REPROLAM
Red de Optimización de la Protección Radiológica Ocupacional en LatinoAmérica y el Caribe

NEWSLETTER

NUMBER 7, AUGUST 2023

REPROLAM WEBINAR

"OPTIMIZATION OF RADIOLOGICAL PROTECTION IN PEDIATRIC INTERVENTIONAL CARDIOLOGY. OPRIPALC: AN EXAMPLE FOR THE WORLD."

August 11, 2023 - 11:00 a.m. (Brasilia)

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Link :meet.google.com/ymg-keax-srg

REPROLAM
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ARTICLE:
OPTIMIZATION OF PROTECTION IN PEDIATRIC INTERVENTIONAL RADIOLOGY IN LATIN AMERICA AND THE CARIBBEAN (OPRIPALC)

Interventional Radiology (IR) and Interventional Cardiology (IC) are increasingly used in pediatric patients as minimally invasive procedures that can replace more complex surgical options. The increase is particularly pronounced in IC. In all these procedures, optimizing radiation doses to patients while maintaining diagnostic image information should be a priority.

The International Basic Safety Standards include specific requirements for medical exposures of patients, with special attention to pediatric patients. The Bonn Call for Action also includes recommendations aligned with these requirements. The International Commission on Radiological Protection (ICRP) recommends the use of Diagnostic Reference Levels (DRLs) to aid in the optimization of interventional procedures.

The OPRIPALC program (Optimization of Protection in Pediatric Interventional Radiology in Latin America and the Caribbean) was established as a joint response by the Pan American Health Organization (PAHO) and the World Health Organization (WHO), in cooperation with the International Atomic Energy Agency (IAEA), to support their member states in complying with the requirements of the International Basic Safety Standards, particularly concerning ensuring that exposures of pediatric patients are kept as low as reasonably achievable to achieve the diagnostic or therapeutic objective of interventional procedures. The determination of Diagnostic Reference Levels (DRLs) is a challenge in pediatrics and a necessity because it represents the most important tool for optimizing radiation protection (RP) in interventional studies.

2.1 OBJECTIVES AND ACTIVITIES:

The objectives of the OPRIPALC program can be summarized in four points:

1. Promote a culture of radiological safety in pediatric interventional procedures.
2. Improve the quality of these procedures in participating centers.
3. Define optimization strategies based on the determination and use of Diagnostic Reference Levels (DRLs) in a sample of representative hospitals in different countries of Latin America and the Caribbean.
4. Produce a consensus document for the region that provides guidance to enhance the optimization of radiological protection in interventional practices in pediatrics.

Activities carried out up to this stage of the project have included:

1. Selecting a set of representative hospitals from the region.
2. Conducting a series of virtual/electronic technical coordination and training meetings to agree on a working methodology.

3. Identifying the most frequent procedures performed in pediatric interventional radiology and cardiology.
4. Collecting and updating details of X-ray equipment used, their quality control tests, and the levels of radiation protection training, as well as information about personnel involved in the procedures (medical specialists, technologists, medical physicists, and others).
5. Making progress on proposing a classification of procedures according to their complexity.

As part of the project, a basic program for quality control of X-ray equipment (including the evaluation of image quality and diagnostic information) was agreed upon and incorporated. Data on patient doses continue to be collected in a centralized database to obtain Diagnostic Reference Levels (NRD). Additionally, the project has incorporated the support of an automatic dose management system (DOLQA), which is being installed in some of the participating centers in OPRIPALC.

A final version of the consensus document is being prepared, which will contain practical guidelines for optimizing radiological protection and safety in pediatric interventional procedures. These actions have been complemented with the development of scientific papers summarizing the methodology and results obtained so far.

2.2. RESULTS

The initial steps of the OPRIPALC program were initiated between 2018 and 2019, inviting Spanish-speaking countries in Latin America and the Caribbean, as well as Brazil. Positive responses were received from a total of 36 hospitals belonging to 10 countries. Out of these, 18 centers from 9 countries completed the phase of initial surveys during the year 2020. In 2021, 21 hospitals from 10 countries actively participated. Currently, after validating the received data, the participation of 27 hospitals from the following countries has been confirmed: Argentina, Brazil, Chile, Colombia, Costa Rica, Cuba, Ecuador, Mexico, Panama, Peru, and Uruguay.

