RESEARCH ARTICLE

Appropriateness of radiographic imaging ordered by emergency physicians: a knowledge-based survey

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Abstract

Objective: To assess the knowledge of physicians working in the emergency department in choosing appropriate diagnostic imaging in different clinical scenarios.

Method: The cross-sectional study was conducted at the Emergency Department of the Aga Khan University Hospital, Karachi, from January 3 to July 2, 2018, and comprised registered medical officers, residents, and consultants of either gender involved in emergency care decision-making. Data was collected using a structured questionnaire that had 10 clinical scenarios based on the American College of Radiology Appropriateness Criteria guidelines. Data was analysed using SPSS 17.

Results: Of the 82 participants, 50(61%) were males and 32(39%) were females. The overall mean age was 34.06±6.42 years. Of the total, 50(61%) subjects had appropriate knowledge regarding imaging. The overall mean number of correct responses was 6.90±1.20. Those belonging to the Emergency Medicine specialty had significantly higher odds of having appropriate knowledge compared to participants belonging to other specialties when adjusted for age, gender, position of practice and years of Emergency Medicine training (Odds ratio: 4.73; 95% confidence interval: 1.07-20.91).

Conclusion: Physicians belonging to the Emergency Medicine specialty were more likely to have adequate knowledge regarding imaging appropriateness compared to other specialties.

Key Words: Appropriateness criteria, Emergency medicine, American College of Radiology, Resident education, Guidelines.

Abbreviations: American College of Radiology (ACR), American College of Radiology Appropriateness Criteria (ACR-AC), Computed Tomography (CT), Emergency Department (ED), Standard Deviation (SD)

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Introduction

The emergency department (ED) has become the prime location of complex patient evaluations and hospital admissions. ED physicians play a critical role in the early diagnosis and management of patients, offering immediate, prioritised and appropriate care. In order for such care to take place, these frontline healthcare providers often require access to a wide range of imaging modalities. Diagnostic imaging plays an important role in today's medical practice. Undoubtedly, these developments have significantly assisted physicians in detecting, diagnosing and treating diseases, and enabled millions of people to live better lives of improved quality.[1]

The value of diagnostic imaging in ED is undisputed. With recent advances in rapidly changing medical technology, imaging examinations are being extensively employed in ED to accurately diagnose diseases and to rule out pathologies with potentially fatal outcomes.[2]

However, while these modalities immensely benefit patient management, significant concerns exist regarding their inappropriate use and overuse, and unnecessary radiation exposure to the patient population.[3]

In recent years, the decision on using the most appropriate imaging modalities has become of greater importance with enhanced focus on healthcare cost containment.[4]

Moreover, given the wider availability of complex imaging modalities in ED settings, and greater awareness of radiation risks, ED physicians are expected to understand the appropriateness of imaging.[5] Studies show that as many as 15-35% of diagnostic imaging tests are inappropriately ordered.[6]

Inappropriately ordered imaging tests cause unnecessary delay in patient treatment, increase the overall healthcare costs and puts patients at risk of potential harm from

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radiation exposure and contrast media toxicity.[7] Overuse of these modalities often results in overdiagnosis of incidental findings, which must then be evaluated, adding to the overall costs and increasing anxiety among patients. Factors that lead to overutilisation of imaging modalities in ED include time constraints, overcrowding, reduced staff, increased patient demands, poor integration of services, and fear of malpractice and litigation.[8] Moreover, majority of the imaging tests requested in ED are ordered without direct consultation from a radiologist, and most are ordered by trainee physicians, like residents and registered medical officers (RMOs).[9]

It has been reported that in ED, often a definitive diagnosis is hard to attain due to which ED physicians may order additional unrewarding imaging studies in a futile attempt to improve the certainty of the diagnosis[10]. In ED, where prompt evaluation and rapid decisions need to be taken, it is important that ED physicians who order imaging tests must understand what each test can reveal, and whether its results would be of value, and the benefit of obtaining these results outweigh the risk to the patient.

The American College of Radiology (ACR) developed the Appropriateness Criteria (ACR-AC) to help guide physicians in choosing the most appropriate imaging examinations for their patients in a variety of clinical settings.[11]

The ACR-AC is a set of evidence-based guidelines available for many imaging applications, but there is a lack of knowledge about them among clinicians and their use is voluntary. Consequently, these criteria are often ignored. Also, these guidelines are not practised in local settings and no such guidelines exist for Pakistan or even South Asia.

