

IAEA activities on RP in interventional procedures

Ola Holmberg, Ph.D.

Head, Radiation Protection of Patients Unit

International Atomic Energy Agency, Vienna, Austria

Image guided interventional procedures



Number of procedures is growing fast

- According to the **UNSCEAR 2008** Report, approximately **3.6 million** interventional radiology procedures were undertaken annually worldwide.
- According to the **UNSCEAR 2020/2021** Report, the estimated total annual number of interventional radiology procedures is about **24 million**.
- This is more than a sixfold increase!



Fluoroscopically Guided Interventional Procedures:

A Review of Radiation Effects on Patients' Skin and Hair

Stephen Balter, PhD
John W. Hopewell, DSc
Donald L. Miller, MD
Louis K. Wagner, PhD
Michael J. Zelefsky, MD

Most advice current skin reactions is based on historical data, and subsequent observations. This review is based on scientific data. Expected effects are presented in table 1 and time after dose and time after dose to estimate the variability of ages of injuries to skin and animals are presented to the National Cancer Institute as a basis for describing the severity of interventional fluoroscopy. For a single individual, noticeable effects may appear 1 month after exposure. The degree of skin injury increases with

radiology



Table 1 National Cancer Institute (NCI)

Tissue Reactions from Single-Delivery Radiation Dose to Skin of the Neck, Torso, Pelvis, Buttocks, or Arms

Band	Single-Site Acute Skin-Dose Range (Gy)*	NCI Skin Reaction Grade†	Approximate Time of Onset of Effects			
			Prompt	Early	Midterm	Long Term
A1	0–2	NA	No observable effects expected	No observable effects expected	No observable effects expected	No observable effects expected
A2	2–5	1	Transient erythema	Epilation	Recovery from hair loss	No observable results expected
B	5–10	1–2	Transient erythema	Erythema, epilation	Recovery; at higher doses, prolonged erythema, permanent partial epilation	Recovery; at higher doses, dermal atrophy or induration
C	10–15	2–3	Transient erythema	Erythema, epilation; possible dry or moist desquamation; recovery from desquamation	Prolonged erythema; permanent epilation	Telangiectasia [‡] ; dermal atrophy or induration; skin likely to be weak
D	>15	3–4	Transient erythema; after very high doses, edema and acute ulceration; long-term surgical intervention likely to be required	Erythema, epilation; moist desquamation	Dermal atrophy; secondary ulceration due to failure of moist desquamation to heal; surgical intervention likely to be required; at higher doses, dermal necrosis, surgical intervention likely to be required	Telangiectasia [‡] ; dermal atrophy or induration; possible late skin breakdown; wound might be persistent and progress into a deeper lesion; surgical intervention likely to be required



Figure A1: NCI skin toxicity grade 1. Two



Figure 5: NCI skin toxicity grade 2 (see Appendix).



Figure A5: NCI skin toxicity grade 3. Increased severity

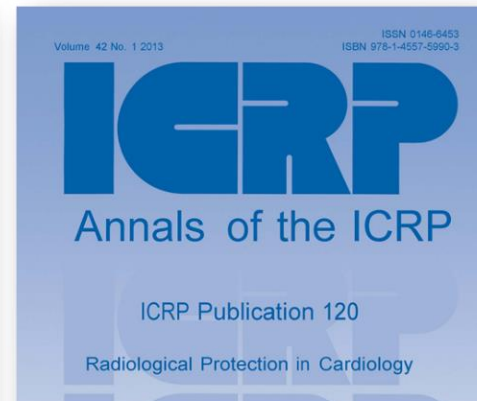
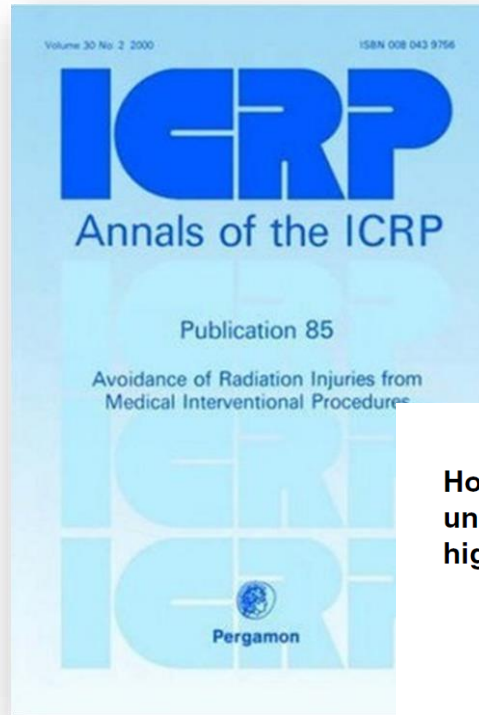
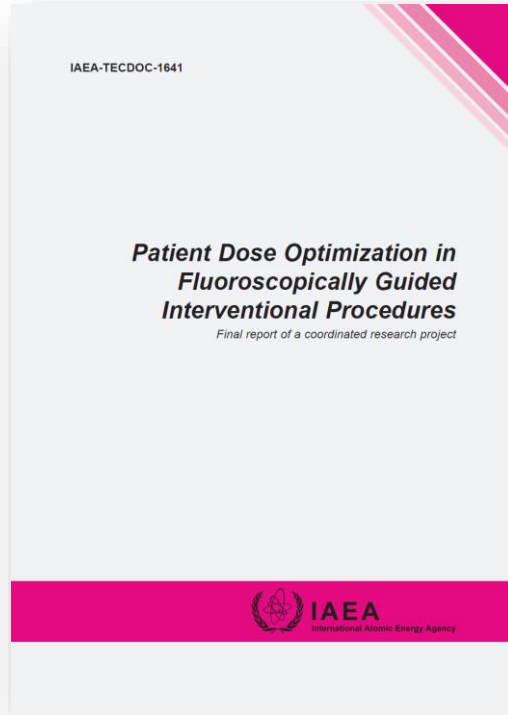


a. b.
Figure A8: NCI skin toxicity grade 4. (a) Central area of deep necrosis surrounded by indurated and

How often do injuries happen?