The project's website (www.opripalc.org) has been launched, providing basic information about the project. As of December 2022, data from 1,945 procedures have been collected. However, the results presented in this report refer to the validated and analyzed procedures.

Given that not all centers provided all requested variables, the final validated samples for procedures (grouped between diagnostic and therapeutic) were 1,587.

Patients were further grouped by age bands (< 1 year; 1-<5 years; 5-<10 years; and 10-<15 years) and weight bands (< 5 kg; 5-<15 kg; 15-<30 kg; 30-<50 kg; and 50-<80 kg), respectively.

The Diagnostic Reference Levels (NRD) for the air kerma per area product (in Gy·cm^2) grouped by age bands were as follows:

- Diagnostic Procedures (574 procedures): 3.8 (< 1 year); 7.6 (1-<5 years); 11.6 (5-<10 years); and 22.1 (10-<15 years).
- Therapeutic Procedures (946 procedures): 5.4 (< 1 year); 7.7 (1-<5 years); 13.0 (5-<10 years); and 40.5 (10-<15 years).

Regarding the NRD for the air kerma per area product (in Gy·cm^2) grouped by weight bands:

- Diagnostic Procedures (538 procedures): 3.8 (< 5 kg); 6.1 (5-<15 kg); 10.6 (15-<30 kg); 14.1 (30-<50 kg); and 37.2 (50-<80 kg).
- Therapeutic Procedures (913 procedures): 4.4 (< 5 kg); 7.3 (5-<15 kg); 11.2 (15-<30 kg); 26.9 (30-<50 kg); and 77.4 (50-<80 kg).

2.3. DISCUSSION, CONCLUSIONS, AND NEXT STEPS

Obtaining NRDs for pediatric interventional procedures presents particular challenges: the number of procedures is usually small compared to adult patients; radiation doses to patients are highly dependent on weight, which varies significantly with age; clinical indications can vary widely and have different names in different countries of the region; and the complexity of interventional procedures also varies greatly.

These four difficulties are being considered in the OPRIPALC program with appropriate approaches and simplifications. Additionally, the impact of COVID-19 on the challenges faced by different hospitals in the region has been taken into account. However, during the current year 2022, it has been observed that centers have been able to resume their activities at a level almost similar to pre-COVID-19 pandemic times.

In conclusion, regional NRD values have been obtained with a larger sample for pediatric interventional procedures, both diagnostic and therapeutic, grouped by age and weight. The sample of patient dose data should continue to be increased, and as a result, the NRDs will need to be updated accordingly.

The promotion of using automatic dose management systems will continue, with collaboration from the radiological industry, and alert levels for potential optimization actions will be incorporated. Currently, we are collaborating with the Medical Physics Service of the Hospital Clínico San Carlos in Madrid, who have provided the use of their automatic dose management system, DOLQA. This system is already operational at the Hospital Roberto del Río in Santiago, Chile, and will be installed at the Hospital Italiano de Buenos Aires in Argentina in the coming months. Meanwhile, alert levels to initiate optimization actions will need to be managed manually in other centers.

There are plans to advance the study of occupational radiation dose levels and establish correlations with patient doses, using TLD, OSL, and electronic dosimetry in centers equipped with this technology.

The programs for quality control of X-ray equipment (including image quality) and the validation of dosimetric results, as well as continued education programs in radiation protection, will be reviewed and updated as necessary. In the same line of work, local NRDs will be established for each individual center, and institutions with doses above the 75th percentile in comparison to other OPRIPALC participants will be identified. Subsequently, personalized optimization strategies will be implemented to assess their impact on patient dose and resulting image quality (diagnostic sufficiency).

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NEWSLETTER

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ARTICLE:
INDIVIDUAL MONITORING OF THE EYE OF THE LENS EXPOSURE: OVERVIEW OF REQUIREMENTS AND DOSIMETERS TYPE FOR HP(3) MEASUREMENT

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INTRODUCTION

In recent years, lens of the eye dosimetry has become more important, mainly due to the reduction of the dose limit. As a result of epidemiological studies in medical workers, which demonstrated the appearance of cataracts for doses less than 0.5 Gy, the ICRP recommended reducing the dose limit for occupationally exposed workers (TOE) [1,2]. The IAEA International Basic Standards (BSS) have been adopted this recommendation for the occupational dose limits [3]. The relevant international organization such as IAEA, ISO and EURADOS have been reviewed and update the metrological and dosimetry implications of this new dose limit [4-6], which should be taken into account by individual monitoring services and end users.

