Education and training in radiation protection in Portugal: present situation and a project for the future

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Abstract
The present situation in education and training in radiation protection in Portugal is reviewed. A project to raise the level of qualification of professionals dealing with ionizing radiation and to upgrade the overall safety standards to internationally accepted levels is presented. The number and geographical distribution of those professionals is estimated. Specific education and training programs for the medical and industrial working environment are outlined for all three levels of qualification. Active collaboration with the IAEA in the preparation and lecture of the courses is recommended.

1. Introduction

The two central aspects of Radiological Protection (RP), namely, RP of professionals exposed to ionization radiations and that of patients submitted to clinical practices involving ionization radiations have been given particular attention at European level. The EU Directives 96/29 and 97/43 of Euratom specifically address these matters. Both Directives have been partially transposed to the legal Portuguese framework. However, in spite of the efforts made so far, the training programmes required to confer the qualification of Expert in Radiological Protection (RPE), as well as the regulations attributing competence to confer that qualification, are yet to be issued.
The present situation is negatively conditioned by the fact that is not mandatory for an industrial installation using sources of radiation to incorporate in its staff a RPE. This may explain why the Portuguese medium and higher education institutions have paid little attention to the field of RP. However, there is an increasing awareness of the need to correct the situation. Reflecting this concern, the IST of the Technical University of Lisbon introduced last year, in collaboration with ITN, a masters course in Radiation Protection. Other initiatives along this line are being prepared.
At a different level, training courses for professionals dealing with ionizing radiations (industrial equipment operators, radiologists), Civil Protection officials and firemen, have been organized and lectured by ITN/DPRSN[1], most of them under request. These are typically one week or less courses, for which no minimum academic preparation of the trainees is required. As for the use of ionizing radiation in medical practices, current legislation imposes that all practices must be performed under the responsibility of a physician with specific knowledge of RP. Furthermore the teams that operate the equipments must include a specialist in medical physics. However it is to be noted that the specialized training programme of the physicians is not clearly defined, and the same applies to the training programmes of the specialists in medical physics.
In conclusion, we believe that the issue of training in RP needs clear improvement in Portugal, and the purpose of this paper is to lay-out proposals that may contribute to achieve that aim.

Since the number of qualified experts in RP depends on the number and complexity of the equipments being operated, we start by presenting a sum up of the equipments installed.

Table 1 presents the most recent data concerning all licensed equipment in Portugal, gathered by the General-Directorate of Health. Figures are separated into five administrative regions: Alentejo, Algarve, Lisboa e Vale do Tejo, Centro and Norte. Equipments are grouped into 12 categories: CT scanner, Veterinary x-ray units, Dental x-ray units, Conventional x-ray units, Orthpantomograph units, Nuclear Medicine (gamma cameras), Mammography, Radioisotope laboratory, Bone densitometry, Brachytherapy, External radiotherapy (linear accelerators and cobalt units) and Industrial radiology (gammagraphy and radiography units, density meters, level meters, thickness meters,).

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Region	CT scanner	Vet. x-ray	Dental x-ray	Conv. x-ray	Ortho p.	Nuclear Medicine	Mammo.	Lab.	Bone dens.	Brachy.	External Radioth.	Ind. Rad.
Alentejo	10	6	30	19	6	0	14	2	10	0	0	6
Algarve	9	0	37	26	6	1	11	2	6	0	1	9
LVT	51	24	419	189	87	9	84	22	76	14	11	181
Centro	15	6	91	58	30	7	23	9	25	4	3	66
Norte	55	45	317	140	79	14	92	8	68	8	3	103
Total	140	81	894	432	208	31	224	43	185	26	18	365

Table 1. Licensed equipment in Portugal. (Source: Directorate-General of Health, 2005)

Fig 1 presents this data graphically. It is noticeable that equipment density is higher closer to the coast and in particular near Lisbon and Oporto. This distribution can be easily correlated with a population density map of the country. The southern and in-land regions have a lower equipment (and population) density.

