Manuscripts published in a special issue of the journal RADIOPROTECCIÓN regarding the Ibero-American Conference on Radiation Protection in Medicine (CIPRaM)

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IAEA
International Atomic Energy Agency

IRPA
International Radiation Protection Association

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Index

Introduction

The publication presents the English and Portuguese translations of the content from the monographic publication in "Radioproteccion", Journal of the Spanish Society for Radiological Protection (no. 87, January 2017), dedicated to the Ibero-American Conference on Radiological Protection in Medicine (CIPRaM) that was held in Madrid between the 18th and 20th of October 2016.

CIPRaM was the fruit of the combined labour of eight entities, including six international organizations; the World Health Organization (WHO), the Pan American Health Organisation (PAHO), the International Atomic Energy Agency (IAEA), the International Commission on Radiological Protection (ICRP), the International Radiation Protection Association (IRPA) and the Ibero-American Forum of Radiological and Nuclear Regulatory Agencies (FORO) – and two Spanish institutions – the Nuclear Safety Council (CSN) and the Ministry of Health, Social Services and Equality (MSSSI).

The objective of this Conference was to promote in Ibero-American countries the application of technical standards for radiation safety within the health sector, and to support the implementation of the ten priority actions identified in the *Bonn Call for Action.*

The Nuclear Safety Council, through its effort to disseminate and communicate internationally the significant results obtained from this Conference, and responding to the numerous requests received from international organizations and experts within the health sector, professing interest in obtaining this information in English, and with agreement from the SEPR and WHO, has produced an English and Portuguese translation of the monographic issue from the Radioprotection journal published by the SEPR.

It is the Nuclear Safety Council's interest in facilitating the exchange of information and communication between all stakeholders involved in this area that will undoubtedly lead to an improvement in the application of radiological protection in the medical sector.

Editorial

Ibero-American Conference on Radiation Protection in Medicine

Eliseo Vañó (International Commission on Radiological Protection, ICRP, Committee on Protection in Medicine) and Maria del Rosario Perez (World Health Organisation - WHO)

It is our pleasure to present this RADIOPROTECCIÓN Journal supplement dedicated to the Ibero-American Conference on Radiological Protection in Medicine (CIPRaM) held in Madrid, Spain, between the 18th and 20th October, 2016.

The first article of this supplement presents a global historical overview of radiological protection in medicine, from the beginning of the last century through to the present, in the context of which the CIPRaM was held. Two previous international conferences - in Málaga in 2002, and in Bonn in 2012 - marked milestones with regard to this issue. That period also saw the revision of the basic international and European radiological protection norms, which substantially expanded the safety requirements for exposure to ionising radiation as a medical practice.

CIPRaM was the fruit of the combined labour of eight entities, including six global and regional organisations - the World Health Organisation (WHO), the Pan-American Health Organisation (PAHO), the International Atomic Energy Agency (IAEA)), the International Commission on Radiological Protection (ICRP), the International Radiological Protection Association (IRPA) and the Ibero-American Forum on Radiological and Nuclear Regulatory Organisations (FORO) - and two Spanish institutions - the Nuclear Safety Council (CSN) and the Ministry of Health, Social Services and Equality (MSSSI). These eight entities agreed to jointly organise a conference to promote the implementation of the new basic radiological safety standards in the health sector in the Ibero-American countries, and to support the implementation of the ten priority actions identified in the "Bonn Call for Action".

A total of eleven representatives from the co-organising entities who were members of the Coordinating Committee and the Organising Committee, joined by eighteen experts from eleven countries who were members of the Programme Committee, worked for nearly two years on preparing the CIPRaM. One of the desires of the co-organisers of the CIPRaM

was that the conference should be representative not only of the geographical origins of those who contributed to it, but also in terms of their profession and profile. We are proud to say that this wish has now been granted.

The CIPRaM proved to be a powerful convening force, as evidenced by the 255 registered attendees, originating from 22 different countries, who participated actively in the discussions. The conference featured 99 invited speakers, panelists, chairpersons and reporters. Among them were radiologists, specialists in nuclear medicine and radiotherapists, medical physicists, radiation protection specialists, imaging technicians and radiotherapists, nurses, patient representatives, health sector regulators, radiological protection regulators, university teachers, researchers, manufacturers of medical equipment and representatives of international organisations.

Thanks to the concerted efforts of the co-organisers, half of the invited speakers were from Latin American territories. This allowed for a far-reaching exchange of experiences and views, balanced between representatives from the Iberian Peninsula and from Latin America. This exchange demonstrated that, while the situations may be different on both sides of the Atlantic, the challenges and some of the opportunities to improve radiological protection in medicine are similar. It also proved that within the context of diversity, it is possible to identify common solutions, agree on proposals and establish bases for cooperation.

The CIPRaM was a singular event not only in terms of its character and content, but also in its structure and format. The themed sessions, organised by discipline or sector and implemented through invited presentations, round tables run by multidisciplinary panels and open discussions, were focused on the identification of priority issues regarding radiological protection in the healthcare field, possible solutions and indicators of progress. The format received positive feedback from attendees, who saw it as innovative and efficient.

A unique feature of the CIPRaM was the interaction of nearly one hundred speakers prior to the conference, during the preparation phase of the sessions, as part of a team exercise coordinated by the Programme Committee and facilitated by the Secretariat. This interaction was maintained throughout the meeting, during the preparatory meetings for each session, the preparation of the summaries and the preparation of the conclusions. The collective work continued after the conference during the preparation of the articles that make up this RADIOPROTECCIÓN Journal supplement, in which the reader will find the description and conclusions of each of the eight themed sessions.

We hope that the information presented in this RADIOPROTECCIÓN Journal supplement may prove to be useful material for those working in medicinal radiological protection in the countries of the region.

Historical overview of Radiological Protection in medicine

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Abstract

The use of ionizing radiation produces large benefits in diagnostic imaging and radiotherapy. On the other hand, the adverse effects of radiation were observed in medical applications from the outset. That is why, at the second International Congress of Radiology (ICR), held in Stockholm in 1928, what is now known as the International Commission on Radiological Protection was established. For 22 years, ICRP publications were mainly devoted to occupational and public protection, but patient protection was excluded from them until 1966. It was also excluded until 1996 from the international standards established by the IAEA. Thereafter, an intense international activity is being developed in the area protection of patients. These activities culminated in the first international conference in Malaga in March 2001. From the Conference the International Plan of Action emerged, under which a series of coordinated activities were developed. Ten years after the approval of the Plan, the second conference was held in Bonn, 2012, which ambrazed all radiological protection in medicine, which led to the "Bonn Call for Action". In addition to identifying ten priority actions, this call puts emphasis on harmonizing activities among international organizations, professional associations, national radiation protection regulatory bodies and health authorities, as well as representative organizations of patients. The result of all this will be reviewed at the third conference to be held in Vienna in 2017.

KEY WORDS: medical exposure, radiation protection of patients, history of radiation protection

Beginnings

Medicine has been associated with radiation since the discovery of X-rays by W. C. Röntgen in 1895. The first adverse effects of the radiation occurred in researchers and in the

personnel who took X-ray pictures. After the discovery of radioactivity by H. Becquerel in 1896 and the subsequent discovery of radium by Marie and Pierre Curie in 1898, new radiation-induced lesions occurred. However, these undesirable effects did give rise to the idea of producing intentional tissue damage, paving the way for radiotherapy (Lindell, 1996 and Clarke, 2005). The first treatment of a cancer patient took place in Sweden in 1899 (Mold, 1993). At the second International Congress on Radiology (ICR), held in Stockholm in 1928, the ICRP[1] (as it is now known) was established, with its initial name being the 'X-ray and Radium Protection Committee'. Rolf Sievert became its first president at age 28 (Lindell de 1996, Clarke 2005). The first recommendations of the then-Committee were published in 1928, aimed at protecting professionals working in radio diagnostics and radiotherapy, and throughout the 22 years that followed (1928-1950) the work of the Committee was mainly concerned with occupational and public radiological protection in medicine.

The ICRP has begun publishing recommendations regarding patient protection.

The protection of patients was excluded from ICRP recommendations until their 9th publication in 1966. Subsequently, the first working group specifically responsible for the protection of patients undergoing X-ray diagnosis was created, resulting in Publication 16 in 1970. This publication was followed by three papers on radiodiagnosis, radiotherapy and nuclear medicine respectively.

The end of the 20th century marked a milestone for the ICRP with the introduction of a series of concise publications, intended to address specific issues that can arise in the various specialist medical fields where radiation is used. Since then, over 20 publications have appeared covering topics such as prevention of accidental exposure during radiotherapy, radio-lesions during interventional procedures, management of radiation doses in digital radiology and computed tomography, protection in paediatric radiology and many others.

International standards and intergovernmental organisations

The statutory function of the International Atomic Energy Agency (IAEA) with respect to security is "to establish or adopt, in consultation and, where appropriate, in collaboration with the competent organs of the United Nations and with the specialised agencies concerned, standards of safety for protection of health (...) and to provide for the application of these standards... ".

Similarly, the Constitution of the Pan-American Health Organisation (PAHO), established in 1902, states that PAHO "shall (...) promote and coordinate efforts of the countries of the Western Hemisphere to combat disease, lengthen life, and promote the physical and mental health of the people..." The PAHO established its Radiology and Radiation Protection Programme in 1960 to promote the role of public health authorities in the field of nuclear energy applications, and since its inception the safe use of ionising radiation in medicine has been one of its main lines of work (OPS 2010).

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[1] ICRP is the English-language acronym for the current International Commission on Radiological Protection.

The International Basic Safety Standards (BSS), co-sponsored by 8 international organisations[2], are based on information on radiation effects published by the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), the recommendations of the ICRP and the input of relevant intergovernmental organisations, in particular the World Health Organisation (WHO and the Pan-American Health Organisation (PAHO). The first protection and security measures were published in March 1960, and the first basic safety standards in June 1962. Those standards were revised in 1967, 1982 and 1996, and most recently in 2014 (OIEA, 2014). Radiological protection of patients was excluded from the standards until the 1996 edition. Since then, patient protection has been an important part of international standards.

The 2014 edition of the BSS is based, amongst other factors, on the most recent recommendations from the ICRP (ICRP, 2007), including, in particular, "planned exposure situations", "emergency exposure situations" and "existing exposure". Medical exposure requirements in planned-exposure situations apply to all medical exposures, including planned, unplanned and accidental exposures. This edition emphasises the requirements for medical exposures, and efforts are being made to provide recommendations and guidance as to how to meet these requirements for the safe use of radiation in medicine as set out in the BSS. These recommendations include the publication of a safety guide on radiation protection and safety in medical uses of ionising radiation (IAEA, in press) co-sponsored by the ILO, the WHO and the PAHO.

The first two International Conferences

In the 1980s and 1990s, medical exposure received increased attention due to the following factors: 1) large-scale studies of image quality and patient exposure, conducted in the USA, in Europe, and later in other countries, showed considerable differences in dosage for the same type of procedure; 2) publications concerning severe skin lesions in patients resulting from interventional procedures and 3) compilations published by the IAEA and the ICRP regarding very serious accidental exposures in radiotherapy.

It was against this backdrop that the first International Conference on the radiological protection of patients was held in Málaga, Spain in March 2001. The most significant outcome of the conference was the demand to formulate a plan of action, in which the IAEA, the WHO, the PAHO, the EC and various professional associations interested in radiological protection of patients participated. This Action Plan was approved by the IAEA governing bodies in 2002 and is intended to ensure that radiological protection is an integral part of medical practice, recognising the benefits of medical radiation and radiation protection without limiting those benefits.

Within the framework of this Action Plan, the IAEA has carried out a number of activities, such as the development of standards, guidelines and training materials, a website

2 International Atomic Energy Agency, International Labour Organisation, Food and Agriculture Organisation of the United Nations, World Health Organisation, Pan-American Health Organisation, United Nations Environment Programme, European Commission and Energy Agency Nuclear Organisation of the Organisation for Economic Co-operation and Development.

dedicated to patient radiological protection (rpop.iaea.org) that receives more than 60,000 visits per month, an international campaign to improve medical exposure justification processes, in collaboration with the WHO and other agencies, the development of a method for long-term tracking of an individual patient's radiological history (smart card), shared learning of safety-relevant incidents in radiation therapy (SAFRON), and X-ray guided interventional procedures (SAFRAD).

In December 2008, the WHO launched a global initiative regarding radiological safety in healthcare that addresses public health issues related to the use of radiation in medicine, and includes activities related to risk assessment, management and communication (Perez and Mikhail, 2015).

Ten years after the adoption of the International Plan of Action, the "International Conference on Radiation Protection in Medicine: Setting the Scene for the Next Decade" was held. The Conference took place in Bonn, Germany in December 2012 and was organised by the International Atomic Energy Agency (IAEA), co-sponsored by the World Health Organisation (WHO), and in cooperation with other intergovernmental organisations, including the PAHO. The most significant outcome of the conference was the so-called "Bonn Call for Action", which identifies ten priority measures to improve radiological protection in medicine.

Overview of the "Bonn Call for Action"

The increasing use of radiation in medicine for diagnostic, therapeutic and interventional purposes is beneficial for hundreds of millions of people every year. More than 10 million diagnostic radiology procedures and 100,000 nuclear medicine diagnostic procedures are performed every day. Ionising radiation is also used in 14,000 radiotherapy sessions every day. Current issues surrounding patient radiation protection include the fact that a significant number of the diagnostic imaging tests performed are unnecessary. In addition, reports on radio-lesions continue to appear in cases that affect safety, which increases the need for accident prevention measures.

As such, a holistic approach is needed, one that would involve the cooperation of national governments, civil society, international organisations, researchers, educators, professional associations and institutions, in order to identify, promote and implement solutions to meet the existing and emerging challenges; and leadership, harmonisation and coordination of activities and procedures at the international level are also needed. The most significant outcome of the conference was the so-called "Bonn Call for Action", which identifies ten priority measures to improve radiological protection in medicine in the coming decade. The objectives of this Call are: a) to strengthen radiological protection of patients and health professionals in general; b) to achieve the greatest benefit with the lowest possible risk for all patients, via the safe and appropriate use of ionising radiation in medicine; (c) to facilitate the full integration of radiation protection into healthcare systems; (d) to help improve benefit-versus-risk dialogue with patients and the public; and e) to improve the safety and quality of medical radiological procedures.

The ten priority actions are as follows:

1) Encourage application of the principle of exposure justification, using the criteria known as “the 3 As” (awareness, appropriateness and audit), which means: 1) be aware of the exposure if a patient is going to be subjected to radiation, 2) understand the clinical indications from imaging tests and 3) perform audits. To do this, it is necessary to develop and apply clinical criteria for the correct application of evidence-based diagnostic imaging tests and to promote the use of electronic means to support decision-making.

