

Training on Radiation Protection in Diagnostic Radiology: Role of the Regulatory Body to Ensure the Safe Use of Ionizing Radiation in Bangladesh

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Abstract:

Radiation has been used since its invention in various sectors like medicine, agriculture, industry, research & education, power production, and so on, for the benefit of mankind. With this trend, Bangladesh is also using radiation to achieve economic development through the application of radiation in all possible ways. Proper education, knowledge, training, and awareness are a mandatory part of using radiation to ensure safe use of it against its harmful effects. Concerning the control of the safe use of radiation, an extensive regulatory system: “Bangladesh Atomic Energy Regulatory Authority (BAERA)” was set up in 2013 in Bangladesh consisting of acts, rules, and guidance. The primary objective of the regulatory body is to protect the workers, the public, and the environment from the possible adverse effects of radiation use. To deal with its objective, it is a core activity of the regulatory body to create radiation awareness among radiation workers and related personnel all over the country through the provision of the existing act and rules regarding radiation protection training. The current study is done to have an overview of the role of the regulatory body in this regard and their present status related to the radiation protection training program for radiation workers in the field of diagnostic radiology in the country.

Keywords: radiation protection, training, regulatory body, radiation worker, legal instrument, diagnostic radiology.

1. Introduction

Despite the harmful effects, the use of radiation in a variety of dimensions is becoming popular worldwide. Bangladesh is not an exception of it. Adequate education and training of occupational workers and related personnel on radiation protection is essential for the safe use of ionizing radiation. Radiation protection training and education play an important role in stimulating the safety culture of occupational workers. This is necessary to understand their responsibilities and perform their duties most safely for themselves, the public, and the patients, where appropriate. The International Atomic Energy Agency (IAEA) General Safety Requirements (GSR) Part 3 requires radiological medical practitioners, medical radiation technologists (also called radiographers), medical physicists, and radio pharmacists, to have specialist

education and training in the particular discipline, including radiation protection and safety (IAEA Safety Standards Series No. GSR Part 3 (Vienna: IAEA), 2014). Specific roles and responsibilities for ensuring compliance with this requirement are delegated to the government, the regulatory authorities, licensees of the medical radiological facilities, as well as professional bodies. In Bangladesh, basic education about radiation is incorporated into the school curriculum while more detailed courses are taught at college and university levels (Ullah, 1999). Also, universities and research organizations carry out research and development work for peaceful uses of radiation in various fields. Furthermore, for the sector of diagnostic radiology, there are courses like 3-year diploma courses in radiology & imaging, and 4 years of undergraduate or BSc courses in Radiology and imaging are available in the country (Directorate General of Medical Education, 2021); (B.Sc in Radiology & Imaging in Bangladesh University of Health Science, n.d.). Besides this academic aspect, the competent regulatory authority, the Bangladesh Atomic Energy Regulatory Authority (BAERA) provides training on radiation protection to radiation workers and the related personnel in diagnostic radiology as a legal instrument to ensure the peaceful use of ionizing radiation throughout the country. To fulfill its role, BAERA implements a strategy for training in radiation protection through the development of appropriate programs that take into account the needs of the existing Act and Rules. The present work demonstrates the assessment of the role of BAERA training activities on particular categories of radiation workers in Diagnostic Radiology in Bangladesh. This could help BAERA to strengthen its radiation safety and protection infrastructure in the future.

2. Legislative Framework

In Bangladesh, there are two legal instruments to regulate radiation activities:

- Bangladesh Atomic Energy Regulatory Act 2012 (Act No. 19 of 2012)
- Nuclear Safety and Radiation Control Rules 1997 (SRO No. 205-Law/97)

2.1 Requirement for education and training

Within its provisions of the NSRC Rules-1997, the licensee must ensure that adequate education, training, and requalification arrangements for the human resources involved in the licensed practice are available and that such education, training, and requalification programs are approved by the regulatory authority (Nuclear Safety and Radiation Control Rules-1997, 1997). The licensee shall ensure that every worker is informed of the potential health risks involved in his job; instructed about the precautions to be taken; and given appropriate training on radiation protection relevant to his/her duties. The licensee shall also provide appropriate, if necessary, retraining and facilities for updating the skills and knowledge of the workers.

