

Qualitative Research on the Radiation Knowledge Levels of Non-Doctor Healthcare Workers and Developing Qualitative Scale

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Abstract:

Radiation is used in a wide variety of fields, especially in the health sector. The human cell must be protected from unwanted radiation doses due to its dangerous effect. Employees' knowledge of radiation is important and therefore this level of knowledge must be known. In this study, a semi-structured qualitative questionnaire was used to determine the perception and knowledge levels of healthcare professionals (nurses, technicians) who do not use dosimeters about ionizing and non-ionizing radiation, and to reveal their experience and opinions on the subject.

In-depth interviews were made. Qualitative data coding, content analysis (calculation and mapping of relationships between code frequencies, themes and categories) were performed in the MAXQDA 2020 package program with the data obtained after the interview. 20 healthcare personnel participated in the study. From the data obtained, 10 main themes related to the subject were determined. Main themes emerging; "Harms of radiation", "type and properties of radiation", "all imaging devices emit radiation", "principles of radiation protection", "non-ionizing radiation", "infrared rays", "diagnosis and treatment", "radiation doses Radiation emission," Radiation pollution and ionizing radiation "Sub-codes of all these main themes were determined, schemes were created and coded participant views were shown in a cross-table form, semi-structured questions and a qualitative scale were developed.

1. Introduction

People in society are constantly exposed to natural radiation which has existed since the creation of universe. It is important to determine the radiation level in medical applications and thus radiation protection is an important issue for patients, individuals in the community and healthcare professionals. In recent years, many studies have been conducted to determine the radiation level in medical applications and to provide protection ways [1]. Hospitals; they are complex institutions that provide examination, diagnosis, treatment and rehabilitation services and form the basis of the healthcare system [2]. Radiation protection is an important consideration for the safe use of ionising radiations in health-care [3]. Healthcare personnel are faced with many risks during the delivery of health services, and accordingly, hospitals are in the very dangerous group within the scope of

Occupational Health and Safety [4]. One of these risks is ionizing radiation exposure.

Radiation is defined as the energy that travels in the environment, and its effect on the human body changes depending on the radiation types [5]. While ionizing radiation has high energy and can ionize an electron from atom, non-ionizing ones does have enough energy to ionize any electron from atom. The non-ionizing radiation having low energy, is emitted by devices such as mobile phones, televisions, satellites, radios, power lines, photocopy machines, microwave ovens. Ionizing radiation, on the other hand, has high energy and the substance it hits can form ions (charged particles) and is more dangerous [6]. The ionizing radiation has four main types namely alpha, beta, gamma, and x-ray [7]. The ionizing radiation is used many different field such as in medicine, industry, agriculture and research is common [8]. As Low As Reasonably Achievable (ALARA) principle is one of the fundamental principles of radiation protection and it states that

ionizing radiations doses should be kept in desirable limit [9]. Safety issues encountered in the early days of the development of X-rays for medical usage were the main point of the requirement [10]. Radioactivity was first used in the field of medicine in 1896 for diagnosis and treatment, and barium contrast was started to be used in the 1920s [11]. Hastanelerde verilen hizmetin gereği olarak tanı ve tedavi hizmetlerinde iyonlaştırıcı radyasyona neden olan; Ağırlıklı olarak x-ışınları ve radyoaktif malzemeler içeren tıbbi cihazlar kullanılmaktadır [6,12-20].

In the study, it was aimed to determine the knowledge level of non-physician healthcare professionals about ionizing radiation and non-ionizing radiation, who do not have to wear a dosimeter, and it was aimed to develop a qualitative scale for this.

2. Material and Methods

In this study, a qualitative research was conducted and a qualitative scale was developed to evaluate the views, radiation awareness and knowledge level of healthcare professionals on ionizing radiation, non-ionizing radiation, radiation protection and administrative measures. Criterion sampling, one of the sampling methods, was used to determine the participants. Criterion sampling, also known as criterion-based sampling, is selected from individuals representing individuals who have experience with the investigated case. In line with this information and by determining the following criteria within the scope of the research, the participants were determined:

- To be graduated from a health-related department (health vocational high school, associate degree, undergraduate)
- Working in a health-related public or private hospital,
- Being a non-physician health worker,
- Working in the field of health for at least 5 years

Charmaz, when the themes of the data collection process are saturated.

