MEDICAL PHYSICS ORGANIZATIONS

MEDICAL PHYSICS EDUCATION AND TRAINING IN LATIN AMERICA: CURRENT STATUS AND CHALLENGES

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Abstract — Due to economic development in many Latin America countries, advanced diagnosis and treatment techniques are being constantly implemented. As a consequence, the need for qualified medical physicists has increased significantly. By acting as the interface between physics and medicine, the medical physicist can improve the effectiveness of both diagnostic and therapeutic medical radiation procedures. An analysis was made in Latin America countries to evaluate the education and training status of medical physics, mainly regarding the availability of courses, and certification and accreditation processes. Data was collected in collaboration with National Medical Physics Associations and Regulatory Bodies. The results indicated that even in radiotherapy where most of the efforts in education and training were initially concentrated, the number of physicists remains insufficient; the problem is worse in nuclear medicine and radiology where the number of both theoretical and practical courses is insufficient to meet the actual demand. It was also observed that most LA countries don't have a proper framework to apply international recommendations. The Medical Physics Associations in Latin America are very concerned about the potential consequences for patients and staff involved in medical radiation procedures. An action plan should be implemented urgently in Latin America, including setting minimum requirements for academic qualifications, continuing training and professional development, and a standard process for medical physicist accreditation which can be accepted in any country of the region. These actions might initiate a strengthening of medical physics in Latin America.

Keywords—Medical Physics, education and training, certification, Latin America

INTRODUCTION

Latin America (LA) is composed of 20 countries: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Ecuador, El Salvador, Guatemala, Haiti, Honduras, México, Nicaragua, Panamá, Paraguay, Peru, Republican Dominican, Uruguay and Venezuela. The total area is approximately 21,069,501 km², representing approximately 3.9% of Earth's surface, or about 14.1 % of its land area. In 2010, its population was estimated at more than 588 million inhabitants, representing 8.5% of the world population.

Despite wide differences in population, economy and health care assistance among constituent countries, some problems are similar throughout the region (Table 1).

In Table 1, it can be observed that for many countries there is no correlation between gross domestic product (GDP) and respective health care level. Cuba has a low GDP but their health care system provides a level I assistance for the population. On the other hand, although there has been significant economic development in Brazil and Chile, the health care remains at level II. This data suggests that the distribution of investment by governments does not always prioritise the health system.

The main problem remains the education and training of health professionals. Although new diagnosis and treatment techniques such as Computed Tomography (CT), Intensity-Modulated Radiation Therapy (IMRT), Positron Emission Tomography (PET), and Functional Magnetic Resonance Imaging (FMRI), amongst others, are being implemented in the region, investment in appropriately qualified staff for facilities providing such techniques are still deficient.

As member states of the United Nations and according to Pan American Health Organization (PAHO) resolution [4], Latin America countries have to be prepared to implement the IAEA General Safety Requirements - GSR Part 3 [5]. However, the requirements regarding the duties of medical physicists, and their qualification, training and competence, are not included in the legislation and consequently have not been implemented in most countries. The problem is more significant in nuclear medicine and diagnostic radiology

where historically the medical physicist has not been considered essential and has therefore not been accepted as much as in radiotherapy.

However, in the last decade, only a few countries have established medical physics courses to provide formal education, training and experience of clinical practice for different areas. In general these courses are not accredited and don't follow any standard or a minimum curriculum to ensure that they provide for the current needs of medical physics.

In order to obtain an overview of the current situation, the aim of this study was to verify the main aspects that affect the current status of medical physics education and training in Latin America region.