2.2 Requirements for Qualifications of RCO (Radiation Control Officer)

According to the legislation in force the RCO is the person who is responsible for ensuring compliance with the regulations in controlled and supervised areas and shall have the educational qualification and training to make him/her capable of fulfilling the duties functions as stated in the NSRC Rules-1997. Also, he/she shall obtain an RCO Certificate approved by BAERA based on an examination conducted by BAERA.

In diagnostic Radiology, education to a secondary school level is considered to be the minimum requirement for RCO. The RCO must be provided with sufficient radiation protection training to enable him to be in the position to effectively carry out his supervisory duties. The required training for RCO competence is one of the specialized training courses. Moreover, an RCO shall also have significant experience in the practice in which he/she is working, in particular the routine procedures, emergency arrangements, etc. As this is primarily a supervisory role, the person must have the required experience

before being appointed as RCO. The minimum period of work experience depends on his educational background.

2.3 Responsibilities and Competencies of RCOs

Duties of RCO are to handle and apply safely the radioactive material, nuclear material and irradiating apparatus ; formulate the necessary radiation protection working procedures in respect to the practice leading to radiation exposure ; establish a system of physical surveillance of radiation exposure and contamination through adequate procedures and practice; organize the radiation monitoring programme for routine and special monitoring ; instruct the radiation workers on hazards of radiation and on safety measures and practices to minimize exposure and contamination, take all necessary steps to ensure that the operational limits are not exceeded ; organize the safe transport, storage and disposal of all radioactive materials including waste containing radioactive material in such a way as it conforms to the conditions specified by the commission ; make arrangements for testing and calibrating all monitoring instruments ; ensure that records are up-to date ; ensure that the quality assurance of radiation monitoring programme is maintained ;investigate and initiate prompt and suitable remedial actions in respect to any situation that may cause radiation hazards ; ensure that the reports on all hazardous situations along with details of any immediate remedial actions taken are made available to the licensee immediately ; control access of people, other than those involved in the work, to any area where practice involving radiation are being conducted ; and in the event of spillage of any radioactive material resulting in personnel, surface or airborne contamination – take steps to arrange for the immediate decontamination of the affected person ; take necessary steps to prevent further spreading of contamination ;take an immediate decontamination measure in an affected area ; and inform the authority immediately of the details of the details of the accident and remedial actions initiated, if any (Nuclear Safety and Radiation Control Rules-1997, 1997).

3. Regulatory Framework

The Training & Documentation Division (TDD) of BAERA is responsible division for conducting various training programs for radiation workers, RCOs, and other relevant persons who use ionizing radiation and radioactive sources. The aim is to create awareness among the radiation workers, to use radioactive sources, and radiation-generating equipment safely in the country, and to motivate them to perform their duties properly in compliance with the requirements of the BAER Act, 2012 and NSRC Rules-1997. The recognition system for RCO is based on examination and consists of obtaining the RCO Certificate approved by BAERA as per the requirement of the Rules. To fulfill this requirement, this division arranges an RCO Certification examination to issue RCO certificates for RCOs after attending the radiation protection training program.

4. Radiation Protection Training

This paper introduced the training program organized by TDD, BAERA to raise awareness about radiation protection among radiation workers as a legal instrument to ensure the safe use of ionizing radiation. TDD, BAERA conducts a two-day radiation protection training for radiation workers in diagnostic radiology.

The training courses are organized with the specific aims:

To provide the initial theoretical, practical, and legislation knowledge needed for obtaining the goal of radiation protection

To ensure the theoretical and legislation knowledge is refreshed every 4 years.

The training courses intended for the initial and refresher radiation workers have to be approved by the

authority. The requirements regarding the necessary topics and durations are approved by the authority and well established. The training courses in the field of radiation protection organized by international bodies are similar to those described in the training program by BAERA. The course module is composed of 10 (10) theoretical lectures including the legislative information, the basic radiation knowledge, and radiation protection aspects in the field of diagnostic radiology. In this part, there is a session for the participants to have an open discussion and provide their feedback regarding the training and authorization process of BAERA. There is a practical session too at the end of the course to provide the participants a hands-on training about the radiation detection method, verification of inverse square law, and shielding effectiveness of the protective gears.