2) Intensify the application of the optimisation principle, using reference levels for diagnosis, quality-assurance programmes and solutions for recording patient exposures.

3) Increase manufacturers’ contributions to security, incorporate radiation protection features into equipment and software as part of the default configuration of equipment, rather than an option, improve the training of users in protection and security issues, comply with applicable regulations, facilitate the sustainability and maintenance of equipment in places with scarce infrastructure and strengthen collaboration and communication between manufacturers, health professionals and users of equipment.

4) Provide more intensive training on radiological protection for health professionals, both globally and in ways specific to each speciality, and integrate such training into professional teaching programmes, facilitating collaboration between training centres and the use of the Internet.

5) To design and promote a strategic research programme for radiological protection in medicine, recognising that among all artificial sources of radiation, medical exposure accounts for the highest contribution to exposure; intensify research into the effects of low-dose radiation, especially on children and pregnant women, as well as individual radiosensitivity and hypersensitivity; the possible identification of biological markers that are specific to radiation; and improved methods for estimating patient doses.

6) Increase the availability of improved global information on medical exposures and occupational exposure in medicine; promote cooperation to collect data on dosage and trends.

7) Improve prevention of medical incidents and accidents involving radiation by supporting participation in voluntary case registration systems for educational purposes and by applying lessons learned from experience; harmonise taxonomy and communication tools, such as event severity scales; incorporate risk analysis methods, in addition to external radiotherapy, also brachytherapy, interventionism and therapeutic nuclear medicine.

8) Strengthen radiological safety culture in health care, recognising that leadership is a critical element; encourage cooperation between regulatory bodies, health authorities and professional societies, learning from best practices in other areas such as the nuclear and aviation industries; integrate radiation protection into health technology assessments; promote recognition of medical physics as an independent profession in the healthcare field, with responsibilities in the field of radiation protection; improve information on radiation protection among professionals using advances in information technology.

9) Encourage dialogue on the risks and benefits of the use of radiation among health professionals, patients and the public; improve risk communication skills, engage communication experts, work to facilitate information-based patient decisions.

10) Strengthen implementation of global safety regulatory requirements; develop guidance on how to apply international basic safety standards in healthcare; establish an adequate legislative and administrative framework for the protection of patients, workers and the public on a national level, including on-site inspections to identify deficits in the application of those requirements.

The IAEA and WHO / PAHO are collaborating closely to support the implementation of these ten priority actions in their Member States. Other international organisations and professional associations are taking these priority actions into account whilst developing their strategic plans with regard to radiological protection. The next International Conference on Radiological Protection in Medicine will be held in Vienna on the 11th-15th December 2017. The main objectives are to review the implementation of the "Bonn Appeal to Action", to harmonise activities between international organisations, professional bodies, national radiation protection regulators and health authorities, as well as organisations that represent patients; and to examine new developments affecting radiological protection in medicine.

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Ibero-American Conference on Radiation Protection in Medicine (CIPRaM)

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Abstract

Radiation Protection (RP) in Medicine remains a challenge as the use of ionizing radiation in diagnosis and therapy provides undisputed benefits. In December 2012, an international conference held in Bonn on this topic identified the main goal as "setting the scene for the next decade". The "Call for Action" derived from that conference highlighted the need for a holistic approach to radiation safety in Medicine and for a full integration of RP into healthcare systems. The Ibero-American Conference of Radiation Protection in Medicine (CPRAaM) was born as an initiative of the WHO and several Spanish Institutions. Other international organizations joined the initiative. The three primary objectives of the CIPRaM were: a) identifying the main problems concerning RP in Medicine (ranked in order of priority); b) suggesting possible solutions and c) developing indicators to be used to assess progress with the solutions proposed. CIPRaM was organized based on 8 topical sessions, four of them related to the most common ionising radiation uses in medicine: diagnostic radiology, image-guided interventional radiology, nuclear medicine, and radiation therapy. These sessions were complemented with four other sessions based around a common theme: the different perspectives of RP in medicine: Health and RP authorities, technicians (technologists) and nurses, medical physicists and radiation protection specialists, and universities and research organizations. As a result of this conference, the most relevant problems in RP in Medicine as well as possible solutions and progress indicators for the short and medium term were identified in the Region. CIPRaM conclusions will also be of some use to the forthcoming International Conference on RP in Medicine, organized by the IAEA in Vienna, in December 2017.

KEY WORDS: radiation protection, competent authorities, diagnostic radiology, radiotherapy, nuclear medicine

Background, hosts and involved entities

Radiation protection (RP) in Medicine continues to be a challenge because of the undeniable benefit of the use of ionising radiation in diagnosis and therapy. Such use implies an increase in the number of procedures, the number of professionals involved and the need to maintain adequate standards of radiological safety in the healthcare field. Recently, the publication of the International Basic Safety Standards (BSS) [1] and European Directive 59/2013 / EURATOM [2], following the recommendations of the International Commission on Radiological Protection (ICRP) [3,4] firmly establishes the need to update existing RP regulations in many countries.

The International Atomic Energy Agency (IAEA), the World Health Organisation (WHO) and the Pan-American Health Organisation (PAHO) have always been at the forefront of promoting the safe use of ionising radiation in medicine. In March 2001 the IAEA, together with the WHO, the PAHO and the European Commission (EC), promoted the International Patient RP Conference in Málaga, Spain, which resulted in a highly relevant Action Plan. In December 2012 a second conference was held in Bonn, Germany, with similar goals to the previous one in Málaga and "setting the stage for the next decade". A"Call to Action" resulted from that Conference, identifying ten very specific priority actions [5]: justification and optimisation of medical procedures that use ionising radiation; strengthening the role of manufacturers in radiological safety; improvement of RP training; the promotion of a strategic RP research agenda; improving global information on medical and occupational exposures; improving prevention of incidents and accidents; the strengthening of radiological safety culture in medicine; the promotion of a better risks-versus-benefits dialogue and stronger implementation of security requirements (BSS).

The Bonn Conference highlighted the need for a holistic approach to radiological safety in medicine, including the collaboration of national governments, civil society, international agencies, researchers, educators, and professional associations and institutions in order to identify, propose and implement solutions to address existing and emerging challenges; as well as leadership, harmonisation and coordination of activities and procedures at the international level.

We should in particular highlight one of the objectives of the Bonn Conference because of its relevance and timeliness: that of "contributing to the full integration of radiation protection within the healthcare system". New diagnosis and therapy technologies, and the enormous benefits of incorporating them into health centres, often mean that radiological safety aspects take a back seat and are not fully integrated into healthcare systems.

The Ibero-American Conference on Radiological Protection in Medicine (CIPRaM) was born as an initiative of the World Health Organisation (WHO) and two Spanish institutions: the Nuclear Safety Council (CSN) and the Ministry of Health, Social Services and Equality (MSSSI), which were hosted by the Pan-American Health Organisation (PAHO), the International Atomic Energy Agency (IAEA), the International Commission on Radiological

Protection (ICRP), the International Association for Radiological Protection (IRPA) and the Ibero-American Forum of Radiological and Nuclear Regulatory Organisations (FORO). It was held in the auditorium of the Spanish Ministry of Health headquarters in Madrid, Spain, between the 18th and 20th October, 2016.

Objectives of the conference

The main objective of the CIPRaM was to verify the progress made regarding the priority actions proposed in the "Bonn Call for Action", to identify problems with implementing these actions, to propose possible solutions and to define indicators of progress. These CIPRaM objectives have been raised as "new" ones which could only be pursued jointly, following the holistic approach suggested in the conclusions document from the Bonn Conference.

We have a good understanding of what needs to be done to improve RP in Medicine. This was clearly defined in Bonn and will probably be updated at the next International Conference, which will be organised by the IAEA in Vienna, Austria, in December 2017. But what we have never done until now is identify and prioritise the relevant problems in RP in Medicine and suggest solutions "in the Region" (Latin America).

The speakers were asked for a comprehensive approach of this nature. They were asked not to address the problems they have in a particular centre or in a particular country, but in the region. This required a major effort on their part to contact colleagues in other countries, medical societies and regional organisations to identify those problems. Both the panelists and the Conference attendees helped to refine those issues and prioritise them.

The three primary objectives proposed for the Conference were:

a) Identify problems related to radiological protection in the healthcare field (in order of priority).

b) Suggest possible solutions to those problems.

c) Formulate indicators to evaluate the progress of the proposed solutions.

It was intended that the Conference should also be an opportunity for the exchange of information and experience gained in recent years in relation to medicinal RP, and to establish and strengthen ties of cooperation between the countries of Latin America with regard to this issue.

Working method (opening and themed sessions)

In the opening session, the hosts' welcoming speech was delivered, along with messages from all the International Organisations involved. The Introduction session began with a global historical perspective on RP in medicine, followed by the presentation of the conference, its objectives and its work methodology. The rest of the programme was grouped into eight themed plenary sessions organised around various sectors and disciplines, including

a keynote presentation by an expert in the relevant sector or discipline and a panel discussion by a panel of representatives from stakeholders in the sector or discipline in question (the "stakeholders"), each followed by a discussion in which all the attendees participated.

Themed sessions addressed the four most relevant areas with regard to the medical use of ionising radiation:

- Medical radiology and dental radiology
- Image-guided interventionism
- Nuclear medicine
- Radiotherapy

These sessions were complemented by an overview (problems and contribution to the solutions) concerning:

- Healthcare authorities and RP
- Technicians (technologists) and nursing staff
- Specialists in Medical Physics and Radiological Protection
- Universities and investigation

Working method (conclusions and final discussion)

Each session was attended by two co-chairpersons, who managed the progress of the meeting, coordination of the discussions, presentation of the preliminary conclusions at the end of the conference, and coordination of the preparation of the articles in this issue of the "Radioprotección" journal, published by the Spanish Society for Radiological Protection (SEPR).

Those reporting on the sessions collaborated in preparing the digests for each day, and contributed to identifying the most relevant of the presentations, discussions and interventions by the attendees for incorporation into the articles that make up this issue of the Radioprotección Journal.

The speakers prepared summaries in advance concerning their overviews of the problems, solutions and follow-up indicators for their respective themed sessions. The panelists analysed the material shared by the speakers ahead of the conference and forwarded their comments, in some cases suggesting additional aspects beyond those cited by the speakers. Finally, the conference attendees had the opportunity to make additional comments at each of the sessions, which were collected by the reporters.

Outcomes

The Conference brought together 255 participants from 22 countries. Out of a total of 99 invited speakers (chairpersons, reporters and panelists), 47 came from Latin Ameri-

can countries. This allowed for the opinions, perspectives and experiences of both Latin America and the Iberian Peninsula to be expressed in an equitable manner. The outcomes obtained were the result of the exchange of information and experiences between regulators, professional societies and other parties interested in applying good clinical practices and the radiological protection standards and recommendations of the healthcare sector.

Existing problems were presented in order of priority, along with possible solutions and indicators of progress for the short and medium term. The second stage will involve identifying problems common to differing themed areas, and the possibility of unifying global solutions will be assessed and the current status and future priorities of the implementation of the "Call to Action" of the Bonn Conference will be evaluated on regional and national levels.

The results obtained will establish the basis for proposing a road map to solve the problems identified and to identify mechanisms to enhance the catalytic role of international agencies and existing regional structures and networks.

The outcomes of the CIPRaM are also expected to be useful at the forthcoming International Conference, to be held by the IAEA in Vienna in December 2017.

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“Medical radiology and dental radiology” session

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Abstract:

This article summarizes the conclusions of the session on “Medical Radiodiagnosis and Dental Radiology” during the Iberoamerican Conference on Radiation Protection in Medicine (Madrid, Spain, October 2016). The main problems identified were: significant number of unjustified radiological procedures, insufficient optimization of protection in radiological procedures, lack of Diagnostic Reference Levels (DRLs), lack of RP continued education and training programs, need to strengthen RP culture in health care including risk/benefit dialogue; and lack of an effective regulation in radiodiagnosis. The following solutions were proposed: adoption/adaptation of referral guidelines for referring physicians and use of IT support solutions; elaboration of quality control handbooks and protocols adapted to the clinical purpose, establishment of DRLs and use of dose management tools; introduction and integration of RP in the pre- and post-graduate education; higher

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clinical interaction between radiologists and their colleagues and patients, use of adverse event reporting systems, promotion of RP campaigns, alliances and message dissemination emphasizing benefits/risks; periodical update of RP regulations in radiodiagnosis and capacity building for regulatory inspections. The following progress indicators were suggested: number of countries with referral guidelines for referring physicians and quality handbooks, number of guidelines/protocols, number of countries with DRLs, annual number of education and training programs/activities; number of hospitals with adverse event reporting systems, number of ongoing PR campaigns; number of updated norms and number of trained inspectors.

KEY WORDS: radiation protection, medical imaging, dental radiology.

Introduction

Ionising radiation has numerous applications in medicine. Technological development has opened up new perspectives for its use, improving the efficiency and safety of procedures. However, improper or inappropriate handling of these technologies can result in risks for both patients and health professionals. Control of such risks must provide an adequate level of protection without unduly limiting the benefits. One of the challenges for the implementation of radiation protection (RP) measures in the healthcare field in Ibero-America lies in the diversity of its component countries, whose heterogeneity is reflected in its economic, social, educational and normative development, with no effective coordination mechanisms existing on the regional level. The objective of the Ibero-American Conference on Radiological Protection in Medicine, or CIPRaM, which was held in Madrid, Spain, between the 18th and 20th of October, 2016, was to verify the progress of the priority actions proposed in the "Bonn Call for Action"[3], to identify problems for the implementation of such actions, to propose possible solutions, and to define indicators of progress [1,2]. The CIPRaM was an opportunity to exchange information and experiences regarding medical radiation protection, to promote good practices, to advocate the implementation of the new basic safety standards (BSS) in the health sector [3, 4] and to strengthen ties of cooperation between the countries of Latin America and the Iberian Peninsula. The conference included eight themed sessions organised around different sectors and disciplines related to the medical uses of ionising radiation. This article summarises the conclusions of the session on "Radiodiagnosis medical and dental radiology" that took place in the framework of the CIPRaM.