The frequency of major radiation injuries is estimated to be between **1:10,000 and 1:100,000** procedures



Review

How often does it happen? A review of unintended, unnecessary and unavoidable high-dose radiation exposures

Ola Holmberg^{1,*} and Miroslav Pinak²

¹ Radiation Protection of Patients Unit, International Atomic Energy Agency, Vienna, Austria

² Radiation Safety and Monitoring Section, International Atomic Energy Agency, Vienna, Austria

IAEA Safety Standards

for protecting people and the environment

Radiation Protection and Safety in Medical Uses of Ionizing Radiation

Jointly sponsored by



Specific Safety Guide

No. SSG-46



- Facilities at which image guided interventional procedures are performed **should have systems in place for identifying patients who may be at risk of late radiation injuries**, typically based on estimates of peak skin dose, cumulative reference air kerma or air kerma-area product, which take account of the fact that patients have different sensitivities to radiation.
- For these patients, information should be added to their medical records so that **appropriate observation and follow-up is ensured**.

SAFRAD (SAFety in RADiological procedures)



- International web-based voluntary and anonymized reporting system for FGI procedures
- Developed 2009-2011; Piloted 2011-2012
- Improvements 2012
- Additional modifications 2015-2017
- Promotion through IAEA meetings and TC events, and during relevant meeting and congresses

The screenshot shows the SAFRAD website interface. At the top, there is a navigation bar with the IAEA logo and the title "Safety in Radiological Procedures (SAFRAD)". Below the navigation bar, the main content area is titled "Safety in Radiological Procedures". It contains introductory text about the IAEA's sub-programme on Radiation Protection of Patients, established in 2006. A photograph on the right shows a patient in a cardiac catheterization lab. Below the text, there is a section titled "Input Data" with instructions for participating in the data collection, including steps for entering hospital information and reporting events. A "Close" button is visible in the top right corner of the input data section.



SAFRAD (SAFety in RADiological procedures)

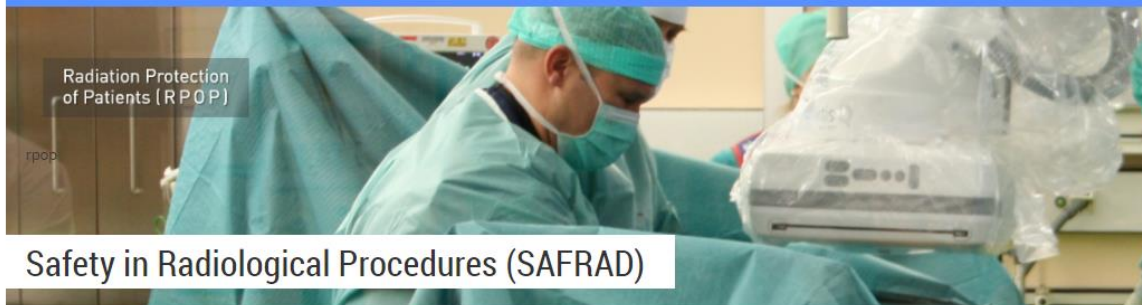
- The primary objective of SAFRAD event reporting system is **educational in nature**
 - Identify patients at risk for deterministic effects
 - Encourage follow-up examinations for adverse side effects
 - Educate physicians/other medical personnel
 - Encourage physicians to educate patients at risk
 - Minimize adverse side effects based on awareness
 - Lessons can be learned and shared
- **Confidentiality is maintained by the IAEA**



SAFRAD (SAFety in RADiological procedures)



Home / Resources / Radiation Protection of Patients / Resources / Databases and Learning Systems



Radiation Protection of Patients (RPOP)

Safety in Radiological Procedures (SAFRAD)

Resources

- 🏠 RPOP Home
- International Safety Standards
- Publications
- Posters and leaflets
- Bonn Call for Action platform
- Smart Card
- Recurrent imaging
- RELID Study
- Training material
- Webinars
- Online Training
- ▼ Databases and Learning Systems
 - SAFRON
 - SAFRAD
 - ISEMIR-IC

SAFRAD (SAFety in RADiological procedures) is a voluntary reporting system aiming to sustain a database of comprehensive data such as patient's dose report and other relevant data when these patients are submitted to defined [trigger levels](#) or events in fluoroscopically-guided diagnostic and interventional procedures. The primary objective of the system is educational. It is believed that going through the process of SAFRAD itself results in safety and quality of service.

All data furnished by participants (hospitals, regulators) will remain accessible to the participant. The participant will have access periodically to analysed results. The IAEA will publish overall summary reports of SAFRAD data from time to time. SAFRAD will not supply identifiable data to any governmental authority or other third party.

- » [Introduction to the project](#)
- » [How to use SAFRAD](#)
- » [Guidelines and forms](#)

How to use SAFRAD

Overview

SAFRAD website provides you with on-line forms to be filled in order to

Related resources

- 🔗 [Access SAFRAD](#)
- 📄 [SAFRAD new triggers](#)

Guidelines and forms

Download:

- [Guidelines for the interventionalist](#)
- [Guidelines for the treating physician](#)
- [Instructions for the coordinator](#)
- [Patient information leaflet](#)
- [Patient data collection form](#)

<https://www.iaea.org/resources/rpop/resource/s/databases-and-learning-systems/safrad>

SAFRAD triggers for reporting (initial set)



1	Fluoroscopy time	> 60 minutes
2	KAP (DAP) values	> 300 Gy.cm ² (cardiac and neuro) > 500 Gy.cm ² (other procedures)
3	K _{a,r} (total air kerma at the interventional reference point)	> 5000 mGy (5 Gy)
4	Measured skin dose	> 3 Gy
5	Number of series or cine runs	> 20
6	Multiple procedures within 12 months	

<https://rpop.iaea.org/safrad/>

SAFRAD status (March 2023)