The criteria for the radiation workers for a training course consist of: education to a secondary school level is considered to be the minimum requirement or shall have significant experience of at least 3 years in the practice in which he/she is working (Instruction for RCO Training by BAERA (In Bengali)).

Up to the present time, a total of 128 training programs on radiation protection have been conducted by the TDD and BAERA in the field of diagnostic radiology. Through these training courses, a total of 4675 radiation workers have been trained. The following graphical presentation illustrates the trend of training programs conducted per year:

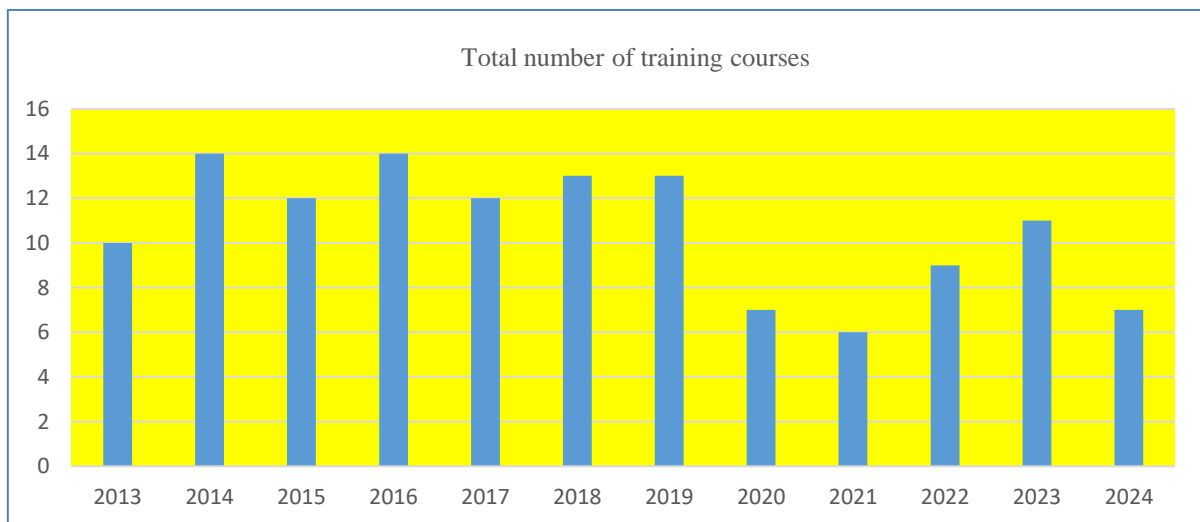


Figure 1: No. of training organized by BAERA per year by TDD, BAERA up to August 2024

From the graph, we find there is a drop in the number of training programs in the year 2020 to 2021. This happened due to the worldwide pandemic situation for Covid-19. At that time, training programs were suspended for the 1st six months as the country declared lockdown. Later on, the programs started with limited participants maintaining the hygiene rules of Covid-19.