It emphasizes that it should be terminated. When new perspectives on the collection of new data or new features do not emerge, it is recommended that the negotiations be terminated. In the light of this view, it was observed that the data started to repeat from the 20th participant and the data collection process ended with the 20th participant.⁸⁹

In-depth interview technique was used in the research. In order not to miss important details during the meeting, a tape recorder was used with the

permission of the participants. In addition, the following information was given to the participants:

- * The information shared in the interview will be kept confidential and will only be used for research,
- * Your real name will be kept,
- * The interview will take at least half an hour,

Semi-structured in-depth interview form was used in the study (Appendix 1). Interview questions were reviewed during the pilot implementation process of the study. Interviews were held with 5 participants for the pilot application. After this meeting, some changes were made to the questions. With the data obtained after the interview, qualitative data coding, content analysis (calculation and mapping of the relationships between code frequencies, themes and categories) were carried out with the MAXQDA 2020 package program.

For this purpose, a 10-item semi-structured questionnaire was prepared by the researcher. Face-to-face interview technique was used with healthcare professionals within the framework of these questions.

In the context of the content of the findings; Due to the Covid 19 outbreak, the data were recorded with interviews made in a comfortable environment outside the hospital. The scope of the study consists of 20 healthcare professionals working in Public and Private hospitals and different clinics.

The reason why qualitative research method is preferred is that it is a technique used to systematically examine the meanings arising from the experience and behavior of the sample group in a realistic and holistic manner [21]. Another feature of qualitative research is that it is exploratory. With this feature, one of the useful and beneficial aspects of the research is that it illuminates and reveals less studied subjects [22,23].

3. Results and Discussions

In order to obtain qualitative data, the following questions were asked, answers and codes were created, and then the main themes were determined. Views of 20 healthcare professionals working in different clinics in public and private hospitals were included.

3.1. Demographic Distribution

The demographic characteristics and relationships of healthcare professionals with themes are shown in the cross-table 1.

Table 1. Demographic Characteristics, Themes and Crosstab

Themes I	Famele	Male	Nurse	Tecnician	+20 Years	5-10 Years	10-20 Years	Private Hospital	Public Hospital	Total
Damages of Radiation	12,3%	27,5%	13,4%	25,4%	9,0%	28,8%	15,0%	13,2%	18,1%	17,0%
Type and Features of Main Theme Rad.	5,2%	7,2%	6,4%	4,5%	5,1%	6,1%	6,3%	11,3%	4,1%	5,8%
All Imaging Devices Emit Radiation	7,7%	7,2%	7,6%	7,5%	7,7%	6,1%	8,8%	5,7%	8,2%	7,6%
Radiation Protection Principles	15,5%	8,7%	15,3%	9,0%	20,5%	9,1%	10,0%	11,3%	14,0%	13,4%
Non-Ionizing Radiation and Effects	5,2%	5,8%	4,5%	7,5%	3,8%	7,6%	5,0%	5,7%	5,3%	5,4%
Infrared Rays	7,7%	5,8%	7,6%	6,0%	5,1%	7,6%	8,8%	5,7%	7,6%	7,1%
Diagnosis and Treatment	14,2%	13,0%	14,6%	11,9%	17,9%	10,6%	12,5%	15,1%	13,5%	13,8%
Radiations Doses Applied to the Patient	7,1%	4,3%	7,6%	3,0%	9,0%	4,5%	5,0%	7,5%	5,8%	6,3%
Radiations Emission from Patient & Heall	8,4%	7,2%	7,0%	10,4%	6,4%	7,6%	10,0%	9,4%	7,6%	8,0%
Radiation Contamination and Ionizion.	16,8%	13,0%	15,9%	14,9%	15,4%	12,1%	18,8%	15,1%	15,8%	15,6%