Development

The themed session included a guest lecture by a representative of the Inter-American College of Radiology, who identified five main problems concerning RP in radiology, proposed possible solutions and suggested indicators of progress with regard to their im-

[3] The "Bonn Call for Action" identifies 10 priority actions to improve radiological protection in medicine. It was published as a result of an International Conference on Radiological Protection in Medicine held in Bonn, Germany, in December 2012, organised by the International Atomic Energy Agency (IAEA) and co-sponsored by the World Health Organisation (WHO).

plementation. A round table was then held, where a panel of stakeholder representatives commented on the aspects presented in the previous presentation and contributed to the discussion with additional insights from their various perspectives. This panel was attended by an oral and maxillofacial radiologist from the Faculty of Dentistry of the University of Costa Rica, two radiologists representing the Spanish Society of Medical Radiology (SERAM) and the Portuguese Society of Radiology and Nuclear Medicine (SPRMN) respectively, a representative of the Regional Ministry of Health of the Community of Madrid, a representative of the Pan-American Network of Patients for Patient Safety and a representative of the Global Diagnostic Imaging, Healthcare IT, and Radiation Therapy Trade Association (DITTA-COCIR). The session concluded with a general discussion in which the audience was encouraged to actively participate via spoken questions and comments, and further comments or proposals in electronic form were invited. The conclusions of this session are outlined briefly below.

Key problems identified

At the outset, a regional technical cooperation project by the IAEA was announced - RLA9057 / RLA9067 on RP in medicine carried out between the years 2007-2013, which covered the topics of radiodiagnosis [5] and the ten actions proposed in the "Bonn Call for Action". During the course of the session, five priority problems were identified regarding RP in radiodiagnosis, with the following being directly related to some of them:

1. A significant number of unjustified radiological studies (Action 1);

2. Insufficient optimisation of protection in radiological procedures and lack of diagnostic reference levels (Action 2);

3. A lack of ongoing RP education and training programmes for health professionals (Action 4);

4. Lack of a strong RP culture in the healthcare sector, including teamwork and risk-versus-benefit dialogue (Actions 8 and 9); and

5. Lack of effective and up-to-date regulation in the area of medical and dental radiodiagnosis (Action 10).

There is still a long way to go with regard to the justification of radiological examinations in the countries of Latin America, and this is also a priority for the countries of the Iberian Peninsula. Justification must be implemented, both with regard to the technique itself and its applicability for a given pathology or condition (generic justification), and in relation to the specific patient (individual justification), including examinations of patients with a given clinical condition, as well as in asymptomatic individuals (e.g. health check-ups). Health regulatory authorities, in collaboration with professional societies, have primary responsibility for generic justification, while individual justification is a responsibility shared by both the prescriber and the party conducting the examination [6]. The degree of uncertainty in decision-making is compounded by the constant renewal of radio-diagnostic equipment, new imaging programmes and the rapid advancement of information technology. This chal-

lenge can also be an opportunity to explore innovative solutions in Latin America, some of which have already been implemented in European countries. There are examples of evidence-based decision-making guidelines, which include assessing the benefits and risks of alternative diagnostic options [7,8]. Although the clinical practice guidelines represent the "lex artis"[4], there is still a lack of adherence to them on the part of prescribing physicians, which could be attributed to lack of adaptation to local situations and needs, lack of periodic updating and limited access from primary care centres.

With regard to the optimisation of protection in medicine, the ALARA principle ("as low as reasonably achievable") is interpreted as a level of dose reduction that does not add benefits to the expected clinical purpose, which in the case of radiology means the obtaining of a diagnostic-quality image. It is desirable to establish Diagnostic Reference Levels (DRLs) or radiological techniques that contribute the most to the population dose, in particular computed tomography (CT) and interventional or fluoroscopic procedures. These DRLs must be established using a standardised methodology that allows for comparative analyses, both at a regional and global level.

So far, the emphasis in RP education has been on the protection of exposed workers. RP education in the health sector requires a paradigm shift, where RP of the patient and of the workers exposed in the course of their duties would be considered in an integral manner. Radiologists and radiology technologists should be allowed greater responsibility for individual doses given to patients. The existing radiological societies and federations in each country can play an important role in the diffusion of knowledge in this area, given their great influence as vehicles for continuing education.

The health professionals with the strongest radiation protection culture (RPC) are medical physicists, whose numbers in the field of radiodiagnosis are still scarce, followed by radiology technicians. More needs to be done to strengthen the RPC of radiologists and oral maxillofacial radiologists, by encouraging teamwork to counteract the increasing tendency of patients to work in the rooms where the images are viewed and reports are made, with little clinical interaction with colleagues. This also applies to dentists, who often work in isolation. As for prescribing physicians (clinicians, GPs, paediatricians, emergency medicine specialists, etc.) they generally do not have up-to-date knowledge of RP, or the potential biological effects of ionising radiation, and often have little interaction with radiology service personnel.

There was consensus on the lack of effective regulation in the field of medical and dental radiodiagnosis in most countries. There is a need for a concrete legal framework to govern the application of RP standards in radiology, and for the definition of clear auditing competency for health ministries and RP regulatory authorities. The new BSS, both international and European, have expanded safety requirements in radiodiagnosis. The countries of the European Union are currently in the process of transposing the BSS, and several Ibero-American countries are updating their regulations in line with international BSS. As such, this represents an opportunity to strengthen the regulatory framework for these practices.

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[4] A jurisprudential term used by one of the panelists, which defines the assessment of a professional act in the healthcare field according to the existing standards and scientific evidence at the time it is executed.

Solutions proposed to address the identified problems

Several possible solutions to the identified problems were considered during the session, some of which are presented below.

1. Adoption or adaptation of internationally recognised guidelines for prescribers, as a result of collaborative work with experts from clinical and radiology societies. The European Society of Radiology (ESR) has decided to adapt the justification criteria of the American College of Radiology (ACR), instead of developing its own documents *de novo* [7]. This example of collaboration could be replicated via an agreement between the Inter-American College of Radiology (CIR) and ACR / ESR. Some national guidelines do exist in Ibero-America, such as those of the Argentine Society of Radiology (SAR) [9], based on an adaptation of the guidelines of the Royal College of Radiologists in the United Kingdom (RCR) [9], and an adapted regional version of the SAR guidelines prepared in 2012, within the framework of the IAEA Technical Cooperation Project-RLA9067- [10]. The use of new information and communication technologies may help to facilitate the implementation of these guidelines (e.g. electronic decision-making support, mobile phone apps).

2. The development of high-quality control manuals for each technique, in particular: general radiology and mammography, dental and maxillofacial radiology, computerised tomography / CT, cone beam computerised tomography (CBCT), fluoroscopy, angiography and protocol design for specific exams (e.g., paediatrics, pregnancy, population screening, individual health checks in asymptomatic subjects and chronic disease monitoring). These manuals and protocols could be developed by joint commissions of medical specialists, radiologists, medical physicists and radiologists, with the support of international organisations such as the IAEA, the PAHO and the WHO (e.g. the SERAM quality manual [11]). It is also necessary to have dental radiology protocols in place for intra-oral and extra-oral techniques, and specific protocols for cone beam computerised tomography [12,13,14]. Health and RP regulatory authorities were encouraged to be more incisive about requiring paediatric protocols and documenting the optimisation process. Emphasis was placed on the need to establish DRLs for the most relevant radiological procedures in terms of population doses, in particular TC and CBCT, and the importance of introducing dose-management tools. The innovative role of dose reduction in the industry was highlighted, along with its social responsibility[5], which should be stimulated by improving procurement processes (e.g. including RP aspects in technical specifications, multidisciplinary assessment of requirements and offers, minimum training requirements for management of new technologies, etc.). Optimisation is also linked to the renewal of technologies and the timely replacement of obsolete equipment. RP research applied to imaging should be encouraged[6].

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[5] This point is linked to Action 3 of the "Bonn Call for Action", which asks that manufacturers play a stronger role in contributing to the global security regime.

[6] This point is truly cross-disciplinary, and is linked to Action 5 of the "Bonn Call for Action", which calls for the promotion of a strategic RP research agenda in medicine.

3. Introduction and integration of RP in undergraduate and postgraduate education (medicine, dentistry, radiology technicians, dental assistants, specialities), with basic and advanced training levels for resident physicians [15, 16]. Strengthened curriculum maps were demanded, taking as an example the WHO curriculum guide on patient safety and integrating RP into it [17], and it was suggested that RP should be a cross-disciplinary subject in medical and dental education, integrated into clinical training. Pre-graduate training is a difficult challenge due to university autonomy, but strategies could be attempted (e.g. regional networks of medical and dental schools). It is important that teaching centres have modern equipment. Ongoing training, both in clinical specialities and in RP, should be mandatory. It was proposed that educational activities covering RP be included at national radiology conferences, organised by national societies or federations. The combination of in-person and virtual modalities (e.g. e-learning platforms) was encouraged, along with further engagement with the industry with regard to the training of users, particularly radiologists, after the acquisition of new technology.

4. Establishment of an RPC involving the team working in diagnostic imaging (medical radiologist and oral radiologist, medical physicist, radiologic technician) as well as hospital managers and administrators. Teamwork should be encouraged, as should the use of adverse event reporting systems to help learn from failures or errors. The creation of mechanisms for disseminating RP activities between radiodiagnostic services and the hospital community (clinical doctors, emergency services, primary care clinics) was encouraged, along with the use of campaigns and alliances to raise awareness about RP in medical and dental radiodiagnosis. Examples of this do exist in other regions, [18, 19, 20, 21] such as the recently-initiated LatinSafe campaign [22]. Awareness should be raised amongst health personnel, patient groups and the media, and efforts should be made to combat both nihilistic and alarmist views via positive messages and balanced information regarding benefits-versus-risks and the use of the Internet and social networks [23].

5. Updating regulations and legal framework for the uses of ionising radiations in medical radiodiagnosis and dental radiology. This must include the development of auditing and inspection powers on the part of regulatory agencies (health ministries, RP regulators). We can benefit from the experiences of other regions, promoting regional cooperation between regulators (e.g.: FORO[7]). The PAHO, the WHO and the IAEA can act as catalysts and / or facilitators.

Indicators suggested to evaluate the progress of proposed solutions

During the session, a number of progress indicators were considered in order to evaluate the effective implementation of the solutions in a quantifiable way (via absolute or percentage numbers). Some of these are presented below.

1. The number of countries with guidelines for prescribers, the number of countries that have implemented clinical guidelines for prescribers, the number of facilities / hospitals using clinical guidelines.

[7] Ibero-American Forum of Radiological and Nuclear Regulatory Bodies http://www.foroiberam.org/

2. The number of countries with quality-control manuals in place, the number of protocols for conducting examinations adopted, the number of countries in the region with national DRLs.

3. The annual number of educational activities of RP per each national society, the number of educational programmes that include RP subjects, the percentage of professionals who have received adequate training at their level.

4. The number of hospitals that have implemented adverse event notification systems, the number of active RP campaigns.

5. The number of standards revised and updated, the number of inspectors who have received training in this area.

Conclusions

As a result of this session, the main problems concerning RP in medical radiodiagnosis and dental radiology were identified. These relate to the implementation of Actions 1, 2, 3, 4, 5, 8, 9 and 10 of the "Bonn Call for Action". Priority was given to improvements in procedure justification and protection optimisation, RP training for those professionals involved, reinforcement of RP culture in radiodiagnosis departments and the application of effective and up-to-date regulation in the area of medical and dental radiodiagnosis. Solutions were proposed to address these problems, along with progress indicators to evaluate the results. Several aspects considered in this session were cross-disciplinary topics that were also addressed in other themed sessions, from a different perspective but with consistent views.

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"Image-guided interventionism" session

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Abstract

The aim of this article was to describe the main problems, solutions and indicators obtained by a group of experts at the "Interventionism guided by images" thematic session held at the Ibero-American Conference on Radiation Protection (RP) in Medicine (CIP-RaM) 2016, which took place in Madrid (Spain) between 18 and 20 October 2016. The conference was aimed at all sectors involved in the medical uses of ionizing radiation. The first of the main problems identified by the experts as associated with RP in interventionist medicine was the lack of RP culture. Reference was also made to difficulties related with reliability of personal dosimetry services, the scarcity of professionals with solid RP training, the lack of specific RP recommendations for interventionist procedures, and the low scientific productivity in the field of RP for this kind of image. Among others, possible solutions included the inclusion of RP topics in undergraduate and postgraduate training programmes for healthcare professionals, as well as investment by healthcare authori-

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ties in resources to improve the efficiency of personal dosimetry and to maintain national registers. Proposed monitoring indicators included the percentage of universities to have implemented mandatory undergraduate and postgraduate RP courses, in addition to the proportion of certified professionals out of the total number of professionals working in interventions.

KEY WORDS: radiation protection, interventionism, safety culture.

Introduction

According to the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), the world population's average annual exposure to ionising radiation (from all sources combined) is approximately 3 mSv / year per person. On average, 2.4 mSv (80%) of the annual dose that each individual receives (from all sources of ionising radiation combined) is due to radon and other sources of natural origin (natural background radiation), 0.6 mSv (19, 7%) is due to medicinal use of radiation and the remaining 0.01 mSv (about 0.3%) is due to other sources of radiation of artificial origin. Therefore, based on these data, ionising radiation applied for medicinal purposes is currently the main source of artificial irradiation received by the world population [1].

Aware of this situation, several intergovernmental organisations have been working together to establish forums and documents with the aim of harmonising the requirements of Radiological Protection (RP) for patients, workers and the public. An example of this was the International Conference on Radiological Protection in Medicine held in Bonn, Germany, in 2012, organised by the International Atomic Energy Agency, sponsored by the World Health Organisation and supported by the German government. It was attended by 536 participants and observers from 77 countries and 16 international organisations. The conference culminated with the issue of an objectives document known as the "Bonn Call for Action" which identified ten priority actions to improve RP in medicine for the next decade [2].

The Ibero-American Conference on RP in Medicine (CIPRaM) 2016 was held between the 18th and 20th October in Madrid, Spain, with the goal of verifying the progress of the implementation of the actions proposed in the "Bonn Call for Action", identifying problems and possible solutions, promoting good practices and defining progress indicators for these actions. The Conference offered an opportunity for the exchange of information and experience gained in recent years in relation to medicinal RP, and to establish and strengthen ties of cooperation between the countries of Latin America with regard to this issue. 255 individuals took part, representing 22 different countries.

The CIPRaM was addressed to all sectors involved in the medical uses of ionising radiation, including, among others, healthcare professionals (users and / or prescribers), healthcare authorities, RP regulatory bodies, other relevant competent authorities (science and technology, education, etc.), professional health and RP societies, patient / consumer associations, medical equipment manufacturers (diagnostic and therapy equipment, dosimetric data management computer equipment, quality-control equipment and RP), and academic and research institutions [3].

The conference was structured without free contributions, and the programme was developed around 8 themed sessions (Radiodiagnostic medical and Dental Radiology, Image-guided Interventionism, Universities and Research, Radiotherapy, Technical and nursing personnel, Medical Physics Specialists and RP, Health and RP Authorities, Nuclear Medicine).

