different hospital departments

Department	N of CT scan requests	N of Justifiable CT scans	Justification (%)
Emergency Department	55	40	72
Neurosurgery	257	188	73
General Surgery (M)	116	81	70
General Surgery (F)	50	25	50
Orthopedics (M)	190	139	73
Orthopedics (F)	177	130	73
ICU	33	17	52
Burn Unit	7	5	71
General Surgery	8	6	75

Note: Data are presented as Frequency (N) and Percentage (%). N indicates the total number of CT scan requests in each hospital department.

[Downloaded from jsurgery.bums.ac.ir on 2026-11-15]

Table 2. Percentage of justifications for whole-body CT (WBCT) scan requests in both males and females

Variable	WBCT	Justifiable	Unjustifiable
Male	Frequency(percent)	25 (28.41%)	63 (71.59%)
Female	Frequency(percent)	10 (29.41%)	24 (70.59%)
Total	Frequency(percent)	35 (28.69%)	87 (71.31%)

Note: Data are presented as Frequency and Percentage (%) for male and female trauma patients. WBCT: Whole-Body Computed Tomography.

In the current study, neurosurgeons accounted for the highest proportion (n=41) of WBCT referrals to the radiology department. The highest rate of justification (36.36%) was observed among patients referred by male orthopedic surgeons. Figure 3 presents comprehensive departmental referral data along with the justification rates for WBCT requests.

Our analysis of justification patterns for anatomical region-specific CT requests in trauma patients revealed significant findings. The study demonstrated a high diagnostic yield of abdominal CT scans in trauma patients, with pathological findings identified in the majority of cases.

Among 59 trauma patients who underwent abdominal CT imaging, pathological findings were identified in 48 cases (31 males and 17 females), corresponding to 81.36% of scans (81.58% in males vs. 80.95% in females). The frequency distribution of justified CT requests stratified by gender is presented in Table 3.

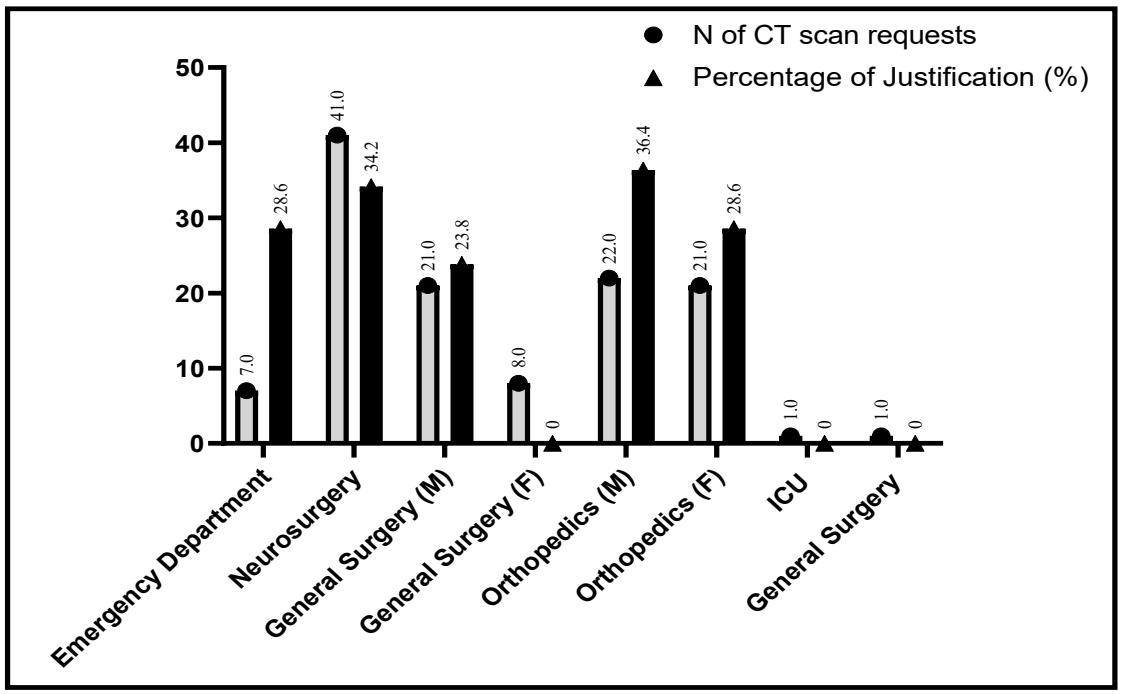


Figure 2. Percentage of justifications for WBCT scan requests referred from different hospital departments