The advances in digital image processing together with the development of special devices (catheters, probes, stents) have contributed to the expansion and popularity of interventional radiology and cardiology techniques. These techniques contribute to avoid other invasive procedures, often not tolerated by the patient due to their age or pathology, to a speedy recovery time and to reducing of the hospital stay. However, these interventional procedures sometimes require long fluoroscopy times, which could delivery high doses to both patients and TOEs.

The BBS have established the following dose limit for occupational exposure: an equivalent dose to the lens of the eye of 20 mSv per year averaged over five consecutive years (100 mSv in 5 years) and of 50 mSv in any single year [3]. In the past when the dose limit for the lens of the eye was 150 mSv in a year, routine monitoring of the dose to the lens was rare. With the introduction of the new dose limits, today there is an international consensus about the need to measure doses in the lens of the eye, although the way to implement are the cause of great debate.

INDIVIDUAL MONITORING OF THE EYE OF THE LENS EXPOSURE

In general, individual monitoring should be carried out for those workers for whom there is a reasonable probability of receiving doses greater than 3/10 of the annual limit. Lens doses should be monitored in situations where non-homogeneous exposure conditions exist, specifically in those workplaces where the eyes are particularly close to the radiation source or emitting equipment (which may also include scattered radiation) or to the radiation beam (e.g., interventional radiology), while the rest of the body can be protected by a lead apron.

Workers exposed to high-energy beta radiation fields may receive significant doses in the lens. The implementation of the new dose limit implies changes in the reference levels concerning occupational exposure, which should be of interest to dosimetry services and end-users. The table below shows a comparison of the reference levels related with both dose limits.

Dose limit (LD)		Old	New
Reference level	**Criteria**	**150 mSv**	**20 mSv**
Low dose	1/10 LD	15,0 mSv	2,0 mSv
High dose	3/10 LD	45,0 mSv	6,0 mSv
Investigation level	Monthly	12,5 mSv	1,7 mSv
	Quarterly	37,5 mSv	5,0 mSv

The values of these reference levels are lower for the new dose limit, which is in line with the need to pay more attention to the individual monitoring of the eye lens doses and the interpretation of the results to verify and evaluate compliance with dose limitation and the optimization of occupational exposures.

The methodology for conducting the individual monitoring of lens of the eye doses primarily depends on the type of radiation to which the worker is exposed. The IAEA TECDOC considers three main impact factors that should be taken into account for each type of radiation:

- Energy and angle of radiation incidence;
- Geometry of the radiation field (which may change during the monitoring period);
- Use of individual protective equipment or shielding and their proper application.

From the radiation protection perspective, the dose limit for the lens is expressed in terms of the equivalent dose Hlens [7]. Since this quantity is not directly measurable, it must be estimated through operational quantities: the personal equivalent dose Hp(3) for personal dosimetry and the directional equivalent dose H'(3) for area dosimetry. The depth of 3 mm was selected as it corresponds to the depth at which the part of the lens considered sensitive to ionizing radiation is located. The definition of Hp(3) was revised within the ORAMED project, which included the proposal of a new simulator consisting of a 20 cm diameter and height cylinder made of ICRU tissue-equivalent material. It was chosen because of its simple shape and size, which are close to the dimensions of an adult head.

The most accurate method for monitoring the equivalent dose to the lens of the eye, Hlens is to measure the operational quantity, Hp(3), with a dosimeter worn as close as possible to the eye and calibrated on a phantom representative of the head. In the absence of such dosimeters, Hp(3) can be estimated from dosimeters calibrated in terms of Hp(10) or Hp(0.07) and placed on the body, extremity, or near the eyes. However, the application of these methods requires knowledge of the radiation field characteristics at the workplace (energy and angle) [5]. Some of the procedures for indirectly estimation of eye of the lens doses, when specific personal dosimeters are not available, will be treat in an upcoming article.

