Letter to the Editor

Sir,
Commentary on Education and training: radiation protection courses for diagnostic radiology in Turkey

Education and training in radiation protection is a basic aspect of the optimisation of medical exposures to radiation. Council Directive 97/43 EURATOM establishes the need for an adequate theoretical and practical training of the staff working in the radiological practices. Ankara Nuclear Research and Training Center (ANRTC) is mainly interested in the area of radiation protection (RP) training and routinely provides training cources both at the national and international levels. This letter describes the Turkish experience in RP education and training of radiation protection officers, such as medical doctors, radiologists, technicians, physicians and workers. Different objectives are established in accordance with professional levels, existing regulations, and feedback obtained from various RP professionals.

Education and training in radiation protection (RP) is considered one of the basic aspects for optimization programmes in medical radiation exposures. The continuous education programmes on RP are of paramount importance to ensure that patient and staff doses are kept to a minimum level. The International Commission on Radiological Protection (ICRP), in its publication 73 [(1)], states that "one important need is to provide adequate resources for the education and training in radiological protection for future professional and technical staff in medical practice. The training programmes should include initial training for all incoming staff and regular updating and retraining." The ICRP has recently issued a new document that is giving recommendations on this related topic. Council Directive 97/43/EURATOM [(2)], establishes in Article 7 that "Member States shall ensure that practitioners and individuals mentioned in related articles should have adequate theoretical and practical training for the purpose of radiological practices, as well as relevant competence in RP. For this purpose, Member States shall ensure that appropriate curricula are established and shall recognize the corresponding diplomas, certificates or formal qualifications." According to Article 9.2, "Member States shall ensure that practitioners and the individuals referred to above those who are performing high doses to patients, such as interventional radiology (IR), obtain appropriate training in these radiological practices."

The purpose of this letter is to present the Turkish experience in RP education and training in diagnostic radiology, different professional levels, the regulatory requirements and the feedback obtained from various RP actions. Radiation protection training is one of Ankara Nuclear Research and Training Center's (ANRTC) tasks among other training activities through which educational courses at national levels are offered and the trainees certified. ANRTC also hosts international courses organized by International Atomic Energy Agency and many other similar organizations at the international level.

The Ankara Nuclear Research and Training Center (ANRTC) is affiliated with Turkish Atomic Energy Authority (TAEA). TAEA was first established with the name of the Atomic Energy Commission in 1956 as a governmental organization. The name of the Atomic Energy Commission and its structure has been reformed by the new Act (No: 2690- year 1982) establishing TAEA with the main objectives of policy making on nuclear energy and technology, regulation, licensing and inspection, research and development and training. All topics in radiation protection in Turkey are regulated and supervised by the TAEA as well. The duties and responsibilities of the ANRTC are national and international education, training and research about topics of RP, such as radiation safety, nuclear power, nuclear safety, application of nuclear/radiation. Providing public information about nuclear topics is also among the duties and responsibilities of ANRTC.

Other centers relevant to training affiliated with TAEK are Çekmece Nuclear Research and Training Center (ÇNRTC) and Sarayköy Nuclear Research and Training Center (SNRTC). The ÇNRTC is located in Istanbul and is specialized in nuclear applications and technology such as research reactors, nuclear engineering, reactor safety, nuclear materials, non-destructive testing, nuclear electronics, radiobiology, radioactivity and analytical measurements and analyses, environmental radioactivity monitoring, radioactive waste management, calibration of nuclear instruments, health physics. The SNRTC located in Ankara and is specialized in various types of radioactivity and analytical measurements and analyses, accelerator physics, nuclear medicine, health physics, detection of irradiated food, nuclear biotechnology, polymer chemistry, radioactivity detection systems, detector and dosimeter materials and neutron physics with respect to nuclear applications. The Gamma Sterilization Facility and Proton Accelerator Facility are in service at the SNRTC. The specialized training, such as in the detection of irradiated food, non-destructive testing methods, comet assay analysis method, fundamentals of radiopharmacy, and radiography, is performed by ÇNRTC and SNRTC are also coordinated by ANRTC.

