Awareness of Risks Associated with the Use of Plain X-Ray, Computed Tomography, and Magnetic Resonance Imaging Among Emergency Physicians and Comparison with that of Other Physicians: A Survey from Turkey

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Background:
Increased use of radiological imaging in all departments of medicine, especially in the Emergency Department, requires that physicians have a high level of knowledge regarding commonly used imaging methods and high awareness of the risks of examinations.

Material/Methods:
The physicians were divided into 5 groups according to their specialties as emergency medicine physicians (EMPs), physicians from any specialty of internal sciences, physicians from any specialty of surgical sciences, general practitioners (GPs), and radiologists. A total of 700 physicians answered the questionnaire via email.

Results:
15.7% of EMPs reported that they did not routinely perform any risk assessment before requesting computed tomography (CT); the rate was 17.9% for direct radiography and 29.3% for magnetic resonance imaging (MRI). The proportions of physicians who do not routinely perform risk assessments for direct radiography, CT, and MRI were as follows: 16.4%, 8.6%, and 19.3% in physicians from medical sciences, respectively; 25%, 22.9%, and 35% in physicians from surgical sciences, respectively; 24.3%, 14.3%, and 37.1% in GPs, respectively; and 27.1%, 22.1%, and 37.1% in radiologists, respectively. In all radiological examinations, 1.4% of EMPs and ≤1.4% of other physicians routinely explain the risks associated with the imaging method to the patients, and discuss the risks and benefits of the imaging with the patients.

Conclusions:
All physicians, including EMPs, need to undergo urgent training to increase their knowledge on risks of imaging methods and discussion of existing risks with patients.

MeSH Keywords:
Education, Medical, Continuing • Radiologic Health • Risk Assessment
Background

Radiological imaging plays an important role in today’s medical practice. Developments in medical imaging increase patients’ life expectancy and quality of life. Undoubtedly, these developments have significantly assisted physicians in recognizing and treating diseases and injuries and offer millions of people the possibility of treatment with a minimally invasive approach as an alternative to surgery [1].

According to the study published by Papanicolas et al., in high-income countries the average number of magnetic resonance imaging (MRI) and mean computed tomography (CT) scans were 82 and 151 per 1000 persons, respectively. These numbers were 118 and 245 in the United States, respectively, and in terms of the number of radiological imaging, the United States is the second country with the highest rate of MRI and CT technology use, following Japan [2]. Turkey shows similar characteristics to the high-income countries in terms of overuse of radiological imaging methods. According to the Organisation for Economic Co-operation and Development European Union (EU) Health Statistics report, between 2011 and 2014, Turkey ranked first in the number of MRI scans and 8th in the number of CT scans. The EU average increase in the use of CT was 49%, while the increase was 60% in Turkey. The EU average increase in the use of MRI was 38%, while Turkey had a 134% increase [3].

The increase in the number of imaging methods in the Emergency Department (ED) is higher than the total increase in the number of imaging methods in hospital inpatient, outpatient, and private physician office settings [4]. This trend is partly associated with the increase in the number of patients admitted in the ED. However, the use of diagnostic imaging exceeded the number of ED visits [5].

The increasing use of imaging methods has led to discussions regarding excessive and unnecessary use. The discussions are mostly centered on increased healthcare cost, exposure to radiation, reactions to contrast material (allergy, contrast-induced nephropathy, nephrogenic systemic fibrosis), and crowding in hospitals related to tests [6–8].

Since its introduction in the 1970s, CT has seen an explosion in its utilization. The major concern with the widespread use of CT is the increased risk of malignancy associated with ionizing radiation. Some authors declare that the relationship between radiation and cancer is based on data from survivors of atomic bombs explosions in Japan and patients occupationally exposed to radiation within the nuclear industry. They state that with the developing technology, patients are given much lower doses of radiation and the news media exaggerates the subject. In addition, these authors emphasize that the relationship between cancer and radiation dose less than 50 mSv for single procedures and less than 100 mSv for multiple procedures is speculative because the radiation dose given for CT is well below these values [9]. However, many studies in the literature suggest that cumulative radiation exposure due to increased CT use may lead to a significant increase in cancer incidence, especially in pediatric patients, young patients, patients with chronic diseases, and patients with cancer susceptibility [10–13]. While the debate about the increase in malignancy due to CT use continues, physicians should balance the benefits and risks of examinations well.

