

# Radiology in the Undergraduate Medical Curriculum: The Student Perspective

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## Highlights of the Study

- This study showed that students know the value of a radiologist in the medical team and believe that knowing radiological concepts is important for a doctor.
- Students believe that the amount of radiology teaching is inadequate.
- Students claim to lack radiological skills, such as reading X-ray, CT, and MRI images.
- Students chose hospital-based and problem-based learning as the best methods for radiology learning.

## Keywords

Radiology · Medical education · Kuwait

## Abstract

**Objective:** Despite the importance of radiology in the diagnosis and management of patients, studies suggest that medical graduates exhibit a minimal level of radiology knowledge. This study aimed to assess the satisfaction of Kuwait's medical students with the radiology teaching and their confidence in their knowledge regarding basic radiological principles, as well as their views and suggestions for adequate teaching time and pattern of radiology teaching at the undergraduate level. **Subjects and Methods:** This cross-sectional study was conducted among medical students in Kuwait University. The study employed a questionnaire, which aimed to assess the students' perception of the current radiological teaching approach. Ethical approval

was obtained, and descriptive analysis was conducted using SPSS. **Results:** Ninety-one percent of the 451 participants believed that the radiologist is an important part of the medical team. Ninety-seven percent of them believed that having a grasp of general radiological concepts is essential for clinical practice. More than half of the participants (55%) believed that the amount of radiology teaching they receive is inadequate. Most students claimed to lack the radiological skills that a competent doctor should own, such as reading X-rays, CTs, and MRIs. Most students chose hospital-based and problem-based learning sessions as their most desired methods for radiology learning. **Conclusion:** Radiology is an essential part of modern medicine. Adequate exposure to radiological techniques and adequate time to radiological teaching must be allocated to students during their undergraduate medical curriculum to improve the proper management of patients.

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## Introduction

The need for adequate radiology teaching and training has never been greater, especially with the significant developments and regular interactions between radiologists and physicians from other medical disciplines [1]. All clinicians interact with radiologists during their clinical practice, as radiology provides significant imaging information to guide clinical decision-making and to guide the course of treatment [1]. Also, with the progression of minimally invasive procedures and interventional radiology, the field is expanding faster than ever. However, as the field of radiology grows, it faces several challenges, including the limited knowledge and interest of medical students, as well as a relative lack of dedicated teaching programs for this specialty [2].

Despite the significance of radiology, studies suggest that new medical graduates exhibit a suboptimal level of radiological knowledge, with approximately half of graduates not knowing how to select appropriate clinical investigations and the associated risks of common investigations [2, 3]. This raises concerns about the lack of adequate specific training in radiology, as this may cause unnecessary investigations being recommended.

Students need proper radiological teaching, and a greater exposure for all students is helpful not only in improving students' knowledge about imaging and its role in medicine, but this will also stimulate their interest in radiology as a career path [3]. However, introducing a core radiology rotation into medical school curricula may be challenging as most curricula are already saturated; an alternative approach is to integrate radiology into the existing rotations. However, this integration may complicate the training process, as it requires coordination between all departments involved. Such coordination is not always easy and can lead to disjointed instruction that may cause poor student learning [4].

Internationally, hours spent in the radiology training at the undergraduate level vary dramatically, as formal radiology education is not offered in all undergraduate medical programs, and it is often offered as an elective instead [5]. Kuwait University follows a 7-year mixed basic sciences and clinical teaching program, with the first 4 years focused on preclinical and basic science teaching and the other three as clinical years; presently, there are no core radiology rotations. Students used to be provided a 1-week core radiology rotation in the hospital during their fifth year. However, in 2018, this rotation was removed, and instead, radiology teaching was incorporated with the rotations in other medical specialties. Since its

removal, radiology rotations were only offered as optional elective for fifth-year students that only accept a maximum of six students a year from the batches that comprise over ninety students. Despite the removal of the core rotation, medical students graduating from Kuwait University are still expected to have the ability to easily interpret basic radiological studies. This was the initial learning objective prior to the removal of this rotation.

