

# EDUCATION IN RADIATION PROTECTION FOR MEDICAL STAFF IN TRAINING

D. HERNÁNDEZ GONZÁLEZ (1), P. CHAMORRO SERRANO (1), P. GARCÍA CASTAÑÓN (1), C. ANSÓN MARCOS (1), M.L. ESPAÑA LÓPEZ (1), S. FERNANDEZ RODRIGUEZ (2), M.D. VICENT GARCÍA (2)

1 - Medical Physics Department

*Medical Physics and Radiation Protection Department, H.U. La Princesa  
Diego de León 62, 28082 Madrid, Spain  
Servicio de formación especializada Consejería de Sanidad,  
Comunidad de Madrid, Spain*

## ABSTRACT

The new Directive 2013/59/EURATOM establishes that professionals involved in medical radiological procedures shall receive adequate education and training in Radiation Protection. In particular, article 18 states that both practitioners and referrers involved in ionizing radiation procedures need to acquire an appropriate level of theoretical and practical education in medical schools. In Madrid, this education is completed during the training programme of interns at Hospitals, as several Radiation Protection courses imparted every year.

This training is organized into two different levels, basic and advanced, according to the degree of involvement in radiological procedures. Basic level of education is also organized into three different sublevels, the first one involves interns who will become mainly referrers in the first year of residency, the second one is intended for the same trainees during third to fifth year of the programme and the third one is aimed to nurses in training. The advanced level applies to practitioners in training: radiology, nuclear medicine, radiotherapy and radiopharmacy residents, specialties directly involved in radiological procedures. This level is organized as a formal education so that the trainees obtain the accreditation needed to perform their activities as practitioners.

All trainees must answer a satisfaction questionnaire at the end of each course, so as to evaluate their level of fulfilment regarding teacher's explanations, contents and applications, documentation supplied and organization of the course. Besides, a section of suggestions is included where any improvement or modification can be remarked.

The aim of this study is to evaluate the success of the Radiation Protection education programme at our country. The analysis is mainly based on the satisfaction questionnaire results corresponding to several courses celebrated between 2013 and 2015.

Radiation Protection basic courses intended for third to fifth trainees have obtained a better score in comparison to those courses aimed to 1<sup>st</sup> year physicians and nurses in training. The best results correspond to those courses from the advanced level. This result may be due to the following reasons; basic courses intended for referrers and nurses during their first year are primarily focused in basic concepts about ionizing radiations, so they refer that contents are not related to their daily activity. Second level of basic education is more practical and focused mainly on justification of radiological practices, so they find it more useful for their activity. On the other hand, advanced courses, intended for practitioners have a great acceptance among trainees. This is due to their familiarization with ionizing radiation at daily practice and also to more practical and specific contents for each specialty, notwithstanding they obtain further accreditation so the trainees are more motivated. It is mandatory that health professionals receive further radiation protection education, adapted to the level of involvement in radiological procedures.

## **1. Introduction**

The Council Directive 2013/59/EURATOM of 5 December 2013 [1], laying down basic safety standards for protection against the dangers arising from exposure to ionizing radiation, emphasizes in its fourth chapter that Member States shall establish an adequate legislative and administrative framework ensuring the provision of appropriate radiation protection education, training and information to all individuals whose tasks require specific competences in radiation protection. The provision of training and information shall be repeated and documented at appropriate intervals.

The contents of the former Directive have been incorporated into the Spanish legislation [2,3], establishing basic Radiation Protection education as part of both the programmes of medical schools and the training programmes of medical specialties. The last Directive is expected to be incorporated into the Spanish legislation before 2018.

According to legislation, this basic education for physicians in training is responsibility of the Medical Physics and Radiation Protection Departments of university hospitals.

The European Commission Guidelines on Radiation Protection Education and Training for health practitioners, 116 and 175 [4,5], establish that such training should include basic Radiation Protection tuition, needed both by the referrers and the practitioners themselves. Knowledge on patient radiation protection such as biological effects of ionizing radiation, justification of exposures, risk-benefit analysis and typical doses for each type of examination are important basis to be learnt by physician and trainees during Radiation Protection courses. In particular, Guideline 175 takes into account new and more complex techniques and equipment related to ionizing radiation, together with the appropriate training necessary for their adequate performance.