319 events reported to date from 25 hospitals

- **19 recognized tissue reactions**
- 2 severe erythema; 2 ulceration; 9 skin erythema (transient); 6 epilation
- 11 PCI; 3 CTO, 3 neuroembolizations head; 1 Arteriovenous malformations (embolization); 1 ICD implantation
- In 6 patients 4 triggers exceeded, in 3 patients 3 triggers exceeded
 - CD:** known in 11: in 10 with >5 Gy; in 1 $<$ trigger
 - KAP:** known in 15: in 12 with > 300 Gy.cm² and 10 with >500 Gy.cm²; in 3 $<$ trigger)
 - FT:** known in all; 10 with > 60 min, 10 $<$ trigger)

Future of SAFRAD



- Many more reports needed to define more realistic trigger dose indicators for different types of interventional procedures
- SAFRAD database needs upgrade to simplify reporting and provide analyses of reported events
- Update of trigger level values needed based on evidence
- The Meeting of consultants in May 2021 advised the IAEA to design an international study

International study of patient doses and tissue reactions from FGI procedures



Objectives:

- **Improve the information** about the frequency of occurrence of tissue reactions in patients from different type of FGI procedures (cardiac, neuro, and body) performed in different parts of the world.
- **Study the relationship** between the tissue reactions and the radiation exposure metrics, procedure factors and patient related factors.
- Use the results of the study to **update trigger level** values for patient follow up for skin reactions.
- **Update recommendations** for improving radiation protection of patients.
- Provide feedback for the needed **development of SAFRAD**.

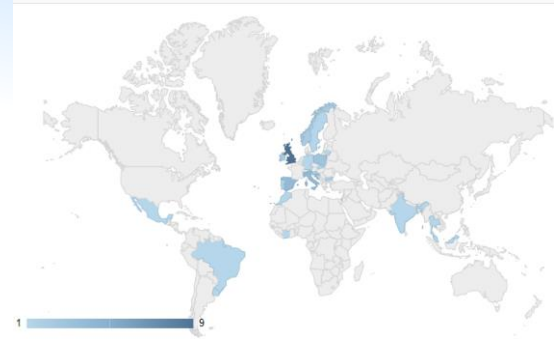
Expert panel:

D. Miller, S. Balter, K. Jones, R. Sánchez, M. Mahesh, A. Rogers; IAEA staff

Study coordinator: J. Vassileva

Current status (May 2023)

- Midterm report (6 months)
- Total 55,849 procedures, out of them:
 - 33,691 cardiac
 - 8,828 non-cardiac vascular
 - 6,658 non-vascular
 - 3,716 neurovascular
 - 632 FG-tumor therapy
- 7 facilities reported 12 cases of tissue reactions (3% of all patients followed)
- Results under analysis



	Total number of procedures	Patients followed-up for tissue reactions	Tissue reaction
Cardiac	34,691	234 (0.7%)	1
Non-cardiac vascular	8,828	62 (0.7%)	0
Non-vascular	6,658	9 (0.1%)	0
Neurovascular	3,716	83 (2.2%)	10
FG-tumor therapy	632	18 (2.8%)	1
Total	54,525	406 (0.7%)	12

Public website <http://rpop.iaea.org>



Radiation Protection of Patients (RPOP) – the leading resource for health professionals, patients and public on the safe and effective use of radiation in medicine. To access the Spanish version of the site click [here](#).

For health professionals



Health professionals can find answers to frequently asked questions about different medical procedures and the safe use of ionizing radiation in medicine.

[Radiology](#)
[Radiotherapy](#)
[Nuclear medicine](#)
[Interventional procedures](#)
[Dentistry](#)
[Other specialities and imaging modalities](#)

For patients and public



Patients, their caretakers, and the public can learn about what to expect during medical examinations that involve ionizing radiation.

[X-Rays](#)
[Computer tomography \(CT\)](#)
[Interventional procedures](#)
[Nuclear medicine](#)
[Radiotherapy](#)
[Brachytherapy](#)

[Bonn Call for Action Platform](#) >

Resources

[Training](#)

[Webinars](#)

[Safety in Radiation Oncology \(SAFRO\)](#)

[Safety in Radiological Procedures \(SAFRAD\)](#)

[Posters and leaflets](#)

[Publications](#)

[RPOP Newsletter](#) >

[Contact](#)

Annually: 1 million pageviews

- Contains useful information and FAQs for health professionals, patients and public
- Links to resources: training material, posters, webinars, videos, etc.



Public website <http://rpop.iaea.org>

2 entries – 2 different audiences

For health professionals



Health professionals can find answers to frequently asked questions about different medical procedures and the safe use of ionizing radiation in medicine.

[Radiology](#)
[Radiotherapy](#)
[Nuclear medicine](#)
[Interventional procedures](#)
[Densitry](#)
[Other specialities and imaging modalities](#)

For patients and public



Patients, their caretakers, and the public can learn about what to expect during medical examinations that involve ionizing radiation.

[X-Rays](#)
[Computer tomography \(CT\)](#)
[Interventional procedures](#)
[Nuclear medicine](#)
[Radiotherapy](#)
[Brachytherapy](#)

[Bonn Call for Action Platform](#) >

Resources

[Training](#)

[Webinars](#)

[Safety In Radiation Oncology \(SAFRON\)](#)

[Safety In Radiological Procedures \(SAFRAD\)](#)

[Posters and leaflets](#)

[Publications](#)

 [RPOP Newsletter](#) >

Contact

Public website <http://rpop.iaea.org>



Patients and public



Patients can read about what to expect during their upcoming medical examinations using ionizing radiation. Information from the RPOP website helps not only to patients but also to their caretakers, and anyone interested in this subject.



X-rays



Computed Tomography (CT)



Interventional procedures



Nuclear medicine



Radiotherapy



Brachytherapy



Patients and public

- 🏠 RPOP Home
- > About radiation
- > X-rays
- > Computed Tomography (CT)
- > **Interventional procedures**
- > Nuclear medicine
- > Radiotherapy
- > Brachytherapy
- > Pregnant women
- > Children

Frequently asked questions by the health professionals

- » Which procedures are associated with higher radiations doses?
- » What are the possible effects of radiation exposure from interventional procedures?
- » Should I be concerned about radiation if my child has been prescribed an interventional procedure?