The studies conducted to date were mostly focused on physicians’ knowledge regarding test-related radiation doses [14–16].

The main purpose of this study was to investigate self-assessment of adequacy of knowledge of emergency medicine physicians (EMPs) on commonly used imaging methods in the ED and their attitudes toward questioning the risks of imaging methods and explaining the risks to patients. Moreover, the answers of EMPs were compared with those of physicians from other specialties, radiologists, and general practitioners (GPs).

Material and Methods

The study was conducted between May 15, 2015 and October 30, 2015, after obtaining approval from the Ethics Committee on April 16, 2015, numbered 16969557/565 with registration number GO 15/286 from the Hacettepe University Non-interventional Clinical Research Ethics Board.

The questions which were used in the survey were based on similar studies in the literature and on past experience. The questionnaire was designed to find the answers to the following three questions:

1. Do doctors consider their level of knowledge sufficient on imaging methods?
2. Do doctors evaluate the risks associated with the radiological test, before ordering an imaging method?
3. Do physicians explain the risks associated with the imaging method to the patients, and discuss the risks and benefits of the imaging with the patients?

The questionnaire consists of 5 parts (Table 1). The first part of the survey contained data on the specialties of physicians and the total duration of their work in the relevant specialties.

In the second part of the questionnaire, physicians were asked to evaluate their knowledge about imaging methods as “very little”, “little”, “moderate”, “good” and “very good”.

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**Table 1. Survey questions.**

**Part 1.**

1. What is your academic degree?
   - a – General practitioner
   - b – Research assistant
   - c – Specialist doctor
2. Which medical specialty do you work in? (for research assistants or specialists)
   
3. a – How many years have you been working in your field of specialty, including specialty training? (only for research assistant / specialist)
   
   b – How many years do you work as a general practitioner? (for general practitioner)
   
**Part 2.**

1. How can you assess your own level of knowledge on imaging methods?
   - a – Very little
   - b – Little
   - c – Moderate
   - d – Good
   - e – Very good

**Part 3.**

1. What is the source of your information on imaging methods? You can select multiple choices.
   - a – Medicine school training
   - b – Specialty training
   - c – Individual interest- based research
   - d – Radiological courses or seminars
   - e – Other (………)

**Part 4.**

1. Do you routinely consider the risks associated with direct radiography for the patient before ordering?
   - a – Yes
   - b – No
2. Do you routinely consider the risks associated with computed tomography for the patient before ordering?
   - a – Yes
   - b – No
3. Do you routinely consider the risks associated with magnetic resonance imaging for the patient before ordering?
   - a – Yes
   - b – No
4. Do you routinely pay attention to radiation exposure before you order a direct radiography?
   - a – Yes
   - b – No
5. Do you routinely pay attention to whether the examination was performed already for the same indication before ordering direct radiography?
   - a – Yes
   - b – No
6. Do you routinely pay attention to radiation exposure, before you order a computed tomography scan?
   - a – Yes
   - b – No
7. Do you routinely pay attention to contrast-induced nephropathy, before you order a computed tomography scan?
   - a – Yes
   - b – No
8. Do you routinely pay attention to contrast agent allergy, before you order a computed tomography scan?
   - a – Yes
   - b – No
In the third part of the survey, the physicians were asked to indicate one or more sources from which they obtained information on imaging methods.

In the fourth part of the survey, the clinicians were asked whether they routinely considered the risks associated with the imaging methods before ordering commonly used imaging methods (direct radiography, CT, MRI) for their patients. Moreover, before requesting imaging methods, clinicians were asked whether the imaging method-related risks such as cancer, nephropathy, and allergies were questioned. The survey questions in Table 1 have been modified for radiologists, and the radiologists were asked whether they routinely re-evaluated risks associated with the imaging methods when clinicians ordered an imaging method.

In the fifth part, physicians were asked whether they routinely explained and discussed the risks and benefits related to the imaging methods with the patient.

The comprehensibility and clarity of the items in the questionnaire were tested by 6 EMPs, 8 physicians from any specialty of internal sciences, 6 physicians from any specialty of surgical sciences, 6 radiologists, and 11 GPs by face-to-face interview. In order not to affect the results, the answers of these physicians were excluded from the study.