Subsequently, some basic training in Radiation Protection is already being provided to medical students during the preclinical training period in Medical University Schools. They receive, through the first academic year, basic knowledge on General Physics, Radiation Physics and Radiation Protection.

Since 2007, additional Radiation Protection education has been established during the residency period of the education, as part of the medical specialist training programme [6,7]. Initially, this tuition was provided during the first year of the residency. In 2009, such experience was analysed and evaluated as a tool for optimization and improvement of the training programme [8].

The objective of this study is to continue with the analysis and evaluation of such education and training programmes, widening the scope of consideration on the Radiation Protection education developed from 2013 to 2015 at our hospital as well as at our region.

## **2. Material and Methods**

The basic Radiation Protection education has been managed together by the regional Council and the Medical Physics and Radiation Protection departments of the university hospitals at our region. The analysis is mainly based on the satisfaction questionnaire results corresponding to several courses held between 2013 and 2015.

This training has been organized into two different levels, basic and advanced, according to the degree of involvement in radiological procedures. Basic level of education is also organized into three different sublevels, the first one involves residents who will become mainly referrers in the first year of residency, the second one is intended for the same trainees during third to fifth year of the programme and the third one is aimed to nurses in training.

The advanced level applies to practitioners in training: radiology, nuclear medicine, immunology, clinical biochemistry, radiotherapy and radiopharmacy residents, specialties directly involved in radiological procedures. This level is organized as a formal education so that the trainees obtain the accreditation needed to perform their activities as practitioners.

The basic level of education aimed to residents in their first year of residency is developed in a one day course with a length of six hours in just one session. After the lessons, the participants have to accomplish an evaluation test and to fill in a satisfaction questionnaire.

The same scheme is followed for the third sublevel, which involves nurses in training. The basic level course aimed to residents in their third to fifth year of the programme takes place in specific sessions enhancing the training practical aspects.

The basic level courses encompass ionizing radiation fundamentals such as structure of matter, radiation quantities and units, X-ray generation, radiation detection, the x-ray tube, x-ray equipment and image formation. These fundamentals were followed by one lesson of biological effects of ionizing radiation and another one of Radiation Protection principles and legislation. Maybe the most important lesson for referrers is the one which focuses on the description of the different procedures and equipment available at the hospital, with a brief notion about the dose received by the patient.

Further editions have meant changes in some of the contents and their complexity, to adequate them to the previous knowledge and interests of students, and to improve those aspects which are more requested in the satisfaction questionnaires of former editions.

The advanced level of education, besides the theoretical contents, includes practical lessons with x –ray equipment at dedicated rooms to optimize radiation protection during radiological procedures. The number of students at this level is reduced, for it applies just to some specialties. This also implies that course editions cannot be annual.

At the end of both courses, basic and advanced, a satisfaction questionnaire, developed by the regional Council, is provided to the trainees following the final evaluation, so as to evaluate their level of fulfilment regarding explanations of the teacher, contents and applications, documentation supplied and organization of the course. In addition, a section of suggestions and observations was included where any improvement or modification could be remarked. Each item of the satisfaction questionnaire was marked between 0 and 10. Special interest had items such as “Utility for your job”, “Degree of knowledge acquired”, or “Global assessment of the course”.

### **3. Discussion and Results**

The satisfaction questionnaires from 2013 to 2015 showed that the trainees were much more interested in medical aspects, of direct application to the clinical practice, than in basic Radiation Physics. They found the theoretical contents extremely difficult, although they admitted they are necessary in order to develop their professional activity.

Other subjects were not just lightened but suppressed; instead of them, it was decided to emphasize on the principles of Radiation Protection and the specific aspects of radiological protection in Medicine. For this purpose, some practical contents have been included since 2009, to complete the theoretical concepts and these changes have been maintained in subsequent courses. These practical contents are focused on radiological risk information for patients and also exposed workers. Of special interest are those situations involving pregnant women (both workers and patients) and paediatric patients, for whom the application of justification principle is even more critical. Actually, the inclusion of practical cases regarding those specific exposures had already been suggested by the trainees in the questionnaires. On the other hand, “Radiobiological effects” has appeared to be one of the subjects that hold more interest of the students, so it has remained in the contents since the beginning, though it has also got lighter.

From the three basic level courses, the one which is aimed to resident in their first year of residency has a great acceptance. More than 1200 students have attended to this course at different hospitals over the three years in evaluation. This number of trainees is 120% higher than the number of participants during the first editions [8].

