# International Resources and Programs for Medical Physicists for Training in Radiation Protection

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## Learning Objectives

1. To learn about educational resources and training programs in the area of radiation protection of patients and medical radiation protection
2. To understand how medical physicist can interact more efficiently with clinical colleagues using radiation protection as a tool.



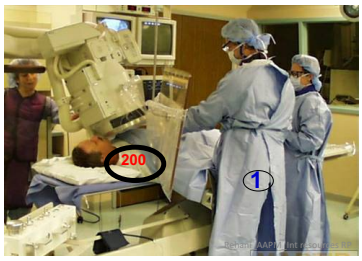
## Changing scenario in Radiation Protection

- Prior to 2000: Occupational Radiation Protection (ORP) dominated the field of radiation protection
- Significant improvements in ORP, doses are minimal typically 0-3 mSv/yr
- Recent issue cataract among interventionalists
- Current century: Focus on Radiation Protection of Patient (RPOP)



## Changing scenario

**Previously: You have to work whole life with radiation, whereas the patient may undergo procedure only few times**




**Now**

**Cumulative life time dose**

**patient>>> staff life time dose**



## International Resources from

- IAEA
- ICRP
- European Commission (EC)
- WHO, UNSCEAR
- Some professional societies: IOMP/IRPA/EFOMP



## National resources (outside the scope of this talk)

- NCRP
- Image Gently
- Image Wisely
- RSNA
- AAPM

## Resources

**FREE download**

- **Power point slides**
- **Publications**
- **Webinars**
- **eLearning material**
- **Presentations**

**Not FREE**

- **Publications**



## Programs

- **IAEA Training Programs: For participants from developing countries. Trainers from developed countries.**
- **IOMP supported training activities**



## International Resources from

- **IAEA**
- **ICRP**
- **European Commission (EC)**
- **WHO, UNSCEAR**
- **Some professional societies: IOMP/IRPA/EFOMP**



## Website http://rpop.iaea.org


**First page of Google search**

20 million hits/y
≈0.4 million visits/y, 190 countries

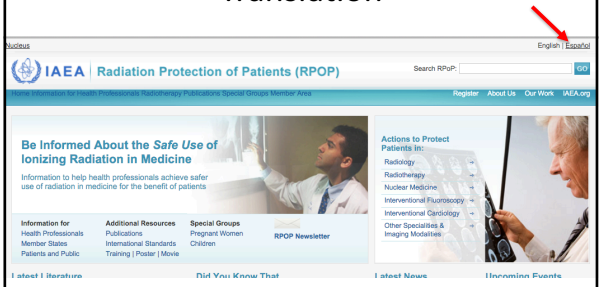


## How to reach RPOP website

- **Google search: Direct on various pages**
- ***radiation protection in…..pregnancy, …mammography, …fluoroscopy, …CT, …radiology, …nuclear medicine, ..radiotherapy, …cardiology, …children, …dental radiology, …DEXA, …PET/CT, …interventional radiology, …fluoroscopy, …gastroenterology, …urology, …orthopedic surgery…***
- **Trough iaea.org: Long [Navigation vs search]**



## Translation



| | Country / Territory | Sessions | % Sessions |
|---|---|---|---|
| 1. | United States | 126,044 | 26.17% |
| 2. | Spain | 33,885 | 7.04% |
| 3. | Mexico | 32,147 | 6.67% |
| 4. | United Kingdom | 31,934 | 6.63% |
| 5. | Colombia | 18,541 | 3.85% |
| 6. | India | 18,266 | 3.79% |
| 7. | Argentina | 14,854 | 3.08% |
| 8. | Canada | 14,781 | 3.07% |
| 9. | Australia | 13,970 | 2.90% |
| 10. | Chile | 11,960 | 2.48% |



Home » Training

## Free Material

As power point slides

- Diagnostic and Interventional Radiology
- Radiotherapy
- Nuclear Medicine
- Prevention of Accidental Exposure in Radiotherapy
- Cardiology
- PET/CT
- Paediatric Radiology
- Digital Radiology
- Doctors using fluoroscopy outside radiology (Urologists, Gastroenterologists, Orthopaedic surgeons etc.)

