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Interesting Moments of the Work during Specialized Training of Staff Working with Ionizing Radiations

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Abstract

Nowadays, ionizing radiation is increasingly used in our lives. This applies in particular to medicine. Devices with ionizing radiation are constantly being introduced in all areas of medicine, both for diagnosis and for treatment. The personnel working with this equipment must therefore have sufficient knowledge and skills and follow the respective rules and procedures associated with the radiation protection of the personnel themselves and the patients. To achieve all this, it is necessary to pay special attention to training of the personnel. Due to the constant introduction of new, modern equipment, it is necessary to periodically conduct the relevant training. The author of the article is responsible for conducting of such a specialized training, held in the Medical University Varna and at the same time trainer in some specific training courses. In this article we show interesting moments from running special courses to acquire the right to work with sources of ionizing radiation. This can be useful for other trainers who conduct such training. We share our experience in running these courses and believe that we can provide new ideas for more effective delivery of these special training courses.

Keywords

Specialized Training, Staff Working, Ionizing Radiation, Varna Medical University

1. Introduction

The concept of ionizing radiation is fundamental to the life of modern people. Already in high school we get knowledge about ionizing radiation: All types of radiation that cause ionization of the substance are called ionizing radiation. Ionization is a physical phenomenon in which positive and negative ions are

created from neutral atoms and molecules.

Medical equipment with ionizing radiation for the diagnosis and treatment of patients has covered almost all areas of medicine.

For example:

- ✓ Imaging diagnostics—X-ray equipment for diagnosing patients: conventional radiography, computer-tomography (CT), mobile C-arm X-ray systems in surgery, etc.;
- ✓ Nuclear medicine—diagnostic equipment with open sources of ionizing radiation: positron emission tomography (PET CT), gamma camera, etc.;
- ✓ Radiation therapy—equipment for cancer treatment: linear accelerator, cyber knife, etc.

For many reasons it is necessary to increase the number of employees who work with these devises. The main reasons are as follows:

- use of higher energies of ionizing radiation in the nuclear medicine and nuclear therapy;
- increasing number of medical equipment;
- increasing number and complexity of the procedures, performed by means of this equipment.

All these factors require improving the quality of work of the staff and accurate following the procedures and manipulations. Last but not least the radiation protection becomes more and more important. The radiation protection is of paramount importance for the personnel who works every day with sources of ionizing radiation. It is especially important to follow three basic rules:

- ✓ Exposure time—Limitation of the exposure time to a minimum, while at the same time the radiation purpose is fulfilled to the maximum extent;
- ✓ Distance source to the object—Increasing of the distance from the radiation source to the object as much as possible while at the same time the radiation purpose is fulfilled to the maximum extent;
- ✓ Radiation barrier between the object and the radiation source—Use of an appropriate and sufficient radiation barrier between the object of irradiation and the radiation source while at the same time the radiation purpose is fulfilled to the maximum extent.

To achieve all this, it is necessary to pay special attention to staff training.

In this article, we are trying to highlight interesting moments from running special courses on acquiring the right to work with sources of ionizing radiation. This would be useful for other trainers who are doing such training.

We share our experience in running these courses and believe that we can provide new ideas for more effective delivery of these special training courses.

1) Preliminary information

According to the Bulgarian legislation, the supreme body regulating the safe use of nuclear energy and ionizing radiation is the Nuclear Regulatory Agency (NRA), which has the rank of a ministry. The competencies of the NRA are defined in the Law on Safe Use of Nuclear Energy (ASIA), Chapter 2, Art 4. (1): "The regulation of the safe use of nuclear energy and ionizing radiation and the

safe management of radioactive waste and spent nuclear fuel is carried out by the Chairman of the Nuclear Regulatory Agency, hereinafter referred to as 'the Agency', which is an independent specialized executive body with competence determined by this law" (Bulgarian Legislation: Nuclear Regulatory Agency, Law on Safe Use of Nuclear Energy).