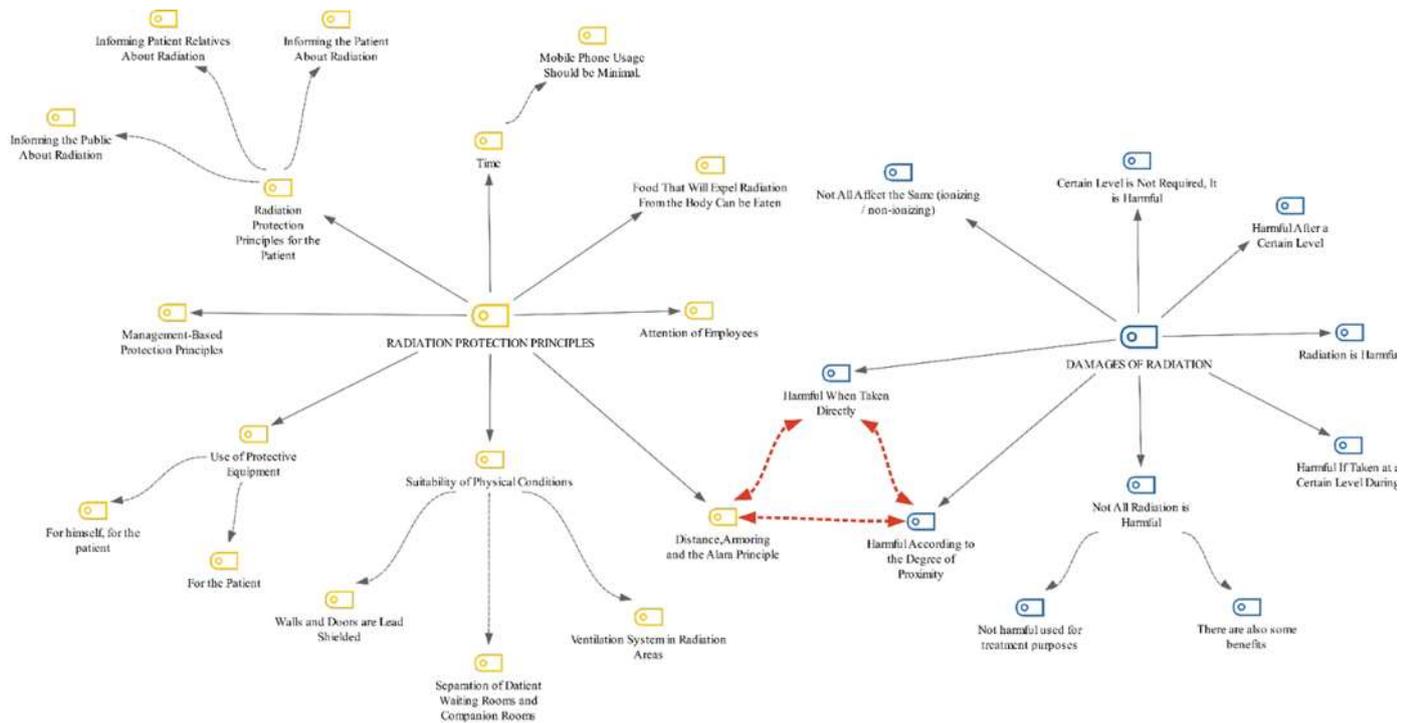


Figure 1. Radiation Protection Principles and the Damages of Radiation and Related Themes