Русский

**About 40,000 downloads/yr**



RPOP

Liked

RPOP on Twitter

### Lectures/Slides

All 23 modules (ZIP of 28 files, 89.29 Mb)

- 00. Principles of Radiation Protection and Motivation for the Course (10,548 KB)
- 01. Overview of radiation protection in diagnostic radiology (1,147 KB)
- 02. Radiation units and dose quantities (2,153 KB)
- 03. Biological effects (7,386 KB)
- 04. International system of radiation protection (871 KB)
- 05. Interaction of radiation with matter (10,586 KB)
- 06. X-ray production (6,517 KB)
- 07. X-ray beam (1,877 KB)
- 08. Factors affecting image quality (16,119 KB)
- 09. Medical exposure BSS (1,739 KB)
- 10. Patient dose assessment (1,050 KB)
- 11. Quality assurance (673 KB)
- 12. Shielding and X-ray facility design (1,047 KB)
- 13. Occupational exposure: Part 1 (1,240 KB)
- 13. Occupational exposure: Part 2 (5,493 KB)
- 14. Radiation exposure in pregnancy (1,101 KB)
- 15. Optimization of protection in radiography: Part 1 (12,399 KB)
- 15. Optimization of protection in radiography: Part 2 (1,207 KB)
- 16. Optimization of protection in fluoroscopy: Part 1 (5,554 KB)
- 16. Optimization of protection in fluoroscopy: Part 2 (1,480 KB)
- 17. Optimization of protection in interventional radiology: Part 1 (1,045 KB)
- 17. Optimization of protection in interventional radiology: Part 2 (1,480 KB)
- 18. Optimization of protection in CT (3,460 KB)
- 19. Optimization of protection in mammography (880 KB)
- 20. Optimization of protection in digital radiology (3,045 KB)
- 21. Optimization of protection in paediatrics (6,113 KB)
- 22. Optimization of protection in dental radiology (5,066 KB)
- 23. Organizing a QA program in diagnostic radiology (1,170 KB)

### Practicals

All exercises (ZIP of 28 files, 59.2 Mb)

- 23. Organizing a QA program in diagnostic radiology (1,170 KB)

### Practicals

All exercises (ZIP of 28 files, 59.2 Mb)

- 12. Shielding and X-ray facility design: Part 1 (1,196 KB)
- 12. Shielding and X-ray facility design: Part 2 (8,126 KB)
- 15. Optimization of protection in radiography: Part 1 (4,102 KB)
- 15. Optimization of protection in radiography: Part 2 (492 KB)
- 15. Optimization of protection in radiography: Part 3 (1,057 KB)
- 15. Optimization of protection in radiography: Part 4 (486 KB)
- 15. Optimization of protection in radiography: Part 5 (520 KB)
- 15. Optimization of protection in radiography: Part 6 (984 KB)
- 15. Optimization of protection in radiography: Part 7 (3,862 KB)
- 15. Optimization of protection in radiography: Part 8 (499 KB)
- 15. Optimization of protection in radiography: Part 9 (511 KB)
- 16. Optimization of protection in fluoroscopy: Part 1 (9,843 KB)
- 16. Optimization of protection in fluoroscopy: Part 2 (8,186 KB)
- 16. Optimization of protection in fluoroscopy: Part 3 (8,113 KB)
- 16. Optimization of protection in fluoroscopy: Part 4 (3,167 KB)
- 16. Optimization of protection in fluoroscopy: Part 5 (788 KB)
- 16. Optimization of protection in fluoroscopy: Part 6 (1,334 KB)
- 18. Optimization of protection in CT (2,121 KB)
- 19. Optimization of protection in mammography: Part 1 (515 KB)
- 19. Optimization of protection in mammography: Part 2 (1,327 KB)
- 19. Optimization of protection in mammography: Part 3 (731 KB)
- 19. Optimization of protection in mammography: Part 4 (568 KB)
- 19. Optimization of protection in mammography: Part 5 (528 KB)
- 19. Optimization of protection in mammography: Part 6 (1,610 KB)
- 19. Optimization of protection in mammography: Part 7 (6,196 KB)
- 19. Optimization of protection in mammography: Part 8 (1,367 KB)
- 19. Optimization of protection in mammography: Part 9 (510 KB)
- 19. Optimization of protection in mammography: Part 10 (518 KB)



## Power Point Slides (not pdf)

IAEA | Radiation Protection of Patients (RPOP)

Search RI

Home | Information for | Additional Resources | Special Groups | Member Area

Information for
Health Professionals
Member States
Patients

Home » Training » Free Material

### Paediatric Radiology

Training material developed in collaboration with
Image Gently

Member Area
- Member States Area
- Drafts Management Area

### Lectures/Slides

All 10 modules (ZIP of 10 files, 40.92 Mb)

