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Main problems and suggested solutions for improving radiation protection in medicine in Ibero-American countries. Summary of an International Conference held in Madrid, 2016

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Abstract

During the International Conference on Radiation Protection in Medicine held in Bonn in 2012, several areas for improvement were identified, including specific actions related with justification, optimization, role of manufacturers, radiation protection education and training, strategic research, data collection on medical and occupational exposures, prevention of incidents and accidents, radiation safety culture, risk-benefit dialogue and implementation of the radiation safety

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standards. The outcomes of the Bonn Conference were summarized in the so-called 'Bonn Call for Action', identifying 10 priority actions to enhance RP in medicine. Trying to analyse the progress in the implementation of this 'Call for Action' in the Ibero-American region, several international organizations organized the 'Ibero-American Conference on Radiation Protection in Medicine' (Conferencia Iberoamericana sobre Protección Radiológica en Medicina, CIPRaM) held in Madrid, in October 2016. CIPRaM was structured in eight thematic sessions dealing with: diagnostic and dental radiology, image guided interventional radiology, nuclear medicine, radiation therapy, health authorities and radiation protection regulators, professional associations of technologists and nurses, professional associations of medical physicists and radiation protection experts, and universities and researchers in radiation protection in medicine. This paper summarizes the main results of that Conference based on the consensus achieved about main problems, solutions, and indicators to evaluate the implementation of the proposed solutions.

Keywords: radiation protection, diagnostic radiology, interventional, nuclear medicine, radiation therapy, medical physicist, radiographer

(Some figures may appear in colour only in the online journal)

Introduction

Radiation protection (RP) in medicine remains a challenge for the undisputed benefit that the use of ionising radiation presents in diagnosis and therapy: a balanced approach is needed, recognizing the multiple health benefits that can be obtained, while assuring that risks are minimised. The advances in health technology continue opening new horizons for the applications of ionising radiation in health care. This has resulted in an increase in the number of medical procedures and professionals involved, and in the need to maintain appropriate standards of radiation safety in the health sector. Recently, the publication of the International Basic Safety Standards (BSS) (IAEA 2014) and the European Directive 59/2013/EURATOM (EU 2014), based on the recommendations of the International Commission on Radiological Protection (ICRP) (ICRP 2007, ICRP 2012), raised the issue of the need to update existing radiation protection norms and regulations in many countries.

The International Atomic Energy Agency (IAEA), the World Health Organization (WHO) and the Pan American Health Organization (PAHO) have always been at the forefront trying to promote the safe use of ionising radiation in medicine. In March 2001, the IAEA, WHO, PAHO and the European Commission (EC) organized the first International Conference on Radiation Protection of Patients in Malaga, Spain (IAEA 2001), which resulted in an Action Plan promoting a relevant international coordination on this topic. In December 2012, the IAEA in co-sponsorship with the WHO organized a second Conference on Radiation Protection in Medicine with similar objectives held in Bonn, Germany, with the main goal of 'setting the scene for the next decade' identified 10 priority actions to strengthen radiation protection in medicine: Enhancing aspects of justification and optimization; strengthening the role of manufacturers in radiation safety; Improving education and training in RP; promoting strategic research in RP; Increasing global information on medical and occupational exposures; Improving prevention of incidents and accidents; Strengthening radiation safety culture in medicine; Promoting better benefit-risk dialogue and Strengthening the implementation of the radiation safety requirements (BSS) (IAEA 2014).

The Bonn conference called to 'aid the full integration of radiation protection into healthcare systems', and highlighted the need for a holistic approach to radiation safety in medicine, fostering the collaboration between national governments, civil society, and international organizations, including all relevant stakeholders.

The Ibero-American Conference on Radiation Protection in Medicine (Conferencia Iberoamericana sobre Protección Radiológica en Medicina, CIPRaM) was held in Madrid, Spain, on 18–20 October 2016, as a joint initiative of WHO and two Spanish organisations: the Nuclear Safety Council (CSN) and the Ministry of Health, Social Services and Equality (MSSSI), who hosted the event. The PAHO, the IAEA, the ICRP, the International Radiation Protection Association (IRPA) and the Ibero-American Forum of Radiological and Nuclear Regulatory Agencies (FORO), immediately joined the initiative. A common motivation for joining efforts to co-organize CIPRaM was to assess the progress of the implementation of the Bonn Call for Action in Ibero-American countries. This paper summarizes the main results of the Conference, based on the consensus achieved about the main problems, possible solutions and progress indicators.