The job title, Radiation Protection Officer (RPO,) is defined by National Regulations of Radiation Security (No:23999) [3] . Pursuant to this Regulation's Article 4-i, the definition of the RPO is a person, who has basic safety standards for radiation protection according to their quality of work, shall apply to TAEK for licence with training and experience in this field that is the key element in the first phase to issue a licence for the Authority. Duties and responsibilities of the RPOs are also defined in the Regulation's Article 73. According to the National Regulations of Radiation Security any facility tackling with radiation, including radiation sources shall have a RPO that certified by TAEK after the RPO having successfully completed training courses. Several pilot probations and training courses were carried out, and evaluated after these attempts at the ANRTC involving RP education and training aimed at specialized education for radiologists, medical doctors, technicians, physicians, radiation workers. The results were seen positive.

In the recommendations from the European Association of Radiology [4] , there is a defined "Core of knowledge for general radiology" syllabus. Elements of the basic sciences of this syllabus include:

Radiation physics;
Radiobiology;
The physical basis of image formation including conventional x-ray, computed tomography, nuclear medicine, magnetic resonance imaging and ultrasound;
Quality control;
Radiation protection;
Anatomy, physiology, biochemistry and techniques related to radiological procedures;
Cell biology, DNA, RNA, and cell activity;
Pharmacology and the application of contrast media;
Basic understanding of computer science, image post processing, image archiving and image communication and teleradiology.

To fulfil these demands, a syllabus for a course, "Diagnostic imaging-physical and biological aspects" has been presented by the European Association of Radiology (EAR), through its working group for radiation protection. The course is meant to fulfil the demands, and designated to be given for 40 hours of theoretical education, supplemented by demonstrations. The syllabus has the following content in the final course programme of the ANRTC according to the EAR recommendations:

Fundamental concept of ionizing radiation (Atomic structure, natural and artificial radiation, radiation dose, external and internal exposure, X-ray production, interaction of X-rays with matter)- 4 hours.
Units and conversions (application)- 2 hours.
Radiation measurement and detection, -1 hour and (application)-2 hours.
Biological effects of radiation- 2 hours.
Systems security of radiation (Justification and optimization)- 2 hours.
Personal monitoring, dose limits, typical patient and staff dose levels.- 2 hours.
Radiation shielding for radiolgy-2 hours.
National legislation for radiation securty-1 hour.
Imaging modalities for diagnostic radiology (e.g. X-ray generators, film and digital sensors, CT, fluoroscopy, new imaging modalities)- 5 hours.
Dose reduction techniques (for physician, patient and technician - 4 hours.
On the job-training for dose reduction (practical radiation protection)- 8 hours.
Quality assurance programmes/acceptance testing - 2 hours.

Figure 1 presents the percentage of total course time devoted to each subject area for the year 2011.

[INSERT FIGURE 1 HERE]

The courses are presented as five-day seminars by physicisst, radiation biologists, radiation protection experts, and medical physicists. Course notes are disseminated to all

attendees for future reference. At the end of each training course, an examination is performed. Evaluation questionnaires are also completed by attendants and their results later used to improve teaching strategies. Five radiation protection courses for diagnostic radiology were organized by the ANRTC and 154 participants were trained in 2011.

[INSERT TABLE 1 HERE]

Table 1 presents the best- and the worst-rated aspects of the training courses for the year 2011 by assessing questionnaires and overall assessments obtained by the ANRTC. Table 2 presents the rated aspects of the training courses by participants for evaluation of instructors in their own designated syllabus performance (over 5 points).

[INSERT TABLE 2 HERE]

At end of the each training course, participants were given a test. The number of participants is shown on the bar graph of the examination scores in Figure 2. The average score was 83,2 (with respect to 100 points) over the past five radiation protection courses. According to examination score, two different certificates were issued for the participants by TAEA. If the examination score was ≥ 70, a "Certificate of achievement" was issued, for lower scores, a "Certificate of attendance" was given. One hundred and fifty three participants took the examinations. The results have shown that examination scores under 70 were only received by two participants. From the above figures, it can be assumed that current RP training programs are quite beneficial and useful to fulfill their intended purpose of providing protection of patients and staff from the harmful effects of radiation.

[INSERT FIGURE 2 HERE]

Education in radiation physics, radiobiology, and RP are, currently well defined, and the guidelines for contents of educational courses are defined through collaboration between the European Association of Radiology (EAR), and the European Federation of Organisations of Medical Physics (EFOMP). Radiological training in Turkey is provided centrally by the competent authority, (TAEA), for RP and, locally, by institutions experienced in this field. Coupled and combined training programmes and on-the-job training programmes were found to be effective and efficient. It was found that RP education and training for diagnostic radiology should be implemented at all levels of education, including continuous training for practioners with professional experience. It has been found that educational objectives should be given appropriately according to the role, played by the physician (referrer, practitioner non-radiologist, radiologist and interventionalist). This training is usually welcomed, when it allows for a better long-term implementation of RP rules.