In our country, emergency medicine is a new specialty in the medical field. There were only 903 emergency medicine specialists in Turkey in 2014, when this study was started [17]. When we added doctors who had been working as emergency medicine assistants for at least 3 years, the number of emergency medicine assistants for at least 3 years, the number of emergency medicine doctors was 1150. Email address of 803

### Table 1 continued. Survey questions.

9. Do you routinely pay attention to whether the examination was performed already for the same indication before ordering computed tomography?
   a – Yes
   b – No

10. Do you routinely pay attention to radiation exposure, before you request a magnetic resonance imaging?
    a – Yes
    b – No

11. Do you routinely pay attention to contrast-induced nephropathy, before you request a magnetic resonance imaging?
    a – Yes
    b – No

12. Do you routinely pay attention to contrast agent allergy, before you request a magnetic resonance imaging?
    a – Yes
    b – No

13. Do you routinely pay attention to whether the examination was performed already for the same indication before requesting magnetic resonance imaging?
    a – Yes
    b – No

### Part 5.

1. Do you routinely inform the patient regarding the risks associated with the imaging method and discuss the risks and necessity with the patient before ordering direct radiography?
   a – Yes
   b – No

2. Do you routinely inform the patient regarding the risks associated with the imaging method and discuss the risks and necessity with the patient before ordering computed tomography?
   a – Yes
   b – No

3. Do you routinely inform the patient regarding the risks associated with the imaging method and discuss the risks and necessity with the patient before ordering magnetic resonance imaging?
   a – Yes
   b – No
emergency physicians were obtained. Since only 140 EMPs responded to the questionnaire, when the number of physicians from other specialties who answered the questionnaire reached 140, the survey was completed.

In this study, the internet-based assessment survey was used. Survey data were obtained via electronic data form from an electronic database. Participation of more than once with the same email address was not allowed.

Data were analyzed using IBM SPSS version 22.0. Numerical variables were summarized with mean ± standard deviation or median (min, max). Categorical variables were presented as numbers and percentages. The Kruskal-Wallis test was used to determine whether there were any differences between the departments in terms of working time. The difference was found using the Siegel-Castellan test. The chi-square test was used to determine the difference between the groups. The group that created the difference was found using the Marascuilo test. A $P$-value <0.05 was considered statistically significant.

## Results

Of the 803 EMPs whose email addresses were obtained, 140 answered the questionnaire. The response rate of EMPs was 17.4%. The study consisted of answers of 700 physicians, 140 in each group. Distribution of the physicians according to the specialties is presented in Table 2.

Table 3 shows the average work duration of physicians according to their specialties. The total work duration of GPs was found to be significantly less than those of other physicians ($P<0.001$).

Figure 1 shows the distribution of the sources of the physicians’ radiological knowledge by specialty. The physicians were able to mark more than one option as an information source. EMPs and radiologists reported a higher rate of specialty training as a source of information on imaging methods than physicians from other specialties ($P<0.001$). The number of physicians with specialty training as a source of information was lowest (58.6%) among those in surgical medical departments and highest (100%) among those in radiology departments. EMPs reported specialty training to be a source of radiological information more often than physicians from internal and surgical medical sciences ($P<0.001$).

The rate of participation in radiology courses or seminars was found to be significantly higher among radiologists, and the rate of research based on personal interest was significantly higher among EMPs and radiologists than among other physicians ($P<0.001$).

Table 4 shows physicians’ self-evaluation of their level of knowledge on imaging methods according to specialties. Particularly, 20.7% of radiologists, 46.4% of EMPs, and >50% of physicians from other specialties reported their knowledge to be “very little”, “little”, and “moderate”, respectively. Radiologists and EMPs evaluated their level of knowledge as “good” compared with other physicians from other specialties, and radiologists evaluated their level of knowledge as “very good” compared with physicians from other specialties ($P<0.001$).