Table 3. Justification rates and numbers of CT scans requested for different anatomical regions in trauma patients

Anatomical Region of CT scan	Justification rate in Males	Justification rate in Females	Overall justification rate	*P*-value
Thoracic CT scans	60 (69.77%)	24(75%)	84(71.19%)	0.58
Brain CT scans	127(67.20%)	38(60.32%)	165(65.48%)	0.32
Facial CT scans	52(78.79%)	18(81.82%)	70(79.55%)	0.76
Cervical CT scans	49(55.06%)	14(42.42%)	63(51.64%)	0.22
Abdominal CT scans	31(81.58%)	17(80.95%)	48(81.36%)	0.96
Pelvic CT scans	19(82.61%)	12(75%)	31(79.47%)	0.56

Note: Data are presented as Frequency (Percentage). P-values are calculated using Pearson's chi-square test to evaluate the difference in justification rates between male and female patients. A p-value < 0.05 is considered statistically significant.

[Downloaded from jsurgery.bums.ac.ir on 2026-11-15]

As demonstrated in Figure 4, neurosurgeons accounted for the highest proportion of thoracic CT referrals (n=34) in our study population. Notably, CT scans requested by male orthopedic surgeons showed the lowest justification rate (53.3%) among all referring specialties.

Analysis of region-specific CT scan justification in trauma patients revealed significant variations across anatomical areas. Cranial CT scans demonstrated a relatively high rate of clinically significant findings, as 65.48% of the 252 examined patients (67.2% males vs. 60.32% females) presented pathological results, indicating appropriate utilization. Neurosurgery accounted for the majority of cranial CT referrals (35.7%), with these requests showing the highest justification rate (73.33%). Similarly, facial CT scans exhibited high clinical utility, with 79.55% of studies (70 out of 88 patients) revealing trauma-related pathology. Gender-specific justification rates were 78.79% for males and 81.82% for females, with emergency medicine and general surgery referrals demonstrating 100% justification.

.