During the three days of the conference, each session included a presentation handled by an expert in the area and discipline in question, followed by a panel discussion between stakeholder representatives, which completed the speaker's overview, and gave rise to to a final discussion with the active participation of the audience [3].

In the light of all the above points, the objective of this article was to describe the problems, solutions and indicators outlined by the expert group at the Image-Guided Interventionism session within the framework of the 2016 CIPRaM.

Development

The session began with a 30-minute presentation by the expert guest speaker, in which he identified what, in his opinion, were the five most important problems surrounding RP during image-guided interventional procedures, while proposing solutions and management indicators for monitoring them. Subsequently, additional comments and input were made, both at the round table by the group of panelists and at the discussion during the conference, and as a result the five problems, solutions and indicators defined by the group of experts attending the session were agreed upon.

Key problems identified

1. Lack of an RP culture. This manifests itself in the reluctance of health professionals regarding the adequate use of individual protection measures, as well as in the lack of knowledge of other strategies to ensure RP of medical staff and patients alike.

2. The lack of an efficient personal dosimetry. There are various technologies available on the market for personal dosimetry (photographic film dosimeters, thermoluminescent dosimeters (TLDs) and optically stimulated luminescence (OSL) that have proven to be effective. However, in some health centres in Latin America, deficiencies have been detected in recent years in the use of photographic film dosimeters, which, together with the generalisation of the use of other technologies, makes it advisable to conduct a local evaluation of the options available for the occupational dose control by personal dosimetry, in case anomalies cannot be corrected. In addition, there are still difficulties in allowing occupationally exposed professionals access to personal dosimetry, as well as in the proper use of dosimeters.

3. There is a shortage of professionals with a solid background in RP, as well as medical physicists specialised in medical interventionism.

4. There is a lack of RP recommendations or good practice guidelines specific to interventional procedures. There is a lack of knowledge of Diagnostic Reference

Levels (DRLs) [4,5] associated with interventionist procedures as well as a lack of normative documents, according to international recommendations, including aspects such as: necessary equipment, regulatory frameworks, training in RP, quality-assurance and control programmes, dosimetry and radiopathology.

5. Low scientific productivity in the RP area, which is evidenced by low execution of research work, which translates into a reduced number of published scientific articles and presentations at congresses.

Solutions proposed to address the problems

6. Supervision of senior doctors with regard to physicians undergoing training on patient RP strategies and the use of RP elements and dosimetry in the daily medical interventionism practices. Establish similar actions for the supervision of other occupationally exposed health professionals, such as nurses or technicians.

7. National health authorities should invest in improving the efficiency of personal dosimetry. Ensure that dosimetry service providers are certified, adequately inform health professionals as to how to use dosimeters properly, conduct periodic assessments of the reading results and investigate any anomalies detected in order to resolve them. On the other hand, electronic dosimeters should be available, at least temporarily and periodically, as an effective method of RP training given the instantaneous response. Monitoring of personal dosimetry should be centralised and evaluated by a Medical Physics Specialist.

8. Medical staff training. Incorporate topics of radiation physics or Radiophysics and RP at all levels (undergraduate, speciality, certification and ongoing training). As for continuous training, with regard to the use of ionising radiation in medicine three distinct categories of physicians may be identified: (a) specialist ionising radiation physicians; b) physicians who use ionising radiation as an integral part of their practice; (c) physicians prescribing procedures using ionising radiation. Recognition and incorporation of the Medical Physics Specialist at the healthcare level (if not done already) by the competent authorities in each country.

9. Preparation of RP recommendations or good practice guidelines. Updating of current norms and laws via interdisciplinary groups (Interventional Physicians, Medical Physics Specialists, Engineers, Technologists or Technicians, Biologists, Competent Authorities, etc.), based on international recommendations and regulations [5-8]. The authorities, together with scientific societies and regulatory bodies, should work on determination of DRLs in their respective countries and promote them as a good RP optimisation practice. Scientific societies must become involved in the dissemination of DRLs to professionals, via use of the Internet. Informed consent for patients should be consolidated with information regarding the risks of possible injury from ionising radiation, when relevant. Records of the individual dose values that have been received by the patients should be maintained, and this data should be included in the patients' report.

10. To stimulate spoken or poster-based presentations at scientific congresses, as well as the drafting of scientific journal articles. Promote the inclusion of topics related to RP in textbooks covering Cardiology and other medical specialities that use interventional radiology. Encourage relationships between interdisciplinary groups to make work more feasible and optimise results.

Indicators suggested to evaluate the progress of proposed solutions

6. Percentage of universities that have implemented compulsory RP courses in undergraduate and postgraduate courses. In addition, the number of certified professionals amongst the total number of professionals working in interventionism must be quantified.

7. Percentage of intervention services that have access to personal dosimetry via TLD or OSL. The percentage of intervention services that have personal dosimetry should also be considered.

8. Percentage of health professionals (including Medical Physics Specialists) who have taken RP courses. The number of Medical Physics Specialists in relation to the number of Interventional Radiology facilities.

9. The number of countries that have adapted their interventional procedure RP regulations according to the Basic International Safety Standards [7], evaluated at five-year intervals.

10. The number of annual publications in scientific journals. The number of annual communications via congresses.

In addition, the following problems and solutions were identified.

Additional problems

- Lack of risk awareness on the part of medical personnel during this type of procedure.
- Lack of quality-assurance programmes and periodic maintenance of medical devices, which are sometimes found with inadequate or obsolete controls and can produce elevated doses and other high-risk situations.
- Repeated unjustified studies, which can cause increased frequency of cancer (particularly in children) and skin lesions. Patients are not always warned.
- Little or no communication between scientific societies, professionals and regulatory bodies.

Additional solutions

- Similar to the principal solutions described in point 3.

- Similar to the principal solutions described in point 4.
- The International Basic Safety Standards, published as of 2014, recommends measures to justify radiological study prescriptions. Prescription justification and quality should be part of medical education from undergraduate level. Guidelines exist in Spanish for proper diagnostic test requests [9,10], which need to be distributed and translated into Portuguese.
- Communication must be stimulated between scientific societies, professionals and regulatory bodies. In this way, incorporation of RP culture into the services will be faster and more feasible.

Conclusions

The main problem found was a lack of RP culture, which can be solved with the incorporation of RP subjects into undergraduate and postgraduate programmes for the training of health professionals. The relevance of continuing education is highlighted, as well as the need to certify training programmes. The percentage of universities that have implemented compulsory RP courses in undergraduate and postgraduate courses was proposed as a possible tracking measure, as well as the number of certified professionals amongst the total number of professionals working in Interventionism Procedures.

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“Nuclear medicine” session

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Abstract

In the session dedicated to Nuclear Medicine (NM) the five aspects considered the most problematic in radiation safety in NM were identified. These refer to:

1) Ensure the correct dose is delivered to the patient;
2) Avoid contamination and irradiation of the upper extremities, lens of the eyes and rest of the body;
3) Ensure the optimization of doses in diagnosis and treatment;
4 Promote the justification of the examinations in NM; and
5) Prevent incidents and accidents.

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The solutions provided to these problems were:

1) To implement quality management systems and quality control protocols as well as to educate and to train adequately the workers;
2) To improve the training and formation of workers, systematic use of personal protection equipment (PPE) and standard operation procedures (SOP's) and adaptation of working procedures;
3) To use standardized doses in diagnosis and planning each treatment by patient-specific dosimetry;
4) To train referring physicians and nuclear medicine physicians and to use referral guidelines for appropriate MN examinations; and
5) To incorporate effectively an incident reporting system for later analysis and learning through the use of event analysis techniques.

The proposed indicators for an adequate evaluation of the obtained progress in each one of the assessed aspects were:

1) Number of centres with an implemented quality management system and its degree of compliance in each centre;
2) Continuous trend analysis of dosimetric reports values;
3 Number of studies with dose optimisation protocols and/or patient-specific dosimetry;
4) Number of undergraduate medical programs that include subjects related to radiation safety and number of written standard operation procedures with indications of each study and percentage of studies that comply with these guidelines;
5) Degree of implementation of security incident reporting systems, degree of use of predictive analysis tools and number of incident evaluation meetings;

Some of the proposed solutions can be easily incorporated into daily practice. However, others require more time and, additionally, actions by international groups working together to provide concrete solutions.

KEY WORDS: radiological protection, nuclear medicine, justification, optimization.

Introduction

Technological development has opened up new perspectives for the use of radiation in medicine, notably improving its safety and efficiency. Nevertheless, as with all human activity, its incorrect or improper use can create health risks.

Given these potential risks, numerous intergovernmental institutions have contributed to the creation of basic radiological safety standards that harmonise the radiological protection requirements of patients, workers and the general public.

As an example, the European Union adopted Directive 2013/59 / EURATOM which establishes the basic safety standards and which has to be transposed into the legislation of

each of the member states before February 2018 [1]. At the global level, eight international organisations have co-sponsored the new basic international standards for radiation safety (BSS) [2].

An international conference on radiation protection organized by the International Atomic Energy Agency (IAEA) and the World Health Organisation (WHO) was held in Bonn in December 2012, culminating in the so-called **"Bonn Call for Action"**, which identified ten priority actions to improve radiological protection in medicine.

The Ibero-American Conference on Radiological Protection in Medicine (CIPRaM) was held in Madrid in October 2016 in order to verify the progress made in implementing the actions proposed in the "Bonn Call for Action", to identify problems and their possible solutions, to promote good practices and to define indicators to confirm that progress is being made. Specifically, the session devoted to Nuclear Medicine sought to formulate these aspects in the field of radiation protection in nuclear medicine (NM).

Development

No activity that uses ionising radiation is without risk, and therefore it must be adequately justified and optimised and, in the case of workers and members of the public, also subject to the established dose limits.

In MN practice - both its diagnostic and therapeutic aspects - the risks are of irradiation of the patient as well as of the worker and public, and of contamination, mainly for the worker.

There are many aspects associated with human resources, technology and the processes involved in radiation protection in MN. These are reflected in the actions identified in the so-called **BONN CALL FOR ACTION**.

During the dedicated MN session, the guest speaker José Luís Rodríguez Pérez (Chile), presented the five aspects that, in his opinion, he considered to be the most problematic for NM radiological protection in the Ibero-American area.

The first, and perhaps the most important, because it can be understood as encompassing all the other aspects, is **GUARANTEEING THAT THE DOSE ADMINISTERED TO THE PATIENT IS CORRECT**: The treatment administered to the patient, both in terms of diagnosis and therapy, is that which gives the patient the absorbed dose and, for it to be adequate, the first dose must be correct, as well as being the correct radiopharmaceutical, and the prescription must be administered to the right patient and must be properly justified, planned, optimised and executed. In the words of Elisa Vázquez (Spain), "whatever you have to do, do it right". At the same time, the equipment (activimeter, gamma camera, PET tomograph, etc.) must be properly calibrated (within correct usage parameters) for adequate radiation detection.

To ensure this, the guest speaker indicated that it would be appropriate to implement comprehensive quality systems (e.g. QUANUM [3,4]) and quality-control protocols, and to ensure that workers are properly trained. Eduardo Savio (Uruguay) went a step further in his

intervention, suggesting that the implementation of comprehensive quality systems and the training of users should be prerequisites for the authorisation of departments by regulators.

The second aspect considered was **CONTAMINATION AND IRRADIATION OF THE UPPER EXTREMITIES**: The manipulation of radiopharmaceuticals during MN practices involves the irradiation and possible contamination of the hands, as the work is done with open sources (it should be pointed out that this problem is exclusive to MN and does not affect radiodiagnosis). Due to low perception of risk by workers (because of overconfidence, malpractice, lack of knowledge, etc.), and according to the ORAMED study [5], the safe limits for skin doses can be exceeded, even more so at present due to the use of higher-energy beta, alpha and positron emitters. Renan Ramírez (Peru) proposed that the scope of this problem be studied, while Erick Mora (Costa Rica) and Elisa Vázquez (Spain) suggested the merits of taking lens irradiation and bodily incorporation into account as well.

The solution proposed by the guest speaker involves better training of workers, systematic use of protective measures and protocols, and the tailoring of working procedures to take these aspects into account. Juliano Cerci (Brazil) placed special emphasis on aspects of proper training and use of guidelines.

The third aspect was the **OPTIMISATION OF DOSES IN DIAGNOSIS AND TREATMENT**: The treatment administered to the patient is not always linked to optimal values or suited to new technologies; the same doses are maintained although the characteristics of the current, more sensitive equipment do not match those of old equipment. This also occurs in therapeutic practices in which the treatments administered are the result of the custom of using fixed doses without taking into account the individual characteristics of the patient. Eduardo O. Savio (Uruguay) added a problematic aspect regarding the traceability of radiopharmaceuticals, indicating that, sometimes, “even the meat of Uruguayan cattle that comes to our tables has better traceability than radiopharmaceuticals.”

The proposed solutions were the use of standardised diagnostic doses, such as those proposed by the Society of Nuclear Medicine and Molecular Imaging of the United States of America (SNMMI) or the European Association of Nuclear Medicine (EANM), and planning treatments with a specific internal dosimetry for each patient. According to Javier de Haro (Spain), to facilitate the latter would require a deeper knowledge of the pharmacokinetics of the radiopharmaceuticals used, and the information provided by the radiopharmaceutical datasheets should be more explicit with regard to these aspects - something which should be required by regulators.

The fourth aspect that was raised was the **JUSTIFICATION OF NM EXAMINATIONS**: This aspect is essential since referring physicians sometimes request MN examinations without knowing how their outcome will impact subsequent clinical decisions, and the nuclear doctor has no say in the proper prescription for the same.

The proposed solution is to improve the training of medical prescribers and nuclear physicians and to provide, and periodically review, appropriate guidelines for MN examinations. Renán Ramírez (Peru) pointed out that few health authorities have established criteria to prescribe ionising radiation tests that allow prescribers to be informed and trained to make suitable prescriptions.

Finally, the last aspect dealt with in the session was **PREVENTION OF INCIDENTS AND ACCIDENTS:** The speaker stated that very little analysis tends to be made of the causes of incidents or accidents, which might otherwise help us to learn from mistakes to avoid them in the future. Renán Ramírez (Peru) indicated that no serious accidents have been known[8] to take place in NM, and Fernando Godinho (Portugal) pointed out that the existence of incidents and accidents should be seen as an opportunity for improvement. Although their consequences may be limited, their occurrence indicates poorly-organised work.