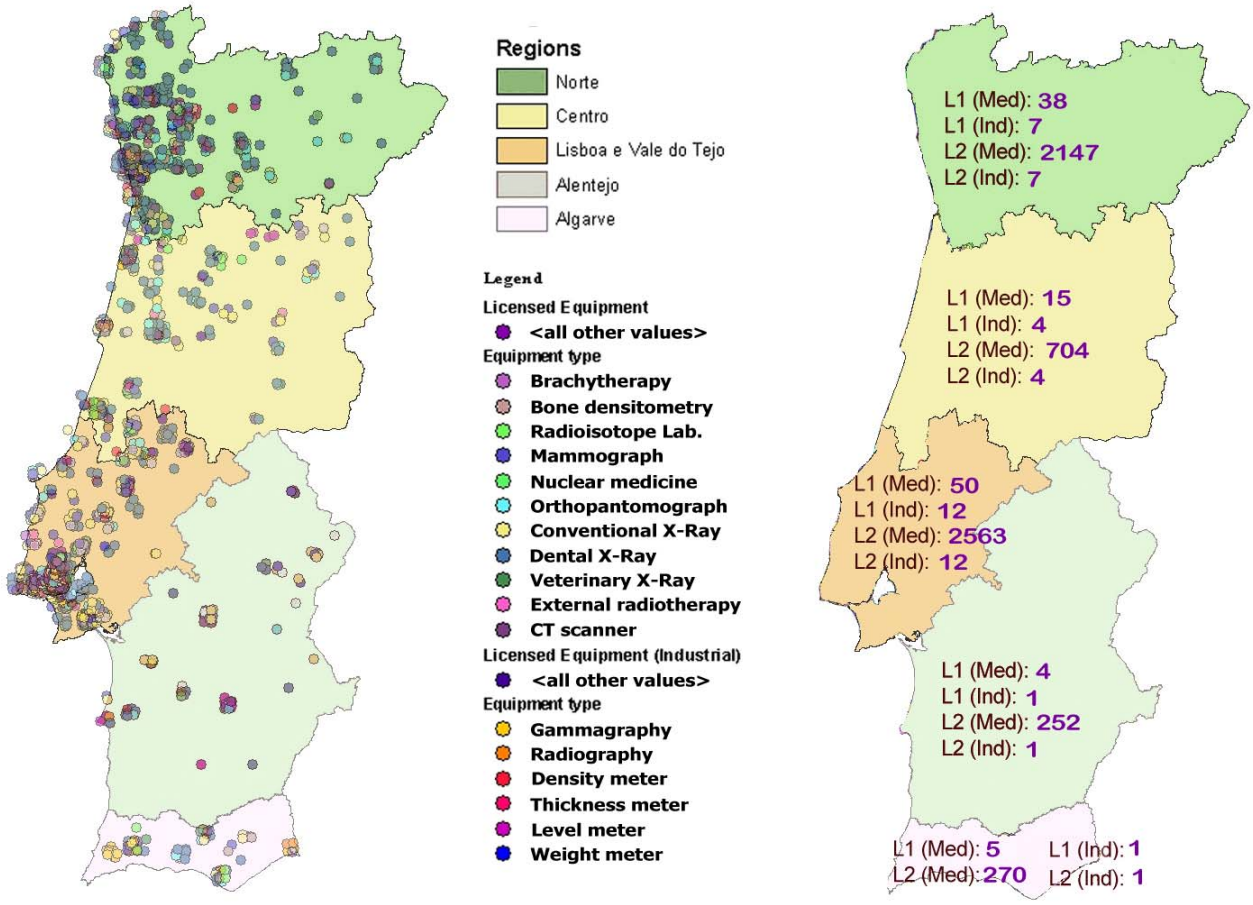

Fig 1. Equipment distribution and corresponding estimated personnel needs. (Source: Directorate-General of Health, 2005)

2. New legislative package

Several EU countries have professionals of RP with different degrees of qualification, requiring different level of education/training. Taking into account the present situation, a system with three qualification levels is proposed for Portugal (see Table 1): Qualified Expert in Radiation Protection (QERP) (higher level); Qualified Technician in Radiation Protection (QTRP) (intermediate level) and Operational Technician in Radiation Protection (OTRP) (lower level).
Table 2 presents the three different qualification levels, access requirements, typical duration of the training the programme, Institutions responsible for the course and for the certification.

	QERP	QTRP	OTRP
Access requirement	Physics University level	Physics, Chemistry, Medicine, Engineering University or Polytechnical level	Exposed workers
Duration	300 h in class+ Internship (6 months)	100 h in class including 10% (or more) dedicated to practical sessions	1 day or more
Programme	Based on AIEA course and EU syllabus	Adapted from the level 1 course	To fit the work environment
Training Entity	Partners: ITN+Central Hospitals+ AIEA (propos)	Partners: ITN+Central Hospitals+ AIEA (propos) or any Competent entity	Any entity approved by the competent authority
Certification	Regulatory authority or equivalent	Regulatory authority or equivalent	Regulatory authority or equivalent

Table 2. Qualification levels.

Full implementation of this proposal requires new legislative measures requiring that all operation of equipment that uses radiation sources must have the supervision of a QERP. Along this line we note that very recently an embryo of a Regulatory Authority bas been created by the Decree-Law n. 139/2005 dated of 19th August. Developments of this legal framework are necessary and expected.

3. Estimated personnel needs

In order to estimate the personnel needs for the entire country we multiplied the data included in table 1 by a factor of 1.3, on the basis that: (*i*) several facilities are still undergoing licensing; (*ii*) new facilities are scheduled to be installed; (*iii*) some licenses have expired and are awaiting renewal. Using this data and the reference personnel/equipment ratios presented in table 3 where applicable, it was possible to estimate the personnel needs for each type of equipment.

Equipment	QERP	QTRP
Linear accelerator	0.37	4
Conventional x-ray	0.03	2
Brachytherapy	0.18	0.4
Gamma camera	0.2	2

Table 3. Personnel needs for each type of equipment on a radiotherapy service (adapted from tables I and II from Annex II of Decree-Law nº 180/2002 of August 8th)

Some assumptions were made for the remaining equipment, namely, that CT scanners, bone densitometers and veterinary x-ray units have the same personnel needs as conventional x-ray units. For dental x-ray and orthopantomograph units, it was assumed that 1 QERP would be able to monitor 40 facilities. For radioisotope laboratories, it was assumed that they have the same personnel needs

as nuclear medicine units. For industrial radiology it was assumed that 1 QERP should handle 20 facilities.
Results from these estimates are presented in table 4 and graphically in Fig 1.

Region	QERP (Medical)	QTRP (Medical)	QERP (Industrial)	QTRP (Industrial)
Alentejo	4	252	1	1
Algarve	5	270	1	1
LVT	50	2563	12	12
Centro	15	704	4	4
Norte	38	2147	7	7
Total	112	5936	25	25

Table 4. Estimated personnel needs for each administrative region

The numbers presented in table 4 provide an estimate on the effort required to upgrade the present situation to an adequate level. The numbers should be considered round numbers since, on one hand, we are in presence of a dynamic situation (the numbers tend to grow), and on the other, there are already in the market many very qualified professionals that do not need to attend the training course to obtain the required qualification.

4. Conclusions
We have outlined a project to raise the level of qualification of professionals dealing with ionizing radiation and to upgrade the overall Portuguese safety standards. The project proposes both a new legislative package, and specific education and training programs for professionals dealing with medical and industrial radiation applications.

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