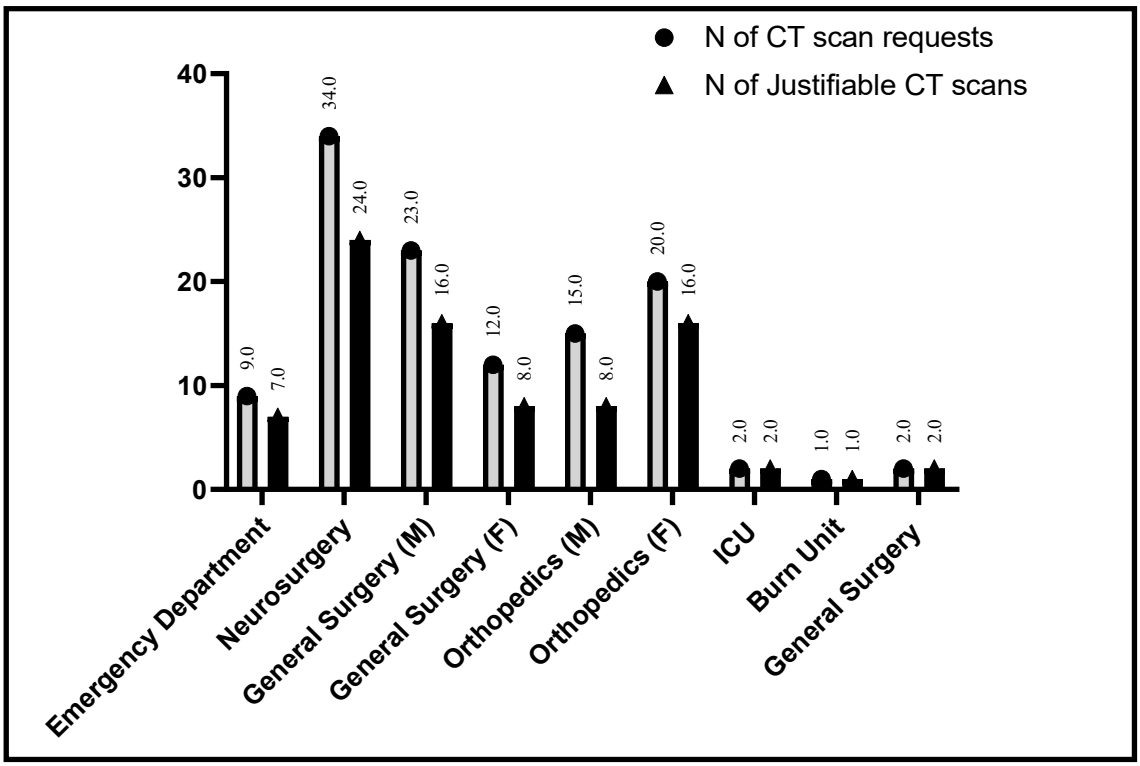


Figure 3. Percentage of justifications for thoracic scan requests referred from different hospital departments

Cervical spine CT examinations showed moderate justification rates overall (51.64%), accompanied by a noticeable gender disparity (55.06% in males vs. 42.42% in females) among 122 reviewed cases. Neurosurgery ordered most cervical CTs (41.8%), whereas general surgery referrals maintained a perfect justification rate (100%). Abdominal CT imaging demonstrated the highest diagnostic yields, with an overall justification rate of 81.63% (81.25% in males and 80.95% in females) across 59 patients. Neurosurgery accounted for 38.98% of these referrals, while the lowest justification rates were seen in female general surgery and emergency departments (50%).

Pelvic CT scans also showed substantial justification (79.94% overall), with male patients showing slightly higher rates (82.61% vs. 75%) among 39 studies. Orthopedic departments were responsible for most pelvic CT referrals (41.03%) and achieved complete justification (100%). Table 4 illustrates the justification status for different scan requests across hospital departments.

In Iran's public healthcare system, where trauma imaging services are provided free of charge, our study reveals significant financial and operational inefficiencies stemming from non-justified CT examinations. The opportunity cost of this practice becomes particularly evident when considering the potential revenue from alternative utilization of these imaging resources for non-trauma cases, while

[Downloaded from jsurgery.bums.ac.ir on 2026-11-15]

still maintaining high-quality emergency trauma services.

As presented in Table 5 our evaluation of 678 CT requests demonstrated that 198 examinations (29.2%) were clinically unjustified, and resulted in direct financial losses totaling 639 million Iranian Rials and waste of 55 productive staff hours.

Table 4. Justification status for different scan requests referred from different hospital departments.

Variable	Emergency department		Neurosurgery		General surgery (M)		General surgery (F)		Orthopedics (M)		Orthopedics (F)		ICU		Burn unit		General surgery	
	# of requested CT scan requested	# of justifiable CT scans	# of requested CT scan requested	# of justifiable CT scans	# of requested CT scan requested	# of justifiable CT scans	# of requested CT scan requested	# of justifiable CT scans	# of requested CT scan requested	# of justifiable CT scans	# of requested CT scan requested	# of justifiable CT scans	# of requested CT scan requested	# of justifiable CT scans	# of requested CT scan requested	# of justifiable CT scans	# of requested CT scan requested	# of justifiable CT scans
Brain CT	14	9		66	32	17	10	5	39	28	44	30	18	8	3	2	2	0
Facial CT	6	6			16	14	6	4	16	11	16	11	5	3	2	1	2	2
Cervical CT	8	4	51	31	16	9	9	0	15	6	18	10	4	2	0	0	1	1
Abdominal CT	2	1		19	12	11	6	3	7	5	8	8	0	0	1	1	0	0
Pelvic CT	5	4	4	2	3	1	2	1	16	16	9	7	0	0	0	0	0	0

Revenue Optimization Potential

The reallocation of imaging slots currently used for unjustified trauma cases could generate approximately 1,890 million Rials (IRR) annually at current utilization rates. This projection accounts for:

1. Base revenue from non-trauma examinations
2. Reduced equipment maintenance costs
3. Improved staff productivity metrics

These results, when interpreted alongside the financial findings presented in Table 5, emphasize the significant opportunity for economic optimization through appropriate CT utilization. Overall, this comprehensive approach balances clinical quality preservation with financial responsibility, creating a sustainable model for trauma imaging services in resource-limited healthcare environments.