According to the above law, only persons who meet the established requirements for education, training and legal capacity to work in nuclear facilities or with sources of ionizing radiation (SIR) are allowed to work with nuclear facilities and sources of ionizing radiation. Certificates for use of SIR are required not only for individuals, working directly in nuclear facilities and with SIR, but also for persons, who perform trainings on simulators, radiation protection experts, as well as persons exercising control (Bulgarian Legislation: Nuclear Regulatory Agency, Law on Safe Use of Nuclear Energy).

Specialized training may be conducted by individuals sole proprietors or legal entities registered in the Republic of Bulgaria, provided that they have a License to conduct the above training from the NRA (Bulgarian Legislation: Nuclear Regulatory Agency, Law on Safe Use of Nuclear Energy).

A license is issued if the applicants meet specific requirements and criteria. The validity of the license is up to 5 years and after the expiration of this term, a new application for license is needed. The licenses for the specialized training are issued, amended, terminated, revoked and controlled under conditions and by order, determined by an ordinance, issued by the Council of Ministers on proposal of the chairman of the agency. This ordinance also determines the requirements, conditions and procedures for issuing, terminating and revoking certificates of competency's (Bulgarian Legislation: Nuclear Regulatory Agency, ORDINANCE on the Terms and Conditions for Acquiring Professional Qualification and on the Procedure for Issuing Licenses for Specialized Training and Certificates of Competency for the Use of Nuclear Energy).

On the basis of this Ordinance on the terms and conditions for acquiring professional qualification and on the procedure for issuing licenses for specialized training and certificates of competency for the use of nuclear energy 2 all persons who work directly with SIR, site managers who work with equipment using SIR, radiation protection officials and controllers are trained (Bulgarian Legislation: Nuclear Regulatory Agency, ORDINANCE on the Terms and Conditions for Acquiring Professional Qualification and on the Procedure for Issuing Licenses for Specialized Training and Certificates of Competency for the Use of Nuclear Energy).

At the end of the training, which lasts 5 working days, each trainee takes an exam before a qualification examination board. Upon successful completion of the exam, the student receives a Certificate of competency to work with equipment using SIR. The certificate is issued for a period of up to 5 years. After the expiration of this term, the person must again undergo a specialized training, ending with a new Certificate for a period of up to 5 years.

Thus, for a certain period of time (up to 5 years) all those who work with SIR

go through a basic course of specialized training. The main topics included in this course are set out in the above-described Ordinance 2 on ionizing radiation (Bulgarian Legislation: Nuclear Regulatory Agency, ORDINANCE on the Terms and Conditions for Acquiring Professional Qualification and on the Procedure for Issuing Licenses for Specialized Training and Certificates of Competency for the Use of Nuclear Energy):

a) Methods and means of measurement, basic dosimetric quantities and units;

b) Biological action of ionizing radiation in external and internal irradiation of the body;

c) Basic principles and methods of radiation protection when working with closed and open sources;

d) Dose limits for staff and population;

e) ALARA principle;

f) Rules of action to reduce exposure;

g) Regulatory framework;

h) Emergency planning and emergency preparedness in case of radiation accident;

i) In the field of medicine-optimization of medical radiation and patient protection.

Between the second and third year after the issuance of the certificate, a short-term supportive training is conducted, which lasts one day. The purpose of the supportive training is to bring to the students' knowledge novelties in the legislation, which occurred during the past period of the last training, as well as information and explanations about newly introduced equipment in the hospitals and in the country. The basic rules for radiation protection are discussed and emphasized, which is of paramount importance for the work of the respective trainee. The students share and discuss emergencies, incidents or accidents that occurred in their practice in the period after the last training.