- 01. Why Talk About Radiation Protection during Radiological Procedures in Children (4,290 k
- 02. Understanding Radiation Units (5,544 KB)
- 03. Radiation Protection of Children in Screen Film Radiography (8,748 KB)
- 04. Radiation Protection of Children in Digital Radiography (3,951 KB)
- 05. Radiation Protection of Children in Fluoroscopy (2,537 KB)
- 06. Radiation Protection of Children During Computed Tomography (6,597 KB)
- 07. Radiation Protection of Children in Interventional Radiology and Cardiology (3,003 KB)
- 08. Standards and Guidelines in Radiological Procedures in Children (6,304 KB)
- 09. Quality Assurance in Paediatric Radiological Procedures (1,497 KB)
- 10. Organization of a Paediatric Radiology Department (6,194 KB)

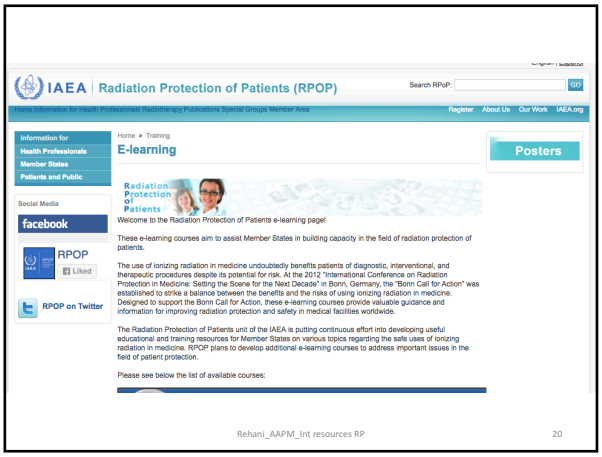


## Diagnostic and Interventional Radiology

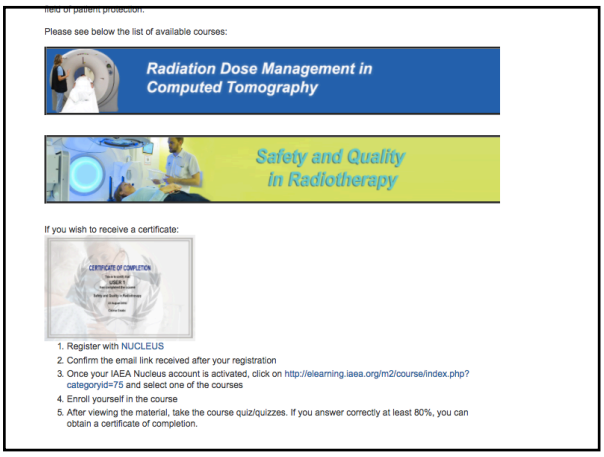
Training material developed in collaboration with
World Health Organization (WHO)
Pan American Health Organization (PAHO)
International Labour Organization (ILO)
International Society of Radiology (ISR)
International Organization for Medical Physics (IOMP)
International Society of Radiographers and Radiological Technologists (ISRRT)