Objectives

The main objectives of the CIPRaM were to identify and prioritize relevant problems in RP in medicine, suggest solutions and define progress indicators for the Ibero-American countries.

The objectives of the CIPRaM were seen as something 'innovative' that had never been done so far and could only be performed jointly, following the holistic approach suggested in the Bonn Conference.

Methodology

The conference brought together 255 participants from 22 countries[10] (including Spain, Portugal and 14 Latin American countries). From a total of 99 invited speakers, panellists, chairs, co-chairs and co-rapporteurs who contributed to the Conference, around 50% were from Latin American countries and the other 50% were from international organizations, Spain and Portugal. The Conference was conducted in plenary sessions, starting by an opening session with messages from the hosts and all international organizations, followed by an introductory session providing an historical overview of RP at global and regional levels and presenting the scope and purpose of CIPRaM. After that, eight thematic sessions were organized by disciplines/areas, all comprising a keynote speaker from the relevant discipline/area, and a roundtable discussion with panellists representing relevant stakeholders in the discipline/area, each of them followed by a discussion open to all attendees to the Conference.

Four thematic sessions were devoted to the disciplines in which ionising radiation is used for health care:

- Medical and dental diagnostic radiology
- Image-guided interventional radiology
- Nuclear medicine
- Radiation therapy

These sessions were complemented with four thematic sessions on the following areas:

[10] Albania, Argentina, Austria, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, USA, Egypt, Spain, Mexico, Nicaragua, Paraguay, Peru, Portugal, United Kingdom, Dominican Republic, Switzerland, Uruguay and Venezuela.

- Health regulators and radiation protection regulators
- Technologists and nurses
- Medical physicists and radiation protection experts
- Universities and research

The invited keynote speakers were asked to follow a comprehensive approach from an Ibero-American perspective, rather than just addressing the problems they have in a given hospital or in local health centres within a specific country. This required a major effort from the speakers before the Conference, to contact colleagues from other countries, regional medical societies and organizations in order to:

(a) identify the five main problems concerning RP (in order of priority).
(b) suggest possible solutions.
(c) define indicators to assess progress with the proposed solutions.

One of the particularities of CIPRaM was that a substantial amount of work was done in advance by the speakers and panellists working in close interaction with the Programme Committee. The keynote speakers prepared a summary of their views on the five most relevant problems in RP in their respective areas/disciplines (presented by order of priority), the suggested solutions and the proposed progress indicators during the implementation of the solutions. Their proposals were made after contacting the relevant national and regional scientific and professional societies. These summaries were shared with the panellists, who had the opportunity to interact with the keynote speakers before the Conference for the preparation of their thematic sessions. During the Conference, the panellists discussed the proposals made by the keynote speakers and suggested potential additional items to contribute to the final conclusions from their various perspectives. About one-third of the time of each session was allocated at the end to open discussions and comments from the audience.

The interaction between speakers and panellists of each thematic area continued after their sessions, to achieve final consensus about the 5 prioritized problems, solutions and indicators to be reported as their conclusions.

Results

The Conference was an opportunity for the exchange of information and experience gained in recent years in relation to RP in medicine and helped establish and strengthen the cooperation between Ibero-American countries in this subject area.

The methodology applied for CIPRaM stimulated the exchange of information/experience and fostered the dialogue before, during and after the Conference. It also promoted cross fertilisation between countries, areas and disciplines and could be considered as one of the steps to support the implementation of the Bonn Call for Action (IAEA 2012) at a regional and national level.

The main conclusions of each of the eight thematic sessions are summarized below by enunciating in priority order the 5 problems identified, with their respective proposed solutions and suggested progress indicators. More detailed descriptions of each of these sessions is available in the proceedings of the Conference (CIPRaM 2016).

