Training in Radioprotection in the School of Pharmacy and Biochemistry, University of Buenos Aires.


Laboratorio de Radioisótopos, Facultad de Farmacia y Bioquímica, Universidad de Buenos Aires, Junín 956, C1113AAB, Buenos Aires, ARGENTINA.

Abstract. The radioisotopes techniques have notably contributed to the advancement of knowledge in medicine and biomedicine during the last 60 years. The School of Pharmacy and Biochemistry of the University of Buenos Aires, Argentina, offers different Courses on methodology of radioisotopes in which the specialized knowledge on Radioprotection is adapted to the following different groups: 1) A course for Biochemistry students; 2) A course for Physicians; 3) A course for Graduates in Biochemistry, Biology, Chemistry or other disciplines related to the health. 4) An up-dating course for licensed professionals; 5) A course for Nuclear Medicine Technicians; and finally, 6) A course for Pharmacy students. The main objective of Radiological Protection teaching is specific and fitted to each level: the course (1) has been given (optional or mandatory) since 1960 for more than 7500 students. Part of the learning process in radioprotection is only informative, because in this case the students are not allowed to ask the Argentinian Nuclear Regulatory Authority authorization for radioactive material handling. Course (2) has been taken by more than 800 Physicians since 1962. Here, the students receive a very intensive training in radioprotection which includes: justification, optimization and dose limits; dosimetric magnitudes and units; internal and external dosimetry of $^{99m}$Tc, $^{201}$Tl, $^{60}$Co and other isotopes used in medicine; safety in occupational exposure; national and international legislation. Since 1962, more than 1000 graduates have attended course (3). In this case the training in radioprotection is as intensive as in course (2) with special focusing in $^{125}$I, $^3$H, $^{14}$C, $^{32}$P and other isotopes used in biomedicine. Course (4) has been given from 1992 and the objective is to up-date knowledge and the intensity of training depends on the requirements of each professional. Course (5) has been given since 1997 and it is mainly directed to the operational aspects of radioprotection for technicians working in Nuclear Medicine Units. Since this course is in a growing demand and an appropriate qualification is required, a new three year lasting degree has been proposed by our laboratory to be offered by the School of Pharmacy and Biochemistry. Since 2005, the Pharmacy degree curriculum includes course (6) as an optional subject.

During our 47 years teaching experience, more than 95% of registered students have passed their respective exams meeting the respective course standards: students, graduate students and technicians. All the training courses above described are planned keeping in mind the optimization of radiation protection in harmonization with the environment.

KEYWORDS: education, training, radiation safety

1. Introduction

The development and application of methodologies employing radionuclides have enormously contributed to the notably advance of biomedical sciences in the last decades. These techniques have found a field of study particularly in pharmacology, molecular and cell biology, and essentially in basic and clinical research, also in veterinary and agriculture investigations. Radiometric techniques are routinely used for endocrine and biochemical diagnostic in vitro. Moreover, radioisotopes, radiopharmaceutical products and ionizing radiation are currently employed in medicine for diagnosis and also for treatment of diverse malignant and non-malignant diseases.

* Presenting author, E-mail: erivera@ffyb.uba.ar
Therefore, the importance of giving an adequate training to the different professionals related to the biomedical sciences has become a challenge for all the teachers involved in the education at undergraduate and post graduate University level.

Early in the 1960s the School of Pharmacy and Biochemistry of the University of Buenos Aires, Argentina, introduced as an optional course the subject Physic III, which provided students with the basis of nuclear physics. Since that moment and up today the Laboratory of Radioisotopes has been continuously increasing the educational offer in this area. At present our proposal consists of different Courses on methodology of radioisotopes in which the specialized knowledge on Radioprotection is adapted according to the background and requirements of the following different groups: 1) A course for students of Biochemistry; 2) A course for students of Pharmacy. 3) A course for Physicians; 4) A course for Graduates in Biochemistry, Biology, Chemistry or other disciplines related to the health. 5) An up-dating course for licensed professionals; and finally, 6) A course for Technicians in Nuclear Medicine.

In the present paper we briefly describe the scope and structure of the different courses as well as the goals achieved.

2. Organization of the Courses and Results

2.1 Undergraduate Course for students of Biochemistry

This Course started in 1962 as a part of the general subject Physics, with the aim of giving to the students the guidelines for an adequate application and handling of radioactive material in their future professional work. It was initially imparted as an optional subject denominated Radiochemistry, and since 1984 it has been incorporated as a regular subject of the syllabus of the career of Biochemistry named Methodology of Radioisotopes.

The students attend to a 140 hour subject, with a schedule of 84 lecture hours and 56 hours of seminars and laboratory practices. The theoretical programme is mainly focussed in the basic and fundamentals of nuclear physics, radiation detection and measurement, radiobiology, radiometry, and radiological protection. The laboratory training includes radiation detection, radioactive material handling, and general application of radioisotopes in clinical biochemistry or in research work. The objective of teaching radioprotection at undergraduate level in Biochemistry is to introduce radioprotection philosophy and to give guidelines for an adequate use and management of radioactive material in their future professional works.