### Table 2. Distribution of physicians according to their specialties.

| Departments                              | n   |
|------------------------------------------|-----|
| Emergency Medicine Physicians            | 140 |
| Internal Medical Sciences                | 140 |
| Internists                               | 65  |
| Family physicians                        | 13  |
| Neurologists                             | 13  |
| Pulmonologists                           | 12  |
| Cardiologists                            | 11  |
| Physical therapy and rehabilitation specialists | 8   |
| Psychiatrists                            | 7   |
| Sports medicine specialists              | 5   |
| Infectious diseases and clinical microbiology physicians | 4  |
| Dermatologists                           | 2   |
| Surgical Medical Sciences                | 140 |
| General surgeons                         | 37  |
| Orthopedists                             | 24  |
| Anesthesiologists                        | 16  |
| Ophthalmologists                         | 14  |
| Gynecologists                            | 11  |
| Otolaryngologists                        | 11  |
| Urologists                               | 11  |
| Neurosurgeons                            | 10  |
| Plastic and reconstructive surgeons      | 3   |
| Cardiac surgeons                         | 2   |
| Thoracic surgeon                         | 1   |
| General Practitioners                    | 140 |
| Radiologists                             | 140 |
| Total                                    | 700 |

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Of the EMPs, 15.7% reported that they did not routinely perform any risk assessment before requesting CT, which is 17.9% for direct radiography and 29.3% for MRI. The proportions of physicians who did not routinely perform any risk assessments for direct radiography, CT, and MRI were as follows: 16.4%, 8.6%, and 19.3% in physicians from medical sciences, respectively; 25%, 22.9%, and 35% in physicians from surgical sciences, respectively; 24.3%, 14.3%, and 37.1% in GPs, respectively; and 27.1%, 22.1%, and 37.1% in radiologists, respectively (Table 5).

In all radiological examinations, 1.4% of EMPs and 1.4% of other physicians routinely explain the risks associated with the imaging method to the patients, and discuss the risks and benefits of the imaging with the patients (Table 6).

**Table 3.** The average work duration of the physicians according to their specialties.

| Departments            | Total working time of doctors (years) |
|------------------------|---------------------------------------|
|                        | Mean (Minimum–Maximum)                | Median | Standard deviation |
| EMPs                   | 8.86 (3–28)                           | 7      | 5.046              |
| Internal Medical Sciences | 9.43 (3–37)                           | 7      | 7.436              |
| Surgical Medical Sciences | 7.68 (3–44)                           | 5      | 5.580              |
| GPs                    | 4.70 (3–30)                           | 3      | 5.108              |
| Radiologists           | 9.21 (3–34)                           | 6      | 6.905              |
| Total                  | 7.98 (3–44)                           | 5      | 6.323              |

EMPs – emergency medicine physicians; GPs – general practitioners.

**Figure 1.** Distribution of the sources of the physicians’ radiological knowledge by specialty.

Of the EMPs, 15.7% reported that they did not routinely perform any risk assessment before requesting CT, which is 17.9% for direct radiography and 29.3% for MRI. The proportions of physicians who did not routinely perform any risk assessments for direct radiography, CT, and MRI were as follows: 16.4%, 8.6%, and 19.3% in physicians from medical sciences, respectively; 25%, 22.9%, and 35% in physicians from surgical sciences, respectively; 24.3%, 14.3%, and 37.1% in GPs, respectively; and 27.1%, 22.1%, and 37.1% in radiologists, respectively (Table 5).

In all radiological examinations, 1.4% of EMPs and ≤1.4% of other physicians routinely explain the risks associated with the imaging method to the patients, and discuss the risks and benefits of the imaging with the patients (Table 6).

**Discussion**

In 2015, according to the data from the National Hospital Ambulatory Medical Care Survey, almost half of all ED visits in the United States resulted in at least one imaging examination, and about 1 in 6 patients were ordered to undergo CT [18]. MRI, which is one of the advanced imaging modalities, has been recently used by the emergency services especially in neuroimaging [19,20]. In the study by Rosenkrantz et al., it was found that the use of CT as an advanced imaging method increased without any significant reduction in ultrasonography and plain radiography in the diagnosis of some diseases such as pneumonia and appendicitis. Furthermore, it was determined that use of diagnostic modalities including multiple imaging methods such as CT and ultrasonography or CT, radiography, and
Table 4. Physicians’ self-evaluation of the level of knowledge regarding imaging methods.