» Which procedures are associated with higher radiations doses?

Interventional procedures - angiography, cardiac catheterisation and Computed tomography (CT) - can be associated with higher doses of radiation with doses that are about 100 to 1000 times higher than that delivered during a chest X ray.

» What are the possible effects of radiation exposure from

Related resources

- 📄 Children and radiation - what patients need to know

Interventional procedures



Health professionals

- 🏠 RPOP Home
- › Radiology
- › Radiotherapy
- › Nuclear medicine
- ▼ **Interventional procedures**
 - › Safety
 - › Radiation doses
 - › Good practices
 - › Staff
 - › Interventional cardiology
- › Dentistry
- › Other specialities and imaging modalities

The use of fluoroscopically guided interventional procedures is increasing around the world. These minimally invasive procedures are used as an alternative to conventional surgery, resulting in reduced patient morbidity and mortality. Radiation doses to patients from fluoroscopically guided interventional procedures may be high enough to cause skin injuries and increased probability of developing cancer in future years. There is also a risk to staff members of deterministic effects such as cataract formation.

Although many fluoroscopically guided interventional procedures are conducted in radiology departments, they are increasingly performed by non-radiologists in other areas of the hospital, such as hybrid operating rooms. It is important to ensure that adequate radiation protection training and support services are provided to staff members involved in fluoroscopically guided interventional procedures in all areas of the hospital.

Related resources

- 📄 [Interventional cardiology](#)

Training resources

- 📄 [Doctors using fluoroscopy outside radiology](#)
- 📄 [Posters and leaflets about radiation protection](#)

<https://www.iaea.org/resources/rpop/health-professionals/interventional-procedures>

Posters on radiation protection topics



Available in 31 languages

10 Pearls: Radiation protection of *staff* in fluoroscopy

Reducing patient dose always results in staff dose reduction

- Use protective devices!**
 - Advisable skirt type lead apron to distribute weight
 - 0.25 mm lead equivalence but with overlap on front to make it 0.5 mm on the front and 0.25 mm on the back (**Provides >90% protection**)
 - Lead glass eyewear with side protection
 - Minimize time
 - Maximize distance as much as clinically possible
 - Thyroid protection
 - Use shielding
- Make good use of time-distance-shielding (TDS) principle**
- Use ceiling suspended screens, lateral shields and table curtains**
 - They provide **more than 90% protection** from scattered radiation in fluoroscopy
 - Mobile floor shielding is advisable when using cine acquisition
- Keep hands outside the primary beam unless totally unavoidable**
 - Hands inside the central area of the primary beam will increase exposure factors (kV, mA) and doses to patient and staff

10. REMEMBER!

- Quality control testing of fluoroscopy equipment enables safe and stable performance
- Know your equipment! Using the equipment's features appropriately will help reduce doses to patients and staff
- Use injector devices

Related Poster!
10 pearls! Radiation protection of patients in fluoroscopy
<http://www.iaea.org/rpop/StaffRadiationProtection>

Page 1 of 2
Fluoroscopy
Staff Radiation Protection

10 Pearls: Radiation protection of *staff* in fluoroscopy

Reducing patient dose always results in staff dose reduction

- Use protective devices!**
 - Advisable skirt type lead apron to distribute weight
 - 0.25 mm lead equivalence but with overlap on front to make it 0.5 mm on the front and 0.25 mm on the back (**Provides >90% protection**)
 - Lead glass eyewear with side protection
 - Minimize time
 - Maximize distance as much as clinically possible
 - Thyroid protection
 - Use shielding
- Make good use of time-distance-shielding (TDS) principle**
- Use ceiling suspended screens, lateral shields and table curtains**
 - They provide **more than 90% protection** from scattered radiation in fluoroscopy
 - Mobile floor shielding is advisable when using cine acquisition
- Keep hands outside the primary beam unless totally unavoidable**
 - Hands inside the central area of the primary beam will increase exposure factors (kV, mA) and doses to patient and staff
- Only 1-5% of radiation falling on the patient's body exits the other side**
 - Stand on the side of the **transmitted beam** (i.e. by the detector), which contains only 1-5% of the incident radiation and its respective scatter
- Keep X ray tube under the patient table and not over it**
 - Undercouch systems provide better protection from scattered dose
- Use personal dosimetry**
 - Use at **least two dosimeters**
 - One **inside** the apron at chest level
 - One **outside** the apron at neck or eye level
 - Additional finger ring dosimeter for procedures requiring hands close to primary beam
 - Real time dosimetry systems are useful
- Update your knowledge about radiation protection**
- Address your concerns about radiation protection to radiation protection specialists (medical physicists)**

10. REMEMBER!

- Quality control testing of fluoroscopy equipment enables safe and stable performance
- Know your equipment! Using the equipment's features appropriately will help reduce doses to patients and staff
- Use injector devices

Related Poster!
10 pearls! Radiation protection of patients in fluoroscopy
<http://www.iaea.org/rpop/StaffRadiationProtection>