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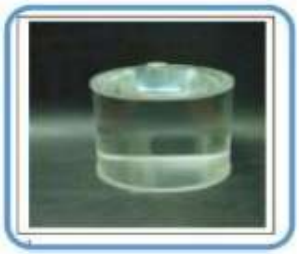
REQUIREMENTS FOR HP(3) INDIVIDUAL MONITORING

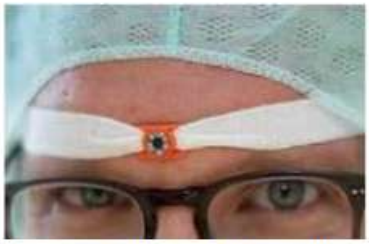


The type testing for eye of the lens dosimeters can be done following the specification of the IEC 62387:2012 standard [8] and ISO 12794:2000 standard [9]. Both the type testing and the system calibration should be carried out on a cylindrical phantom. If the calibration is done using normal incidence (the most common practical situation), the slab phantom used for Hp(10) calibration is also suitable. However, for type tests, especially those conducted with incidence angles greater than 30°, the cylindrical phantom should be used. The requirements for measurement uncertainty of Hp(3) are the same as for dosimetry in Hp(10), thus the acceptance levels are recommended by the ICRU [10].

The ideal design of a dosimeter is one where the detector and its support reproduce exactly the same conditions as defined for the operational quantity to be measured. Therefore, for Hp(3) or H'(3) measurement the detector should be covered by a 3 mm thick layer of tissue-equivalent material. Many dosimeter used the option of a bolus of hemispherical or similar shape. In addition, behind the detector is needed a sufficient thickness of tissue-equivalent material to reproduce the backscatter radiation, if the dosimeter is not worn next to the skin. These two conditions can be quite easily fulfilled in practice. However, it also necessary to taking into account that the energy response of the detector is not always strictly equivalent to tissue. At the end, the important question is that the dosimeters (detector and the case around) composition and shape must be adapted to fulfill the criteria for energy and angular response.

The dosimeter specifically dedicated to measuring Hp(3) should be placed at the eye level, as close to the eye as possible, and in contact with the skin. In practice, the two most commonly used options are as follows: (a) close to the eyebrow (either right or left) or (b) between the two eyes. In general, there is not one single method which will be preferred by the majority of the customers.

(a) Allows measurement of the maximum exposure value



(b) Allows estimation of the average exposure of both eyes

When using individual protection, for example glasses, the dosimeter should be put under this protection to provide a more accurate information about the real lens exposure. However, in practical situations, it is often not possible to place the dosimeter for lens measurement in the ideal position (close to the eyes and/or behind protective equipment like lead glasses). In such cases, correction factors need to be applied to the dosimeter readings to account for the deviation from the ideal position. These correction factors depend on the radiation energy, which means that the radiation field to which the worker is exposed must be known. These factors typically need to be determined through measurements and possibly combined with mathematical simulations to account for the shielding effects of the protective equipment. By applying these correction factors, the dosimeter readings can be adjusted to provide a more accurate estimation of the radiation dose to the lens, even when the dosimeter is not placed in the ideal position for direct measurement.

BRIEF REVIEW OF AVAILABLE DOSIMETERS

The variety and types of dosimeters specifically dedicated to measuring the quantity Hp(3) have increased. Generally, the dosimeters are based on passive methods, of which the thermoluminescent detectors (TLDs) is the most commonly used. However, there are now dosimeters based on other luminescent methods, such as Optically Stimulated Luminescence (OSL) and Radio-Photoluminescent (RPL) detectors.

Most models of lens dosimeters use a headband or strap to hold them in place, allowing for a comfortable and anatomically adjusted fit. Here are some dosimeter models and their characteristics. These are just a few examples of dosimeter models available for measuring Hp(3). For more technical and commercial information, you can refer to the websites of dosimeter suppliers and manufacturers.

EYE-DTM DOSIMETER:

Plastic holder with a cavity to place a TLD detector. When used with a LiF;Mg,Cu,P (MCP-N) TLD, its properties are:

- Energy dependence for photons (30 keV-1.33 MeV): <20%.
- Dose range: 10 µSv to 10 Sv.
- Angular response: 20% at 0° and 80° (cylindrical simulator).