The solution proposed by the guest speaker consisted of the effective incorporation of incident reporting systems for later analysis and learning through the use of event analysis techniques (root cause analysis) or predictive tools such as the SEVRRA Risk Assessment System for Radiotherapy [6.7]

In the context of input from the panelists that fell outside the scope of the problems outlined by the speaker, Fernando Mut (Uruguay) made a plea in favour of the appropriate use of radiation and against "radiophobia", indicating that it should be accepted that we need it, but that it should be used intelligently. He added that optimisation of protection does not always imply a lower dose, but that the dose should be adequate for the intended purpose: in diagnosis, it is the dose sufficient to achieve adequate images and avoid repetition of tests, while in therapy it means subjecting the tumour to the maximum dose, whilst steering clear of healthy tissues. Mónica Penedo (Spain), as a representative of the industry, said that manufacturers have made a great effort to develop and implement tools as part of their equipment to help determine the dose received by the patient, as well as radiation protection and quality-control systems that require users to have a good knowledge of the optimal use of radiation, and in recent years they have also incorporated training as a key element of MN diagnostic and treatment equipment. Erick Mora (Costa Rica) indicated that isolation times must be tailored once the patient has received a therapeutic treatment in order to minimise exposure of family members and the general public.

The indicators proposed for the adequate assessment of the progress achieved in each of the aspects evaluated were:

1. The number of centres with a quality-assurance Programme implemented and compliance scoring for each centre.
2. Trend analysis of reported dosimetric data.
3. The number of examinations with dose optimisation protocols or patient-specific dose estimation.
4. The number of undergraduate medical curricula that include subjects related to Radiological Protection and the number of written clinical protocols with indications of each study and the percentage of examinations that comply with these guidelines.
5. The degree of implementation of security incident notification systems, the degree of use of predictive analysis tools and the number of event evaluation meetings.

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[8] See further comments on this point from the attendees

Once the problems were known and solutions proposed, the last aspect dealt with was the roadmap for their implementation. It is obvious that some of the proposed solutions can be easily incorporated into daily practice. However, others require more time and, most importantly, actions by international groups working together to provide concrete solutions.

Additional contributions from attendees

Following the presentation by the guest speaker and the panelists, those participating in the session made a number of highly interesting contributions:

Laura B. Castro (Argentina) brought up an important and specific aspect of MN (with radiopharmaceuticals being one). Since radiopharmaceuticals are the element responsible for irradiating the patient and the worker, the regulation and authorisation processes governing the same have an important role in radiological protection. Other attendees added additional aspects, such as the production of radiopharmaceuticals on-site in health centres, the importance of quality-control and protection in the manufacture of radiopharmaceuticals.

The implications of the proliferation of hybrid equipment such as SPECT-TC and PET-CT in radiological protection were also pointed out.

Josep Martí (Spain) pointed out the need to register the actual dose of radiopharmaceutical given to the patient as an element of the traceability of that radiopharmaceutical

Caridad Borrás (Spain) reported a case of a NM fatal accident as the result of administration of an inadequate therapeutic dose to the patient [8,9]. On the same subject, Erick Mora (Costa Rica) pointed out that, although radiation was not considered the cause of death, a patient death was reported a few years ago by the screening team [10].

Other participants referred to issues that had also been highlighted in other sessions of the conference, such as the ongoing training of MN workers and the need for more comprehensive training (in the case of Spain, university degrees), and others sought to underscore the existence and use of working protocols for MN explorations, the existence and use of quality-control protocols in MN, and that MN treatments should be effected according to personalised dosimetry, deprecating historical practices and standard or fixed doses.

Conclusions

The main problem encountered is the need to do our jobs well in order to protect the patient, ourselves as workers, and the population in general. To this end, we must work to ensure that the correct dosage is administered to the right patients and that appropriate and up-to-date training is required, that adequate working, quality-control and radiation protection protocols are used and updated according to the technology in service at any given time, carrying out the studies based on a correct prescription by the prescriber and supervised or validated by a qualified nuclear doctor and avoiding incidents or accidents but assuming these as an opportunity for improvement.

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"Radiotherapy" Session

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Abstract

In this article, the aspects covered in the Ibero-American Conference on Radiological Protection (PR) in Medicine (CIPRaM) 2016, related to the radiotherapy area, are presented and discussed. This conference was held in October 2016 in Madrid, Spain, and it was aimed to promote the exchange of information and experience obtained in recent years in relation to Radiation Protection in Medicine, as well as to establish cooperation between the countries of Ibero-America. Concerning radiotherapy, the main problem observed was the current shortage of human resources, with a significant deficit of medical physicists, aggravated by the lack of their professional recognition, emphasizing the need to support existing training programs, as well as to promote the development of new training programs. Also, the need for training and professional updating of the workers involved in radiotherapy, the insufficient quality in the utilization of modern radiotherapy techniques and a consequent number of incidents and accidents observed were highlighted. The urgency of improving the radiotherapy quality assurance programs and the dose verification

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systems was evident. Another aspect was the fact that, frequently, the purchase of radiotherapy equipment is accomplished without the proper advice of the group of professionals that work in the area, emphasizing the need for these professionals to be involved in the decisions. Inadequate administration of radiotherapy treatments in pediatric patients has also been the subject of discussion, evidencing the need to develop clinical and dosimetric recommendations for this population.

KEY WORDS: radiation protection, radiotherapy, patient safety.

Introduction:

The general health and cancer situation in the Americas region was analysed by the Pan-American Health Organisation (PAHO) in the "Health in the Americas" publication [1] of 2012. According to their findings, between 2005 and 2010, the total population rose from 886 to 935 million inhabitants and continuing this trend, it is estimated that by 2020 the continental population will amount to about 1,027 million inhabitants (13.4% of the world population). Likewise, between 2005 and 2010, the overall mortality rate in the region continued to decline (from 6.9 to 6.4 per 1,000 inhabitants), while the overall fertility rate fell from 2.3 to 2.1 children per woman. It is stated that, while these trends reflect public health achievements over the last century, ageing brings an increase in chronic diseases and disability.

According to reports from Globocan 2008 [2], in America, cancer represents a growing burden in all countries; it is estimated that by 2030 the number of new cases presented each year will double, with about 1.7 million new cases and 1 million deaths annually expected.

Of all non-surgical cancer treatments, radiation therapy results in the most cures (surgery 49%, radiotherapy 40%, and chemotherapy 11%). It is used for curative purposes in 60% of patients and is increasingly effective and accurate thanks to its its technological development, when combined with surgery and / or chemotherapy and ultimately with biological therapies. It is an effective option for planning and symptomatic control with advanced cancer. It is an effective substitute in many cases for supra-radical surgery, obtaining higher rates of anatomical and functional preservation of organs and improving quality of life for cancer patients. In addition, radiotherapy is becoming increasingly relevant in the treatment of non-cancerous lesions, such as benign tumours or neurological diseases.

According to the latest data published by the Scientific Committee of the United Nations for the Study of Atomic Radiation (UNSCEAR) regarding medical exposure, it can be estimated that more than 10,000,000 diagnostic radiology procedures, about 100,000 nuclear medicine treatments and 10,000 radiotherapy treatments have been effected worldwide. In addition, there is a significant increase in the number of procedures each year. However, from these considerations, it is possible to identify medical exposures as the main contributors to the individual annual average dose, often exceeding those values due to natural radiation [3].

In 2012, the International Conference on Radiological Protection in Medicine, organised by the International Atomic Energy Agency and sponsored by the World Health Organisa-

tion, was held in Bonn, Germany. It was hosted by the German Government via the Ministry of the Environment, Nature Conservation and Nuclear Safety. This conference, which was attended by 536 participants and observers from 77 countries and 16 international organisations, produced a call-to-action document, known today as the "Bonn Call for Action", in which ten priority actions were identified to improve radiological protection in medicine for the next decade [4].

Four years after the launch of the "Bonn Call for Action", we can see some advances in the awareness of the professionals involved with the application of ionising radiation in medicine, with the aim of reducing unnecessary doses in medical procedures. But at the same time, more complex technologies continue to emerge which, while representing great benefits to patients, also involve significant radiation doses and involve new challenges for safety. Incorrect use of these complex technologies can lead to increases in the occurrence of adverse events or accidental exposures.

With the objective of verifying the execution status of the actions proposed in the "Bonn Call for Action", indicating the main needs or problems and indicators of progress, the Ibero-American Conference on Radiation Protection in Medicine (CIPRaM) was held in Madrid, Spain on the 18th-20th October, with the aim of encouraging the implementation of the actions proposed in the "Bonn Call for Action". 255 people from 22 different countries participated in the Conference, representing the various medical fields involved [4]. The programme was designed to enable a view of the issues from different perspectives and to facilitate the analysis of practical problems and solutions in the various medical disciplines in which ionising radiation is used. The radiotherapy session was one of the eight topics covered.

Development

At the conference free contributions were presented, the programme being structured around sessions themed by area and discipline, which included a guest lecture by an expert in the field in question followed by a discussion panel composed of representatives of the parties concerned. The panelists worked on complementing the guest speaker's vision and pointing out additional aspects, along with active audience participation.

During the radiotherapy session, the expert guest speaker presented for 30 minutes, followed by contributions from the panelists and the audience, and identified the five main problems, solutions and indicators of progress in relation to Radiological Protection:

First, the problem of insufficient human resources - both radio-oncologists, medical physicists and technologists - was addressed. The deficit of medical physicists and the lack of recognition of this professional group was emphasised. In addition, a serious deficit in training and updating was highlighted. As a solution to this problem, the need to support existing training programmes was mentioned, as well as the need to encourage the creation of new programmes. The importance of improving professional recognition and encouraging the promotion of specialities in undergraduate courses was discussed. Emphasis was placed on the need for continuing training and re-certifications of professionals. Finally, the need to include Radiological Protection in both training and updating programmes became

evident. As a follow-up indicator to observe the progress of the issues, it was suggested that the increase in the number of professionals active in the region over the next five years could be checked.

The second problem concerns the unsafe use of radiotherapy techniques, both external (ranging from 3D to other new technologies) and brachytherapy, and the lack of homogeneous criteria for prescription, recording and reporting. As a solution, it was proposed that the quality-assurance programmes for radiotherapy processes and the verification systems for administered doses should be improved. At the same time, the need to stimulate external audits was discussed as a solution. The proposal, with regard to verification of the indicators of progress, was to observe the number of facilities that have their own protocols and apply them and also verify the number of facilities subject to external audits.

Regarding the third problem, related to the occurrence of incidents and accidents in the application of radiotherapy, the need to encourage the use of risk analysis methodologies (reactive and proactive) was emphasised. In addition, the importance of encouraging the declaration of incidents was highlighted, as this makes it possible to learn from past experiences. Finally, the obligation to promote ongoing education regarding Radiological Protection was discussed. As a follow-up indicator for this problem, it was proposed that the number of facilities that produce risk profiles be verified, as well as the number of reported incidents.

The fourth problem, which may also have a significant impact on the radiological protection associated with the practice, is related to the purchase of equipment without consulting the group of professionals involved in the radiotherapy practice, as well as outdated information from sanitary authorities on the capacity and human resources in place. The proposed solutions addressed the need to include radiotherapy professionals in decision-making, the development of purchasing parameters that include the needs of each country, and raising awareness among governors, politicians and decision-makers regarding the effectiveness of radiotherapy (RT). As an indicator of progress, it was suggested that the participation of radiotherapy professionals (physicians and physicians) in decision making be checked.

The fifth problem addresses the inadequate and unsafe use of radiation therapy in susceptible populations (children and adolescents). As a solution to this significant problem, the need to develop clinical and dosimetric recommendations (both for planning and administration of treatment) for paediatric and adolescent populations with high precision techniques in order to minimise risks was discussed. As a progress and follow-up indicator for this problem, the need to develop and implement regional paediatric and adolescent cancer treatment guidelines, developed and implemented in the region, became evident.

Other very important issues were addressed in the conference debates. The importance of implementing in vivo dosimetry was emphasised for the estimation of doses in new techniques. In addition, the current importance of the requirement to optimise and justify new technology was mentioned, as well as that of the imaging techniques that support the application of RT. Similarly, the need to include the topic of brachytherapy in new technologies was emphasised. In general, the need to promote a safety culture was evident, especially between health and clinical managers. In particular, we discussed the timely appli-

cation and effective results of the risk analysis tool called SEVRRA (*Sistema de Evaluación del Riesgo en Radioterapia*, the Radiation Therapy Risk Assessment System) in adapting to new technologies. The importance of establishing research agendas in radiobiology and individual sensitivity was also mentioned. Finally, the desirability of breaking down the walls between hierarchies via encouraging courses and joint activities was mentioned.

Conclusions

Among the main problems highlighted during the current application of radiotherapy techniques is the insufficiency of human resources. The shortage of medical physicists and their lack of professional recognition represents a great challenge to overcome, as well as the need for training and updating of these individuals and other groups of professionals such as radio-oncologists. As a follow-up indicator to observe the progress of the issues raised, it was suggested that the increase in the number of professionals active in the region over the next five years could be checked.

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Technical Session on Medical Imaging and Radiotherapy and Nursing Personnel

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Abstract

The Ibero-American Conference on Radiological Protection in Medicine (CIPRaM 2016) was held from 18 to 20 October in Madrid, Spain to verify the implementation and impact of the Bonn Call for Action.

In the session dedicated to Radiographers and Nurses, 5 priority problems concerning radiation protection have been identified: lack of life-long learning and mandatory education and training in radiation protection, lack of using correct radiation protection measures, difficulties in the optimization of procedures due to the lack of knowledge of dose exposure, lack of well-established national and international guidance to establish diagnostic reference levels and limitations/difficulties to audit procedures exposure and quality control.

The participants of the session have proposed solutions and indicators tobenchmark the implementation.

Solutions: Implement periodic continuous training; Verify the existence of suitable protective devices for health professionals; Develop specific routine protocols and establish

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dose reference levels; promotion of a clinical audit program based on national/international recommendations.

Indicators: Number of courses on radiation protection, mandatory for health professionals; Number of centres that verify and compare the occupational dose exposure values; Number of centres who have a PACS system with normalized dose values information and number of diagnostic reference levels established by modality and procedure. The proposals and indicators presented should be applied by the radiographers to improve the quality of care to the patients and reduce the risks derived from radiation exposures.

Key words: radiological protection, imaging technologists, radiotherapy technologists, nursing staff

Introduction

The use of ionising radiation and radioactive material for medical purposes, both for diagnostic and therapeutic purposes, has become one of the fundamental pillars for the provision of health care to patients, allowing the most appropriate and timely decision to be made, and in many cases it is less aggressive and proven to give the best clinical results.

Despite this, the use of radiation for medical purposes must be performed ensuring that the benefits always outweigh the risks, to avoid deterministic effects and to decrease the likelihood of potential stochastic effects of radiation on tissues and organs (1).