This study utilized Pearson's chi-square test to evaluate the relationship between patient age and unjustified CT scan requests across various anatomical regions (modeled as a dichotomous variable). The Pearson test was selected as the appropriate statistical method given the categorical nature of the analyzed variables.

Our findings demonstrated no statistically significant association ($p>0.05$) between patient age and unjustified CT requests in any anatomical region except for facial scans. This suggests that chronological age alone does not serve as a reliable independent predictor for unjustified imaging requests in trauma settings. It is important to note that this analysis specifically examined the age-request relationship, and other clinical decision-making factors not captured in this study may significantly influence imaging utilization patterns.

[Downloaded from jsurgery.bums.ac.ir on 2026-11-15]

Table 5. Wasted resource and time expenditure for unjustified trauma CT scan requests

Variable	Cost (IRRs.)	Number of unjustifiable CT scans	Total Cost (IRRs)	Time (Minutes)	Total time wasted (Minutes)
Brain	2,891,380	87	251,550,060	7	609
Facial	4,780,240	18	86,044,320	17	306
Cervical Spin	2,587,190	59	152,644,210	20	1180
Lumbar Spin	4,366,740	15	65,501,100	25	375
Abdominal	6,141,190	11	67,553,090	60	660
Pelvic	1,957,310	8	15,658,480	20	160
Total			638,951,260		3,290

Note: IRR: Iranian Rial. Total time wasted is reported in minutes. Financial and time indexes represent direct resource burdens and financial losses incurred due to unjustified trauma CT requests.

Discussion

The results of this study demonstrate that the justification rate for WBCT requests by physicians was at an acceptable level compared to similar studies. The percentage of traumatic findings for WBCT was approximately 29%, which aligns with the findings of Bågenholm et al. (2020), who reported inappropriate imaging request rates of 29.1% for CT and 33.3% for MRI in the United States (19). This finding suggests that while WBCT can be an essential diagnostic tool in trauma assessment, a significant proportion of these scans may still be clinically unnecessary.

In the current study, the frequency of traumatic findings for thoracic CT scans was approximately 71%, showing more favorable results than the 24% reported by Khosravi et al. (2023) (20). This discrepancy may be explained by differences in study populations, as our research exclusively focused on trauma patients, in whom thoracic CT is often clinically justified. Similarly, the justification rate for brain CT requests was also higher than in most previous studies, with 65.48% of scans yielding traumatic findings. This rate differs markedly from Chaparian et al. (2018), Moradi et al. (2021), and Khosravi et al. (2023), who reported justification rates of 34.2%, 9%, and 19%, respectively (20–22). The discrepancy may result from the inclusion criteria and classification approach of the present study, which specifically focused on trauma-related justifications.

Facial CT scans demonstrated particularly high clinical utility in our study, with 79.5% of scans justified, compared to the 42.5% justification rate reported by Khosravi et al. (2023) (20). Cervical spine CT scans, however, presented more moderate justification rates (51.64%), indicating that nearly half of these examinations may have been unnecessary. This result is comparable to the findings of Oikarinen et al. (2009), who reported approximately 3% inappropriate imaging requests in Finland (8). The relatively low justification rate of cervical CT scans emphasizes the need for more selective imaging protocols, as these examinations often yield negative findings despite high radiation doses.

Abdominopelvic CT scans showed the highest diagnostic yield in this study, with abdominal CT achieving a justification rate of 81.36%, which is more favorable than the 30% and 37% reported by Khosravi et al. (2023) and Oikarinen et al., respectively (8, 20). The differences among studies could be attributed to population type, evaluation methods, and sample characteristics. For pelvic CT scans, the justification rate was approximately 79.49%, compared to 10% in Khosravi et al.'s study (20). Such variation highlights the influence of trauma-centered sampling, which naturally produces higher justification rates due to the urgency and complexity of injury assessment.