Diagnostic radiology (including medical and dental radiology)

1. *Problem*: Significant number of diagnostic procedures not justified.
   Solution: Adoption and adaptation of referral guidelines and use of new information technology for their implementation at the point of care as clinical decision support tools.

Progress indicator: Number of countries with available guidelines (or new equivalent tools as computer clinical decision support). Number of Healthcare centres using the guidelines (or the new equivalent computer tools).

2. *Problem*: Insufficient optimization actions and lack of diagnostic reference levels (DRLs).
   Solution: Develop or adapt quality control (QC) manuals, protocols for specific procedures (e.g. paediatrics, pregnancy, screening, dental, etc), establishment of DRLs, use of dose management tools and a planning to implement new technology.
   Progress indicator: Number of countries with QC manuals in use. Number of protocols adopted. Number of countries with DRLs implemented.
3. *Problem*: Lack of education and training programmes in RP including continuous training for health professionals.
   Solution: Integration of RP education at the medical and dental schools, but also for other health professionals (e.g. technicians). This education and training (initial and continuous) should also be implemented in a more advanced level during the clinical residency.
   Progress indicator: Number of annual educational activities on RP for the different scientific societies. Number of educational programmes including RP topics. Number of professionals trained in RP.
4. *Problem:* Lack of RP culture in the health sector (including the lack of benefit-risk dialogue) and the need to work as a team of different professionals.
   Solution: Promote the RP culture trough the team work (radiologists, radiographers and medical physicists) involving the hospital management. Use of adverse event reporting systems to learn lessons from unintended and accidental exposures. Improve communication with patients and media (e.g. RP campaigns).
   Progress indicator: Number of hospitals with a system to register adverse events. Number of campaigns to promote RP culture.
5. *Problem:* Lack of an effective and updated regulation in RP for diagnostic and dental radiology.

Solution: Update of the existing regulation with impact on diagnostic and dental radiology. Promote the training of inspectors. Promote the regional and international cooperation.

Progress indicator: Number of updated standards. Number of inspectors trained. Number of international cooperation activities.

Image-guided interventional radiology

1. *Problem:* Lack of RP culture; misuse of RP tools; lack of knowledge of RP strategies for patients and staff.
   Solution: Supervision of senior doctors and physicians in training.
   Progress indicator: Number of RP courses and number of health professionals certified in RP knowledge.
2. *Problem*: Lack of proper personal occupational dosimetry.
   Solution: Investment by national authorities to improve the efficiency of personal dosimetry services and to maintain national registers.
   Progress indicator: Percentage of interventional units having appropriate personal occupational dosimetry.
3. *Problem:* Scarcity of professionals, especially medical doctors, trained in RP for interventional procedures and scarcity of medical physicists properly trained for supporting these practices.

Solution: Promote the training in RP for interventionists and the training of medical physicists to support these procedures.
Progress indicator: Number of medical doctors certified in RP for interventional procedures and number of medical physicists available to support these practices.

4. *Problem:* Lack of recommendations and good practice guidelines on RP for interventional procedures, lack of knowledge about DRLs for interventional procedures.
Solution: Produce or update recommendations and good practice guidelines using interdisciplinary working groups and promote the use of DRLs.
Progress indicator: Number of produced or updated documents containing these RP recommendations, number of facilities/countries that have adopted RP norms/regulations, to be reviewed every 5 years.
5. *Problem:* Scarce number of scientific papers on RP during interventional practices.

Solution: Promote the submission of scientific papers on RP for interventional practices to scientific congresses and dedicated journals.

Progress indicator: Number of papers dealing with RP issues, published in recognised journals and number of presentations on RP presented in the scientific congresses.