According to the BEIR VII Report from the National Academy of Sciences, the scientific evidence is consistent with the hypothesis that there is a linear dose-response relationship between exposure to ionising radiation and the occurrence of biological effects in humans (2). A report published by the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) shows that there is an increased likelihood of occurrence of radio-induced cancer in people exposed to ionising radiation (3).

Aware of the importance of this issue, the International Atomic Energy Agency (IAEA) held the "International Conference on Radiological Protection in Medicine: Setting the Stage for the Next Decade" in Bonn, Germany, in December 2012, for the specific purpose of identifying and highlighting topics relevant to radiological protection in medicine.

This conference resulted in the "Bonn Call for Action" with the objectives of: (a) reinforcing radiological protection for all patients and healthcare workers; b) achieving the greatest possible benefit with the lowest possible risks for all patients, via the appropriate and safe use of ionising radiation in medicine; (c) assisting with the full integration of radiation protection into the health care system; (d) helping to improve benefit-versus-risk dialogue with patients and the public; and e) improving the safety and quality of radiological procedures in medicine (4). At this meeting in Bonn, ten priority actions were identified to improve radiological protection in medicine for the next decade.

With the goal of verifying the progress of the implementation of the actions proposed in the "Bonn Call for Action", identifying problems and possible solutions, promoting good

practices and defining progress indicators for these actions, the 2016 Ibero-American Conference on Radiation Protection in Medicine (CIPRaM) was held on the 18th-20th October in Madrid, Spain, allowing a forum for the exchange of information and experiences acquired in recent years regarding medicinal radiological protection and establishing or strengthening ties of cooperation between Latin American countries with regard to this issue (5).

One of the 8 themed sessions of CIPRaM 2016 was dedicated to medical imaging and radiotherapy and nursing personnel, whose education, training, qualification and competence in safety and security is fundamental for the implementation of a radiological safety culture (6).

Professionals who work as medical imaging and radiotherapy technicians, internationally known as Radiation Technologists or Radiographers, are in most cases the only professionals who maintain direct contact with patients before, during and after exposure to ionising radiation. Basic international safety standards define such professionals as: health professionals who have received specialised training in radiological radiology and are competent in radiological procedures in one or several specialist fields of radiology, radiotherapy or nuclear medicine (7).

The session included a presentation by an expert in the area and discipline in question, followed by a panel discussion involving representatives of the various stakeholders who complemented the guest speaker's overview, and a final discussion with the active participation of the audience throughout the three days of the conference.

Progress

At the meeting, the speaker made a presentation, suggesting five highly significant problems regarding radiological protection for medical imaging and radiotherapy and nursing professionals, and also proposed solutions and management indicators to follow the implementation of the proposed solutions. These proposals were expanded upon by the guest speaker. Subsequently, additional aspects of both problems were presented, along with solutions and indicators, which were provided during the round table and final discussion of the conference, ultimately leaving the five problems, solutions and indicators that the group of experts of the session defined as being key.

Main problems

1. Lack of continuous and compulsory training in radiation protection.
2. Failure to use correct personal radiation protection measures.
3. Failure to optimise procedures due to ignorance of exposure values.
4. Lack of well-established national and international support resources to develop diagnostic dose reference levels (DRLs), meaning that adequate analysis of procedures is not possible.
5. Difficulties and / or limitations with regard to auditing exposures and equipment quality-control.

Main solutions

1. Implement continuous training in radiological protection in departments, schedule it on a regular basis, and use the results of practice analyses and dose values from professionals and patients to perform team self-assessment.
2. Check the existence of suitable radiation protection material for each professional, perform the appropriate periodic quality-control checks and maintain it in accordance with its usage instructions. To do this, it is vital to create team awareness, to remember the importance of its proper use and to involve the specialised occupational healthcare personnel in each centre when giving care and advice to professionally exposed workers.
3. Make the issue of radiation protection more relevant by creating a responsible team, communicating with and assisting the various professionals and developing specific protocols so that the techniques are appropriate to the equipment and technology used.
4. Identify the most frequent procedures, define routine protocols and establish DRLs. Additionally, analyse procedures and exposure values critically and implement optimisation measures.
5. Promote a clinical audit programme based on recommendations. Create a common methodology for the performance of equipment quality-control, defining a pattern of diagnostic image quality relating the exposure value to the clinical prescription.

Main indicators

1. The number of courses which are given on radiological protection, and the obligation upon professionals to take a minimum number of such courses in a specific period of time.
2. The number of centres that verify and compare personal dose values every 3 months. The number of centres that carry out and analyse the results of personal protective equipment quality-control checks every 6 months.
3. The percentage of centres that have a PACS system with normalised dose value information. Percentage of centres that have a PACS system with normalised dose value information. Additionally, conduct an annual awareness campaign.
4. The number of DRLs established by modality and exploration in each centre, checking and comparing them annually with those defined by the authorities. Quantify the number of centres that have performed checking activities, measurements and / or estimation of DRLs.
5. The number of centres that annually comply with current clinical audit regulations. Evaluate the objective and subjective quality of diagnostic images semi-annually, together with the number of centres that have performed quality-control activities and dose measurements.

Conclusions

The representatives from Ibero-American countries presented suggestions for solving and improving the five problems posed with regard to medical radiological protection.

The proposals and indicators developed should be applied by medical imaging and radiotherapy technicians to improve care work and, consequently, reduce the risks arising from exposure to radiation, so that patients are subjected to better quality procedures and lower doses of radiation, thus applying the ALARA philosophy.

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"Health Regulatory Authorities and Radiological Protection" Session

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Abstract

This article summarizes the conclusions of the session on " Regulatory Authorities: Health and Radiation Protection Authorities " during the Ibero-American Conference on Radiation Protection in Medicine (Madrid, Spain, October 2016). The principal problems identified were: the lack of effective coordination between regulatory authorities at the national level; regulatory problems of different nature such as limited regulation and effective control over purchase-sale, quality control, and maintenance of radiological technology; deficiencies in the education and training programs for health professionals and regulators concerning new technologies; and limited information for decision-making and prioritization of actions by the regulatory authorities and insufficient research on radiation protection

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to support the regulatory work. The proposed solutions included to: improve communication, coordination and collaboration among regulators; update regulations in accordance with international standards and guides; introduce regulatory requirements for acceptance testing, programs of quality assurance and maintenance of the technology taking into account nationally and internationally recognized standardized protocols, implement ; review and update the plans of education of the professionals in subjects of radiation protection; and involve professional societies and interested parties to tackle the identified problems. The suggested progress indicators were: number of cooperation agreements or similar between regulators at the highest level; number of laws, regulations, norms or guides jointly reviewed and prepared between the regulatory authorities; existence of effective regulation in the country that includes the control over the purchase-sale, quality control, and maintenance of the technology; existence of regulation to recognize educational plans in radiation protection; and existence of research plans on radiation protection and initiatives to identify mechanisms that guarantee the participation of professional societies and stakeholder involvement.

KEY WORDS: radiation protection, regulatory body, standards, authorization, health authorities.

Introduction

The advantages and risks of using radiation in medical applications are well known. The introduction, at the end of the 19th century, of healthcare technologies that use ionising radiation has been producing great changes in medicine, both in the field of diagnosis and therapy. In recent years, these diagnostic and therapeutic procedures have evolved rapidly. The beneficial effect on public health is enormous. Thanks to these health technologies, it is now possible to diagnose multiple diseases at an earlier stage and more accurately, and facilitate healing [1].

However, ever since these technologies were first used, they have been found to entail possible health risks and hazards, which implies that governments need to take special measures for the radiological protection of patients, workers, the public and the environment.

The relevant intergovernmental organisations with authority in the matter agreed on the international standards, whose latest version is under the title "*Radiological Protection and Security of Radiation Sources: International Basic Safety Standards*" (BSS) [2, 3]. These international standards lay down, among other technical requirements, the application of the principles of justification and optimisation in medical exposures, the establishment of a comprehensive quality-assurance programme with the participation of qualified experts competent in the relevant disciplines, as well as national regulatory bodies.

Imaging, interventional radiology, nuclear medicine and radiotherapy departments have been increasing considerably in number and in technological complexity in response to major public health problems. As a result, national regulatory infrastructures must adapt to this scenario of increasingly complex health technologies that use radiation, respond appropriately to safety requirements and provide a regulatory framework that promotes safety culture in medical facilities.

In Latin America, the Regulatory Bodies are located either within the Ministries of Health or in other government agencies, or the competencies are divided between several governmental organisations. In most countries, the existing legislation assigns regulatory powers to more than one governmental organisation in terms of medical radiological protection. Without effective coordination, this situation can create ambiguities, gaps and overlaps, with consequent operational difficulties for these agencies and an excessive administrative burden for users. In some countries, the competencies of each regulatory body are defined according to the radiation source, separating the medical uses of X-rays on one hand from nuclear radiation on the other. In other countries, competencies are established according to the exposed group, i.e. the public and patients. This division of competences, while allowing for a clearer definition of the scope to be regulated, may be burdensome for users, who will probably need two or more separate authorisations for the same source of radiation, under rules that may be contradictory [4].

It should be borne in mind that health authorities are those that authorise and enable health centres, and that they are always responsible in terms of quality and safety in health care; in the authorisation of health centres and services; and in the protection of public health in general. Therefore, some requirements of the BSS are focused on health authorities. Therefore, for a regulatory exercise to be effective, close co-ordination and co-operation between regulatory agencies and health authorities is essential, even if the latter do not have explicit powers to regulate the use of ionising radiation.

Development

The thematic session focused mainly on actions 8 and 10 of the Bonn Call for Action [5] and several of the sub-actions related to strengthening radiological safety culture in health care and implementation of radiological safety requirement[9]. It included two invited presentations by representatives of the Brazilian National Health Surveillance Agency and the Uruguayan National Radio-Protection Regulatory Authority, who identified the main problems, proposed solutions to them and suggested progress indicators for the implementation of said solutions. A panel discussion followed by a panel composed of representatives of the Ministry of Health, Social Services and Equality of Spain, the Brazilian Nuclear Energy Commission, the Nuclear Safety Council of Spain, the National Nuclear Safety Center of Cuba, the Federal Commission for Protection against Health Risks of Mexico, the Public Health Ministry of Venezuela, the Ibero-American Forum of Radiological and Nuclear Regulatory Bodies and the European Association of Competent Authorities in Radiological Protection. The panelists commented on the aspects presented in the previous papers and contributed to the debate with additional contributions, from their different perspectives. The session concluded with a general discussion in which the audience was encouraged to actively participate via spoken questions and comments, and further comments or proposals in electronic form were invited. The conclusions of this session are outlined briefly below.

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[9] Action 8.b: "Promote closer cooperation between radiation regulatory authorities, health authorities and professional societies", Action 10. a: "Develop practical guidelines to ensure the implementation of the International Basic Safety Standards in health systems worldwide": and Action 10.b: "Promote the establishment of a legislative and administrative framework at the national level, sufficient for the protection of patients, staff and the public, including the application of training requirements and radiation protection training for health professionals, and inspections in situ to identify any deficiencies in the application of the requirements of said framework"

Key problems identified

It was agreed that the main problems that can be identified are:

1. Lack of effective coordination between national regulatory authorities in cases where there are divided regulatory responsibilities.
2. The existence of various normative problems, such as: lack of consistency between regulations; lack of updates; challenges posed by new technologies (regarding both their approval and their regulation); lack of implementation guidelines; excessive loads for users; and limited coercive roles.
3. Effective control over the purchase, sale, quality-control and maintenance of the equipment as well as the regulation regarding these subjects, is in many cases very limited.
4. The existence of deficiencies, the lack of regulation in medical staff education and training programmes, the lack of up-to-date training of regulatory staff in both new technologies and knowledge of radiation protection.
5. Regulatory Bodies often rely on limited information to make decisions and prioritise actions based on risk.

Solutions proposed to address the problems identified

Several possible solutions to the identified problems were considered during the session, some of which are presented below:

1. Improve communication between regulators, with the participation of professional societies and stakeholders (patient associations, radiological protection forums, etc.). Encourage coordination among regulators with regard to facility authorisation programmes, with particular attention to so-called 'hybrid equipment' (PET-CT, PET-MRI).
2. Clearly identify the scope of each agency's competencies; update the regulations in accordance with international standards and guidelines; create dynamic regulatory frameworks that allow adjustments to occur to account for the emergence of new technologies; publish guidelines for implementation of standards; grant authority to regulatory bodies; legislate for independence and promote transparency of regulatory bodies.
3. Develop the following for each territory: acceptance test regulations, quality-assurance and equipment maintenance programmes; joint management of manufacturers, distributors and health services regarding quality and safety processes; systems or standards to verify checks performed on equipment; guidelines and protocols for acceptance testing and quality-control.
4. Review and update training plans for health personnel with professional associations including radiation protection issues and legislation; update the training of staff of regulatory bodies; implement ongoing training and up-to-date online courses accessible to professionals and regulators; and promote the development of a safety culture.

5. Encourage the participation of professional societies and stakeholders; increase international collaboration (international organisations, forums of regulators, etc.); promote and use strategic research carried out in medicinal radiological protection fields; and create and promote collegial bodies to evaluate health technologies.

Indicators suggested to evaluate the progress of proposed solutions

In order to measure the degree of progress of the effective implementation of the solutions in a quantifiable manner, several progress indicators were considered, including the following:

11. The number of cooperation agreements between regulators at the highest level. The existence of open channels between professional societies and interested parties.
12. The number of laws, regulations and / or guidelines reviewed and developed jointly by the regulatory authorities that have been implemented.
13. The existence of regulations in a given country that include control over the purchase and sale, quality-control and maintenance of the equipment. The existence of documents or guidance guidelines for manufacturers, distributors and health services on this subject in accordance with existing technologies in the country.
14. The existence of regulations for the recognition of radiological protection training plans; number of authorised and recognised radiation and on-line courses in radiation protection; and the percentage of professionals trained in regulatory bodies.
15. The existence of radiological protection research plans. The existence of mechanisms to ensure the participation of stakeholders in the decision-making process.

Conclusions

As a result of this session, the main problems concerning the regulation of the uses of radiation in medicine were identified, solutions were agreed to improve them; and measurable achievement indicators were suggested. These relate mainly to the implementation of Actions 8 and 10 of the so-called “Bonn Call for Action”. It was also noted that many of the issues considered in this session were cross-disciplinary themes relevant to all the themed sessions.

Coordinated work between regulatory bodies and health authorities, together with non-governmental institutions such as professional societies and other associations committed to patient protection and representatives of the industry, among others, is necessary for a sound and efficient medical radiological protection regulatory programme. It is therefore essential that the regulatory bodies and health authorities actively promote this strategy of cooperation with the organisations involved, developing and maintaining the necessary infrastructure and channels of communication and coordination necessary to facilitate the broad participation of society. There is also a need for a local analysis of the aspects that make compliance difficult and to establish a strategy and a programme to overcome them.