| Departments                     | Very little | Little | Moderate | Good | Very good | Total |
|---------------------------------|-------------|--------|----------|------|-----------|-------|
|                                 | %           | %      | %        | %    | %         | n     | %    |
| EMPs                            | 0.0         | 12.1   | 34.3     | 52.9 | 0.7       | 140   | 100  |
| Internal Medical Sciences       | 2.9         | 26.4   | 52.1     | 17.9 | 0.7       | 140   | 100  |
| Surgical Medical Sciences       | 3.6         | 20.0   | 54.3     | 20.0 | 2.1       | 140   | 100  |
| GPs                             | 12.9        | 32.9   | 47.9     | 6.4  | 0.0       | 140   | 100  |
| Radiologists                    | 0.7         | 1.4    | 18.6     | 50.0 | 29.3      | 140   | 100  |
| Total                           | 4.0         | 18.6   | 41.4     | 29.4 | 6.6       | 700   | 100  |

EMPs – emergency medicine physicians; GPs – general practitioners.

Table 5. Self-assessment by the physicians’ attention to the risks of commonly used imaging methods before ordering the imaging tests.

|                           | EMPs       | Internal Medical Sciences | Surgical Medical Sciences | GPs        | Radiologists | Total |
|---------------------------|------------|---------------------------|---------------------------|------------|--------------|-------|
|                           | n          | %                         | n                         | %          | n            | n     |
| Before ordering direct radiography |            |                           |                           |            |              |       |
| I do not routinely question the risks associated with the method | 25         | 17.9                      | 23                        | 16.4       | 35            | 25    |
| I routinely pay attention to radiation exposure | 44         | 31.4                      | 36                        | 25.7       | 40            | 28.6  |
| I routinely pay attention to recurrent radiological imaging | 7          | 5                         | 11                        | 7.9        | 22            | 15.7  |
| Before ordering CT |            |                           |                           |            |              |       |
| I do not routinely question the risks associated with the method | 22         | 15.7                      | 12                        | 8.6        | 32            | 22.9  |
| I routinely pay attention to radiation exposure | 74         | 52.9                      | 62                        | 44.3       | 59            | 42.1  |
| I routinely pay attention to contrast-induced nephropathy | 32         | 22.9                      | 45                        | 32.1       | 25            | 17.9  |
| I routinely pay attention to contrast-agent allergy | 40         | 28.6                      | 30                        | 21.4       | 27            | 19.3  |
| I routinely pay attention to recurrent radiological imaging | 9          | 6.4                       | 19                        | 13.6       | 17            | 12.1  |
| Before ordering MRI |            |                           |                           |            |              |       |
| I do not routinely question the risks associated with the method | 41         | 29.3                      | 27                        | 19.3       | 49            | 35    |
| I routinely pay attention to contrast-agent allergy | 21         | 15                        | 15                        | 10.7       | 19            | 13.6  |
| I routinely pay attention to contrast-induced nephropathy | 10         | 7.1                       | 30                        | 21.4       | 12            | 8.6   |
| I routinely pay attention to radiation exposure | 0          | 0                         | 0                         | 0          | 1             | 0.7   |
| I routinely pay attention to recurrent radiological imaging | 22         | 15.7                      | 19                        | 13.6       | 11            | 7.9   |

EMPs – emergency medicine physicians; GPs – general practitioners.
ultrasonography in the diagnosis of urinary calculi increased at the same visit [21].

EMPs should have a good knowledge of the imaging methods often used. In this study, EMPs evaluated their knowledge on radiological imaging as higher than GPs and other physicians, with the exception of radiologists. Additionally, EMPs reported their specialty training to be a source of information at a higher rate than physicians from internal and surgical medical sciences. We found that EMPs and radiologists obtain information through learning and research based on personal interest more than other physicians. These results indicate that EMPs are aware of the importance of their frequent use of imaging methods and that they are making more efforts than physicians from other specialties to improve themselves. However, almost half of the EMPs evaluated their knowledge on the subject as very little, little, and moderate.

Radiologists may not always be available in all institutions. It may also take hours for radiologists to interpret the relevant examination. In many emergency cases in the ED, the radiological examination may need to be evaluated immediately because time is critical. An EMP must be able to interpret the basic imaging studies and situations that need to be identified urgently in more complex imaging studies.

Radiology education is an important issue in the field of emergency medicine, and emergency medicine residents undergo formal radiology training within their curriculum. However, EMPs may encounter some difficulties in interpreting methods such as chest radiography and head CT [22–25].