Nuclear medicine

1. *Problem:* Need to ensure that the correct dose is delivered to the patient.
Solution: To implement quality management systems and QC protocols as well as to educate and to train adequately the workers.
Progress indicator: Number of centres with an implemented quality management system and its degree of compliance in each centre.
2. *Problem:* Need to avoid contamination and irradiation of the upper extremities, lens of the eyes and rest of the body.
Solution: To improve the education and training of health workers, systematic use of personal protection equipment and standard operational procedures.
Progress indicator: Continuous trend analysis of occupational dose values.
3. *Problem:* Need to ensure the optimization of doses in diagnosis and treatment.
Solution: To use standardized doses in diagnosis and planning each treatment by patient-specific dosimetry.
Progress indicator: Number of studies (and percentage) with dose optimization protocols and/or patient-specific dosimetry.
4. *Problem:* Need to promote the justification of the examinations in nuclear medicine.
Solution: To train referring and nuclear medicine physicians to use referral guidelines for appropriate examinations.
Progress indicator: Number of undergraduate medical programs including subjects related to radiation safety and percentage of studies that comply with referral guidelines.
5. *Problem*: Need to prevent incidents and accidents.

Solution: To incorporate effectively an incident reporting system for later analysis and learning using event analysis techniques.

Progress indicator: Degree of implementation of the radiation incident reporting system, degree of use of predictive analysis tools and number of meetings on incident evaluation.

Radiation therapy

1. *Problem*: Insufficient human resources (medical radio-oncologists, medical physicists and technologists) and need to update their training.
Solution: Support and update existing training programmes including RP aspects; Encourage the recertification of professionals.

Progress indicator: increase in the number of professionals active in the countries and region in the next five years.

2. *Problem*: Insufficient quality and safety in the use of new technologies and lack of standards for the prescription, registry and reporting.
   Solution: Improve the quality assurance programmes in radiotherapy. To promote external audits.
   Progress indicator: Number of facilities with own protocols and their proper application and number of installations subject to external audits.
3. *Problem*: Incidents and accidents in radiotherapy.
   Solution: Promote the use of risk analysis methodologies (reactive and proactive) and stimulate the declaration and analysis of incidents to learn from past experiences promoting continuing education in RP.
   Progress indicator: Number of facilities implementing the risk analysis as well as the number of incidents reported.
4. *Problem:* Buying new equipment without proper technical advice.
   Solution: Include all the team of professionals of the radiotherapy in the decision making. Development of technical specifications for purchase new equipment and need to raise awareness among health managers on this issue.
   Progress indicator: Participation of professionals of radiation therapy (physicist and medical) in making the decisions about procurement.
5. *Problem:* Inappropriate and unsafe use of radiation therapy in critical population groups (paediatric and adolescent).

Solution: Develop clinical and dosimetric recommendations for the paediatric and adolescent population to minimise risks.

Progress indicator: To verify the development and implementation of regional paediatric and adolescent cancer treatment guidelines.

Health and radiation protection authorities

1. *Problem:* Lack of effective coordination between regulatory authorities at the national level.
   Solution: Improve communication between regulators with participation of professional societies and stakeholders and encourage coordination between regulators.
   Progress indicator: Number of agreement actions between regulators at the highest level. Meetings with professional societies and interested parties.
2. *Problem:* Regulatory problems of different nature, such as inconsistency between different regulations, need of update and lack of implementation guidelines.
   Solution: Identify the competencies of each authority. Update regulations in accordance with international standards.
   Progress indicator: Number of updates in regulations and guidelines.
3. *Problem:* Lack of effective control over purchase or sale of equipment, QC and maintenance of radiological technology.
   Solution: Develop regulation and guidelines involving manufacturers, on acceptance tests, maintenance process and quality assurance programmes.
   Progress indicator: Existence of regulation to control the purchase and sale of equipment, the QC and maintenance. Existence of guidance for manufacturers, vendors and maintenance services.
4. *Problem*: Deficiencies in the education and training programmes in RP for health professionals and regulators especially for new technologies.

Solution: Review and update the training programmes for staff including RP issues and standards. Implement continuing education and promote the safety culture.
Progress indicator: Existence of regulation for the recognition of training programmes in RP. Number of courses and percentage of professionals of the regulatory bodies trained and re-trained.

5. *Problem:* Limited information for decision-making and prioritization of actions by the regulatory authorities.

Solution: Promote the dialogue with professional societies and stakeholders. Increase international collaboration. Promote strategic research on radiological protection issues in medicine. Promote the evaluation of health technologies.