Page 2 of 2
Fluoroscopy
Staff Radiation Protection

10 Способов радиационной защиты персонала

Снижение дозы на пациента всегда приводит к снижению дозы персонала

- Используйте защитные средства!**
 - В свинцовой фартуке типа юбка для равномерного распределения веса
 - 0,25 мм свинцового эквивалента, но с нахлестом спереди, чтобы сделать 0,5 мм спереди и 0,25 мм сзади (**Обеспечивает >90% защиты**)
 - Защитные очки со стороны защиты
 - Минимизируйте время
 - Максимизируйте дистанцию, насколько это клинически возможно
 - Защита щитовидной железы
 - Используйте экранирование
- Сделайте хорошее использование принципа времени-дистанции-экранирования (ВДЭ)**
- Используйте навесные экраны, боковые экраны и шторы стола**
 - Они обеспечивают **более 90% защиты** от рассеянного излучения при флюорографии
 - Мобильное экранирование пола рекомендуется при использовании кинематографии
- Следите за тем, чтобы руки были вне первичного пучка, если это возможно**
 - Руки в центральной области первичного пучка увеличат факторы экспозиции (кВ, мА) и дозы для пациента и персонала
- Только 1-5% радиации, падающей на тело пациента, выходит с другой стороны**
 - Встаньте на стороне **переданного пучка** (т.е. со стороны детектора), который содержит только 1-5% инцидентной радиации и ее соответствующее рассеяние
- Положите рентгеновскую трубку под стол пациента, а не над ним**
 - Системы подстолья обеспечивают лучшую защиту от рассеянной дозы
- Используйте персональную дозиметрию**
 - Используйте **по крайней мере два дозиметра**
 - Один **внутри** фартука на уровне груди
 - Один **снаружи** фартука на уровне шеи или глаза
 - Дополнительный дозиметр на пальце для процедур, требующих близкого контакта рук с первичным пучком
 - Системы реального времени дозиметрии полезны
- Обновите свои знания о радиационной защите**
- Обращайте свои опасения по поводу радиационной защиты к специалистам по радиационной защите (медицинские физики)**

10. НЕ ЗАБЫВАЙТЕ!

- Контроль качества тестирования оборудования флюорографии обеспечивает безопасную и стабильную работу
- Знайте свое оборудование! Использование особенностей оборудования поможет снизить дозы для пациентов и персонала
- Используйте инъекционные устройства

Related Poster!
10 pearls! Radiation protection of patients in fluoroscopy
<http://www.iaea.org/rpop/StaffRadiationProtection>

Page 2 of 2
Fluoroscopy
Staff Radiation Protection

10 Punkte: Strahlenschutz für *Mitarbeiter* i.d. Durchleuchtung

Reduktion der Patientenabgabe resultiert immer in einer Reduktion der Mitarbeiterabgabe

- Schutzvorrichtungen verwenden**
 - Verwende als Bleischürze den Rocktyp zur Gewichtsverteilung
 - 0.25 mm Blei Äquivalent, vorne überlappend, somit 0.5 mm vorne und 0.25 mm hinten (**Bietet >90% Schutz**)
 - Bleiglasbrille mit Seitenschutz
 - Schildrüdenschutz
 - Abstrahlung reduzieren
 - Den Abstand so groß wie klinisch möglich machen
 - Abstrahlung so groß wie klinisch möglich machen
 - Verwendung von Abschirmung
- Sinnvolle Verwendung des Zeit-Abstand-Abschirmung Prinzipis**
 - Zeit reduzieren
 - Den Abstand so groß wie klinisch möglich machen
- Verwendung von Abschirmungen in der Decke, lateralen Abschirmungen und Tischvorhängen**
 - Diese bieten **mehr als 90% Schutz** vor Streustrahlung i.d. Durchleuchtung
 - Mobiler Abschirmung ist ratsam bei Verwendung von cine-Technik
- Die Hände sollten ausserhalb des primären Strahlengangs bleiben sofern nicht unbedingt notwendig.**
 - Hände im primären Strahlengang erhöhen Expositions-faktoren (kV, mA) und Dosis für Patienten und Mitarbeiter
- Only 1-5% of radiation falling on the patient's body exits the other side**
 - Stand on the side of the **transmitted beam** (i.e. by the detector), which contains only 1-5% of the incident radiation and its respective scatter
- Keep X ray tube under the patient table and not over it**
 - Undercouch systems provide better protection from scattered dose
- Use personal dosimetry**
 - Use at **least two dosimeters**
 - One **inside** the apron at chest level
 - One **outside** the apron at neck or eye level
 - Additional finger ring dosimeter for procedures requiring hands close to primary beam
 - Real time dosimetry systems are useful
- Update your knowledge about radiation protection**
- Address your concerns about radiation protection to radiation protection specialists (medical physicists)**

10. REMEMBER!

- Quality control testing of fluoroscopy equipment enables safe and stable performance
- Know your equipment! Using the equipment's features appropriately will help reduce doses to patients and staff
- Use injector devices

Related Poster!
10 Punkte! Strahlenschutz für Patienten i.d. Durchleuchtung
<http://www.iaea.org/rpop/StaffRadiationProtection>

Page 1 von 2
Durchleuchtung
Mitarbeiter-Strahlenschutz

<https://www.iaea.org/resources/rpop/resources/posters-and-leaflets>

Posters on radiation protection topics



Available in 30 languages

10 Pearls: Radiation protection of *patients* in fluoroscopy

- Maximize distance between the X ray tube and the patient to the extent possible.
- Minimize distance between the patient and the image receptor.
- Minimize fluoroscopy time.

Keep records of fluoroscopy time and DAP/KAP (if available) for every patient.
- Use pulsed fluoroscopy with the lowest frame rate possible to obtain images of acceptable quality.

Pulsed fluoroscopy reduces exposure.
- Avoid exposing the same area of the skin in different projections.

Vary the beam entrance port by rotating the tube around the patient.

Figure adapted from L. K. Wagner

Radiological Protection of Patients
<http://rpop.iaea.org>

Page 1 of 2
Fluoroscopy
Patient Radiation Protection

10 Pearls: Radiation protection of *patients* in fluoroscopy

- Larger patients or thicker body parts trigger an increase in entrance surface dose (ESD).

ESD: 1 unit, 2-3 units, 4-6 units, 8-12 units
- Oblique projections also increase ESD.

Be aware that increased ESD increases the probability of skin injury.
- Avoid the use of magnification.

Decreasing the field of view by a factor of two increases dose rate by a factor of four.

INTENSIFIER Field-of-view (FOV)	RELATIVE PATIENT ENTRANCE DOSE RATE FOR FOV SIZE UNITS
12" (32 cm)	100
9" (22 cm)	177
6" (16 cm)	400
4.5" (11 cm)	711
- Minimize number of frames and cine runs to clinically acceptable level.

Avoid using the acquisition mode for fluoroscopy.

Cine dose rate = (10-60) × normal fluoroscopy dose rate.