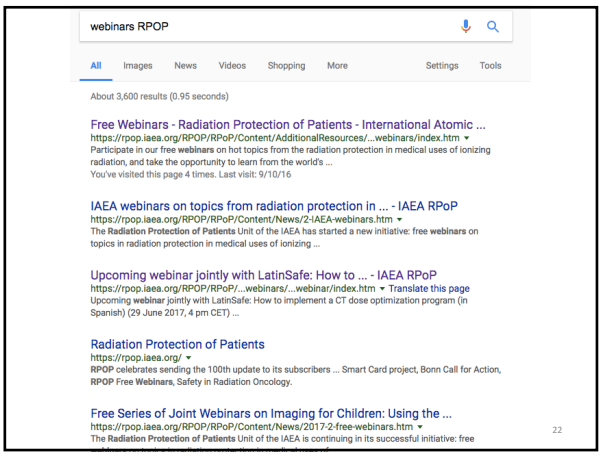
Русский



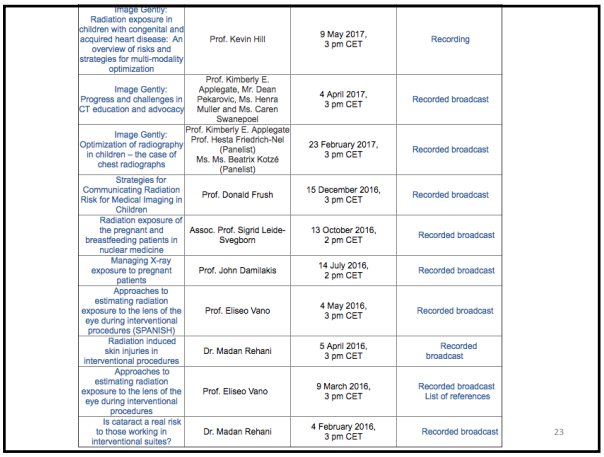





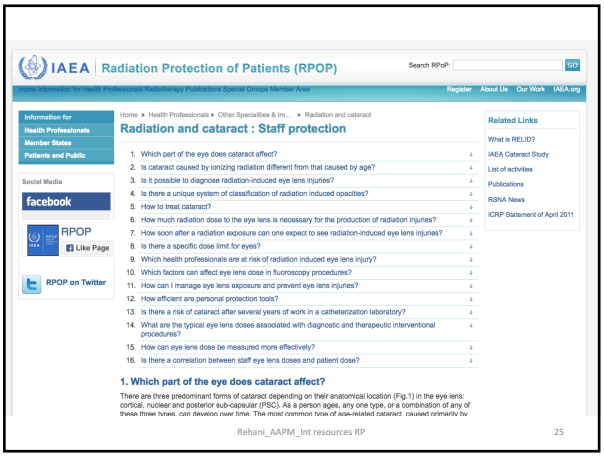


| | | | |
|---|---|---|---|
| Image Gently: Radiation exposure in children with congenital and acquired heart disease: An overview of risks and strategies for multi-modality optimization | Prof. Kevin Hill | 9 May 2017, 3 pm CET | Recording |
| Image Gently: Progress and challenges in CT education and advocacy | Prof. Kimberly E. Applegate, Mr. Dean Pekarovic, Ms. Henra Muller and Ms. Caren Swanepoel | 4 April 2017, 3 pm CET | Recorded broadcast |
| Image Gently: Optimization of radiography in children – the case of chest radiographs | Prof. Kimberly E. Applegate Prof. Hesta Friedrich-Nel (Panelist) Ms. Ms. Beatrix Kotzé (Panelist) | 23 February 2017, 3 pm CET | Recorded broadcast |
| Strategies for Communicating Radiation Risk for Medical Imaging in Children | Prof. Donald Frush | 15 December 2016, 3 pm CET | Recorded broadcast |
| Radiation exposure of the pregnant and breastfeeding patients in nuclear medicine | Assoc. Prof. Sigrid Leide-Svegborn | 13 October 2016, 2 pm CET | Recorded broadcast |
| Managing X-ray exposure to pregnant patients | Prof. John Damilakis | 14 July 2016, 2 pm CET | Recorded broadcast |
| Approaches to estimating radiation exposure to the lens of the eye during interventional procedures (SPANISH) | Prof. Eliseo Vano | 4 May 2016, 3 pm CET | Recorded broadcast |
| Radiation induced skin injuries in interventional procedures | Dr. Madan Rehani | 5 April 2016, 3 pm CET | Recorded broadcast |
| Approaches to estimating radiation exposure to the lens of the eye during interventional procedures | Prof. Eliseo Vano | 9 March 2016, 3 pm CET | Recorded broadcast List of references |
| Is cataract a real risk to those working in interventional suites? | Dr. Madan Rehani | 4 February 2016, 3 pm CET | Recorded broadcast |