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Session: "Specialists in Medical Physics and Radiological Protection"

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Abstract

The "medical physicist" and the "radiological protection expert" are professions recognized by the International Labour Office. The functions of the radiological protection expert have always been included in the International Basic Safety Standards (IBSS), but the profile and responsibilities of the medical physicist appear in those of 2014. Although these functions are described in detail in recommendations of competent professional bodies and societies, the role of the medical physicist in the medical field is largely unknown. It is necessary to disseminate these documents, especially the IBSS, and work together with medical societies. Personnel from radiation protection and health authorities, who often lack sufficient knowledge about medical exposures, require specialized training and may rely on independent radiological protection services authorized to supplement certain regulatory activities. There is an insufficient number of suitably trained medical physicists, radiological protection specialists and technologists, especially in diagnostic radiology, interventional radiology and nuclear medicine. It is necessary to strengthen postgraduate

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programs in medical physics and radiological protection in those areas, facilitate the access of medical physicists to programs of clinical residencies or hospital practices, and establish certification and accreditation programs. For technologists, good training can be included within their clinical practice. Medical physicists should document improvements in health care as a result of medical physics activities (e.g. in the acquisition or validation of image acquisition protocols) and participate with medical professionals in health services, teaching and research activities in order to improve the quality of health care.

Keywords: Radiation protection, medical physicist, radiological protection

Introduction

The "medical physicist" and the "radiation protection expert" are professions recognised by the International Labour Organisation (ILO) in their publication "International Standard Classification of Occupations", ISCO-08 [1]. The medical physicist, although classified in Group 2111 of "Physicists and astronomers", is considered to be part of the health staff along with those occupations classified in Sub-group 22 as "Health professionals." The radiation protection expert is classified as "Occupational Health and Environmental Practitioner" in Group 2263. The functions of the "radiation protection expert" have always appeared under the International Basic Safety Standards (NBIS) [2,3], but the profile of the medical physicist appears for the first time in the 2014 NBIS [4]. The designation of both professionals varies by country. In European Union (EU) Directives - which EU countries such as Spain are obliged to follow - the terminology used is "expert in medical physics" and "expert in radiological protection" [5]. In Latin America, depending on the country, different names are used. For example, a medical physicist in Brazil is called a "specialist in medical physics" *[translated from Portuguese]* [6], in Peru the term is "medical-field physicist" [7] and in Spain, the legal name is "specialist in hospital radiophysics [8]. An expert in radiation protection in Cuba is referred to as a radiological protection manager" [9], in Peru, the term is "radiation protection expert" [7] and in NBIS [4], although it is recognised that there may be "qualified experts", the requirements of the "radiation protection officer" are described. In this publication, the terms used will be "medical physicist" and "radiological protection specialist".

Regardless of the names, and recognising that, depending on the complexity of the installed technology, some medical centres can use a single individual to perform both positions, it is important to distinguish the functions assigned to these professionals. NBIS [4] demands that during radiotherapy procedures, the medical physicist perform or supervise the calibration, acceptance, commissioning and quality-assurance requirements of the radiological equipment, and that the diagnostic and interventional radiology procedures be carried out under "supervision, or with the written advice of a medical physicist whose degree of participation is determined by the complexity of the radiological procedures and associated radiological risks." Although these functions are detailed in publications of competent professional bodies and societies such as those of the International Organisation for Medical Physics (IOMP) [10], there is a general ignorance of the role of the medical physicist in the medical environment, and a lack of recognition in many Latin American countries, particularly regarding nuclear medicine and radiology, where there are often no specific regulations set out by the Ministries of Health. At the same time, the staff of regulatory bodies, including the health authority, may not have sufficient training in medical

exposures to perform their duties. In general there is an insufficient number of medical physicists, radiation protection specialists and technologists who are adequately trained in the areas of radiodiagnosis, interventionism and nuclear medicine; there is a shortage of postgraduate programmes in medical physics and radiological protection in these fields and there are few clinical residences or hospital practices accessible to medical physicists. To improve the situation, international organisations such as the IOMP, the International Atomic Energy Agency (IAEA), the European Federation of Organisations for Medical Physics (EFOMP) and the European Commission have issued education and training guidelines for medical physicists [11-17], and the IOMP has created an international body for certification of medical physicists [18], which provides models for countries to establish their national certification programme. While in Spain the job title of the medical physicist - known as a hospital radiophysicist - is recognised by the Ministry of Health [8], in Latin America only a few countries have professional certification programmes; a notable example is Brazil, where the Brazilian Society of Medical Physics certifies medical physicists in radiotherapy, radiodiagnosis and nuclear medicine [6, 19].

In terms of department accreditation, the World Health Organisation (WHO) has developed a guide to develop hospital accreditation in Europe [20], the Pan-American Health Organisation (PAHO) for hospitals in Latin America [21,22], and the WHO Headquarters has published a review of quality and accreditation programmes around the world [23]. As a result of these efforts, most countries have accreditation programmes, but most do not include radiation protection requirements. In Spain, the regulatory body may require that, depending on the radiological risk, the centres that use ionising radiation have a Radiological Protection Service (RPS) or that a Technical Unit for Radiological Protection (TURP) is contracted to provide them with specific advice on radiological protection and to entrust them with the radiological protection functions that fall within their remit. [24].

One of the consequences of the situations described is that technological management in medical centres that use ionising radiation cannot draw on a multidisciplinary team of doctors, physicians, specialists in radiological protection and biomedical engineers who, with the support of the management, would be able to define or evaluate the technical specifications of the radiological equipment and take care of the commissioning thereof by performing acceptance tests and establishing the necessary tolerances in the results of the measurements of the equipment operation and quality parameters to implant a quality-assurance programme, in radiotherapy and in radiodiagnosis, interventionism and nuclear medicine. A fundamental aspect that must be improved in these last three areas is the establishment or validation of image-acquisition protocols. The NBIS recommends that a medical physicist take charge of this activity [3,4].

The International Radiation Protection Association (IRPA) has produced statements and publications with recommendations regarding certification, qualification, education and training of such professionals, which are very useful for adoption at the national level [25].

Progress

The problem faced by medical physicists and radiation protection specialists and their impact on the quality of health care was analysed by the main guest speaker at the session,

who made recommendations for improvement and suggested indicators to monitor progress. Seven panelists then gave presentations describing the situation in their respective countries, and also noted recommendations and indicators. The moderators of the session, along with the reporters, evaluated the problems described, choosing five that they considered fundamental; proposed various solutions to them and suggested some indicators to assess the progress of the proposed solutions. The final conclusions were presented at the global session at the end of the Conference, during which the audience provided some additional suggestions. The conclusions of this session are detailed below.

Key problems identified

1. Lack of knowledge of the functions of the medical physicist and radiation protection specialist, especially in radiology, interventionism and nuclear medicine. This ignorance is apparent even in the health professionals responsible for the care of patients, and in some cases members of health and radiological protection authorities.
2. There are insufficient staff properly trained in medical physics and radiation protection in those centres that use ionising radiations.
3. National authorities responsible for licensing and control of medical exposures generally do not have adequately trained personnel.
4. Only a few centres have specific, functional quality-management programmes for medical exposures that include defined specifications for radiological equipment, acceptance and commissioning tests and the establishment of quality-assurance programmes, as well as the initial and periodic training of the staff that operate the equipment.
5. Lack of recognition of the medical physicist as a health professional. This problem does not exist in Spain, which recognises “hospital radiophysics” as a health speciality, but it does in Latin America, especially in public hospitals.

Solutions proposed to address the problems

1.a Disseminate documents from international organisations and professional societies describing the functions of both professions, for example during radiological protection courses.

1.b Implement the 2014 NBIS, where the responsibilities of the medical physicist and radiation protection specialist are explicitly described.

2.a Create graduate programmes in medical physics with specialisations in radiotherapy physics, radiodiagnosis, interventionism and nuclear medicine.

2.b Establish clinical residences for medical physicists.

2.c Establish certification processes for medical physicists and specialists in radiation protection.

2.d For technologists, effective training in radiation protection can be included within their clinical practice.

3.a Train officials from national authorities, for example, within the same Authority, using more experienced staff as trainers.

3.b Authorize independent radiological protection services to complement regulatory activities such as inspections and evaluation of shielding.

4.a Include aspects of quality-management in radiological protection regulations.

4.b Make hospital managers aware of the need to implement a quality-management programme by a multidisciplinary group.

4.c Participate in accreditation programmes for those services where norms are on a voluntary basis.

5.a Broadcast the classification of the medical physicist as a health professional, as published by the ILO.

5.b Document the improvements in medical care that can be achieved with the contribution of a medical physicist.

5.c Collaborate with medical societies, e.g. when drafting clinical guidelines and ionising radiation protocols.

5.d Participate in medical congresses on radiotherapy, radiodiagnosis, interventionism and nuclear medicine, by for example educating others about new technologies in therapy and imaging, discussing benefits versus risks, clarifying dosimetric concepts, etc.

5.e Use national medical journals - preferably writing in collaboration with physicians - to publish the results of studies and ionising radiation treatments that have been improved by the involvement of medical physicists.

5.f Create a medical physicist certification system that can be recognised by the national authorities.

5.g Develop medical physics research programmes, for example in image reconstruction and filtration, dose calculations using Montecarlo, the design or application of new detectors, etc.

Indicators suggested to evaluate the progress of proposed solutions

1.i National regulations specifying the functions of the medical physicist and radiological protection specialist.

1.ii The number of annual courses addressing the subject; these courses can be local, regional or international.

2.i The number of graduate programmes available in the country covering the various sub-specialities of medical physics.

2.ii The number of graduate programmes (master's or doctoral) with hospital practice included in their curriculum, or residences accessible to medical physicists.

2.iii The number of hours of practical training in radiological protection for technologists.

3.i The existence of an internal assessment system on the part of the national authorities to demonstrate knowledge of radiation protection in medical exposures.

3.ii The number of independent radiological protection services authorised in a region or country.

4.i The results of periodic audits (internal and / or external), which assess physical and clinical aspects that impact on radiological protection.

4.ii The existence of quality-management protocols in each medical center that uses ionising radiation.

4.iii Training certificates issued by equipment manufacturers, or local equipment distributors that are authorised by those manufacturers.

5.i The number of budget medical physicist positions in the public and private healthcare sectors.

5.ii The number of publications in scientific and / or medical journals.

5.iii The number of medical physics presentations at medical and / or medical physics congresses.

Conclusions

Medical physicists and radiation protection specialists are essential professionals in those clinical services that use ionising radiation. In order for the various responsibilities to be recognised and valued in the medical environment, documents produced by international intergovernmental organisations such as the WHO, the PAHO and the IAEA and statements and publications from professional societies such as the IOMP, the EFOMP and the IRPA. It is essential to insist that national authorities adopt or adapt NBIS in their regulations and promote joint work with national scientific and professional societies, especially medical societies. Radiation protection must not only establish standards, but also a safety culture. It is vital to expand the training of members of health and regulatory authorities related to medical exposures, and increase the quantity and quality of medical physicists, radiation protection specialists and technologists appropriately trained in radiological protection as applied to the areas of radiodiagnosis, interventionism and nuclear medicine. It is necessary to strengthen postgraduate programmes in medical physics and radiological protection in those areas, to allow medical physicists access to clinical residency or hospital practice programmes, and to establish certification programmes. For technologists, good training in radiotherapy and nuclear medicine can be established as specialisation programmes in addition to their training in radiology, which is clearly established in most countries. Medical physicists should document improvements in health care due to medical physics activities; combining their efforts with those of medical professionals undertaking support activities, teachers and researchers, in order to guarantee and improve the quality of healthcare. The implementation of the solutions suggested for identified problems should be monitored using appropriate indicators.

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Universities and investigation session

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Abstract

In the field of Universities and Research five main problems have been identified: 1) Lack of sufficient education and training in radiological protection and physics of ionizing radiation for graduates in medicine and other health specialties. 2) Scarcity and lack of regional coordination in the delivery of continuing training courses for health professionals using ionizing radiation. 3) Difficulty to perform quality controls in radiodiagnosis, given the general shortage of medical physicists dedicated to the area. 4) Difficult access to metrology services and calibration laboratories, which also have little coordination between them. 5) Lack in the region of coordinated research studies between universities and hospitals on radiological protection in medicine, including epidemiological studies and the follow-up of patients treated with ionizing radiation. In addition, two other problems were identified: the rapid introduction of new technologies and equipment without previous training of personnel and the lack of mutual recognition among countries in the region of the training of professionals specialized in radiological protection. Universities and research centres of the region have an opportunity to contribute to the solution of these problems by implementing

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the proposals and assessing the progress indicators suggested in the session, which are described in this article.

KEYWORDS: Education, Training, University, Courses, Research

Introduction

Linking directly with the fourth and fifth actions of the "Bonn Call for Action" [1] -"strengthen radiation protection education and training of health professionals"- and -"shape and promote a strategic research agenda for radiation protection in medicine"-, the aim of this session of CIPRaM 2016 was to raise the problems in Latin America regarding university training in radiation protection (RP) for health professionals, as well as the research needs regarding key issues affecting the improvement of RP in medicine, both for professionals and patients.

The session members, who are the co-authors of this article, begin by recognizing that the government and the various competent authorities have front-line responsibility for RP, but also that other organisations and institutions such as universities can contribute significantly to its implementation, and to the development of radiological safety culture right from the start of medical professional training.

From this initial approach, reflection and debate were organized -in the same way as in the other sessions of the Conference- so that the main problems could be identified, proposing solutions for them and a series of indicators that would allow future progress to be assessed. The article has been organized around these problems, ending with a series of conclusions and practical proposals that would allow them to be mitigated.

PROBLEMS DETECTED, SUGGESTED SOLUTIONS AND SUGGESTED PROGRESS INDICATORS

Problem 1: Insufficient development of radiological protection issues in the region's undergraduate degree programmes in medicine and dentistry.

Across the entire Ibero-American region, including Spain and Portugal, the current situation is that medical students usually undergo a very extensive curriculum, typically of a longer duration than at other levels, beginning with courses in basic sciences, continuing with courses in anatomy, physiology, biochemistry, followed by the various branches of medicine and ending with courses in medical ethics, legal medicine, seminars and supervised hospital practices. Generally speaking, the physician is trained as a "future prescriber" of radiological tests and upon graduation, lacks the processes and actions relevant to patient exposure justification and the radiological safety of staff in hospital settings.