If all CT requests were entirely justified, the concept of a diagnostic risk threshold would become negligible, underscoring the importance of maintaining an appropriate balance between clinical caution and radiation protection. In our study, 198 unjustified requests resulted in approximately 55 hours of wasted time, in addition to increased maintenance costs and accelerated equipment depreciation. A more comprehensive clinical evaluation of trauma patients, including assessment of vital signs, level of consciousness, and polytrauma indicators could reduce unnecessary CT

[Downloaded from jsurgery.bums.ac.ir on 2026-11-15]

requests. In many cases, alternative diagnostic approaches or detailed physical examinations may provide adequate information without exposing patients to avoidable radiation. This finding is consistent with recent evidence demonstrating that validated clinical prediction rules, such as the Pediatric Emergency Care Applied Research Network criteria, can safely reduce unnecessary CT imaging in trauma patients while maintaining excellent diagnostic performance (23). Recent evidence has also demonstrated that validated clinical decision rules, particularly the Canadian CT Head Rule, achieve excellent diagnostic performance and can be further enhanced by incorporating serum biomarkers, such as Glial Fibrillary Acidic Protein, thereby improving patient selection for CT imaging (24).

Although CT scanning remains one of the most powerful diagnostic modalities in trauma management, it carries substantial financial and radiobiological costs. Despite significant advancements in modern diagnostic technology, CT imaging is not entirely risk-free. The present study, conducted at Imam Reza Hospital in Birjand, provides one of the few region-specific assessments of CT justification in Iran and highlights that while justification rates were generally favorable, substantial opportunities remain to further reduce unjustified scans. The lowest and highest justification rates in this study were observed in WBCT (29%) and abdominal CT (81%), respectively.

Excessive reliance on imaging, pressure to employ advanced technologies, and patient expectations are among the key contributors to unnecessary imaging. Donnelly (2005) identified these as primary drivers of overuse, while Boodman (2010) reported that 30–50% of all medical imaging may be unnecessary (25, 26). These findings reinforce the need for continuous physician education, adherence to clinical guidelines, and greater awareness of radiation protection principles to achieve an optimal balance between diagnostic benefit and patient safety.

The relatively high justification rate observed in our study may be partly explained by the inclusion of trauma patients, who often require imaging as part of urgent diagnostic protocols. Nevertheless, when compared with other trauma-focused studies, the justification rate remained higher in our study, likely due to stricter adherence to established CT indication criteria.

The present study has several strengths. It evaluated a relatively large number of CT scan requests from the main trauma referral center in South Khorasan, Iran, and assessed imaging justification across multiple anatomical regions and hospital departments using a standardized approach. In addition, the study incorporated an economic assessment of unjustified CT utilization, providing practical information for healthcare resource management.

This study also has several limitations. First, it was conducted at a single referral center, which may limit the generalizability of the findings to other healthcare settings. Second, justification was primarily determined based on documented clinical information and CT findings, which may not fully capture the physician's real-time clinical decision-making process. Third, the retrospective design limited the evaluation of some important clinical variables, such as trauma severity scores and long-term patient outcomes. Future multicenter prospective studies incorporating standardized clinical decision rules and patient follow-up are recommended to further validate these findings.

Conclusion

Through more precise examinations and adherence to clinical protocols, the number of unjustified trauma CT scans can be effectively reduced, thereby minimizing unnecessary radiation exposure to patients. Future studies are recommended to further investigate the relationship between radiation dose from unjustified imaging requests and potential long-term cancer risks.

Implementing awareness campaigns for both the public and physicians regarding accurate diagnostic practices is essential. Successful implementation requires coordinated education efforts and transparent reporting of healthcare resource constraints.

[Downloaded from jsurgery.bums.ac.ir on 2026-11-15]

Regular physician training should be implemented through monthly workshops on appropriate CT use criteria, case-based educational programs, and periodic feedback regarding individual imaging request patterns. Public awareness should be improved through community educational seminars promoting rational imaging utilization and informational campaigns emphasizing appropriate diagnostic pathways and the potential risks of unnecessary imaging. By adopting these strategies, medical centers can maintain high-quality trauma services while enhancing radiology department efficiency and optimizing resource use and revenue potential.

Ethics Approval and Consent to Participate

This study was approved by the Research Ethics Committee of Birjand University of Medical Sciences (Approval No. IR.BUMS.REC.1402.247).

Consent for Publication

Not applicable, as this study did not include any identifiable personal data, images, or information requiring patient consent for publication.

Data Availability Statement

The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Funding Statement

This study was financially supported by Birjand University of Medical Sciences, Birjand, Iran.