The authors would like to express their gratitude to the training instructors of TAEA and personnel of the ANRTC for their contributions to the presentation of the courses.

REFERENCES

(1) International Commission on Radiological Protection. Radiological Protection and Safety in Medicine. ICRP Publication 73, Ann. ICRP 26(2) (Oxford: Elsevier Science) (1996).
(2) International Commission on Radiological Protection. The 2007 Recommendations of the International Commission on Radiological Protection. Publication 103.Ann. ICRP 37(2–4), 1–332 (2007).
(3) National Regulations of Radiation Security (No: 23999), Official Newpaper(2000).
(4) EAR. European Training Charter For Clinical Radiology (Vienna: EAR) (2005).

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Table 1. The best- and worst-rated aspects of the training courses (%).

Educational Planning and Materials	Agree absolutely	Agree in part	Don't agree
Suitability and content	74,1	25,9	none
Lecture notes	55,1	41,4	3,5
Presentation material	62,1	37,9	none
Course period	79,3	20,7	none
Educational Content			
Scope	65,5	32,8	1,7
Applications	41,4	44,8	13,8
The place of training and organization			
Lecture hall	91,4	8,6	none
Transportation	93,1	5,2	1,7

Table 2. The rated aspects of the training courses by participants for evaluation of instructors in performing designated syllabus (over 5 points).

Fundamental concept of ionising radiation	4,2
Units and conversions	4,3
Radiation measurement and detection	4,1
Radiation measurement and detection (application)	4,0
Biological effects of radiation	4,0
Systems for security of radiation	4,2
Personal monitoring	4,0
Radiation shielding for radiology	4,1
National legislation	4,2
Imaging modalities for diagnostic radiology	4,2
Dose reduction techniques	4,3
On the job-training for dose reduction	4,1
Quality assurance	4,0

Figure 1. Subject areas and relative percentages of the total course time for 2011.

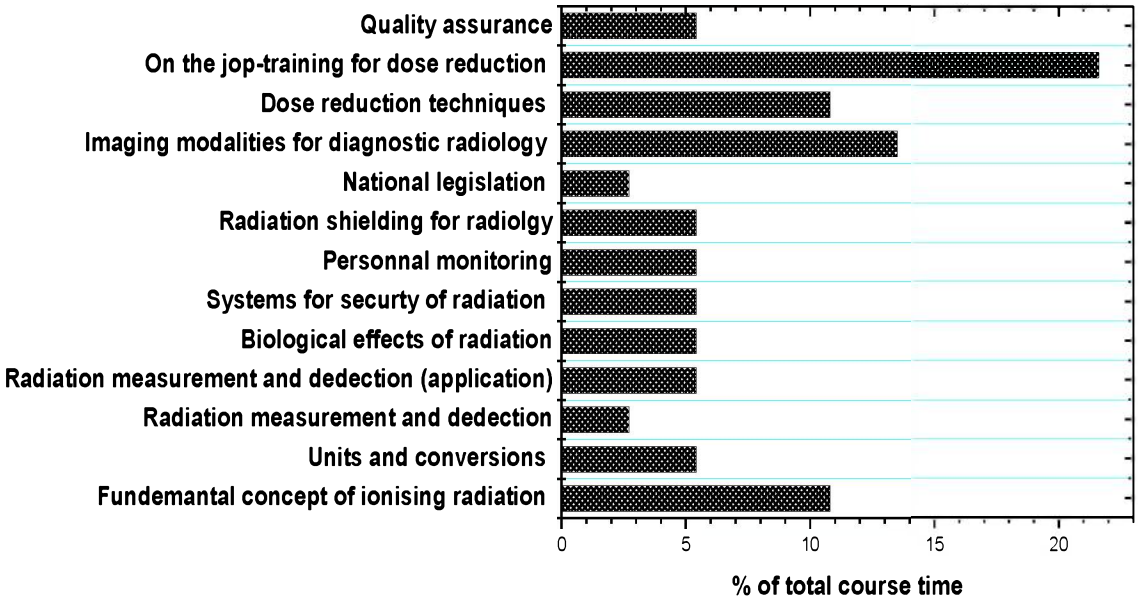

Figure 2. The number of participants vs. examination score range