2.2 Undergraduate Course for students of Pharmacy

The goal of this course is to train students of pharmacy in the management of radiopharmacy services. Radiopharmacy as part of the Pharmaceutical sciences is specialised in the study of radioactive drugs. The syllabus includes the design, synthesis, preparation and quality control of radiopharmaceuticals; clinical uses, mechanisms of action, radiopharmacology and interaction of diagnostic and therapeutic radiopharmaceuticals; quality assurance and legal aspects of radiopharmacy and radiopharmaceuticals. The course has been offered since 2004 for the students of the Pharmacy career with a schedule of 84 lecture hours and 56 hours of seminars and laboratory practices. Initially presented as an optional subject, it has been recently incorporated as an elective subject for the specialization cycle in Industrial or Hospital Pharmacy. The new programme of study proposed for the career of Pharmacy will be completed and approved during this year for its starting in 2009.

2.3 Postgraduate Course on Methodology of Radioisotopes for Physicians

The Course on Methodology on Radioisotopes for Physicians started simultaneously to the course for biomedicine related graduates, in 1962. Both course shares many topics related to the fundamentals of
nuclear physics, radiation detection and measurement, radiobiology and basic principles of radiological protection.

The specific syllabus includes Production of radioisotopes and radiopharmaceutical materials. Purity and control criteria. Medical application of radionuclides and ionizing radiation. Radiopharmaceuticals for diagnosis and treatment, national and international regulations. Instrumentation in Nuclear Medicine, quality control of equipment. Computation in Nuclear Medicine.

The goal of this Course is to enable the graduates to:
Acquire criteria for a correct application of the radioprotection philosophy with especial emphasis in the importance of this practice as well as the potential environmental impact that it implies.
Planning of professional practices with an adequate training of the human resources involved.
Optimization of procedures and practices.
Internal dosimetry calculus including MIRD methodology
External dosimetry

Graduates attend to 122 hours of lectures and 100 hours of laboratory practice. The approval of this course allows them to apply for a personal authorization for the in vivo use of radioactive material extended by the Argentine Nuclear Regulatory Authority

Radiological protection represent the central point in the courses for professionals therefore 30% of the theoretical classes and 40% of practical training is dedicated to the teaching of this topic.

Here, the students receive a very intensive training in radioprotection which includes: justification, optimization and dose limits; dosimetric magnitudes and units; internal and external dosimetry of $^{99m}$Tc, $^{201}$Tl, $^{60}$Co, $^{18}$F, $^{67}$Ga, $^{131}$I and other isotopes used in medicine; safety in occupational exposure; national and international legislation. Since 1962, more than 800 graduates have attended course

2.4 Postgraduate Course on Methodology of Radioisotopes for professionals in Biomedicine disciplines

The Course on Methodology on Radioisotopes for Biomedicine post graduates started in 1962. The training in Radioprotection is both theoretical and practical. It encompasses the study of the basics principles of radioprotection, dosimetric quantities and units, internal and external dosimetry of nuclides employed in assays for in vitro diagnostic, radiometry and basic or clinical research. Shielding, physical barriers and handling to avoid contamination, management of radioactive wastes, national and international legislation.

In this case the training in radioprotection is as intensive as in course (2) with special focusing in $^{125}$I, $^3$H, $^{14}$C, $^{32}$P and other isotopes used in biomedicine

The goal of this Course is to enable graduates in biomedical sciences to:
Acquire criteria for a correct application of the radioprotection philosophy with especial emphasis in the importance of this practice as well as the potential environmental impact that it implies.
Planning professional practices with an adequate training of the human resources involved.
Optimization of procedures and practices.

Graduates attend to 122 hours of lectures and 100 hours of laboratory practice. The approval of this course allows them to apply for a personal authorization to employ radioactive material extended by the Argentine Nuclear Regulatory Authority

2.5 Up-dating course for licensed professionals

This course is being offered since 1992 and provides professionals related to biomedical sciences the opportunity of making an up-grade on general and specific knowledge on methodology techniques employing radionuclides. The course schedule consists in 50 lecture hours and 50 hours of seminars and laboratory practices. Through this course the Argentine Nuclear Regulatory Authority renovates the licences for the use of radioactive material.
2.6 Course for Technicians in Nuclear Medicine

This course was offered for the first time in 1997, and started with a few students. Remarkably, in 2008 the number of students applying for this course is over 70. The schedule consisted of 112 lecture hours and 100 hours of seminar and laboratory practices. It mainly emphasized in the operational aspects of radioprotection at technician level and the aim is to train Nuclear Technicians on their future work in Nuclear Medicine Centres. This course represents the basis for the Career of Technicians in Nuclear Medicine. The notable increasing number of students since the beginning of this course moved us to implement the University Career that is now almost organized at The University of Buenos Aires and represents a new attractive short university career for students that are interested in a position in the continuously growing field of Nuclear Medicine.

3 Conclusions

The employment of radioisotopes in professional activities is a widespread practice and must be carried out in the framework of radiological safety and in harmonization with the environment. The best way to avoid detrimental events during the manipulation of radioactive sources is an adequate training of the professionals and human resources, in the theoretical and practical knowledge of the use of radioisotopes, with strong emphasis on radiological protection.

The experience in research and teaching for more than 45 years in our Laboratory at the University of Buenos Aires, contributes to an excellent professional and technical instruction of the experts. Our staff consists of more than 20 scientists and professors, most of them with the maximum academic degree (PhD) and in every course we include the participation of specialists from the Argentine Nuclear Regulatory Authority, from Centres of Nuclear Medicine and from other critical areas.

With the inclusion of Radiopharmacy in the curricula of the career of Pharmacy, the proposal and organization of the University Career of Technicians in Nuclear Medicine we think that our Laboratory is one of the mayor contributors to the instruction of human resources in the area of Methodology of radioisotopes by teaching and attending the day to day increasing activity in Nuclear Medicine in our country.

REFERENCES