Table 1: Latin America countries social and economic characteristics * *No data*

Country	Population Thousands (2010) [1]	Physicians ratio 10,000 hab. [1]	Per capita GDP U$ (2011) [2]	Health Care Level (UNSCEAR) [3]
Argentina	40,412	32.1 (2004)	9162	I
Bolivia	9,93	4.9 (2008)	1978	II
Brazil	194,946	16.0 (2007)	10716	II
Chile	17,114	9.3 (2004)	11888	II
Colombia	46,295	15.0 (2008)	6223	II
Costa Rica	4,659	18.6 (2009)	7704	II
Cuba	11,258	66.3 (2008)	5704	I
Dominican Republic	9,927	13.2 (2008)	5195	II
Ecuador	14,465	16.2 (2007)	4073	I
El Salvador	6,193	20.1 (2008)	3426	II
Guatemala	14,389	9.9 (2008)	2882	III
Haiti	*	*	*	*
Honduras	7,601	3.0 (2008)	2026	III
Mexico	113,423	14.0 (2006)	9101	II
Nicaragua	5,788	16.4 (2003)	1132	II
Panama	3,517	13.4 (2008)	7614	I
Paraguay	6,455	13.0 (2008)	2771	II
Peru	29,077	9.2 (2009)	5411	II
Uruguay	3,369	29.0 (2009)	11952	I
Venezuela	28,98	13.0 (2007)	13503	I

MATERIALS AND METHODS

During 2011-2012, a questionnaire was prepared and sent to the medical physics associations or, where an association was not established, a representative of the national regulatory body was invited to participate. The countries which collaborated were: Argentina, Brazil, Costa Rica, Colombia, Chile, Ecuador, El Salvador, Guatemala, México, Nicaragua, Peru, Panamá, Republic Dominican, Uruguay and Venezuela. Although there are 20 countries in Latin America, in this survey it was only possible to obtain the data from 19 countries, and furthermore the responses from some countries were not complete.

The main topics were: status of medical physicist recognition, legislation, number of installations and equipment per area, education and training, beyond certification and accreditation program.

RESULTS

Despite the difficulty in obtaining all the relevant information, the responses to the questionnaires were received by mail. It must be emphasised that this data was considered properly provided by the participants.

Because some of the information sent by the participants was incomplete, the results were collated and are discussed below.

The number of medical physicists in each country is presented in Figure1 where it can be seen that 8 countries, 40% of the total, have no registered or certified medical physicists.

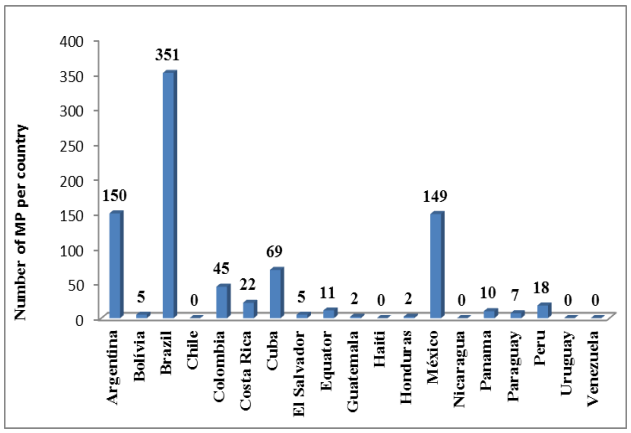

Figure 2. Number of Medical Physicists for each LA country.

As expected, the distribution by specialty confirms that there is an obligation established by law or regulation of the availability and qualification of medical physicists in radiotherapy, which does not happen in other areas. It can be seen from Figure 2 that 72% of medical physicists are working in radiotherapy, where the risk has always been considered higher than diagnostic radiology and nuclear medicine. However, due to the complexity of newer equipment, plus the need for individualised dosimetry studies and radiation protection reasons, the work of this

professional is also essential for the proper performance of a service in the other applications of ionising radiation.

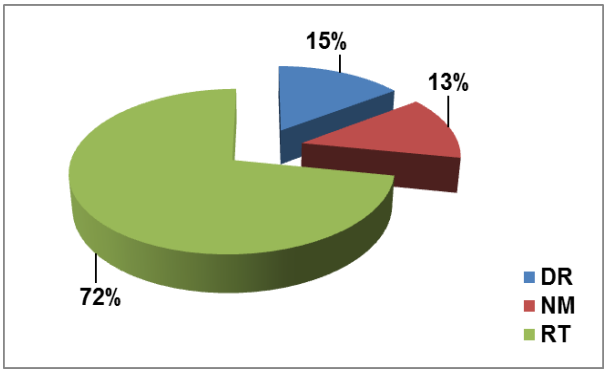

Figure 2. Number of Medical Physicists for each specialty: Diagnostic Radiology (DR), Nuclear Medicine (NM), Radiotherapy (RT)

Considering the number of medical physicists certified in each country it can be concluded that there isn't a formal process of regulation of the profession, or even a certification scheme established in each country. However, one fundamental problem is the lack of available basic training for medical physicists, even at undergraduate level. Figure 3 shows the degree courses for each country, where ~~it~~ can be seen that undergraduate courses in Medical Physics are established only in Argentina, Brazil, Nicaragua, Uruguay and Venezuela, totalling 25% of the participating countries.