## FAQs and Posters


IAEA Radiation Protection of Patients (RPOP)
Radiation and cataract : Staff protection
1. Which part of the eye does cataract affect?
2. Is cataract caused by ionizing radiation different from that caused by age?
3. Is it possible to diagnose radiation-induced eye lens injuries?
4. Is there a unique system of classification of radiation induced opacities?
5. How to treat cataract?
6. How much radiation dose to the eye lens is necessary for the production of radiation injuries?
7. How soon after a radiation exposure can one expect to see radiation-induced eye lens injuries?
8. Is there a specific dose limit for eyes?
9. Which health professionals are at risk of radiation induced eye lens injury?
10. Which factors can affect eye lens dose in fluoroscopy procedures?
11. How can I manage eye lens exposure and prevent eye lens injuries?
12. How efficient are personal protection tools?
13. Is there a risk of cataract after several years of work in a catheterization laboratory?
14. What are the typical eye lens doses associated with diagnostic and therapeutic interventional procedures?
15. How can eye lens dose be measured more effectively?
16. Is there a correlation between staff eye lens doses and patient dose?
1. Which part of the eye does cataract affect?
Related Links
Rehani_AAPM_Int resources RP
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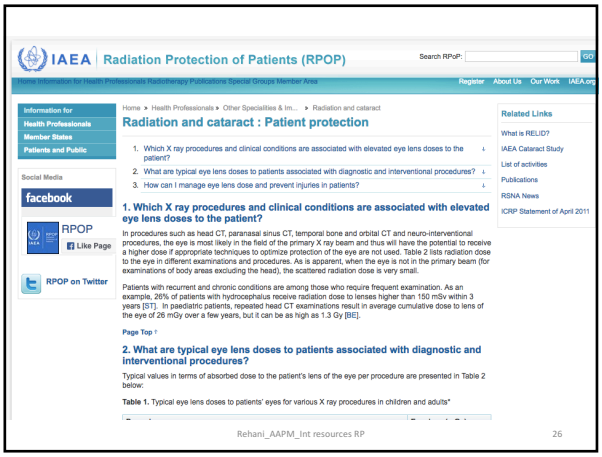
IAEA Radiation Protection of Patients (RPOP)
Radiation and cataract : Patient protection
1. Which X ray procedures and clinical conditions are associated with elevated eye lens doses to the patient?
2. What are typical eye lens doses to patients associated with diagnostic and interventional procedures?
3. How can I manage eye lens dose and prevent injuries in patients?
1. Which X ray procedures and clinical conditions are associated with elevated eye lens doses to the patient?
2. What are typical eye lens doses to patients associated with diagnostic and interventional procedures?
Related Links
Rehani_AAPM_Int resources RP
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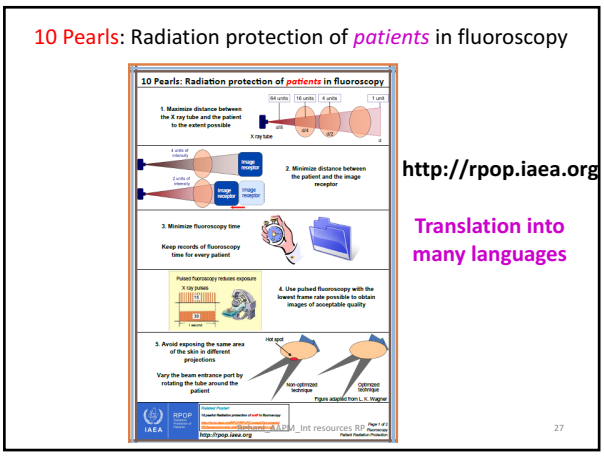
10 Pearls: Radiation protection of patients in fluoroscopy
http://rpop.iaea.org
Translation into many languages
Rehani_AAPM_Int resources RP
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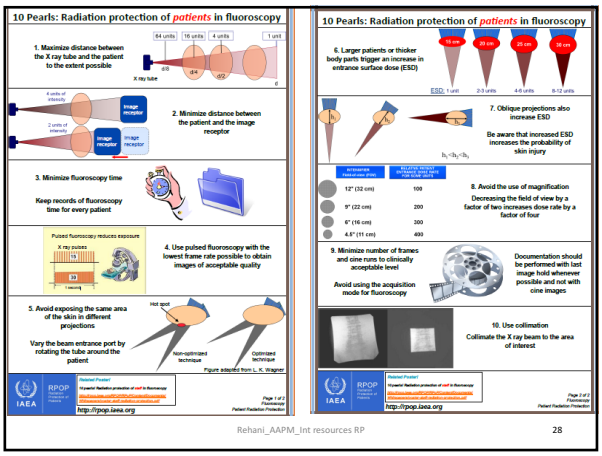
10 Pearls: Radiation protection of patients in fluoroscopy
1. Maximize distance between the X ray tube and the patient to the extent possible
2. Minimize distance between the patient and the image receptor
3. Minimize fluoroscopy time
Keep records of fluoroscopy time for every patient
4. Use pulsed fluoroscopy with the lowest frame rate possible to obtain images of acceptable quality
5. Avoid exposing the same area of the skin in different projections
Vary the beam entrance port by rotating the tube around the patient
6. Larger patients or thicker body parts trigger an increase in entrance surface dose (ESD)
7. Oblique projections also increase ESD
Be aware that increased ESD increases the probability of skin injury
8. Avoid the use of magnification
Decreasing the field of view by a factor of two increases dose rate by a factor of four
9. Minimize number of frames and cine runs to clinically acceptable level
Avoid using the acquisition mode for fluoroscopy