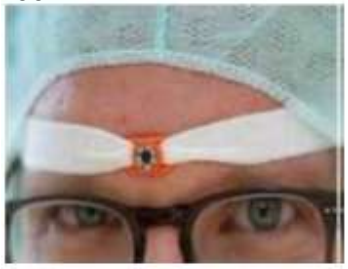
HARSHAW “chipstrates” (left):

TLD DXT with 3 mm PTFE filter

HARSHAW “EXT-RADTM” (right):

TLD with 1.5 mm PTFE filter. Performance with TLD-100:

- Dose range: 0.15 mSv to 10 Sv
- Energy range (photons): 16 - 662 keV
- Angular response: up to 45°



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DOSIRIS DOSIMETER:

Rigid headband with an integrated TLD detector (7LiF:Mg,Ti) in a 3 mm thick polypropylene cap. Each detector is identify by a circular bar code. The system is calibrated to measure Hp(3) and complies with IEC 62387-1:2012 requirements. Some performance:

- Dose range: 100 µSv to 50 Sv (photon and beta)
- Energy range: photon: 20 keV to 1.3 MeV, beta: above 700 keV.

LANDAUER VISION DOSIMETER:

Ergonomic, light and small made of a plastic resistant to torsion. Flexible, can be worn closer to the eye. Calibrated for Hp(3) measurement for photon and beta. Performance:

- Dose range: 0.1 mSv to a 10 Sv (photon and beta),
- Energy and angular response: photon ± 60° from 24 keV to 6 MeV Beta ± 45° ; 0.8 MeV (Emean))

RECENT DEVELOPMENTS:

The development of products to support lens dosimetry has evolved from research devices to more commercial ones. The model shown on the left is a very interesting development, in which the lens dosimeter is integrated into protective glasses. It is based on OSL detector.

REPROLAM ACTIVITIES

To support the efforts of external dosimetry services in the REPROLAM region, the Intercomparison Exercise for External Dosimetry Services for extremity and lens dosimetry (ICReprolam2023ext&cri) is currently underway. The call for participation was issued in the REPROLAM newsletter, and the registration process was concluded on June 30th. At this time, participating laboratories should be sending the dosimeters to the coordinating laboratory, which is the Radiation Metrology Laboratory of the Department of Nuclear Energy at the Federal University of Pernambuco (LMRIDEN/UFPE) in Brazil. The intercomparison exercise aims to enhance the accuracy and reliability of external dosimetry measurements in the region and promote best practices in radiation protection.

CONCLUSIONS

The dosimetry of eye lens doses has gained greater importance since the reduction of the annual dose limit from 150 mSv to 20 mSv. The requirements for individual monitoring of eye lens doses have been reviewed and updated. The most accurate estimation of the lens dose is achieved by measuring the operational quantity Hp(3) using dosimeters specifically designed for this purpose, calibrated in terms of Hp(3) and placed close to the eyes. The quantity and diversity of dosimeters for Hp(3) measurements have increased with more suitable designs. In general, their performance covers:

- Energy range:
  - Photons: from a few keV to energies equal to 60Co.
  - Electrons: up to 700 keV
- Dose range: 0.1 mSv to 10 Sv.

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10TH CONGRESS ON RADIATION PROTECTION OF THE COMMUNITY OF PORTUGUESE-SPEAKING COUNTRIES.

COIMBRA, DECEMBER 11TH TO 15TH, 2023

ORGANIZED BY THE PORTUGUESE SOCIETY OF RADIATION PROTECTION AND THE BRAZILIAN SOCIETY OF RADIOLOGICAL PROTECTION.

Important Dates:

- Abstract submission deadline: September 15, 2023
- Notification of abstract acceptance: October 15, 2023
- Early registration deadline: September 15, 2023

The topics of the IX Congress on Radiation Protection of the Community of Portuguese-Speaking Countries are as follows:

1 - Biological effects of radiation
2 - Dosimetry and instrumentation
3 - Radiological protection in healthcare
4 - Radiological protection of workers and the public
5 - Radiological protection in the industry
6 - Management of radioactive sources and waste
7 - Safety culture in radiological protection
8 - Regulation, policies, and international recommendations in radiological protection
9 - Planning and response to radiological and nuclear emergencies
10 - Natural radioactivity
11 - NORM industries (Naturally Occurring Radioactive Materials)
12 - Radon
13 - Non-ionizing radiations

Contacts: Email: IXCPCR@gmail.com Phone: +351 239 700 650

For more information: **https://www.sppcr.pt/congressos/ixcpcr/#contactos**

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APPLICATIONS OPEN FOR THE 2023 IAEA MARIE SKLODOWSKA-CURIE FELLOWSHIP PROGRAMME

The fourth application cycle of the IAEA's Marie Sklodowska-Curie Fellowship Programme (MSCFP) is now open. Women interested in studying nuclear related subjects are encouraged to apply by 30 September 2023. Interested applicants can find more information on how to apply here. This year, the MSCFP is expected to award 200 students scholarships, which is the highest number per cycle to date.