Acknowledgements

The authors would like to thank the staff of Imam Reza Hospital for their valuable cooperation in the data collection process.

Author's Contribution

All authors contributed substantially to the conception and design of the study, acquisition, analysis and interpretation of data, drafting and critical revision of the manuscript, and approved the final version for publication. All authors agree to be accountable for all aspects of the work and ensure that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Conflict of Interest

The authors declare that they have no competing interests.

Declaration of Generative Artificial Intelligence (AI) in Scientific Writing

The authors did not use generative artificial intelligence to generate or interpret the scientific content of this manuscript. ChatGPT (OpenAI) and Grammarly were used solely for grammar and spelling checks and to improve language clarity. All scientific content, interpretations, and conclusions were developed, reviewed, and approved by the authors, who take full responsibility for the final manuscript.

References

1. Müskens JL, Kool RB, van Dulmen SA, Westert GP. Overuse of diagnostic testing in healthcare: a systematic review. BMJ Qual Saf. 2022;31(1):54-63. [DOI: 10.1136/bmjqs-2020-012576]
2. Arora R, Arora AJ. Justification of whole-body CT in polytrauma patients, can clinical examination help selecting patients? Quant Imaging Med Surg. 2019;9(4):636-41. [DOI: 10.21037/qims.2019.04.02]
3. Brenner DJ, Hall EJ. Computed tomography an increasing source of radiation exposure. N Eng J Med. 2007;357(22):2277-84. [DOI: 10.1056/NEJMra072149]
4. Moradi M, Behzadi N. Evaluation of received radiation rate in patients with trauma hospitalized in isfahan city, iran. J Isfahan Med Sch. 2019;37(530):624-9. [DOI: 10.22122/jims.v37i530.11916]
5. MaxinenS, Jochelson MD, Tali Amir MD, Ann Brow n MD, Megan Adamson MD, Paul Baron MD, et al. American college of radiology: acr appropriateness criteria. J Am College Radiol. 2023;21(6):126-43. [DOI: 10.1016/j.jacr.2024.02.019]
6. Smith-Bindman R, Miglioretti DL, Larson EB. Rising use of diagnostic medical imaging in a large integrated health system. Health Aff. 2008;27(6):1491-502. [DOI: 10.1377/hlthaff.27.6.1491]
7. Wilds jr, Edward l. Radiation protection and safety of radiation sources: international basic safety standards vienna austria iaea international atomic energy

[Downloaded from jsurgery.bums.ac.ir on 2026-11-15]