This study aimed to assess the satisfaction of Kuwait University's medical students with the radiology teaching and their confidence in ordering appropriate imaging studies and making common diagnoses. Also, this study aimed to assess the perspectives of students on their knowledge regarding the basic radiological principles, as well as their recommendations to improve the teaching process.

## Materials and Methods

This cross-sectional study was conducted among undergraduate students in Kuwait University's Faculty of Medicine, which follows a 7-year program for its medical students, integrating basic science knowledge with clinical teaching. The study sample included students starting their 4th year of study, which is when their radiological teaching intensifies, up to students in their 7th and final year of study, after completing all their required core and elective clinical rotations. A list of current students was obtained, and all medical students who fit the inclusion criteria were approached. Students who were not in the 4th to 7th year of medical school were excluded from the sample population. The study employed a questionnaire designed to assess the perceptions of students regarding the radiology teaching in the Faculty of Medicine, as well as their confidence in their grasp of common radiological skills that arise during clinical practice. Students were approached during their breaks, and participation was voluntary.

The questionnaire was reviewed by a faculty member, and feedback was incorporated during revision of the questionnaire. The questionnaire was pre-tested on 10 students similar to the target population, and it was revised as required after pre-testing. The questionnaires took on average 5–10 min to complete. This study was approved by Kuwait University's Faculty of Medicine Ethics Committee and the Health Sciences Ethics Committee for Student Research.

The data were collected in a 2-week period (from February 9 to February 20, 2020). Data were entered, cleaned by removing missing data and students who fit the exclusion criteria, and analyzed using the Statistical Package for the Social Sciences version 25 (IBM). Univariate analysis was performed to calculate percentages, frequencies, means, and standard deviations. Significant associations between dependent and independent categorical variables were tested using the Pearson  $\chi^2$  test. The binary logistic regression model was used to adjust the odds ratio for potential confounding variables. Age, gender, and confidence in radiological knowledge were the variables included as covariates in the model for adjustment, as they were significantly associated with the score in the crude analysis. A *p* value of  $\leq 0.05$  and 95% CI were considered to be the levels of significance.

## Results

A total of 451 medical students participated in the study, with a participation rate of 97% (14 rejections, 451/465). Starting with demographics, there was a relatively even split of participants across the year groups, with slightly more (29%) being in their 4th year of study ( $n = 129$ ). For the rest of the participants, 24% were in the 5th year ( $n = 108$ ), 22% in the 6th year ( $n = 100$ ), and 25% in the 7th year ( $n = 114$ ). The majority of the participants were females ( $n = 361$ , 80%) with a mean age of 22.5 years ( $p < 0.05$ ). Also, of note, the vast majority ( $n = 404$ , 90%) of the study participants were Kuwaiti in nationality, with only 45 participants having other nationalities, but this finding was not statistically significant ( $p > 0.05$ ).

When asked about the importance of a radiologist as a member of the medical team, 92% of the participants believed that the radiologist is an integral and a critically important part of the medical team ( $n = 414$ ), while only 8% thought that this profession is somewhat important or not important at all ( $n = 37$ ). Ninety-seven percent of the students believed that having a grasp on general radiological concepts is important for their future medical practice ( $n = 438$ ), while 3% believed that it is not important to be familiar with these concepts for their future practices ( $n = 13$ ) ( $p < 0.05$ ).

Thirty-one percent of the students claimed they did not receive any form of radiological teaching in the hospital or in the university outside their core medical radiological rotation ( $n = 141$ ) ( $p = < 0.05$ ). Also, when asked about the extent of the radiological education offered in their medical curriculum, more than half of the participants (54%) believed it is inadequate ( $n = 247$ ), with 11% of them believing that it is very inadequate and does not meet their expectations ( $n = 51$ ) ( $p < 0.05$ ).

Regarding their level of confidence in reading X-rays at the end of their medical training, 55% felt confident ( $n = 251$ ), whereas 44% did not feel confident in their abilities ( $n = 200$ ). When asked about their confidence in reading CT studies, including head, body, and urgent CTs at the end of their medical training, a large proportion of the participants did not feel confident at all (22%) ( $n = 100$ ), and even less were confident (49%) ( $n = 219$ ), whereas only 29% of the participants felt that they can read CTs ( $n = 132$ ) ( $p < 0.05$ ). Students were also asked about their confidence in their abilities to read MRI studies; 69% of them did not feel confident in that regard ( $n = 312$ ).