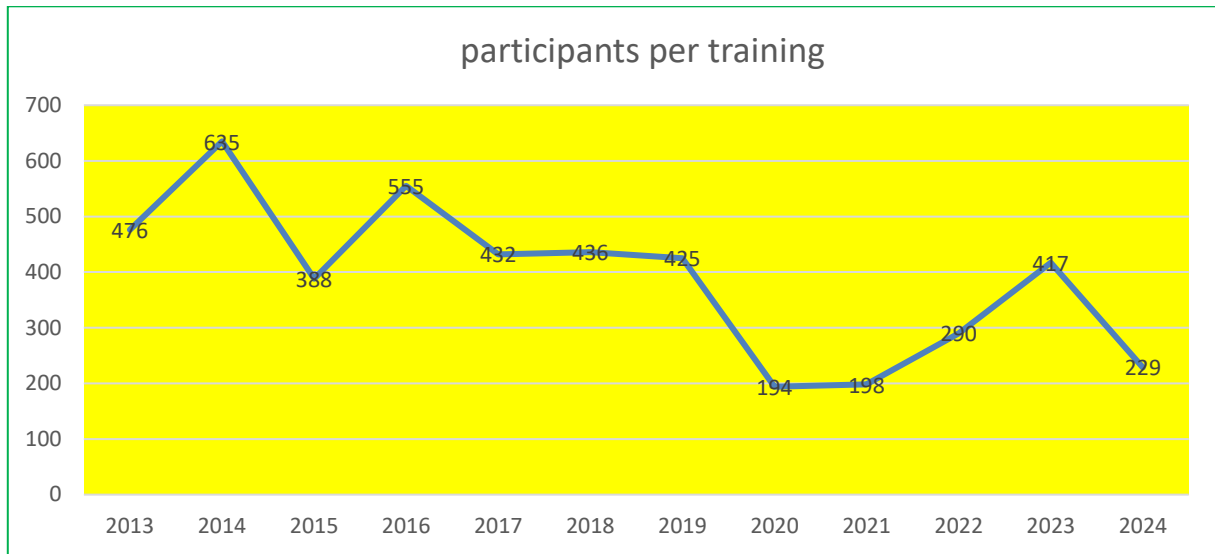


Figure 2: No. of Participants per training from 2013 to August 2024

Figure 2 illustrates the total number of radiation workers trained through the training program of TDD, BAERA. There is a drop in the number during the year 2020-201 for the same issue of Covid-19 described earlier.

It is interesting to find the ratio of female participants in these training courses. The following graph shows that:

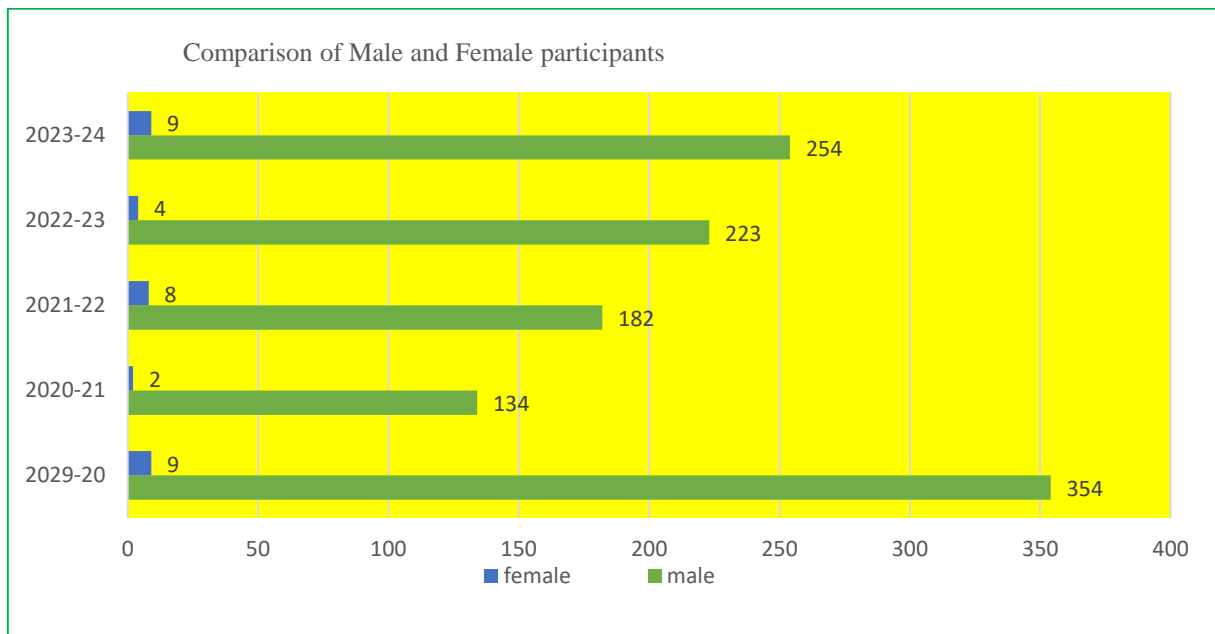


Figure 3: Number of male and female workers per training for the last 5 years

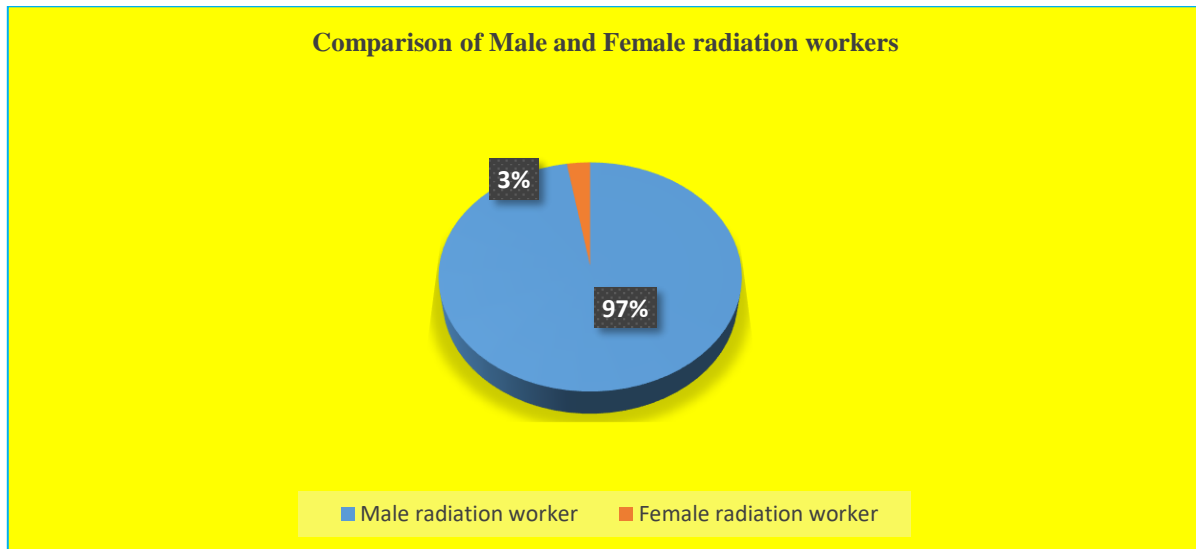


Figure 4: Ratio of male and female workers per training for the last 5 years

Though the ratio of female and male radiation workers is not that comparable, it is the bright side that females are getting interested in choosing to work in this field of diagnostic radiology, overcoming the radiation fear in society.

5. Examination Procedure

The examination for issuing the RCO Certificate consists of a written test for the applicant, containing 100 questions, each of them having four possible answers. The applicant must recognize the correct answer. The questionnaire is prepared by the resource persons based on their lecture materials. Some questions can be formulated in the form of a mathematical problem. A candidate is considered to have passed the examination if he/she answered correctly to at least 60% of the questions in the examination time of one and a half hours.

There are provisions for the participant to sit for more exams who failed in 1st attempt. In this case, he/she needs to make some additional payment regarding the examination fee whereas, the 1st exam is free of charge with the condition of attending the training course (Instruction for RCO exam by BAERA (In Bengali)).

The following figure shows the number of RCO Certification examinations arranged by the TDD, and BAERA for the radiation workers in Diagnostic Radiology:

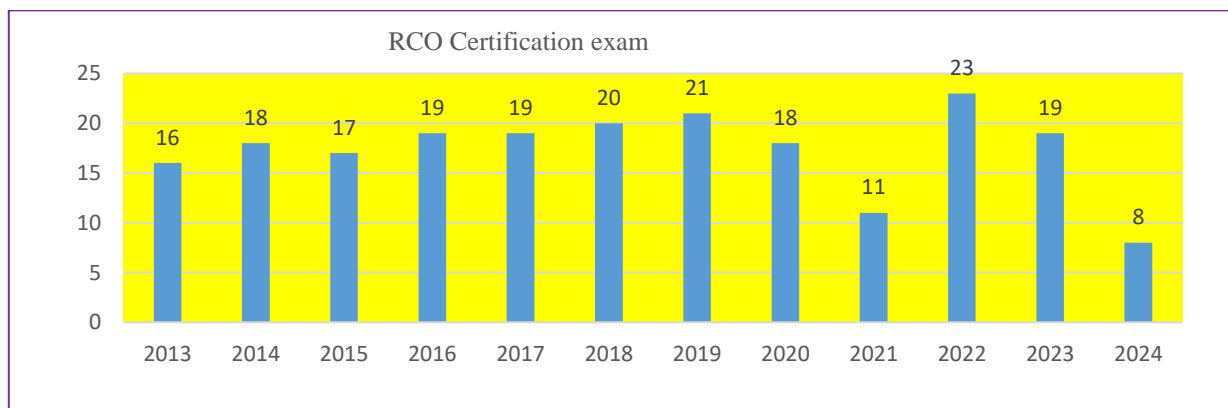


Figure 5: No of RCO Certification Exam by the TDD, BAERA

It is found that, since 2013, a total of 209 exams have been arranged by the TDD, BAERA in which a total of 2194 radiation workers took part. Among them, 1927 radiation workers passed the examination which implies the rate of passing the exam and getting an RCO certificate is 87.83%. This indicates a positive side of the training program conducted by the TDD, BAERA as above 87% of participants are getting passed with the knowledge of radiation protection in the field of diagnostic radiology. The ratio has been illustrated in the following graph:

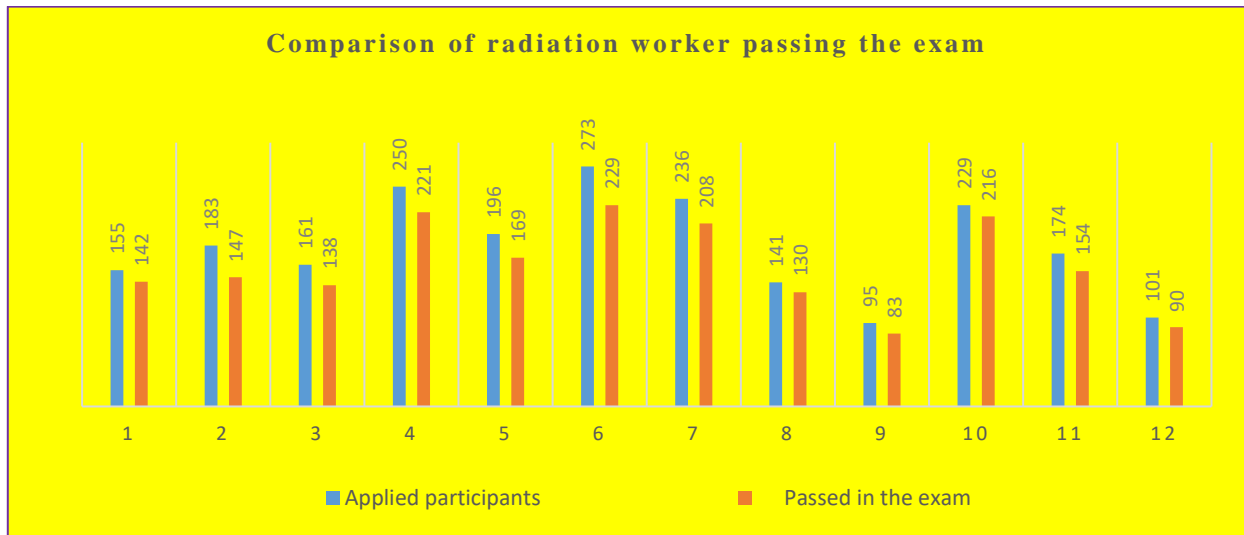


Figure 6: Comparison between radiation workers attending the exam with the number of those who passed the exam for the last 12 years.

6. Recertification

The RCO Certificates are issued over a period of 4 years. To maintain the recognition of competence in radiation protection the RCOs shall undertake appropriate refresher training courses and get renewed Certificates.

7. Records

The information about training, refresher courses, and sanctions of RCOs are recorded by TDD, and BAERA in the database.

8. Conclusion

Proper training is essential for radiation workers to understand the peaceful use of ionizing radiation. To bring light on the current situation about the training of radiation workers; this paper reviewed the present status of the role of the regulatory body in this regard in Bangladesh. However, the current system could not cover all radiation workers within the training program as no regulatory system can be 100 percent effective. However, efforts are made to create awareness and provide proper training to the related personnel within its capability of logistic support and existing manpower. The success of the program depends on the proper management, the availability of experts as resource person, and the cooperation of the users. It is strongly believed that this training program will be successful in building up a strong safety culture among the radiation workers and related personnel soon.

9. Acknowledgement

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