Documentation should be performed with last image hold whenever possible and not with cine images
10. Use collimation
Collimate the X ray beam to the area of interest
Rehani_AAPM_Int resources RP
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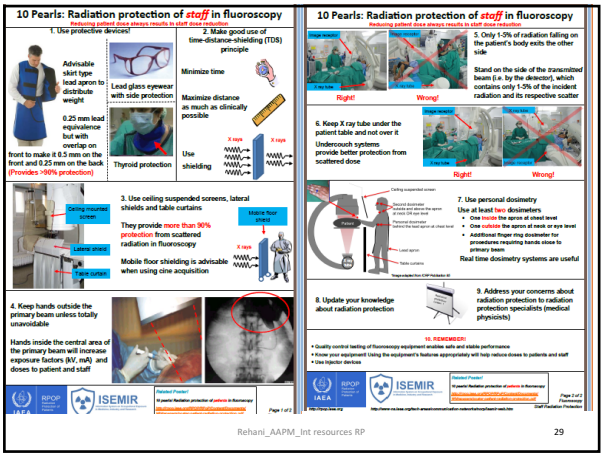
10 Pearls: Radiation protection of staff in fluoroscopy
1. Use protective devices?
Advisable skirt type lead apron to distribute weight
Lead glass eyewear with side protection
0.25 mm lead equivalence but with overlap on front to make it 0.5 mm on the front and 0.25 mm on the back (Provides >90% protection)
Thyroid protection
2. Make good use of time-distance-shielding (TDS) principle
Minimize time
Maximize distance as much as clinically possible
Use shielding
3. 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
4. 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
5. 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
6. Keep X ray tube under the patient table and not over it
Undercouch systems provide better protection from scattered dose
7. Use personal dosimetry
Use at least two dosimeters
Real time dosimetry systems are useful
8. Update your knowledge about radiation protection
9. Address your concerns about radiation protection to radiation protection specialists (medical physicists)
10. REMEMBER:
Rehani_AAPM_Int resources RP
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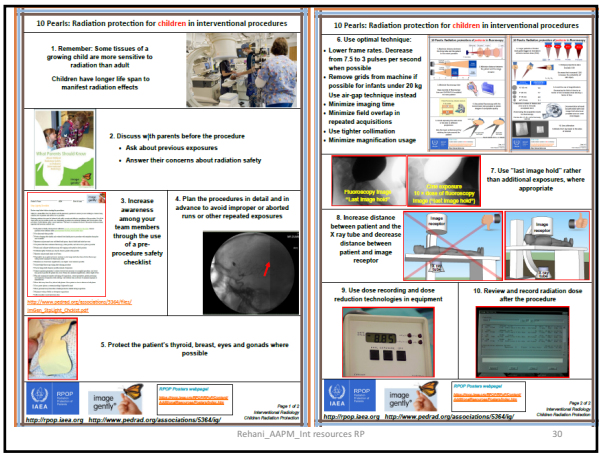
10 Pearls: Radiation protection for children in interventional procedures
1. Remember: Some tissues of a growing child are more sensitive to radiation than adult
Children have longer life span to manifest radiation effects
2. Discuss with parents before the procedure
Ask about previous exposures
Answer 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
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
Rehani_AAPM_Int resources RP
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| Language | Patient | Staff |
|---|---|---|
| |  |  |
| English | **10 pearls on radiation protection of patients in fluoroscopy** Download PDF | **10 pearls on radiation protection of staff in fluoroscopy** Download PDF |
| عربي (Arabic) | **١٠ لآلئ العشر: الوقاية الإشعاعية للمرضى من التنظير الإشعاعي** Download PDF | **١٠ لآلئ العشر: الوقاية الإشعاعية لفريق التنظير الإشعاعي** Download PDF |
| български (Bulgarian) | **10 златни правила: Радиационна защита на пациентите при скопия** Download PDF | **10 златни правила: Радиационна защита на персонала при скопия** Download PDF |
| 中文 (Chinese) | **十大要诀：X射线透视中患者的放射防护** Download PDF | **十大要诀：X射线透视中职业人员的放射防护** Download PDF |
| Hrvatski (Croatian) | **10 Zlatnih Pravila—Zaštita bolesnika od zračenja u dijaskopiji** Download PDF | **10 Bisera: Zaštita osoblja od zračenja pri dijaskopiji** Download PDF |
| Deutsch (German) | **10 Tipps: Strahlenschutz für Patienten bei Durchleuchtung** Download PDF | **10 Tipps: Strahlenschutz des Personals i.d. Durchleuchtung** Download PDF |
| Ελληνικά (Greek) | **10 χρυσοί κανόνες: Ακτινοπροστασία ασθενών κατά την ακτινοσκόπηση** Download PDF | **10 χρυσοί κανόνες: Ακτινοπροστασία προσωπικού κατά την ακτινοσκόπηση** Download PDF |
| Français (French) | **10 Recommandations: Radioprotection des patients en fluoroscopie** Download PDF | **10 Recommandations: Radioprotection du personnel en fluoroscopie** Download PDF |