In terms of the amount of radiological teaching in Kuwait University, the vast majority of participants agreed that more teaching of radiology is needed during medical

school, with 40% stating that much more teaching is needed ( $n = 180$ ), and 46% saying that a little more teaching is needed ( $n = 208$ ). In contrast, 13% thought that the teaching is adequate ( $n = 57$ ), and only 1% claimed that less teaching is needed ( $n = 6$ ). Students were also asked about the number of hours that they think should be provided for radiological teaching per month; 32% opined that they should get 1–4 h ( $n = 142$ ), while the majority of respondents (53%) stated that 5–10 h is needed on a monthly basis in order for them to obtain adequate radiological knowledge by graduation ( $n = 208$ ). In contrast, 15% averred that 10–15 h is needed monthly (69), and only one student (0.2%) thought that more than 15 h is needed per month for proper radiological education ( $p < 0.05$ ).

When asked about their opinions on the duration of the radiology rotations, almost equal proportions of the students (38% and 37%) thought the radiology rotations should be 1 and 2 weeks long, respectively ( $n = 169$ , 166, respectively). Fifteen percent thought they should get 2 weeks of radiology ( $n = 66$ ), and a minority of 11% thought that the core rotation should be 4 weeks long ( $n = 48$ ). In addition, 76% of students reported that they would like subspecialties, including pediatric radiology, neuroradiology, vascular, and interventional radiology to be taught during their core medical rotation ( $n = 339$ ), while 24% reported they would not in favor of that ( $n = 112$ ).

Finally, participants were asked to rank the format in which they would like to receive radiological teaching in their curriculum. Most students (48%) thought that it should be provided as hospital-based learning sessions, during which physicians would give them one-on-one descriptions and examples of common radiological concepts ( $n = 217$ ). The second highest ranked method of education was problem-based learning, with 23% of students ranking it as their most desired method ( $n = 105$ ), followed by group learning activities (19%) ( $n = 86$ ), and didactic lectures, which were chosen most as the least desired teaching method (33%) ( $n = 147$ ).