Studies in the literature show that physicians have insufficient knowledge on the amount of radiation the patient is exposed to during radiological examinations [14,15,26,27] and there is a lack of awareness at undergraduate and postgraduate level [28,29]. The curriculum of undergraduate and postgraduate education should be revised to include a broader and more effective training on the subject. In 2015, the Emergency Medicine Consensus Conference was held in the United States to optimize the use of diagnostic imaging in emergency medicine [30]. One of the 6 titles of this conference was “Training, Education, and Competency”. In this conference, it was stated that simulations could be used to increase the training and education of EMPs. Furthermore, it was emphasized that effective methods should be developed for the dissemination and administration of the clinical decision rules.

Courses and simple efficient training on radiological imaging can help correct the deficiencies in the matter [30–32]. Radiology training must include more than just the information on the use and interpretation of imaging methods. Sequential and appropriate use and the assessment of risks associated with the method are also important components of radiology education. Radiological imaging is like a double-edged blade. Excessive and unnecessary use of imaging methods causes overdiagnosis and increases costs without a significant increase in quality of the results. Other unintended consequences associated with overuse are crowding in the ED, prolonged hospital stay, radiation exposure, and contrast-induced nephropathy and allergic reactions caused by the contrast material [2,4,5,8,10–12,33–35].

In this study, a high percentage of physicians reported that they did not routinely pay attention to the risks associated with radiological examinations. Furthermore, it was determined that the risks such as cancer, contrast allergy, and contrast-induced nephropathy were questioned at a low rate. It was found that physicians leave the assessment of these risks to radiology technicians and nurses. Since we did not expect high-risk assessment to be ignored to this extent, we did not investigate why risks were not examined by physicians in this study. However,

| Specialties                  | Direct radiography | Computed tomography | Magnetic resonance imaging |
|-----------------------------|--------------------|---------------------|---------------------------|
|                             | n      | %     | n      | %     | n      | %     |
| EMPs                        | 2      | 1.4   | 2      | 1.4   | 0      | 0.0   |
| Internal Medical Sciences   | 0      | 0.0   | 0      | 0.0   | 0      | 0.0   |
| Surgical Medical Sciences   | 1      | 0.7   | 2      | 1.4   | 1      | 0.7   |
| GPs                         | 0      | 0.0   | 2      | 1.4   | 1      | 0.7   |
| Radiologists                | 0      | 0.0   | 0      | 0.0   | 0      | 0.0   |
| Total                       | 3      | 0.4   | 6      | 0.9   | 2      | 0.3   |
we believe that physicians may ignore the risks related to imaging methods because of lack of knowledge. A United States study of health care providers showed that less than 50% of radiologists and only 9% of ED personnel were aware of the potential relationship between CT and malignancy development [36]. An assessment of American pediatric surgeons found that 75% of all respondents underestimated the dose delivered by CT compared with a chest x-ray [37]. In addition to lack of knowledge, factors such as crowding and lack of time may cause non-questioning of the risks associated with imaging methods [14,15,26,38,39].

Unfortunately, these diagnostic tools come at a cost in the form of radiation exposure. There is an increasing concern that, in the future, there may be an increase in malignancy associated with diagnostic imaging. CT is the most discussed diagnostic tool since it uses more radiation compared with radiography. Brenner and Hall estimated that 1.5–2% of all cancers in the United States may be related to radiation exposure due to CT [10]. Especially in pediatric patients with longer life expectancy, the risk of cancer is more likely to increase. Miglioretti et al. estimated that 4 million pediatric CT scans (head, abdomen/pelvis, chest, or spine) performed annually will cause 4870 cancer cases in the future [11]. Sodickson et al. suggested that 0.7% of the expected total basal cancer incidence and 1% of total cancer mortality were associated with CT [12]. Although some authors argue that the CT devices used in the above studies were older and therefore the amount of radiation given to the patient was calculated more and less radiation is now given to the patients by using newer CT devices and radiation protection strategies [9], there is a general acknowledgment by many authors that there is a potential risk of cancer from radiation exposure [10–13]. Physicians should have adequate training and knowledge in order to establish a good balance between the benefits and risks of imaging methods.