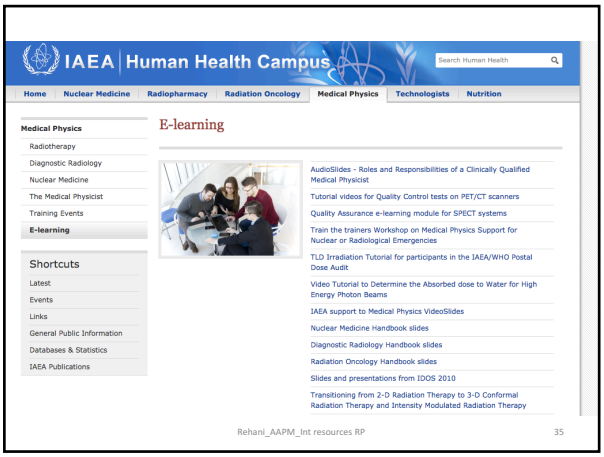
| | | |
|---|---|---|
| עברית (Hebrew) | **10 כללי הזהב להגנת המטופל מקרינה בשיקוף** Download PDF | **10 כללי הזהב להגנת הצוות מקרינה בשיקוף** Download PDF |
| Indonesia (Indonesian) | **10 Mutiara: Proteksi Radiasi Bagi Pasien pada fluoroskopi** Download PDF | **10 Mutiara: Proteksi Radiasi Bagi Staf Pada Fluoroskopi** Download PDF |
| Italiano (Italian) | **10 Regole d'oro: Radioprotezione del paziente in fluoroscopia** Download PDF | **10 Regole d'oro:radioprotezione degli operatori in fluoroscopia** Download PDF |
| 한국어 (Korean) | **10개 원칙: 투시검사 시 환자의 방사선 방어** Download PDF | **10개 원칙: 투시검사 시 종사자의 방사선 방어** Download PDF |
| Македонски (Macedonian) | **10 Златни правила: Заштита на пациентите од радијација при флуороскопија** Download PDF | **10 Златни правила: Заштита од радијација на персоналот при флуороскопија** Download PDF |
| Монгол улс (Mongolian) | | **10 Шилтгээ санамж: Рентген харалтын үед ажилтанд үзүүлэх цацрагийн хамгаалалт** Download PDF |
| Polski (Polish) New! | **10 zasad: Ochrona radiologiczna pacjenta podczas fluoroskopii** Download PDF | **10 zasad: Ochrona radiologiczna personelu podczas fluoroskopii** Download PDF |
| Português (Portuguese) | **10 Recomendações para proteção de pacientes em fluoroscopia** Download PDF | **10 Recomendações para a proteção do staff em fluoroscopia** Download PDF |
| Русский (Russian) | **10 Способов радиационной защиты пациентов** Download PDF | **10 Способов радиационной защиты персонала** Download PDF |
| српски (Serbian) | **10 Bisera: Zaštita pacijenata u fluoroskopiji** Download PDF | **10 Bisera: Zaštita osoblja u fluoroskopiji** Download PDF |
| Español (Spanish) | **10 Recomendaciones para protección de pacientes en fluoroscopia** Download PDF | **10 Recomendaciones para la protección del staff en fluoroscopia** Download PDF |
| Svenskt (Swedish) | **10 råd: Strålskydd för patienter vid genomlysning** Download PDF | **10 råd: Strålskydd för personal vid genomlysning** Download PDF |