2) Specialized Training Conducted by Varna Medical University

After fulfilling the conditions for a certificate receive, Medical University Varna received a License for specialized training on work with SIR (Ser. CO, Reg-Nr. 5023/ 12 February 2016). This is the only Medical University in Bulgaria that has a License for specialized training of medical and non-medical professionals using SIR. The specialized training includes theoretical and practical training, which are carried out in the University Hospital St. Marina Varna. The hospital is one of the leading institutions in Bulgaria implementing continuously modern medical equipment. The training is conducted by highly qualified teachers like most of them are both lecturers at the University and leading specialists in the relevant medical fields in the hospital, namely Imaging, Nuclear Medicine and Metabolic Therapy and Radiation Therapy. Other lecturers are representatives of the Regional Health Inspectorate (RHI), Radiation Control Department, Varna.

In the period from the moment of receiving the License, February 12, 2016 to June 2020, for almost 4 years, 90 training courses were conducted. The total number employees using SIR who have completed the training courses is 338.

The basic courses for initial training are 73 with 254 participants, and the courses for supportive training are 17 with 84 participants.

After the completion of each training, we consult the opinion of both the trainees and their direct supervisors about the effect of the completed training. We receive opinions on the following issues from the trainees:

a) Are you satisfied with program of the course?

b) Do you get enough useful knowledge from the lectures?

c) Do you get enough useful knowledge from the practical exercises?

d) Does the conducted training contribute to raising your qualification?

e) Does the examination format correspond to the training carried out?

f) Write your opinion and recommendations about the course.

We address the following request to the direct supervisors of the trainees: "Please express your opinion about the acquired knowledge of your employees, who have passed the specialized training for acquisition of legal capacity to work with SIR".

In detail:

a) Do your employees follow radiation protection rules?

b) Do you find violations related to radiation protection during they work?

c) Do you think there is an improvement in radiation protection after your employees have attended this course?

The training in these specialized courses is a two-way process that we are constantly striving to improve. Receiving feedback from all participating trainees, we draw conclusions about the success and usefulness of the training. The received opinions and recommendations help us to change our work during the subsequent trainings in order to make them even more effective.

Summarizing all these opinions and from our personal contacts with the trainees during the course, we encounter interesting opinions that we want to share here.

2. Exposure

Working with people and training them specifically is not an easy task. For the training of people with a broad general culture and an established value system to be effective, the trainer must be able to create an appropriate atmosphere. This atmosphere removes any tension during work and is based on trust and understanding between the trainer and the trainees.

The trainees are grouped according to the respective type of equipment and activities which they do. According to the above criteria, there are two main groups of trainees:

- Trainees working directly with the equipment using SIR.
- Trainees who work as controlling staff: radiation protection officers, heads of clinics and units working with SIR and persons controlling the observance of the rules for radiation protection (inspectors from the Radiation Control Department of the RHI or from the National Center for Radiobiology and Radiation Protection).

Each of these groups is divided into subgroups, according to the used type of the equipment with sources of ionizing radiation:

- ✓ Staff working with equipment using X-rays;
- ✓ Staff working in clinics in nuclear medicine and metabolic therapy;
- ✓ Staff working in radiotherapy clinics.

In each of these subgroups, the staff is divided into medical (with medical education) and non-medical specialists (responsible for the technical use of the equipment: physicists, chemists, biologists and engineers for technical maintenance and repair of the equipment).

The initial training starts with an entrance test based on the knowledge of the ionizing radiation which the respective group of trainees is using and the respective measures and rules for radiation protection. The purpose of this test is to obtain information about the initial level of knowledge of the trainees in the respective course. This test is only checked by the trainers. Based on this information, the respective trainer compiles his/her specific program for the given course.

In addition to the mandatory topics included in the training course, the trainer can choose the focus areas where more attention should be paid if the entrance tests have shown poorer results on some topics.

The information about the input level of knowledge tells the trainer how to approach each of the trainees in this course. Of course, this test does not necessarily determine the level of the trainees and is therefore used only as a preliminary guideline. In the process of communication during the training a broader understanding of each learner's level is created. The first contact with the learners is also very important. To a large extent this depends on the creation of an atmosphere of trust during the training.