One of the important issues that are ignored is the cumulative radiation dose in patients who undergo recurrent radiological examinations. In this study, high rate of physicians reported that they did not pay attention to whether the examination was performed already for the same indication before requesting test. The healthcare system in our country does not allow access to patients’ examinations at other hospitals. Therefore, patients are at risk of re-exposure to the same examination at each new hospital. Additionally, in cases that cannot be diagnosed, complaints in more than one system, or patients who are diagnosed but followed, and patients with chronic diseases, the incidence of cancer increases due to the cumulative radiation dose they are exposed to [12,13,26,27,35,38–41]. The development of warning systems where physicians are provided with radiation information due to previous examinations of the patient may reduce the cumulative radiation dose.

In this study, 2 physicians (0.3%) revealed that MRI could lead to radiation exposure despite the fact that, so far, no radiation exposure related to MRI has been determined. The literature shows that a large number of physicians with a wide range of experience and in different branches, such as intern, GPs, pediatric surgeons, radiologists, family physicians, and specialists, did not know whether MRI examinations involved ionizing radiation [26,27]. Since MRI does not use ionizing radiation such as CT and direct radiography and offers increased accessibility and, in some cases, good, or even better, diagnosis as that in CT, MRI is increasingly used in EDs [19,20]. However, MRI is not a completely harmless examination tool. The risk of MRI-incompatible materials and claustrophobia is important for the quality of the examination, patient’s safety, and prevention of possible complications. Contrast allergy and contrast-induced nephropathy are relatively rare with iodinated agents used in MRI but should be considered in every patient [42–44].

In this study, it was determined that very few physicians provided information to the patients by discussing the benefits and risks of imaging methods. Other studies in the literature similarly show that only a low percentage of physicians talk to the patient about the risk of cancer due to imaging methods [14,26,30,38,45]. EMPs may order the imaging methods without obtaining patients’ consent if the patient is unstable, unconscious, or unresponsive or if the patient’s life is in danger. However, for many emergency patients, there are time and opportunities to inform the patient about the risks associated with the examination. Although the risk of medical imaging-induced radiation has become a matter of debate for both public and policymakers, EMPs do not routinely inform patients about these risks. For patient-centered care, it is important for patients and their families to have high-quality communication, and informed consent is a good opportunity for patients to become part of the shared decision-making process. Physicians should discuss with the patient the purposes, benefits, risks, and alternatives of imaging methods and clearly answer the questions of patients. However, the lack of potential methods to involve patients in the imaging decision, worry about whether the risk associated with the imaging methods will be exaggerated and the test will be refused by the patient, and physicians’ inadequate knowledge of the imaging methods and their risks may prevent them from discussing the imaging methods with the patient [30]. However, Baumann et al. showed that patients rely on the physician’s decision to request CT [46]. It is only possible for physicians to provide accurate information to their patients about the benefits and risks of the imaging methods by increasing their training on the subject.

This study includes data from a particular region. Due to the low number of EMPs, differences between residents and specialists could not be compared. Additionally, it is likely that the
results of the study would be different if the EMPs were compared to physicians specializing in one department such as general surgeons only instead of physicians in surgical medical sciences. However, in our opinion, this study is not far from reflecting the situation about this topic in our country.

Conclusions

EMP's reported their knowledge of radiological imaging studies as “good” at a higher rate than GPs and physicians from other specialties, with the exception of radiologists. However, about half of EMPs and more than half of all physicians, with the exception of radiologists, evaluated their knowledge of radiological imaging to be “very little”, “little”, or “moderate”. It was determined that all physicians, including the EMPs, did not pay attention to the risks associated with imaging methods at high rates, and discussing the risks with the patients was at extremely low rates. Improvements are required in the education of physicians about this topic. This and similar studies will increase awareness among physicians who request imaging methods, people preparing medical education curriculum, and trainers. During specialty and medical school education, more information and training should be provided on balancing the risks and benefits of imaging methods and explaining the risks and benefits to the patient. Increasing and disseminating training about indications of imaging methods, sequential use, and risk assessment can reduce excessive use, recurrent radiological tests, health costs, and radiation-related cancer incidence. In addition, informing the patient about the risks and benefits of imaging methods will also contribute to improving patient-centered care.

Conflict of interest

None.

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