Documentation should be performed with last image hold whenever possible and not with cine images.
- Use collimation.

Collimate the X ray beam to the area of interest.

Radiological Protection of Patients
 10 pearls! Radiation protection of *staff* in fluoroscopy
<http://www.iaea.org/rpop/rpop/Content/Content.aspx?ContentID=201&ContentID=201&ContentID=201&ContentID=201&ContentID=201>
<http://rpop.iaea.org>

Page 2 of 2
Fluoroscopy
Patient Radiation Protection

اللائحة العشر: الوقاية الإشعاعية للمرضى من التصوير الإشعاعي

10 Altn Kuralı Floroskopi İncelemelerinde Hastanın Radyasyonun Korunması

- X ışın tüpü ile hasta arasındaki uzaklığı mümkün olduğunca artırın.
- Hastayı görüntü alıcıya mümkün olduğunca yakın tutun.
- Floroskopi süresini en aza indirin.

Her hasta için süreyi ve DAP/KAP kaydedin.
- Sürekli floroskopi yerine en düşük kare hızıyla çalıştırılabilir floroskopi kullanın.

Zaman zaman görüntü kalitesi kabul edilebilir düzeyde olsun.
- Farklı pozisyonlarda aynı bölgeyi görüntülemeyin.

X ışın tüpünü hastanın vücudunun farklı bölgelerine döndürerek görüntü alınmasını sağlayın.

10 zasad: Ochrona radiologiczna pacjenta podczas fluoroskopii

- Maksymalnie zwiększaj odległość (d) między lampą rentgenowską a pacjentem.
- Zmniejszaj odległość między pacjentem a wzmacniaczem obrazu.
- Ograniczaj czas fluoroskopii.

Zachowaj zapis czasu fluoroskopii oraz DAP/KAP (jeśli dostępne) dla każdego pacjenta.
- Stosuj fluoroskopię pulsacyjną o najmniejszej liczbie ramek, umożliwiającą uzyskanie obrazu o zadowalającej jakości.
- Unikaj ekspozycji tego samego obszaru skóry w różnych projekcjach.

Zmieniaj położenie miejsca wejścia wiązki promieniowania obracając lampę wokół pacjenta.

Radiological Protection of Patients
 10 Pearls! Radiation protection of *staff* in fluoroscopy
<http://www.iaea.org/rpop/rpop/Content/Content.aspx?ContentID=201&ContentID=201&ContentID=201&ContentID=201&ContentID=201>
<http://rpop.iaea.org>

Page 1 of 2
Fluoroscopy
Ochrona Radiologiczna Pacjenta

<https://www.iaea.org/resources/rpop/resources/posters-and-leaflets>

Posters on radiation protection topics



Available in 26 languages

10 Pearls: Radiation protection for children in interventional procedures

1. Remember: Some tissues of a growing child are more sensitive to radiation than adult
Children have longer life span to manifest radiation effects

2. Discuss with parents before the procedure

- Ask about previous exposures
- Answer their concerns about radiation safety

3. Increase awareness among your team members through the use of a pre-procedure safety checklist

4. Plan the procedures in detail and in advance to avoid improper or aborted runs or other repeated exposures

5. Protect the patient's thyroid, breast, eyes and gonads where possible

IAEA RPOP image genitly RPOP Posters webpage!
http://www.pedrad.org/associations/5364/files/IntGen_SafetyList_Checklist.pdf

Page 1 of 2
International Radiology
Children Radiation Protection

10 Pearls: Radiation protection for children in interventional procedures

6. Use optimal technique:

- Lower frame rates. Decrease from 7.5 to 3 pulses per second when possible
- Remove grids from machine if possible for infants under 20 kg
Use air-gap technique instead
- Minimize imaging time
- Minimize field overlap in repeated acquisitions
- Use tighter collimation
- Minimize magnification usage

7. Use "last image hold" rather than additional exposures, where appropriate

8. Increase distance between patient and the X ray tube and decrease distance between patient and image receptor

9. Use dose recording and dose reduction technologies in equipment

10. Review and record radiation dose after the procedure

IAEA RPOP image genitly RPOP Posters webpage!
http://www.pedrad.org/associations/5364/files/IntGen_SafetyList_Checklist.pdf

Page 2 of 2
International Radiology
Children Radiation Protection

الأكثر: الوقاية الإشعاعية للأطفال في الإجراءات الإشعاعية التداخلية

Հուսանելի և անվտանգ երեխաների ճառագայթային պաշտպանություն

10 Regole d'oro: Radioprotezione del bambino nelle procedure interventistiche

1. Ricorda: alcuni tessuti del bambino in fase di crescita sono più sensibili alle radiazioni rispetto a quelli degli adulti
Gli effetti delle radiazioni hanno più probabilità di manifestarsi nei bambini perché hanno una maggiore aspettativa di vita

2. Parla con i genitori prima della procedura

- Informati circa eventuali esposizioni precedenti
- Fornisci loro chiarimenti su eventuali preoccupazioni sulla sicurezza delle radiazioni

3. Aumenta la consapevolezza dei membri del tuo team con la compilazione di una check list di sicurezza da compilare prima della procedura

4. Pianifica le procedure nel dettaglio e anticipatamente al fine di evitare sequenze improprie o interrotte o esposizioni ripetute

5. Proteggi dove possibile tiroide, mammella, occhi e gonadi del paziente

IAEA RPOP image genitly RPOP Posters webpage!
http://www.pedrad.org/associations/5364/files/IntGen_SafetyList_Checklist.pdf

Page 1 of 2
Radiologia Interventivistica
Radioprotezione del bambino

<https://www.iaea.org/resources/rpop/resources/posters-and-leaflets>

Posters on radiation protection topics



Available in 30 languages

Pregnant?

or think
you could be?

Please tell
the staff
before an X ray
or nuclear medicine
procedure



What you need to know

Unborn babies are more sensitive to radiation

Risk depends on stage of pregnancy, type of procedure and the amount of radiation used

Diagnostic radiological procedures are safe under most circumstances even during pregnancy

DO's and DON'T's

Don't avoid the procedure if it is important for your health

Do ask the medical staff what measures will be taken to reduce any risk

Do seek advice before the procedure if you are concerned

Do ask if a pregnancy test is needed.