The current study was planned to assess the knowledge and competence of ED physicians in choosing appropriate diagnostic imaging in different clinical scenarios.

Subjects and Methods

The cross-sectional study was conducted at the Emergency Department of the Aga Khan University Hospital (AKUH), Karachi, from January 3 to July 2, 2018. After approval from the institutional ethics review committee, the sample size was calculated using the World Health Organisation (WHO) calculator[12] with 5% margin of error. The highest prevalence of knowledge regarding appropriateness criteria was taken as 85.15% (range: 72.4-97.9%)[13]. The sample was raised using non-probability consecutive sampling technique. Those included were registered medical officers, residents, and consultants of either gender involved in ED decision-making. Medical staff, including nurses, were excluded.

After taking written informed consent, data was collected using a self-administered survey questionnaire in English language. It comprised demographic and occupational data, such as age, gender, current year of postgraduate level, position of practice, number of years spent providing emergency care and field of specialty. The questionnaire comprised 10 clinical scenarios excerpted from the ACR-AC guidelines[11] to select the most appropriate imaging study. Responses were graded, with correct answers derived from the guidelines. Each participant was given 10 minutes to fill out the questionnaire completely. No pilot study conducted before the survey was executed.

The residents and medical officers were formally requested to fill out the questionnaire in one of their weekly core study sessions. Faculty and senior medical officers were approached individually to fill out the questionnaire. All questionnaires were filled on the same day to reduce the risk of response bias. Once the questionnaire was filled an answer sheet was provided which contained a short explanation of each answer, as per the criteria[11]. A post-questionnaire presentation was also conducted at a weekly core study session which gave the participants an opportunity to be further educated on the topic. The presentation was inclusive of correct answers to all questions with a detailed reasoning for each along with the results of the research. A link to the main page of the ACR website[11] was also provided to the participants.

Data was analysed using SPSS 17. Data was presented as mean ± standard deviation or as frequencies and percentages, as appropriate. Univariate regression analysis was applied to assess the relationship of knowledge with study variables to decrease potential confounding risk to each variable. Multiple logistic regression analysis was then carried out. $P \leq 0.05$ was taken as statistically significant.

Results

Of the 82 participants, 50(61%) were male and 32(39%) were female. The overall mean age was 34.06±6.42 years. Of the total, 50(61%) subjects had appropriate knowledge regarding imaging. The overall mean number of correct responses was 6.90±1.20. Age ($p=0.04$), position of practice ($p<0.01$) and years of experience ($p=0.01$) were significantly associated with appropriate knowledge. Among those with appropriate knowledge32(64%) belonged to the Emergency Medicine specialisation and

Table-1: The relationship of demographics and other characteristics with knowledge (n=82).

*p<0.05		Knowledge		
		Inappropriate (n=32)	Appropriate* (n=50)	*P-value*
Age		32.25 ± 5.73	35.22 ± 6.62	0.04*
Gender	Male	16 (50)	34 (68)	0.10
	Female	16 (50)	16 (32)	
Position of practice	Resident/Medical officers	23 (71.9)	20 (40)	< 0.01*
	Faculty/Senior medical officers	9 (28.1)	30 (60)	
Years of training in ED	≥ 4 years	9 (28.1)	28 (56)	0.01*
	< 4 years	23 (71.9)	22 (44)	
Specialisation	Other	15 (46.9)	18 (35)	0.33
	Emergency Medicine	17 (53.1)	32 (64)*	

ED: Emergency department.

Table-2: Logistic regression analysis for the association of study parameters with knowledge (n=82).

*p<0.05		Crude OR (95% CI)	Adjusted OR (95% CI)*	*P-value*
Age		1.08 (1.00, 1.18)*	1.12 (0.94, 1.32)	0.04*
Gender	Male	Ref	Ref	0.1
	Female	0.47 (0.19, 1.18)	0.62 (0.23, 1.70)	
Position of practice	Resident/Medical officers	Ref	Ref	<0.01*
	Faculty/Senior medical officers	3.83 (1.47, 9.97)*	3.57 (0.62, 20.66)	
Years of training in ED	≥ 4 years	Ref	Ref	0.01*
	< 4 years	0.31 (0.12, 0.80)	1.75 (0.24, 12.59)	
Specialisation	Other	Ref	Ref	0.33
	Emergency Medicine	1.57 (0.64, 3.87)	4.73 (1.07, 20.91)*	

OR: Odds ratio, CI: Confidence interval, ED: Emergency department.