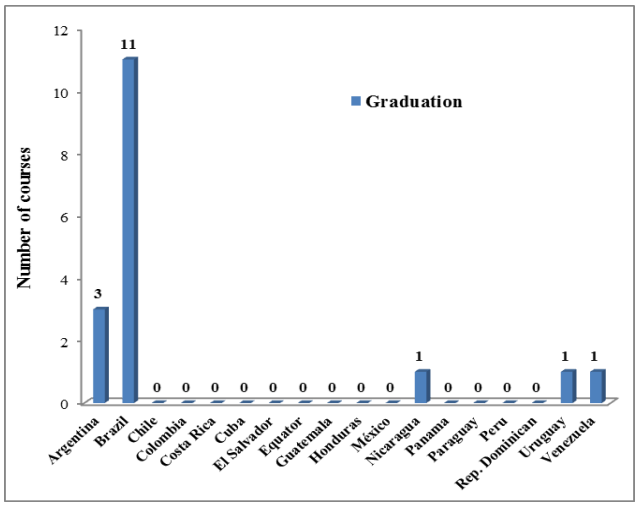

Figure 3. Number of Medical Physics courses for each LA country.

This information is rather contradictory when compared to the number of medical physicists available in each country, as shown in Figure 2. For example, there are courses in Nicaragua, but no certificated medical physicists. There is also the issue of recognition of the profession in each country –for example in Brazil, where there are 323 trained and certificated medical physicists, but the profession is not yet recognised by the Ministry of Labour.

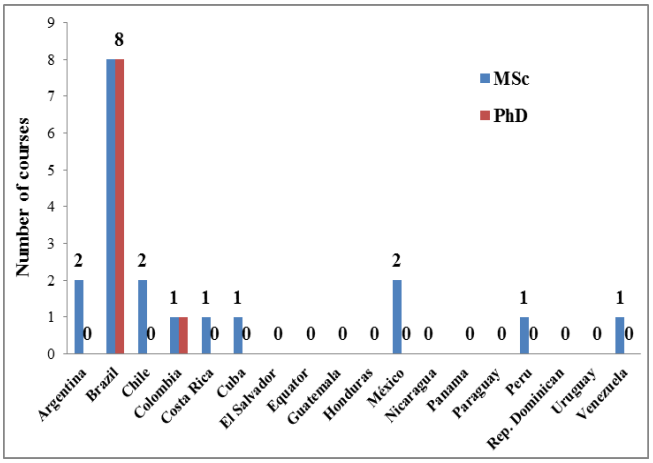

Figure 4. Number of Medical Physics post-graduation courses for each LA country

In the absence of courses in their own countries, many professionals, looking to get specialization, have to go abroad where there are postgraduate courses already established. Figure 4 shows the Master of Science (MSc) and PhD degree courses available in the region. It can be seen that in some countries, such as Peru or Chile, there are MSc and PhD courses but no undergraduate courses.

Another problem is the need for clinical practice training that is fundamental to the development of medical physicist competence. Only a few hospitals and clinics are now accredited to provide this training; Figure 5 shows the number of practical training placements available annually for each country.