<https://rpop.iaea.org>

ВИЕ СТЕ
БРЕМЕННА
ИЛИ Е
ВЪЗМОЖНО
ДА СТЕ
БРЕМЕННА?

Уведомете за това
нашият медицински
персонал преди
на прием на
нуклеарна медицина

怀孕了?
或认为你可
能怀孕了?

请在接受X射线或
核医学检查之前
告诉工作人员。



КАКВО ТРЯБВА ДА ЗНАЕТЕ?

Плодът в утробата на майката е по-чувствителен към облъчването.

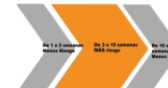
Vous êtes
enceinte
ou pensez

你需要知道的事情
胎儿对辐射更敏感。

风险取决于妊娠阶段。检查类型

¿Está embarazada
o cree que
puede estarlo?

Por favor, informe
al personal médico
antes de someterse a
una radiografía o a
un procedimiento de
medicina nuclear.



Ce qu'il faut savoir

Les bébés dans le ventre de leur mère sont plus sensibles aux rayonnements.

Les risques varient selon le stade de la grossesse, le type d'acte et les doses de rayonnements administrés.

Les risques de radiologie diagnostique sont la plupart du temps sans danger, même pendant la grossesse.

Debe saber que

El feto es más sensible a la radiación.

Los riesgos dependen del estado de gestación, del tipo de procedimiento y de la cantidad de radiación utilizada.

En la mayoría de los casos los procedimientos radiológicos de diagnóstico no entrañan riesgos, ni siquiera en el embarazo.

Recomendaciones

No deje de someterse al procedimiento si es importante para su salud.

Pregunte al personal médico las medidas que se tomarán para reducir los riesgos.

Si está preocupada, pida consejo antes de someterse al procedimiento.

Pregunte si ha de realizarse una prueba de embarazo.

<https://www.iaea.org/resources/rpop/resources/posters-and-leaflets>

IAEA free training resources



<https://www.iaea.org/resources/rpop/resources/training-material>

Diagnostic and interventional radiology



[Lectures →](#)

[Exercises →](#)

[Lectures \(in Spanish\) →](#)

[Exercises \(in Spanish\) →](#)

[Lectures \(in Russian\) →](#)

[Exercises \(in Russian\) →](#)

Cardiology



[Lectures →](#)

[Lectures \(Russian\) →](#)

Lectures:

01. Why talk about radiation protection in cardiology?
02. Talking about radiation dose
03. What radiation effects are possible? (besides skin injuries)
04. X ray production and angiography equipment
05. Patient dose management: Part 1-2
06. Standards and guidance
07. Occupational exposure and protective devices
08. Image quality in cardiac angiography
09. Optimization of radiation protection in cardiology
10. Radiation protection in paediatric interventional cardiology
11. Cardiac CT - radiation doses, dose management and practical issues
12. Examples of Good & Bad Practice (physical factors): Part 1-2

Doctors using fluoroscopy outside radiology



[Lectures →](#)

[Lectures \(in Spanish\) →](#)

Lectures:

- 01. Overview of radiation protection
- 02. Understanding radiation units
- 03. What can radiation do?
- 04. Anatomy of fluoroscopy & CT Fluoroscopy Equipment
- 05. How do I reduce my radiation risk?
- 06A. Radiation protection for patients in orthopaedic surgery
- 06B. Radiation Exposure in Gastroenterology
- 06C. Other medical specialties that use fluoroscopy
- 07. International standards and recommendations

Paediatric radiology



[Lectures →](#)

[Lectures \(in Spanish\) →](#)

Providing training

Training courses and workshops under TC regional and national projects

- Regional training courses
- National training courses
- Main target audience: health professionals in hospitals



RPOP webinars



- Online lectures on topics in radiation protection of patients and staff
- In English, Spanish, Portuguese, Russian
- Held in cooperation with Image Gently, ESR (EuroSafe Imaging), LatinSafe, EFRS, IOMP, CIRSE
- Free registration and attendance
- Recording available for viewing

<https://www.iaea.org/resources/rpop/resources/webinars>

RPOP webinars (2016-2019)

<https://www.iaea.org/resources/rpop/resources/webinars>



 International Atomic Energy Agency
Radiation Protection of Patients Unit




Is cataract a real risk to those working in interventional suites?

4 February 2016

Presenter:
Prof. Madan Bahari



 International Atomic Energy Agency
Radiation Protection of Patients Unit





Approaches to estimating radiation exposure to the lens of the eye during interventional procedures

9 March 2016

Presenter:
Prof. Elisa Vano




 International Atomic Energy Agency
Radiation Protection of Patients Unit





Radiation induced skin injuries in interventional procedures

5 April 2016

Presenter:
Prof. Madan Bahari



 International Atomic Energy Agency
Radiation Protection of Patients Unit






Dose and quality assessment of X-ray devices for interventional angiography and cardiology: an important task for the medical physics expert in radiology

Presenter:
Prof. Nicholas Marshall

Panelist:
Prof. Hilde Bosmans

Panelist:
Michiel Dehaes



 International Atomic Energy Agency
Radiation Protection of Patients Unit



Radiation protection in interventional radiology: practical hints and tricks



Prof. Hilde Bosmans
Belgium

 International Atomic Energy Agency
Radiation Protection of Patients Unit



Patient radiation management in interventional fluoroscopy

Presenter: Prof. Stephen Balter



RPOP webinars (2020-)

<https://www.iaea.org/resources/rpop/resources/webinars>



IAEA
International Atomic Energy Agency

RPOP
Radiation
Protection
of Patients

CIRSE

What's new in understanding radiation risks for patients in interventional procedures?