Demonstrating interest of the trainers in the personality of the trainees, of course within reasonable limits, marks the beginning of a calm and effective working environment for the upcoming training. In our work as trainers, we encourage asking questions and exchanging views while clarifying the lecture material. We believe that the interruptions for questions and opinions direct the learners to an interesting part of the topic and thus the relevant information is more clearly realized and remembered. These interruptions also provide an opportunity to diversify the monotony of presentation and activate the attention of all participants in the training. By creating a dialogue during lectures, trust is achieved in the group both between the learners and the trainer and between the learners themselves. A relaxed atmosphere is created in which everyone can express an opinion or share an event from their work practice with the SIR. This discussion is especially useful for learners attending such a course for the first time. In this way, they find it easier to orient themselves in the subject, which in theory they studied at the university, but now it is necessary to apply this knowledge in their practice. We have heard a question from them many times: "Why do we have to take such a course? At the university we were given this knowledge." By participating in the dialogue carried out during the training, they find the answer to this question themselves.

At the beginning of the training, the communication attempts are timid and for the most part, by the older trainees, but over time everyone gets involved. The small number of trainees in the group, from 5 to 10 participants, also facilitates this communication. This gives the opportunity, as well as the time, to are hear and then discuss the opinions of all trainees.

Trainees often share some irregularities and problems from their practical work and seek advice on how to deal with such situations. Putting the problem to the attention of the whole group, it is discussed by everyone and often its solution emerges during the discussion. If solving the case is more difficult and requires expert opinion, we as trainers give our opinion. It happens that the case is not within our competence, then we seek contact with the relevant competent authority and reach the necessary solution. We never leave an unresolved issue that has been communicated to us. We always find a way, even outside of course time, to answer in one way or another. In this way we show practically that every problem has a solution and we demonstrate to them different approaches to solve the situation.

There are cases in which the trainees ask us the following question "Why is it necessary to conduct such training every 5 years after having passed such a training course once?" Our answer is that this is necessitated by the fact that more and more modern equipment is put into operation and this leads to changes in the procedures and methods of work, as well as changes in the legislation. But we also have a funny answer like: "To scare you, so you don't forget to be careful when working with SIR!"

The cheerful atmosphere, mixed with appropriate jokes, is another prerequisite for the high efficiency of the training. When a person is tense, no matter how focused he is on listening, he fails to cope with its understanding and learning with sufficient quality. Conversely, a calm and cheerful mood requires significantly less effort for understanding and remembering the knowledge provided.

The main goal in our work, as trainers, is to create and maintain throughout the course a calm and comfortable atmosphere for the trainees. It often happens that the students in the respective course come from different medical institutions and do not know each other. Creating a sense of calm and comfort, from the very beginning, is a solid prerequisite for the success of the training.

3. Conclusion

We set our activity as trainers on the basis of creating a calm atmosphere in which there is trust between the various participants and confidence in the correctness of the training.

The effectiveness of our efforts is unequivocally indicated by the fact that all trainees who have taken our training, have passed successfully the exam. About 99.7% of the output tests have 100% correct answers. There are only a few cases when wrong answers and mistakes are made inadvertently. Very often our students come to the course after a night shift and are quite tired and distracted. To this fact we attribute the errors received.

During the discussion in the oral part of the exam, everyone shows the necessary

Figure 1. Moments from running the specialized training led by the author of the article.

knowledge, giving correct and maximally informative answers. The effectiveness of our training is also evident from the answers to surveys and the answers of the trainees and their immediate superiors. Their main recommendation is to continue our trainings in the same way, because it is very interesting, memorable and useful for them. Surveys performed by their superiors confirm the success of the course. All respondents give a positive answer in what concerns improvement of performance and compliance with the rules of radiation protection.

The fifth year of the License for specialized training, issued for the Medical University of Varna, is currently underway. This is the period of evaluating the completed trainings. The conclusions we draw from our work will be included in the prepared documentation, through which we will apply for renewal of the License for specialized training before the NRA (**Figure 1**).

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Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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