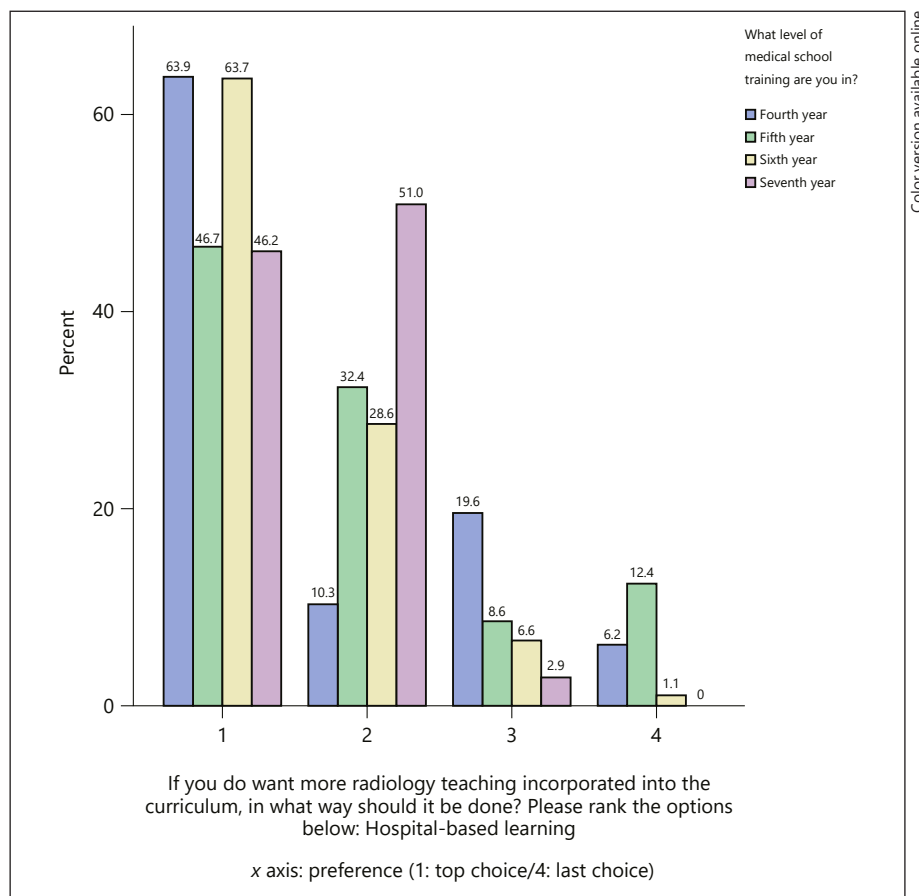
## Discussion

The importance of clinical radiology in modern medicine is undeniable. It is a field that integrates knowledge of anatomy, pathology, and the clinical aspects of medicine in order to aid in the establishments of diagnoses and even treatment of patients; therefore, teaching radiology is essential for all future medical doctors [6].

**Table 1.** Comparison of results of this Kuwait University study with universities in the USA

Category	Students in Kuwait University	Students in US universities <sup>#</sup>
Participants, <i>n</i>	451	653
Radiologists are an integral part of a medical team, %	92 ( <i>n</i> = 414)	59 ( <i>n</i> = 385)
Confident in reading CT images, %	29 ( <i>n</i> = 132)	23 ( <i>n</i> = 150)
More hours of radiology teaching are needed, %	86 ( <i>n</i> = 388)	67 (437)
Preferred form of radiologic teaching, %	Hospital-based teaching sessions; 48 ( <i>n</i> = 217)	Didactic lectures; 9 ( <i>n</i> = 59)

<sup>#</sup> Average counts of studies conducted in the USA (*n* = 376) (*n* = 1,223) (*n* = 361) [1–3].



**Fig. 1.** Bar chart analyzing the relationship between the year of medical school training and preferences of medical students regarding the favored methods of receiving radiology teaching. This figure addresses the most common (hospital-based learning) method. It shows a unanimous preference of medical students to learning radiology during their hospital rotations.

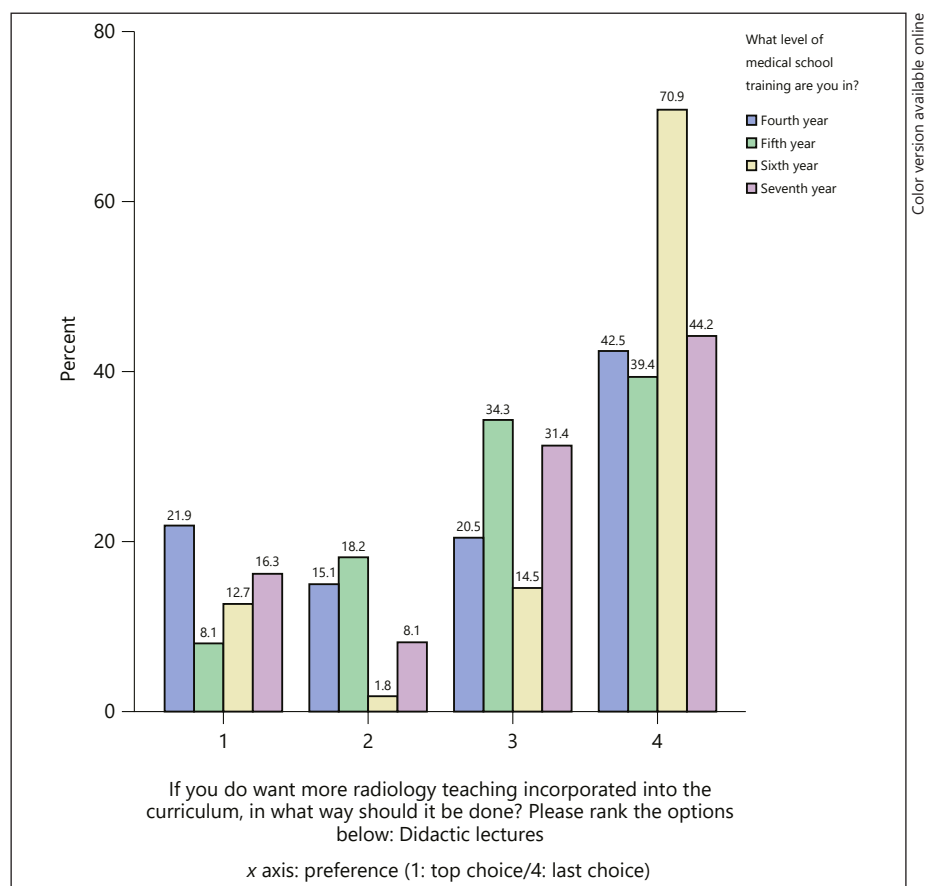
The results of this study show that medical students in Kuwait view radiology as an integral part of modern medicine. We compared the findings of this study to those of studies conducted elsewhere (Table 1). We found that students from Kuwait University value the role of a radiologist in the medical team more than their international peers (92% vs. 59%). In addition, the majority of our students agreed that having a grasp on radiological skills is a very important asset for a healthcare provider, which may show that this specialty is appreciated among students in