In 2012, nurses in training in the first year of their residency programme at our region, were invited to attend at the basic level course for medical trainees. Due to the high participation registered and the specific training needs of nurses, it was decided to adapt the basic course programme and create a new modality for this group. This basic course sublevel has started in 2013. Table 1 shows some of the questions from the satisfaction questionnaire.

Basic Level Course for nurses in their first year of residency			
Year	2013	2014	2015
Number of participants	235	120	120
Theoretical contents	6.91	6.22	6.04
Practical contents	5.74	5.56	5.46
Methodology suitability	6.49	5.54	5.31
Utility for their job	5.82	5.18	4.52
Degree of knowledge acquired	6.26	5.43	5.62
Aroused interest	5.91	5.31	4.96
Response to previous expectations	6.21	5.25	5.32
Delivery documentation quality and suitability	7.35	5.78	7.04
Employed resources quality and suitability	7.03	6.11	6.64
Employed installations suitability	8.00	7.55	7.13

Tab 1: Averaged outcome (from 0 to 10) of some evaluated questions from the satisfaction questionnaire.

The basic level course aimed to trainees during third to fifth year of residency had a great acceptance.. The evaluation of the course by the students is the highest among the three sublevel courses (table 2). Their higher degree of knowledge of the course topics causes a greater motivation among the participants.

Basic Level Course for trainees during third to fifth year of residency at Madrid County		
Year	Number of participants	Global assessment of the course
2013	752	6.83
2014	755	7.05
2015	2731	6.79

Tab 2: Number of participants and average outcome of the global assessment of the course aimed to trainees during third to fifth year of residency.

The advanced level course is held every two years and aimed to trainees belonging to specialties which directly make use of ionizing radiations. It is the best evaluated course because their contents are more related to the daily practice of the participants. The students also obtain the accreditation needed to perform their activities as practitioners [9].

#### 4. Conclusions

The imparted courses during these years have been a great support in arising a better understanding of ionizing radiation and the radiation protection principles. As a consequence, justification of radiologic procedures has been improved.

Optimization of radiation protection for both operational and medical exposures has been achieved due to a wider knowledge of ionizing radiation risks.

A higher degree of implication and motivation of the residents has been assured by creating and putting into practice specific courses with contents adapted to clinical practice.

New technologies and more sophisticated procedures require continuous education in Radiation Protection to be imparted for all health professionals.

Since the attendance to these courses rises every year, an increasing number of people (both workers and patients) benefits from such education.

A better communication of radiation risk, especially in paediatric patients and pregnant women, leads to a higher patient safety in medical radiological procedures.

## 5. References

[1] European Commission. Council Directive 2013/59/EURATOM of 5 December 2013 laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation, and repealing Directives 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/43/Euratom and 2003/122/Euratom; 13:14-15

[2] Ministerio de Sanidad y consumo, Gobierno de España. REAL DECRETO 815/2001, de 13 de julio, sobre justificación del uso de las radiaciones ionizantes para la protección radiológica de las personas con ocasión de exposiciones médicas. 2001 14/07/2001;13626(168):25591-25594.

[3] Ministerio de Sanidad y consumo, Gobierno de España. Resolución mediante la que se acuerda incorporar en determinados programas formativos de especialidades en ciencias de la salud, formación en Protección Radiológica. 2006. 21/04/2006

[4] European Commission. Radiation Protection 116: Guidelines on education and training in radiation protection for medical exposures. 2000.

[5] European Commission. Radiation Protection 175: Guidelines on radiation protection education and training of medical professionals in the European Union. 2014

[6] ICRP. Radiation protection in medicine. ICRP Publication 105. Ann.ICRP 2007;37(6):1-63.

[7] ICRP. Education and Training in Radiological Protection for Diagnostic and Interventional Procedures. ICRP Publication 113. Ann.ICRP 2009; 39(5): 1-56.

[8] Education in radiation protection for physicians in training. A three year experience. Garcia Castañón P. ETRAP 2009.

[9] Instrucción IS-17, de 30 de enero de 2008, del Consejo de Seguridad Nuclear, sobre la homologación de cursos o programas de formación para el personal que dirija el funcionamiento u opere los equipos en las instalaciones de rayos X con fines de diagnóstico médico y acreditación del personal de dichas instalaciones. CSN. 30/01/2008; 43: 9023-9033.