Progress indicator: Existence of research programmes on RP in Medicine. Existence of mechanisms to ensure participation of the stakeholders in the process of decisions.

Professional associations of technologists and nurses

1. *Problem:* Lack of lifelong learning and mandatory education and training in RP.
   Solution: Implement periodic continuous training in RP.
   Progress indicator: Number of courses on RP (mandatory) for health professionals.
2. *Problem:* Lack of proper use of RP measures and tools.
   Solution: Verify the existence of suitable protective devices for health professionals.
   Progress indicator: Number of centres that verify and compare the occupational dose values.
3. *Problem*: Difficulties in the optimization of procedures due to the lack of knowledge of exposure parameters and their impact on patient dose.
   Solution: Develop specific routine protocols for the different imaging procedures.
   Progress indicator: Number of centres having PACS (picture archiving and communication system) with normalized information on dose values.
4. *Problem:* difficulties in the optimization of procedures due to lack of knowledge of dose exposure, lack of well-established national and international guidance to establish DRLs.
   Solution: Establish and use DRLs.
   Progress indicator: Number of DRLs established by modality and procedure.
5. *Problem:* Limitations/difficulties to audit procedures exposure and the QC of the equipment.

Solution: Promotion of a clinical audit program based on national/international recommendations.

Progress indicator: Number of centres fulfilling the clinical audit standards, including evaluation of image quality and quality control of equipment.

Professional associations of medical physicists and radiation protection

1. *Problem:* Lack of knowledge of the tasks and responsibilities of the medical physicist and radiological protection specialist, especially in radiology, interventionism and nuclear medicine.
   Solution: Disseminate documents of international organizations and professional societies with the recognition (ILO 2012) and describing the tasks and responsibilities of both professions (IAEA 2014, EU 2014). This should be part of the RP training courses in the health sector.
   Progress indicator: National regulations specifying the functions of the medical physicist and radiological protection specialists.

2. *Problem:* Insufficient human resources properly trained in medical physics and RP.
   Solution: To promote postgraduate programs in medical physics with specializations in radiotherapy, radiodiagnosis, interventionism and nuclear medicine. Establish clinical residences and certification process.
   Progress indicator: Number of annual courses addressing the topic. Number of graduate programmes in the various subspecialties of medical physics. Number of graduate programs with hospital practice or residences, for medical physicists.
3. *Problem:* National authorities responsible for the licensing and control of medical exposures do not generally have adequately trained personnel.
   Solution: Train members of national authorities in RP for medical exposures. Authorize independent services to complement regulatory activities such as inspections and evaluations.
   Progress indicator: Existence of an internal evaluation system of the national authorities to demonstrate knowledge of RP in medical exposures. Number of independent RP services authorized in a region or country.
4. *Problem:* There is a lack of quality management programmes for medical exposures, including specifications for radiological equipment, acceptance and commissioning tests, as well as the initial and periodic training of the operators.
   Solution: Include aspects of quality management in RP regulations. To raise the awareness of hospital management on the need to implement quality assurance programmes by a multidisciplinary group.
   Progress indicator: Results of periodic audits (internal and/or external), which assess physics and clinical aspects that impact on RP. Existence of quality assurance programmes. Certification of training.
5. *Problem:* Lack of recognition of the medical physicist as a health professional.

Solution: Disseminate the classification of the medical physicist as a health professional (ILO 2012). Document the improvements in medical care that can be achieved with the contribution of a medical physicist. Promote a system of certification of medical physicist recognized by the national authorities. Work together with medical societies. Develop research programs in medical physics.

Progress indicator: Number of budgeted positions of medical physicist in the public and private health sectors. Number of publications in scientific and/or medical journals.

Universities and research

1. *Problem:* Lack of sufficient education and training in radiological protection and physics of ionising radiation for graduates in medicine and other health specialties.
   Solution: Joint actions at the medical and dentistry faculties for the introduction of PR and the physics of ionising radiation in undergraduate syllabi. For other healthcare professionals, such as nursing staff, the content should focus primarily on occupational exposure.
   Progress indicator: Number of faculties of medicine and dentistry that have introduced RP in the undergraduate programs.
2. *Problem:* Scarcity and lack of regional coordination in the delivery of continuing training courses on RP for health professionals using ionising radiation.
   Solution: Training modules tailored to different medical specialties and supporting staff and even for management staff who can make decisions about the PR of medical services. A recognized accreditation system at the regional level would be desirable.
   Progress indicator: Number of courses and modules per area, generated in a period not exceeding five years, and the number of professionals who have successfully completed them annually.