Kuwait, despite the comparatively brief exposure to radiology as a core rotation in the past, its recent removal, as well as the lack of explicit lectures. In previous studies, around half of the participants only agreed to the major importance of imaging studies, in comparison with the proportion of 92% in this study sample [7]. It is reasonable for a newly graduated medical doctor to possess the ability to read plain radiographs, CT scans, and other radiological investigations to identify common pathologies.

**Table 2.** Comparison of results between Kuwait University and international studies\*

Category	Kuwait University students	Charles et al. [13]	Dmytriw et al. [6]	Branstetter et al. [5]
Participants, <i>n</i>	451	376	1,223	361
Radiologists are an integral part of a medical team, %	91 ( <i>n</i> = 414)	49 ( <i>n</i> = 185)	91 ( <i>n</i> = 1,112)	38 ( <i>n</i> = 137)
Confident in reading CT images, %	29 ( <i>n</i> = 132)	25 ( <i>n</i> = 94)	7 ( <i>n</i> = 85)	36 ( <i>n</i> = 130)
More hours of radiology teaching are needed, %	86 ( <i>n</i> = 388)	91 ( <i>n</i> = 520)	63 ( <i>n</i> = 770)	47 ( <i>n</i> = 170)
Preferred form of radiologic teaching, %	Hospital-based teaching sessions; 48 ( <i>n</i> = 217)	–	Didactic lectures; 26 ( <i>n</i> = 317)	–

\* This table demonstrates the difference in the proportions of answers submitted by participants in studies that focused on radiology teaching for students in universities in the USA.



**Fig. 2.** Bar chart analyzing the relationship between the year of medical school training and preferences of medical students regarding the favored methods of receiving radiology teaching. These figures address the least common (didactic lectures) method.

The majority of medical students in Kuwait want more radiological teaching in their medical curriculum, which directly reflects their appreciation and understanding of radiology and its importance in the field of medicine. Most students claimed to be lacking in confidence when it came to the ability to interpret radiological studies such

as reading X-rays, CTs, and MRIs. However, an interesting finding was that older students were less confident about their skills in comparison with younger students, which contrasts with a previous study which concluded that the less exposure students have to this specialty, the less likely they are to be confident of their radiological

knowledge and skills [8]. This discrepancy could be due to the exposure to complex cases and late rotations in the latter years of medical education in Kuwait. In addition, there are several factors other than education that affect the confidence of students in answering questions, such as self-confidence, as well as the difficulties of clinical scenarios.