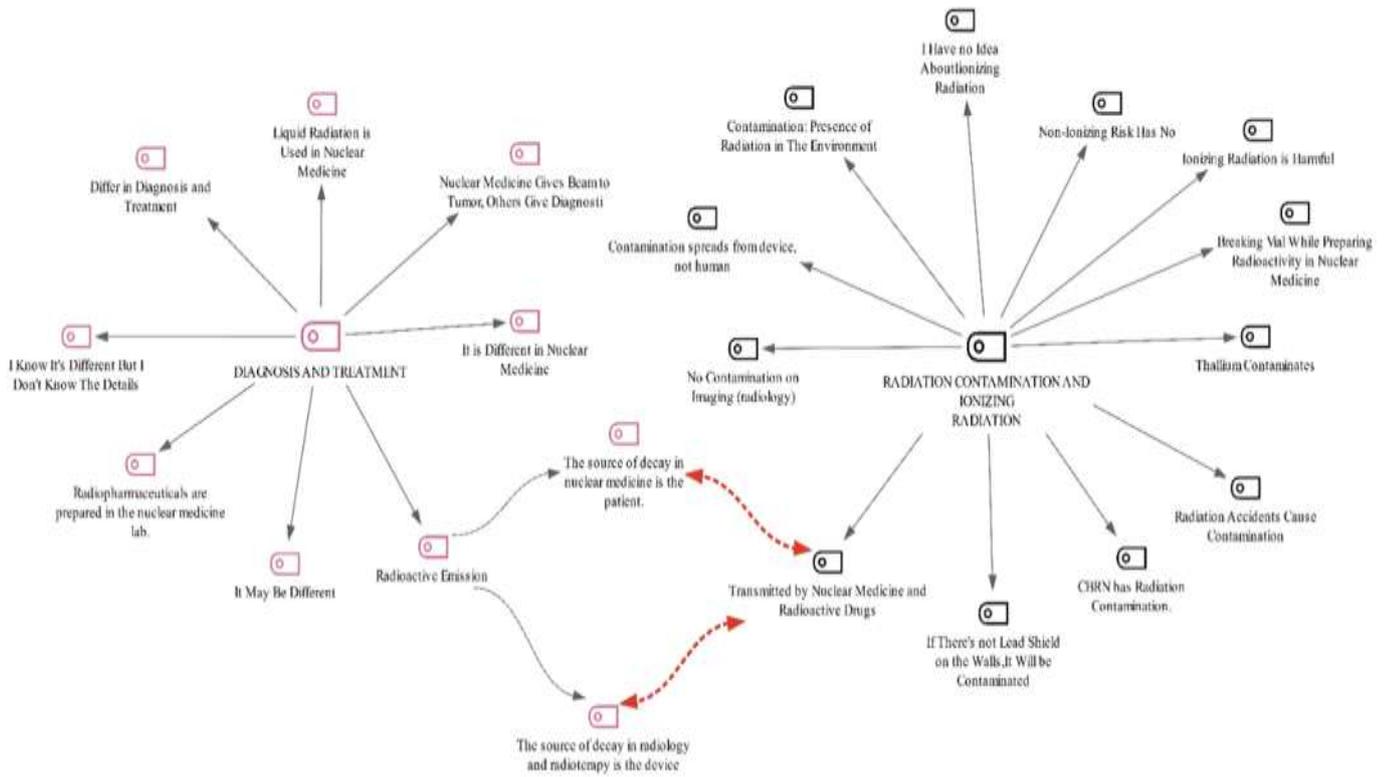


Figure 2. Codes Related to the Theme of Diagnosis and Treatment with Ionizing Radiation

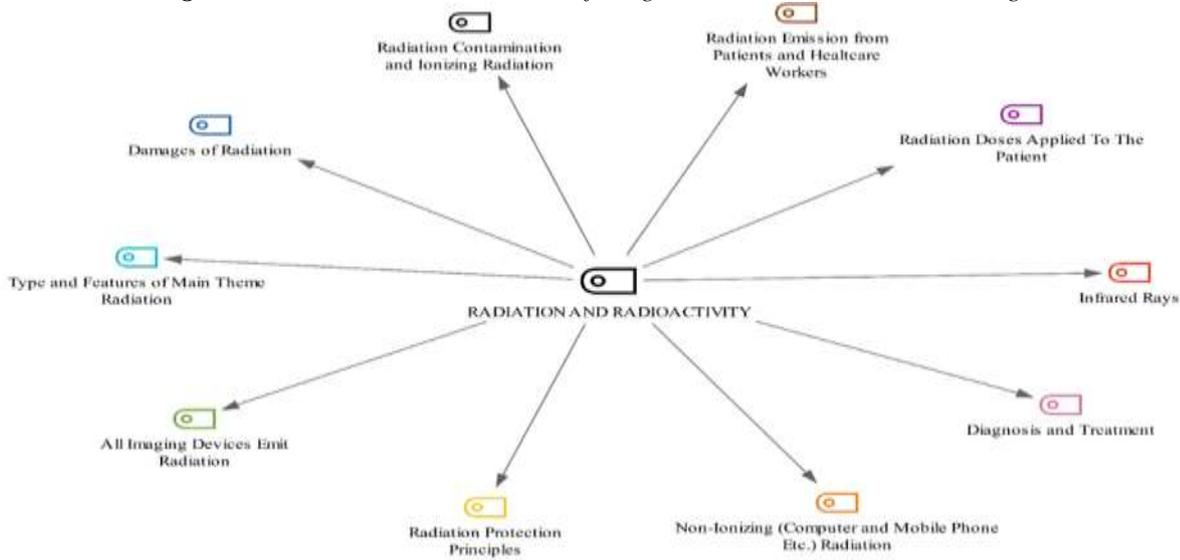


Figure 3. Radiation, Radioactivity and Themes

3. 2. Themes

Healthcare professionals involved in the study focused on 10 main themes related to radiation and radioactivity. As a result of the data obtained, the most emphasized subject was the principles of radiation protection, harmful effects of radiation,

radioactive contamination, diagnosis and treatment themes. These themes and their relationships are in figure 1 and figure 2. The main codes within the framework of radiation and radioactivity concepts:

1. Damages of radiation
2. Radiation protection principles

3. Radiation pollution and ionizing radiation
4. Diagnosis and treatment
5. Non-ionizing radiation
6. Radioactive spread in patients and workers
7. Type and properties of radiation
8. Infrared rays
9. Imaging devices emit radiation
10. Radiation doses administered to the patient

3.3. Sub-Codes Regarding the Themes of Radiation Protection and the Harmfulness of Radiation (two theme relations)

In the research, codes were created with the expressions of the participants. (C1, C2 etc.) 1. Theme Regarding the theme of the harms of radiation, "What do you think about the harms of radiation?" and "Is any kind of radiation harmful?" 2nd theme "What are the principles of radiation protection?" Sub-codes resulting from the answers given to the question. It is given in Figure 3. In addition, the indirect relations of the two themes are also specified.

3.4. Sub Codes Related to Diagnosis and Treatment Contact with Ionizing Radiation Pollution

What can you say about radiation and radiation sources (Radiology, Nuclear Medicine and Radiotherapy) used in diagnosis and treatment? 8 codes were determined from the answers given to the question. What can you say about Ionizing Radiation and Radiation Pollution? 12 subcodes were determined from the answers given to the question. The Relationship of Two Themes is in figure 3

3.5. Sub Codes for the Non-ionizing Radiation and Its Effects Theme

What would you say about the radiation emitted from computers and cell phones? What are the damages? With the data obtained from the interviews, the perceptions of non-ionizing radiation (mobile phone, computer, etc.) of healthcare professionals were evaluated. From the data obtained, 8 subcodes for non-ionizing radiation were determined. The sub codes of the radiation theme are as follows.

- I think this is harmful and affects Teens
- Duration of Exposure Matters
- Harmful
- I Don't Know What Ionizing Radiation Is
- Does Not Seriously Damage But Stochastically Affects
- Ionizer But I'm Not Sure

- Not ionizer

3.6. Sub-Codes Related to the Contact of Radiation Doses Applied to the Patient

Two subthemes were determined according to the theme of radiation doses applied to the patient. Three sub-codes of the sub-theme "Doses administered to the patient are different" were determined. Two sub-codes of the theme "Doses administered to the patient are not different" were determined.

What can you say about the radiation doses applied to patients in imaging clinics? Are different doses used? The answers and opinions of healthcare professionals to the question are given below.

1. Doses Administered to Patients are not Different
 - Doses are The Same in Magnetic Resonance Imaging
 - The Doses are the Same in Tomography
2. Different
 - 2a. It Different According to the Patient
 - The Doses Administered for Diagnostic Purposes are Different
 - Treatment Doses are Different
 - Different According to the Weight of the Patient
 - 2b. Varies According to the Disease
 - 2c. Radiation Dose is Different in All Units
 - Doses are Different for Radioactive Drugs (radiopharmaceuticals)
 - Radiation Dose is Different According to the Disease
 - It Differs According to the Size of the Mass in the Patient

3.7. Radiation Emission, Radiation Type and Properties, Infrared Rays, Imaging Devices

Themes and Radiation Emission and Sub-Codes are given in Table 2.

4. Conclusions

In the study, it was determined that the risk perception of ionizing and non-ionizing radiation and the knowledge level of the healthcare professionals participating at a moderate level. While the perception of radiation risk varies according to the unit of study, the level of knowledge varies according to the professional title. In the interviews, it was determined that there was false information as well as correct information about the hazards of radiation, in short, information