This problem is cross-disciplinary, taking in the undergraduate training of the majority of health professionals, and not just doctors. The exception appears to be medical imaging and radiotherapy technologists, who enjoy a training programme with a clear focus on RP. With regard to the development of training curricula in terms of RP practitioner knowledge, skills and competences, international harmonization would be desirable (for example, ac-

cording to the European guidelines [2]); for the case of Spain and Portugal, the transposition of European Directive 2013/59 / EURATOM concerning RP [3] may prove opportune.

The **solution** to this problem would be to propose joint actions at the level of Faculties and Schools of Medicine and Dentistry, for the introduction of RP and the physics of ionising radiation in undergraduate subjects, using teaching methods that appeal to the profession, and putting special emphasis on the justification and promotion of the radiation safety culture and safety and quality in the use of radiation. For example, to motivate medical students, work should be done on courses related to the subject of imaging, which can present the basics of imaging, the biological effects of radiation and the concepts of RP and image-based optimisation. With this approach, a better connection can be made between the physical concepts of radiation and the clinical results of the image, making students take more interest in the subject.

Training curricula should be coordinated between universities to facilitate the mutual recognition of qualified professionals in the region. The knowledge, skills and competences that need to be developed by students of the various clinical specialities (general medicine, dentistry, orthopaedics, pulmonology, paediatrics, neurology, cardiology, etc.) should focus on aiding clinical decisions, where it is already a key principle of justification, so that the results of training would be decidedly improved by including exposure to radiation and RP as one of the factors to be considered, but not the only one. For other healthcare professionals such as nursing staff, the content should focus primarily on occupational exposure. To develop this, it would be constructive to encourage the incorporation of RP and medical physics specialists, who could teach some RP-specific sessions. It is important to achieve effective cooperation between varied professionals, as well as between training centres and health centres, when it comes to promoting RP training.

As an **indicator** of the progress of these solutions, it is proposed that we should quantify the number of faculties and schools of medicine and dentistry that have followed the initiative within a five-year period, having succeeded in introducing RP content into the healthcare training programmes that they offer at the undergraduate level. It has also been proposed that we should seek the involvement of several specific universities where the impact of the implementation of these improvements can be monitored via, for example, surveys of basic and key knowledge of radiation physics and RP among its graduates. Another possible indicator could be the number of countries that have established a mandatory RP training programme for health professionals, with the collaboration of universities.

Problem 2: Shortage of short courses focusing on radiological protection for health professionals with regard to radiodiagnosis, nuclear medicine and radiotherapy (doctors, dentists, technicians, nurses, auxiliaries...).

Medical professionals are increasingly having to work with ionising radiation. These are typically radiologists and dentists, nuclear doctors and radiotherapists, but also those covering other specialities such as orthopaedic or cardiological surgery. That is why it is difficult to execute fully inclusive training plans to allow their continuous training. Both regulatory authorities and scientific societies in the countries in question are keen to keep

these professionals updated regarding issues such as justification and optimisation of procedures, protection issues for patients and occupationally exposed personnel, incident and accident handling, quality-control procedures, etc., but the reality is that it is not enough and it is not possible to reach out to all professionals.

It is necessary to have simple training modules adapted to the different specialities, such as interventional physicians (cardiologists, neurologists, orthopedists), support staff (nurses, patient assistants) and even administrative staff who can make decisions that influence RP in medical services. There are already many available, but they are all independently generated teaching resources; for example, in Spain there are several ongoing education courses in RP for health professionals, content has been defined and procedures established for accreditation and recognition by the competent authorities and the use of new technologies has been incorporated to facilitate participation. For its part, the IAEA has made a significant effort in preparing and distributing free RP teaching materials.

It would be desirable to unify the contents, so as to allow courses recognisable throughout the Ibero-American region, ensuring a comparable level of professionals, establishing continuing training requirements for prescribing physicians and other health professionals which are not included in the current plans. Given their great importance, the communication skills of trainers and professionals should also be improved during the courses.

In order to solve the problem, higher education institutions in the region can join forces by networking and generating both online and face-to-face courses in Spanish and Portuguese, developed by university professors, medical physicists and technologists in all three areas. The courses would have to be available through the universities so that the health professionals would have access to them. These courses would have to be continuously updated, focused on specific objectives depending on the speciality, type of professional and responsibilities, and would have to take into account the requirements of the regulatory authorities for healthcare professional licensing processes. Existing training materials, such as training packages developed by the IAEA or the FORUM documents, could be used. The development of courses would be complemented by a system of accreditation recognised at the regional level, with the participation and collaboration of scientific societies and regulatory authorities, within a strategy of RP training. As such, the certificate would be recognised by all regulatory authorities in the region and would facilitate professional mobility.

In addition, this network of universities would provide a platform for the exchange of experience that would allow sharing of good practices among workers, teachers and researchers, industrialists, etc. to facilitate the adoption of new technologies and to promote the training of trainers. The broader and more plural the framework of the agents involved, the better the quality and sustainability of the system would be: universities, professional associations, professional colleges, health and nuclear regulators and authorities, manufacturers, etc.

A good **indicator** of the degree of progress in this issue would be the number of courses and modules per area generated in a period not exceeding 5 years and the number of professionals who have successfully completed them annually.

Problem 3: There is little coverage of services with systems that guarantee the quality of the images and the doses received by the patients in the radiodiagnosis area, largely due to the limited number of medical physicists in those services.

There seems to be in general very little culture of radiological safety in radiodiagnostic institutions, which motivates little interest in the implementation of quality-assurance systems in their departments. We should highlight the recommendation of European Directive 2013/59 to encourage greater involvement of the medical physicist in radiological practices, and to make such involvement proportional to the complexity of the available equipment and treatments. In radiotherapy and in nuclear medicine the situation is different, as the importance of RP has been imposed from the beginning, with the daily presence of qualified medical physicists in those departments being practically the norm throughout the whole region. The consequence of this situation is that the implementation of quality-control programmes in mammography, general radiology, interventional, tomography and dentistry departments is limited.

On the other hand, with the generalisation of digital systems in radiodiagnosis and centralised repositories of images, it is increasingly feasible to send data or images to be monitored remotely to evaluate the quality of the image. Professionals from higher education institutions can collaborate by creating remote quality-control centres for image quality analysis and dose optimisation.

As a result, the **solution** to this problem is firstly the creation of interdisciplinary working groups, together with representatives of competent authorities and professional societies, to develop guidelines as to how to proceed with the implementation of clinical audits [4] and to stimulate the training of technicians in aspects of quality-control, under the supervision of qualified physicians in the radiodiagnosis field who have practical experience in radiology quality-control programmes. In this field, the priority should be to train the services in how to carry out the checks, increasing the collaboration between the Universities and the health teaching units. Collaboration between accredited companies to perform RP technical services and radiodiagnosis quality-control could also prove highly constructive.

In addition, remote access tools with which universities or technical assistance companies can monitor radiodiagnostic equipment should be developed and implemented by universities as part of the activities of a formal quality-control programme. These “remote quality-control centres” would perform the analysis of images or data sent directly or from data of the DICOM headers, also offering technical support for optimisation tasks. This would allow collection of data in digital systems, focusing on each installation, regarding the most significant techniques or procedures. In order to serve small centres, several of them could be connected to the same quality-control center, grouped by geographic areas, with technicians relocating periodically to ensure the quality of equipment and procedures.

In order to carry out audits on quality-control checks, it would be advisable to set up committees involving universities, together with representatives of competent authorities and professional societies.

A proposed indicator of progress is the number of radiology institutions that have implemented a quality-assurance system in each country, which would elevate the RASIMS (Radiation Safety Information Management System) [5] to a radiodiagnosis optimisation role. The objective is to see, within the next five years, the emergence of five Ibero-American university reference centres capable of remotely monitoring radiodiagnostic equipment quality-control tests.

Problem 4: Poor accessibility to Ionising Radiation Metrology Services for medical physicists in the region.

Medical physicists have only limited access to properly calibrated equipment to help ensure the proper dosimetry of patients in the fields of radiodiagnosis, nuclear medicine and radiotherapy. The implementation of ionising radiation metrology laboratories is usually expensive and requires a staff and physical infrastructure that meets all the requirements to achieve the traceability of the readings taken. Generally, universities and research centres have high-profile, stable staff and better resources to be able to implement such laboratories, although one of the key challenges is to guarantee the availability of human and material resources in the future, guaranteeing adequate generational handover.

In Latin America, eleven secondary dosimetry laboratories are now available in the IAEA / WHO (SSDL) network [6], but in spite of this a problem has been detected regarding limitations in access and payment of calibrations, as well as in terms of human resources.

Therefore, it is necessary first of all to identify the real calibration needs in the region, and as a **solution** to the shortcomings, it is proposed to support the laboratories that provide these services in the region, strengthening the existing SSDL network and facilitating access to monitor calibrations and other dosimetric equipment via regional programmes or projects where the entire region is involved with established programmes. The objective is to have a network of laboratories in the region that are mutually supportive in responding to the calibration needs of the region, in improving the training of personnel and in promoting inter-laboratory exercises that guarantee the traceability of measurements and calibrations. The collaboration of universities, providing their resources and participating in these regional programmes or projects, can be of great value. They can also collaborate in the development of instrumentation verification programmes.

Consequently, as **indicators** of progress, it has been proposed, firstly, to prepare a study with a complete description of the situation in the region, identifying needs and elaborating a proposal for the optimisation of resources, which will be the basis for the search for definitive solutions. Second, the creation of a network of metrology service laboratories for medical applications within a period of no more than 3 years, and better access to the services provided. An additional quantitative indicator could be the number of intercomparison exercises between existing laboratories.

Problem 5: Lack of research studies in radiological protection in medicine in the region.

The lack of sufficient coordinated research studies between universities and hospitals on RP in medicine, including epidemiological studies and follow-up of patients treated

with ionising radiation, is a problem in the region. A sensitive issue in patient monitoring is adequate data protection, which often hinders some research programmes. On the one hand, patient registration forms generally do not contain detailed information with the doses given in the examinations. In the particular case of interventional radiology, follow-up of the patient after the procedure is not performed to evaluate the possibility of deterministic effects. In the case of radiotherapy and nuclear medicine, the treatment is performed in a clinic and assisted by an oncological doctor who does not always have the information relevant to the treatment performed. On the other hand, medical physicists working in hospitals are rarely available to follow up patients. Universities, having multidisciplinary teams of professionals, could generate and maintain databases with patient information and follow them up appropriately after medical treatment. This information is very valuable and is currently being lost.

Universities could help **solve** this problem by fostering coordinated projects with hospitals, proposing methodologies and providing multi-disciplinary capabilities. The most relevant types of studies should be identified in each area, with the goal being to develop a methodology common to all countries in the region. Support from universities by maintaining databases could facilitate the long-term follow-up of, for example, epidemiological studies of secondary cancers and side effects from irradiation of healthy tissues such as the cardiovascular system. These actions should be coordinated with health authorities and scientific societies.

After identifying the types of studies most relevant to the region, the objective **indicators** in this area would be the protocols developed and the number of coordinated studies between university and hospital centres, involving at least three universities jointly.

Additional problems and challenges detected

Other current problems and challenges for the university sector and research were identified during the session, and are summarised below.

Challenges in radiological safety during the implementation of new technologies.

It is evident that there has been rapid technological progress in radiological equipment, and the current challenge from an RP perspective is the implementation of these technologies. In general there is a tendency to introduce new technology into institutions without an adequate exchange of experience.

As a **solution**, it has been proposed that universities, using their multidisciplinary human and material resources, could develop a platform for the exchange of experiences (internet-based, for example) with new technologies, also involving equipment suppliers.

The **indicator** of progress in overcoming this problem would be the number of institutions actively collaborating on such a platform within the next 5 years.

Establishment of criteria for reciprocal recognition of training in radiation protection.

There is nothing regulating recognition of the profession of Medical Physicist among the various countries of Latin America. Likewise, there is a lack of criteria and systems for recognising the training of RP experts and other professionals working with radiation for medical purposes (doctors, technologists, nurses, etc.).

As a **solution**, it is proposed that higher education institutions (universities and polytechnic schools) assume leadership of an endeavour that would lead to the proposal of a common core of RP training and mutual recognition of training in this area. To this end, a working group should be set up with that mission, also including regulatory authorities and professional associations.

An indicator of progress would be the provision, within three years, of a proposal for mutual recognition of RP training of medical physicists, RP experts and radiology and medical imaging technologists working with radiation. A proposal for other professionals, including doctors, should have been completed within five years.

Conclusions

In the field of universities and research, five main problems have been identified for which medium-term solutions and indicators of compliance have been proposed, and the following points should be briefly summarised:

1. There is a lack of training in RP during undergraduate study of health sciences (including medicine, dentistry, orthopaedics, pulmonology, paediatrics, neurology, cardiology, etc.). Students have very broad curricula and very little time to cover topics such as justification (vital for prescribing physicians), optimisation and worker and patient RP. The solution to this problem would be the introduction of RP and the physics of ionising radiation in syllabuses, using teaching methods that appeal to the profession, and putting special emphasis on the justification and promotion of radiation safety culture and safety and quality in the use of radiation.

2. There is a shortage of short courses granting accreditation and continuous training to health professionals working in radiodiagnosis, interventionism, nuclear medicine and radiotherapy and there is no regional uniformity between them, which potentially could be the case. If universities, competent authorities and scientific societies join forces, modules for face-to-face use or preferably mixed use (online and face-to-face) common to the entire region could be created.

3. There are difficulties in carrying out quality-controls in radiodiagnosis given the general shortage of medical physicists dedicated to the area. Digital technology, however, provides the opportunity to remotely monitor many parameters, an opportunity that universities could take advantage of by forming multidisciplinary working groups to develop appropriate tools and methodologies.

4. In many cases it is difficult to access metrology services and calibration laboratories, which also have little coordination between them. Universities and research

centres are a very appropriate actor to strengthen the Ibero-American network of laboratories and thus improve access for professionals in the region.

5. There is a lack in the region of sufficient coordinated research studies between universities and hospitals on RP in medicine, including epidemiological studies and follow-up of patients treated with ionising radiation. The universities could help to alleviate this problem by leading studies, proposing methodologies and contributing their multi-disciplinary capacities, dealing with the saturation and lack of means to carry out research that the medical physicist must undertake in the hospital environment. A sensitive issue in patient monitoring is adequate data protection.

Finally, two more problems were pointed out in the debate. The first is the rapid introduction of new technologies and equipment without previous training of the personnel in charge of its use, meaning that a platform for exchange of experience, supported by university centres, could be very useful. The second is the lack of mutual recognition between countries in the region regarding medical physicist training (and also of RP specialist and technologist training). Universities, leading players in the award of higher education qualifications, could spearhead a proposal for mutual recognition in these matters.

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