This study also showed that a very large proportion of the students did not believe that they are exposed to radiological teaching outside their core rotation except some radiology-oriented lectures and few hospital sessions dispersed throughout the other medical rotations. This claim may be a testament to the quality of radiological teaching that is provided to students outside their core rotation, or the method of teaching, as most of the radiology teaching outside the core rotation is done in the form of didactic lectures. In addition, of the included sample, only current 7th-year students experienced a radiology core rotation, with the others only experiencing radiology as integrated sessions in other modules or electives. Another study concluded that problem-based sessions with cases directly aimed at radiological teaching provide the most benefit to students, as radiologists can supervise and be fully available to answer questions that may arise during sessions [3].

Another question answered in this study was the desired length of the core radiology rotation during medical school. The majority of the students thought that the rotation should be two to 3 weeks long, while there is no core rotation in radiology currently provided for 5th-year students. Interestingly, most students who thought that the core rotation should be two to 3 weeks long were the final-year students (7th-year students), who had already completed a 1-week long core rotation in radiology, which could indicate that returning to the old system in Kuwait University, which provided a 1-week long core rotation in radiology, may not be the ideal solution. Several studies on undergraduate medical radiology teaching emphasize the importance of formal radiology teaching, particularly in the form of a formal curricular core rotation [9–11].

When asked about the interest of the students to receive education about radiological subspecialties, such as pediatric radiology, neuroradiology, vascular and interventional radiology during their core rotations, most students stated their interest in it. Despite the fact that a basic knowledge of radiology can be a sufficient goal for a newly graduated medical doctor, knowledge about radiological subspecialties can widen the scope of students in regard to radiology, and this knowledge can lead to an

increase in the number of students considering radiology as a future specialty to train in during their postgraduate training [12].

The final question in the survey aimed to assess the preference of students on the format of radiology teaching that they would like to be given to them. An interesting finding was that students in Kuwait ranked hospital-based learning sessions their most preferred method of receiving radiological teaching, and they placed didactic lectures as their least preferred method. Upon further analysis and correlation between the preference and year of medical training (Fig. 1, 2), it was found that the majority of students across all of the years of medical training had a similar trend in making this choice. This is interesting considering that didactic lectures are the most common and most preferred form of radiological teaching internationally (Table 1), and this may hint at a problem in the system of didactic lectures in Kuwait.

In summary, medical students in Kuwait University expressed an interest in more teaching in the field of radiology during their medical school teaching time, Table 2. They do not feel confident in their abilities to read and interpret radiological studies. Despite the importance of radiology as a part of modern medicine, medical graduates exhibit a minimal level of radiology knowledge. Limitations of this study include the fact that it may have some selection bias, as the questionnaires were administered to students on a voluntary basis.

## Conclusions

Radiology is a very important specialty that is an inherent part of modern medicine. Radiology teaching in medical schools plays a critical part in clinical training of students. This study found that medical students in Kuwait University want more radiology teaching during their undergraduate medical curriculum. Students believe that this is best provided through problem-based learning sessions or core rotations in hospitals. Additional teaching will aim to ensure that students are confident in dealing with radiological studies, as this will provide the students with the needed skill-set and will better prepare them for the upcoming clinical responsibilities after graduation.

## Statement of Ethics

The Faculty of Medicine Ethics Committee approved the study. Informed consent was obtained from all participants; there were no risks to participation in this study, and benefits of the study

were explained to each participant while obtaining their informed consent. The study protocol and data collecting instruments were reviewed and approved by the Health Sciences Ethics Committee for Student Research. Anonymous questionnaires were used to assure the privacy and confidentiality of the data collected. All students participated voluntarily and understood that they had the right to refuse to partake in the study without any academic penalty. The study was performed according to the latest version of the Declaration of Helsinki, and data were protected in accordance with the ethical guidelines of the Council for International Organizations of Medical Sciences.

### Conflict of Interest Statement

The authors have no conflicts of interest to disclose.

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### Author Contributions

Hasan Ashkanani and Yasmeen AlDallal contributed to data collection, entry, as well as writing of the manuscript. Abdullah Almajran contributed to data analysis. Renu Gupta contributed to supervising and reviewing this study. All authors have reviewed the manuscript and provided consent for publication.

### Data Availability Statement

Data are available with the corresponding author and can be obtained upon request.