Table 2. Themes and Radiation Emission and Sub-Codes

RADIATION EMISSION					
Does radiation spread from patient to employee, patient to patient, employee to employee? What can you say about this topic? The 3 sub-codes and indirect codes obtained according to the answers given to the question are as follows.					
1. Ionizing Radiation is not Emitted a. Does not Spread From Employee to Employee. b. Ionizing Radiation is not Emitted From Patient to Employee		2. In Nuclear Medicine, It Can Spread From Patients to Employees		3. Radiation is Emitted a. Spreads from Oncology Patients Treated With Iyot 131 to Others b. Non-ionizing Radiation is Emitted c. Radiation is Emitted from Patient to Employee	
TYPE AND FEATURES OF MAHIN THEME RADIATION					
What would you say about the type and properties of radiation used in healthcare? The theme, direct and indirect codes created according to the answers to the question are given below.					
1. Radiation of the Same Type But Quantity Matters.		2. Different Types and Properties of Radiation. a. The Radiation Types is Different but the Effect is the Same. b. The Radiation Properties Used in Diagnosis and Treatment are Different. c. Different but not Sure		3. Radiation-Related Specialties Different. 4. The type of radiation is different. a. Its effect is also different. b. The time of exposure to radiation is important	
INFRARED RAY THEME AND SUB-CODES					
Six sub-codes were determined from the views and data obtained about infrared rays and their damages. What can you say about infrared rays and their harm? The codes obtained from the answers of the questions are given below.					
Less Harmful	Too Much is Harmful	It is Harmful	It Will be Harmful in the Future	I Don't Have Full Information a. I don't Have Full Information b. I don't Have Full Information But It can be Harmful	I Don't Have Full Information But It can be Harmful
SUBCODES ASSOCIATED WITH IMAGING DEVICES AND RADIATION EMISSION					
What can you say about radiation emission? Do all devices emit radiation in Medical Imaging? The following are the answers to their questions: "In Medical Imaging, all devices emit radiation". 5 direct subcodes and 2 indirect subcodes related to the theme were determined.					
1. Some devices emit radiation a. Some radiopharmaceuticals emit radiation	All devices emit	MRI and USG do not emit radiation	MRI not emit radiation	Not all devices emit radiation a. They are not All Ionizing Radiatio	

confusion. However, while it was determined that the employees had the correct information originating from the hospital experience, it was determined that there was a lack of knowledge in theoretical and conceptual framework. In addition, it has been observed that healthcare professionals have knowledge about the principles of radiation protection based on their work experience, but do not have clear information about ionizing radiation and non-ionizing radiation and their harms, and therefore experience extreme anxiety. Codes created by employees as incomplete and incorrect information; Theme 1 (C8) "It is harmful if exposed to a certain level of radiation during pregnancy". C10 of the 2nd theme is "the same type of radiation, but the amount is important". Radiation during pregnancy does not need to exceed a certain threshold to be harmful, it is risky in every way, and not all types of radiation are the same. C11.1 of the second theme "All types of radiation are different, but the effect is the same". Different effects of radiation types are also different. C11.3 "The types of radiation are different, but I'm not sure" reveals ambiguity and lack of information. The other wrong code is code 13 for theme 3. C13 "All imaging devices emit radiation" is misinformation that ionizing radiation is present in ultrasonography and magnetic resonance. There is no radiation in these two devices. Regarding the principles of radiation protection in Theme 4, the expression C.22 "Food that will expel radiation from the body is edible and drinkable" does not include the full protection principle.

In addition, the most emphasized code in radiation protection is the importance of administrative measures (doors and walls in radiation areas to be lead-coated, ventilation systems to be complete, provision of protective equipment, etc.) The question posed in Theme Fifth is, "Is the radiation from cell phones and computers ionizing radiation?" Some healthcare workers answered the question as C.26, "I don't know exactly what ionizing radiation is". This answer expresses a lack of knowledge. Again, some of the participants answered in C32, "It's ionizing radiation, but I'm not sure."

The expression "nuclear medicine treats tumor, others are for diagnosis" related to the 7th theme titled "Diagnosis and Treatment" in C44 also expresses incorrect and incomplete information. The eighth theme is the theme of "doses administered to the patient". Regarding this theme, C49.1 "The doses administered to the patient in tomography are the same" and C49.2 "Patient doses in magnetic resonance are the same." His statements give false information about this.

The sub-codes containing false information regarding the 10th theme titled "Radiation pollution

and ionizing radiation" are as follows; C54 "No radiation pollution in radiology", C64 "I have no idea about ionizing radiation". C58 "Contamination spreads from device, not from patient" statements.

Courses on ionizing radiation and protection methods should be added to the university education curriculum (undergraduate, associate degree) of healthcare professionals (nurses, technicians, etc.) and non-physicians who do not have to wear a dosimeter. In-service trainings should be provided in hospitals and health institutions, and trainings on occupational hazards and risks should be kept up to date. The importance of personal protective measures should be emphasized in the trainings and a control mechanism for everyone's use should be established.

Author Statements:

- **Ethical approval:** All procedures performed in the current study involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration. Istanbul Okan University, Research Ethics Committee, approved this study with Decision number: 127 (Date: 21.10.2020).
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