3. *Problem:* Difficulty to perform QCs in diagnostic radiology due to the general shortage of medical physicists dedicated to this area.
   Solution: Higher education institutions can create remote quality control centres for image quality analysis and optimization. Increase collaboration between universities and health centres.
   Progress indicator: Number of radiology institutions that have implemented in each country a quality assurance system for radiodiagnostic optimization. Number of Ibero-American university centres able to carry out controls remotely.
4. *Problem:* Difficult access to metrology services and calibration laboratories, which also have poor coordination between them.
   Solution: Identify the actual calibration needs in the region. Universities and research centres have high-profile staff and resources to implement these laboratories. Ensure the availability of human and material resources in the future.
   Progress indicator: Complete a study of the situation in the region identifying the needs. The creation of a network of laboratories for metrology services for medical applications. Number of intercomparison exercises between existing laboratories.
5. *Problem:* Lack in the region of coordinated research programmes between universities and hospitals on RP in medicine. The fast introduction of new technology is a challenge for many RP aspects.

Solution: Universities, with a multidisciplinary team of professionals, could generate and maintain databases with patient information and carry out adequate follow-up after medical treatments. These actions should be coordinated with health authorities and scientific societies.

Progress indicator: Protocols developed and number of coordinated studies between university and hospital centres.

Discussion

Health technologies in diagnosis and therapy, and the enormous benefits gained from incorporating them into health services, often leads to a relegation of aspects of radiation safety that are not always properly integrated into health systems.

The main outcome of CIPRaM has been the collection of a list of problems, possible solutions and progress indicators for the Ibero-American region. This region comprises 20 Latin-American countries[11] (around 621 million inhabitants), plus Spain and Portugal (around 57 million inhabitants). The Portuguese-speaking countries (around 212 million inhabitants) include Brazil and Portugal. Therefore, the outcomes of the CIPRaM could be considered as indicative of the main problems in RP in Medicine for a population of 678 million of inhabitants (PAHO 2016).

Many of the identified problems on RP in medicine for the Ibero-American countries may also exist in other regions in the world and the proposed solutions could be useful for similar situations. Differences in the organization of the health systems, the infrastructure, the number and complexity of technology, the economic resources and the number and skills of health professionals have a relevant impact on the selection and prioritization of the problems and the proposed solutions. These aspects should be therefore considered when using the

[11] Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, México, Nicaragua, Panama, Paraguay, Peru, Puerto Rico, Uruguay and Venezuela.

conclusions of this Conference. Problems and solutions need to be tailored to the specific countries and regions.

Conclusions

There are some aspects of the identified problems in the eight thematic sessions that are quite common to several areas: i.e. need to improve the training -initial and continuous- in RP in Medicine and the culture of radiation safety, need to improve and update regulations and guidelines, need to improve the training of inspectors, lack of medical physicists, need to promote the use of DRL, need to enhance efforts to avoid incidents and accidents in medical exposures and need to strengthen efforts for the safe use of new technology in medicine, among others.

The exchange of information and experiences among regulators, professional societies and other stakeholders during the Conference, on the implementation of good clinical practice and the recommendations of RP standards in the health sector will encourage implementing the solutions suggested to the identified problems. Collecting baseline data on the status of the proposed indicators could serve as a starting point for assessing the impact of the implementation of the proposed solutions in the future.

The conclusions of the Conference can also be used as a roadmap to help in implementing solutions to the problems identified and suggest mechanisms to enhance the catalytic role of international organizations and existing structures and regional networks. It is also expected that the results of the Conference will be of value for the forthcoming International Conference on Radiation Protection in Medicine organized by the IAEA, cosponsored by WHO and PAHO, to be held in Vienna, Austria, in December 2017.

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