agency. Health Physics. 2013;104(2):232-3. [DOI: 10.1097/HP.0b013e3182751a99]
8. Malone J, Guleria R, Craven C, Horton P, Järvinen H, Mayo J, et al. Justification of diagnostic medical exposures: some practical issues. Report of an International Atomic Energy Agency Consultation. Br J Radiol. 2012;85(1013):523-38. [DOI: 10.1259/bjr/42893576]
9. Health effects of security scanners for passenger screening (based on X-ray technology) European Commission: Health And Consumers Scientific Committees; 2012. [URL: https://www.julkari.fi/items/685a9a10-18b3-4897-acad-187fef82ccf8]
10. Oikarinen H, Meriläinen S, Pääkkö E, Karttunen A, Nieminen MT, Tervonen O. Unjustified CT examinations in young patients. European Radiology. 2009;19:1161-5. [DOI: 10.1007/s00330-008-1256-7]
11. Borgman M, Spinella P, Holcomb J, Blackbourne L, Wade C, Lefering R, et al. The effect of FFP: RBC ratio on morbidity and mortality in trauma patients based on transfusion prediction score. Vox Sang. 2011;101(1):44-54. [DOI: 10.1111/j.1423-0410.2011.01466.x]
12. Mathews JD, Forsythe AV, Brady Z, Butler MW, Goergen SK, Byrnes GB, et al. Cancer risk in 680 000 people exposed to computed tomography scans in childhood or adolescence: data linkage study of 11 million Australians. Bmj. 2013;346:2360. [DOI: 10.1136/bmj.f2360]
13. Rizzo AG, Steinberg SM, Flint LM. Prospective assessment of the value of computed tomography for trauma. J Trauma Acute Care Surg. 1995;38(3):338-43. [DOI: 10.1097/00005373-199503000-00005]
14. Yazdani S, Jahandideh H, Ghofrani H. Validation of the ottawa ankle rules in iran: a prospective survey. BMC Emerg Med. 2006;6(1):1-7. [DOI: 10.1186/1471-227X-6-3]
15. Sanei A, Pourafzali SM, Raeisi H, Chireh F. Concordance between clinical examination and pelvic radiography in trauma patients admitted to the emergency department: a diagnostic accuracy study. Iran J Emerg Med. 2021;8 (1):4. [DOI: 10.22037/ijem.v8i1.33436]
16. European Society of Urogenital Radiology. ESUR guidelines on contrast agents. Version 10.0. Vienna: European Society of Urogenital Radiology; 2023. [URL:https://www.esur.org/wp-content/uploads/2022/03/ESUR-Guidelines-10_0-Final-Version.pdf]
17. Sodickson A, Baeyens PF, Andriole KP, Prevedello LM, Nawfel RD, Hanson R, et al. Recurrent ct, cumulative radiation exposure, and associated radiation-induced cancer risks from ct of adults. Radiology. 2009;251(1):175-84. [DOI: 10.1148/radiol.2511081296]
18. United Nations Scientific Committee on the Effects of Atomic Radiation. Sources Effects and Risks of Ionising Radiation UNSCEAR Report to the General Assembly Scientific Annexes A and B. [Internet]. Vienna: United Nations. 2017. [URL:https://www.unscear.org/unscear/en/publications/2017.html]
19. Bågenholm A, Dehli T, Eggen Hermansen S, Bartnes K, Larsen M, Ingebrigtsen T. Clinical guided computer tomography decisions are advocated in potentially severely injured trauma patients: a one-year audit in a level 1 trauma centre with long pre-hospital times. Scand J Trauma Resusc Emerg Med. 2020;28:1-12. [DOI: 10.1186/s13049-019-0692-5]
20. Khosravi H, Hamidi M, Nikzad S, Tapak L. Evaluating the outcome of an unnecessary request for ct scan in be'sat hospital of hamadan. Radiol Res Pract. 2023;2023:3709015. [DOI: 10.1155/2023/3709015]
21. Chaparian A, Shoushtarian M, Sadeghi M, Susani M, Sabbagh M, Askariyeh M. Justification of CT scan requests to reduce radiation-induced cancer risk. J Isfahan Med School. 2018;36(477):433-8. [DOI: 10.22122/jims.v36i477.9673]
22. Moradi H, Chehre H, Ghaderi B, Saghatchi F, Najafi M, Karami P, Rezaeejam H. Evaluating the necessity and radiation risk of brain ct scans requested by the trauma emergency department. J Biomed Phys Eng. 2023;13(6):515-22. [DOI: 10.31661/jbpe.v0i0.2012-1251]
23. Holmes JF, Yen K, Ugalde IT, Ishimine P, Chaudhari PP, Atigapramoj N, Badawy M, McCarten-Gibbs KA, Nielsen D, Sage AC, Tatro G. PECARN prediction rules for CT imaging of children presenting to the emergency department with blunt abdominal or minor head trauma: a multicentre prospective validation study. The Lancet Child & Adolescent Health. 2024 May 1;8(5):339-47. [DOI: 10.1016/S2352-4642(24)00029-4]
24. Papa L, Ladde JG, O'Brien JF, Thundiyil JG, Tesar J, Leech S, et al. Evaluation of glial and neuronal blood biomarkers compared with clinical decision rules in assessing the need for computed tomography in patients with mild traumatic brain injury. JAMA Netw Open. 2022;5(3):e221302. [DOI: 10.1001/jamanetworkopen.2022.1302]
25. Donnelly LF. Reducing radiation dose associated with pediatric CT by decreasing unnecessary examinations. AJR Am J Roentgenol. 2005;184(2):655-7. [DOI: 10.2214/ajr.184.2.01840655]
26. Bresnahan BW. Economic evaluation in radiology: reviewing the literature and examples in oncology. Acad Radiol. 2010;17(9):1090-5. [DOI: 10.1016/j.acra.2010.05.020]

[Downloaded from jsurgery.bums.ac.ir on 2026-11-15]