Prof. Werner Jaschke



• Chair of Radiation Protection Subcommittee of CIRSE
• Former Director and Chair of the Department of Radiology at Medical University Innsbruck, Austria

Prof. Madan Rehani



• President of RPOP
• Director of Global Outreach for Radiation Protection at NGH, Boston, USA
• Member of IGRP

IAEA
International Atomic Energy Agency
Atoms for Peace and Development

RPOP
Radiation
Protection
of Patients

CIRSE

Managing radiation protection in fluoroscopy guided interventions:
How we do it?

Gabriel Bartal



Interventional radiologist,
Tel Aviv, Israel

Eliseo Vano



Medical physicist,
Madrid, Spain

IAEA
International Atomic Energy Agency

RPOP
Radiation
Protection
of Patients

Online monitoring of patient exposure in diagnostic and interventional radiology: Experience of Spain

José Miguel Fernández



Eliseo Vaño



Roberto Sánchez



IAEA
International Atomic Energy Agency
Radiation Protection of Patients Unit

Aproximaciones para estimar las dosis ocupacionales en cristalino durante los procedimientos intervencionistas

4 de Mayo de 2016

Presentador:
Prof. Eliseo Vaño



IAEA
International Atomic Energy Agency
Atoms for Peace and Development

RPOP
Radiation
Protection
of Patients

ТЕОРИЯ И ПРАКТИКА РАДИАЦИОННОЙ БЕЗОПАСНОСТИ В ИНТЕРВЕНЦИОННОЙ РАДИОЛОГИИ

Часть 1: 24 ноября, 14 ч. CET

CIRSE

Д-р Габриэль Бартал



Тель-Авив, Израиль

Ст.н.с. Сарычева Светлана Сергеевна



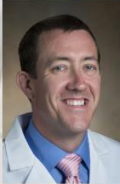
Санкт Петербург, Россия

IAEA
International Atomic Energy Agency

RPOP
Radiation
Protection
of Patients

A First Look at the Clinical Data from the American College of Radiology Fluoroscopy Dose Index Registry (DIR-Fluoro)

Prof. Aaron Kyle Jones



- Professor at the University of Texas MD Anderson Cancer Center, USA
- Diagnostic medical physicist with a clinical focus on interventional and intraoperative imaging.
- Authored over 70 peer-reviewed publications and in 2013 he received the Farrington Daniels Award for best paper on Radiation Dosimetry in Medical Physics.
- Fellow of the American Association of Physicists in Medicine (AAPM) since 2019.
- Physics editor for the Journal of Vascular and Interventional Radiology
- Chair of the American College of Radiology Dose Index Registry Committee

E-learning with certification

Radiation Protection in interventional radiology (2019)



- Based on the 6 webinars
- Final quiz
- Certificate of completion if >80% correct answers
- Available from the e-learning platform of the IAEA

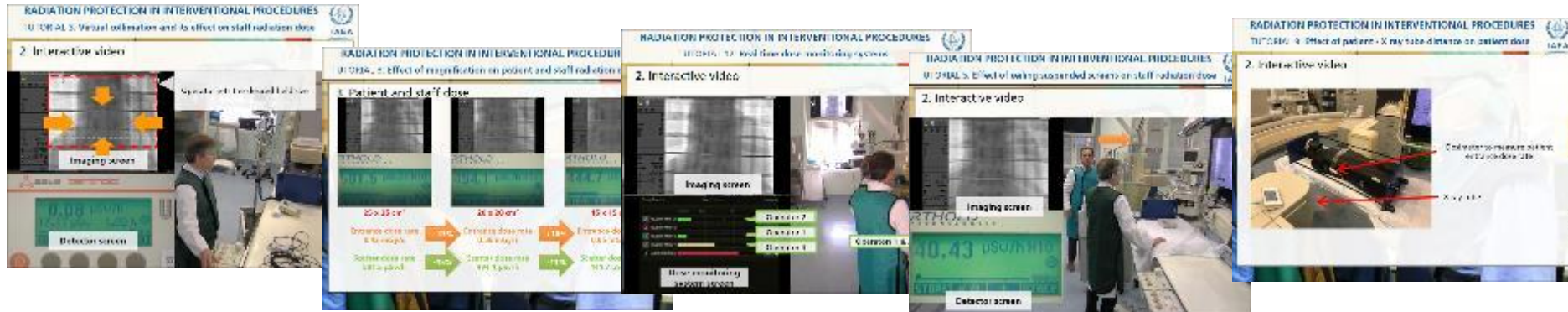
<https://www.iaea.org/resources/rpop/resources/online-training>

E-learning with certification



- 13 short practical tutorials, 4-8 minutes each with interactive videos
- To learn effect of various factors on patient and staff dose
- Available also for viewing without registration and for free download and use by trainers

<https://www.iaea.org/resources/rpop/resources/online-training>



The collage displays various screenshots from the e-learning tutorials. Key elements include:

- Interactive video interface:** Shows a video player with a '2. Interactive video' title and a 'Detecting screen' label.
- Dose rate and distance diagrams:** Illustrates the relationship between distance and dose rate. For example, at 20m, the dose rate is 0.025 µSv/h, and at 10m, it is 0.1 µSv/h. A diagram shows a person at 20m from a source, with a dose rate of 0.025 µSv/h, and another person at 10m, with a dose rate of 0.1 µSv/h.
- Imaging and detector screens:** Shows a person operating a fluoroscopy unit, with labels for 'Imaging screen' and 'Detector screen'.
- Effect of magnification:** A diagram shows a person at 20m from a source, with a dose rate of 0.025 µSv/h, and another person at 10m, with a dose rate of 0.1 µSv/h. A diagram shows a person at 20m from a source, with a dose rate of 0.025 µSv/h, and another person at 10m, with a dose rate of 0.1 µSv/h.
- Effect of suspended screens:** A diagram shows a person at 20m from a source, with a dose rate of 0.025 µSv/h, and another person at 10m, with a dose rate of 0.1 µSv/h. A diagram shows a person at 20m from a source, with a dose rate of 0.025 µSv/h, and another person at 10m, with a dose rate of 0.1 µSv/h.



<https://www.iaea.org/resources/rpop>