18(36%) to other specialties (Table 1).

Those belonging to the Emergency Medicine specialty had significantly higher odds of having appropriate knowledge compared to participants belonging to other specialties when adjusted for age, gender, position of practice and years of Emergency Medicine training (Odds ratio [OR]: 4.73; 95% confidence interval [CI]: 1.07-20.91) (Table 2).

Discussion

In the current study, 61% subjects had appropriate knowledge regarding imaging as per the ACR-AC, which is comparable to a similar study conducted in Iran.[14] Another study reported an average score of 71% without finding significant improvement in knowledge scores among junior and senior residents over the course of a 4-year training programme.[13] The current study found that participants belonging to the Emergency Medicine specialty were more likely to have adequate knowledge regarding imaging appropriateness compared to those in other specialties. Among Hirschl et al.[15] evaluated paediatrics residents and reported an average score of 56.6%. Taragin et al.[16] evaluated the knowledge of Internal Medicine physicians and reported an average score of 62%, with <50% respondents answering more than half of the questions correctly. A study in the United States reported that the overall percentage of correct responses was 65%.[17]

It is evident that while many specialties are involved in regularly ordering imaging tests, there is limited awareness regarding imaging appropriateness among the physicians. Studies show that physicians underestimate the risks of radiation exposure due to a lack of awareness regarding radiation exposure risks associated with imaging modalities.[18]

An American study conducted among trainees across various clinical specialties reported that 72% respondents were involved in ordering diagnostic imaging studies during their training, but 47.8% had appropriate knowledge about radiation dose and safety, and only 34% had adequate knowledge regarding imaging appropriateness in pregnancy.[19]

Imaging modalities are being increasingly utilised in ED settings all over the world to ensure faster diagnosis of a variety of ailments and injuries. X-ray and computed tomography (CT) both employ ionising radiation, which is an established carcinogen. CT scanning is associated with much higher radiation doses compared to conventional X-ray imaging.[20]

Lee et al, reported that 9% of ED physicians had adequate awareness regarding radiation risks associated with CT scans, and that only 3% patients believed that there was increased risk associated with scanning.[21] The matter warrants attention in Pakistan as well.

Nishtar et al. reported the overuse of CT scans in ED, and showed that 90% of the scans done were CT head, of which only 34% had any positive findings.[22]

Another study reported that due to inadequate training and lack of awareness, Emergency Medicine residents were least comfortable in counselling their patients on radiation risks.[23]

A study in Spain reported that only 47.8% of the ordered imaging tests were appropriate, according to the ACR-AC, and that inappropriate tests were associated with increase in total effective radiation dose and total healthcare cost.[24]

The use of ACR-AC clinical decision support algorithms has been shown to improve the decision-making process in ED settings.

Rao et al. reported that when ACR-AC was applied among patients presenting with low back pain to ED, majority of the patients did not have to undergo any imaging and those patients who underwent imaging were imaged appropriately, as recommended by ACR-AC.[25]

Another study on the use of such algorithms for mild traumatic brain injuries found a reduction of about 13.4% of CT-scans, with no increase in delayed diagnosis of radiologically significant findings.[26]

Increasing the knowledge physicians regarding ACR-AC will increase their use in practice, prevent unnecessary imaging tests, increase diagnostic yield and inevitably result in decreased healthcare costs and improved patient healthcare outcomes. This can only be achieved if ACR-AC is taught during undergraduate and postgraduate training.

The current study, to the best of our knowledge, is the first of its kind in Pakistan even though it has its own limitations, being a single-centre study with a small sample size and without a randomised design.

Conclusion

There was satisfactory knowledge of imaging appropriateness among ED physicians. Those belonging to the Emergency Medicine specialty were more likely to have adequate knowledge regarding imaging appropriateness compared to those in other specialties.

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