Named after the pioneering physicist and twice Nobel Prize laureate, Marie Sklodowska-Curie, the MSCFP encourages women to enter and pursue careers in the nuclear field by providing scholarships for tuition and living costs along with internship opportunities. In addition, students also benefit from networking opportunities at technical events and through the MSCFP Students and Alumnae group. By reducing this financial burden, the programme further motivates young women to complete advanced studies in the chosen nuclear disciplines. As the programme covers all IAEA Member States, it contributes to global gender parity in the nuclear field.

For more information, please visit: https://www.iaea.org/es/newscenter/news/abierto-el-plazo-de-presentacion-de-candidaturas-para-la-edicion-de-2023-del-programa-de-becas-del-oiea-marie-sklodowska-curie

IRPA 16 HPS

CALL FOR PAPERS
16TH INTERNATIONAL CONGRESS OF IRPA (IRPA16) - 'HARMONIZATION OF RADIATION: UNITED FOR PROTECTION

The 16th International Congress of the IRPA (IRPA16) will take place during July 7-12, 2024, in Orlando, USA, with the theme “Radiation Harmonization: Standing United for Protection”. The International Congress Organizing Committee welcomes IRPA delegates and radiation safety professionals from around the world to come and share their knowledge and practices in radiation protection.

All abstracts must be submitted electronically through the abstract portal (link available 7/1/23) by 1 October 2023. Abstracts submitted via e-mail, fax, or surface mail will neither be accepted nor acknowledged. Submitted abstracts can be revised through the portal during the abstract submission period. All submitted abstracts will be reviewed and assigned to appropriate sessions. Notification on acceptance will be sent to the corresponding author by email on 1 February 2024 for oral presentation and 1 March 2024 for poster presentation. The conference will be held in English.

You are invited to contribute papers in one or more of the Main Areas (MA) listed below. Before preparing and submitting abstracts, please review the MAs you are interested in and learn about the scope of each MA and the topics it covers.

Please consider the following special notes:

- Ethics as an overarching topic is relevant to many MAs, ranging from ethical foundations to the applications in specific areas of radiation protection (e.g., medicine, environment, emergency);
- Non-ionizing radiation (NIR) is fully integrated in the program and covered under various MAs, with MA8 addressing only practical applications;
- Abstracts on experience gained and lessons learned from preparedness for and responses to emerging diseases and from managing radiation protection in the context of geopolitical conflicts are encouraged, under relevant and appropriate MAs.

For more information, please visit: **https://burkclients.com/IRPA/2024/site/call_for_papers.html**

EURADOS

EURADOS invites Young Scientists who are presenting their work at relevant conferences to apply for the EURADOS Young Scientist Conference Support (YSCS). The YSCS will consist of a sum up to 500 € to contribute covering either the conference fee and/or the travel and/or the subsistence costs, up to the applicant's choice and following the EURADOS reimbursement rules.

The events and conferences in 2023 selected by EURADOS with still open submission deadlines for YSCS:

ERPW 2023 European Radiation Protection Week
9-13 October 2023 in Dublin, Ireland
Number of YSCS: 4
Application deadline was extended to 18 August 2023

ICRP 7th International Symposium on the System of Radiological Protection
6-9 November 2023 in Tokyo, Japan
Number of YSCS: 1
Application deadline was extended to 18 August 2023

For more information: https://eurados.sckcen.be/news-overview/eurados-young-scientist-conference-support-yscs-2023-extended-deadlines

The Network for Optimization of Occupational Radiological Protection in Latin America and the Caribbean (REPROLAM) is a scientific and cultural society with a non-profit, non-political, non-religious, and non-racial nature. It has an unlimited duration and aims to promote the optimization of occupational radiological protection. REPROLAM seeks to enhance academic and scientific cooperation among its members to foster appropriate radiological protection for workers.

Visit our website for more information.: **http://www.reprolam.com/**
How to contact: **reprolam2020@gmail.com**