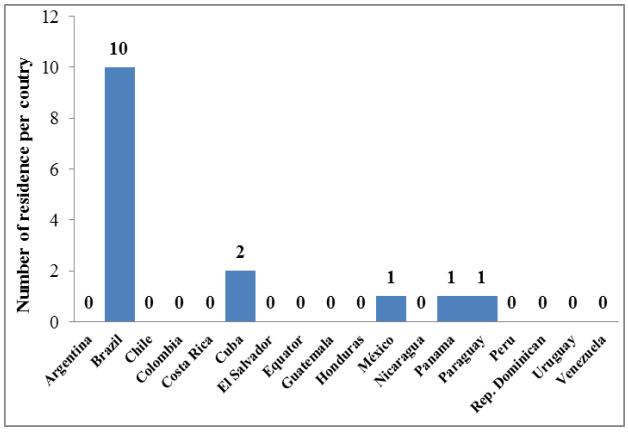

Figure 5. Number of hospitals and clinics providing clinical practice training in Medical Physics

Even in Brazil, where there are at least 10 accredited hospitals for clinical training, the number of hours of practice differs greatly from place to place. Moreover, the annual number of vacancies is not enough to meet the demand, as shown in Table 2.

Table 2: Placements for MP clinical practice training available in Brazil.

Institution	Period (hours)	Annual vacancies
1	3380	6
2	3900	3
3	3940	2
4	3840	2
5	4000	1
6	1920	2
7	1920	1
8	3800	1
9	3800	3
10	6240	1

It should be recognised the role of associations in labor regulation and certification of the professionals. Figure 6 shows the percentage of countries that have a Medical Physics Association, an established certification process and the recognition by law of Medical Physics as a professional.

It can be seen that 50% of the countries have a Medical Physics Association in place, but a professional accreditation process is only established in 17% of them. To corroborate with this, recognition of the profession is not established for most of the countries - only 11% of the countries have adequate legislation providing such recognition.

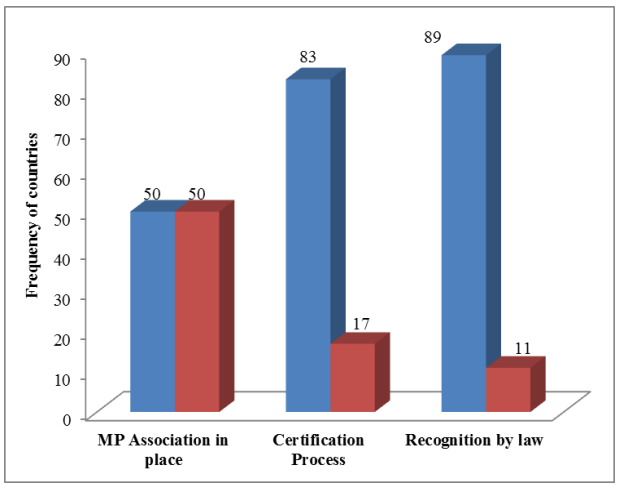

Figure 6. Frequency of: MP Association established in LA countries (formal and informal); countries with established certification process; countries where the MP professional is recognised by law.

CONCLUSIONS

There are several problems to be addressed in order to improve the situation of the profession of medical physicist in LA. ALFIM would like to start convening the Class Associations to work together in defining a comprehensive plan of action.

The proposal is the establishment of the following parameters:

- Legislation;
- Regulatory requirements;
- Educational;
- Certification Process.

Participation of the Education, Labour, and Health ministries of each country is paramount to the success of this plan.

None of these subjects have a lower importance and must all be treated simultaneously. The establishment of minimum requirements for a syllabus, and the required number of hours of theory and clinical practice training is considered to be a good start.

Knowledge of the situation in other regions and already-established models such as that recently published by the European Community will be used to establish policies for the LA region.

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REFERENCES

1. Pan American Health Organization – PAHO. Health Situation in the Americas Basic Indicators (2011).
2. United Nations website http://data.un.org. Database GDP per capita (2012)
3. United Nations Scientific Committee on the Effects of Atomic Radiation UNSCEAR 2008 Report Volume I: General Assembly, Scientific Annexes (2008).
4. Organización Panamericana de Salud - OPAS, Resolución CSP28/1, Rev.1. Protección Radiológica y Seguridad de las Fuentes de Radiación: Normas Básicas Internacionales de Seguridad, 28ª Conferencia Sanitaria Panamericana, 64ª Sesión del Comité Regional, 2012.
5. International Atomic Energy Agency - IAEA, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards – GSR Part 3, 2011.

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