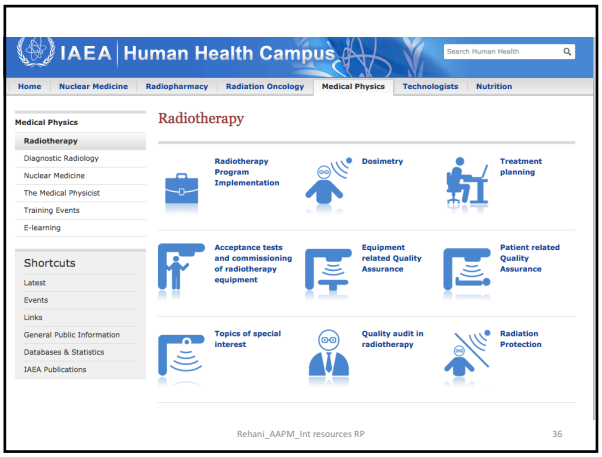
# IAEA
# Dosimetry & Medical Physics







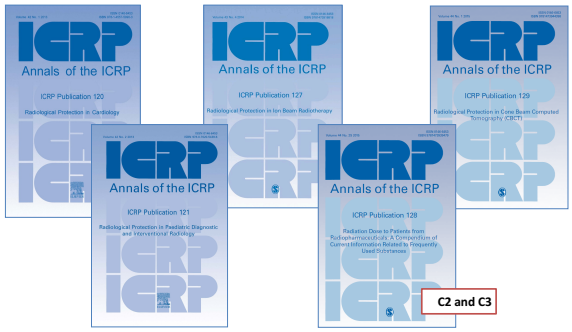



## International Resources from

- IAEA
- ICRP
- European Commission (EC)
- WHO, UNSCEAR
- Some professional societies: IOMP/IPRA/EFOMP



## ICRP Committee 3: The most recent documents






## ICRP C3 most recent publications

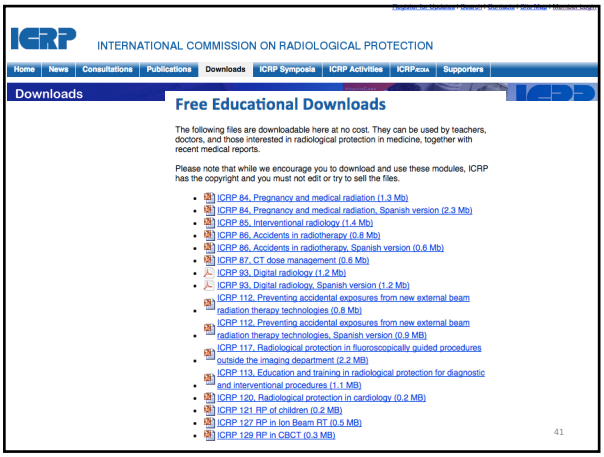
- P120. Radiological Protection in Cardiology. Ann. ICRP 42(1), 2013.
- P121. **Radiological Protection in** Paediatric **Diagnostic and Interventional Radiology**. Ann. ICRP 42(2), 2013.
- P127. Radiological Protection in Ion Beam Radiotherapy. Ann. ICRP 43(4), 2014.
- P128. Radiation Dose to Patients from Radiopharmaceuticals: A Compendium of Current Information Related to Frequently Used Substances. Ann. ICRP 44(2S), 2015 (with Committee 2).
- P129. Radiological Protection in Cone Beam Computed Tomography (CBCT). Ann. ICRP 44(1), 2015.



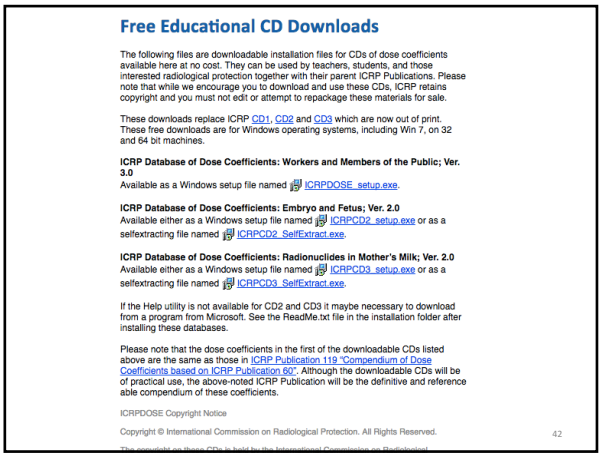
## Current Work Plan (a) of Committee 3

- WP on Diagnostic reference levels (DRLs) in Medical Imaging. *In press* (E. Vano).
- WP on Occupational radiation protection issues of interventions guided by radiological imaging. *iUndergoing public consultation* (P. Ortiz).
- TG 36 (with C2): Radiation dose to patients from radiopharmaceuticals (D. Nosske and S. Mattsson).
- WP on Radiological Protection in Therapy with Radiopharmaceuticals (Y. Yonekura and S. Mattsson).
- WP (with C1) on Radiological Protection in Medicine in relation to the Individual Response to Ionising Radiation (M. Bourguignon).







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|---|---|
| ICRP Publication 28 | Principles for Handling Emergency and Accidental Exposures of Workers (FREE PDF) |
| ICRP Publication 27 | Problems Involved in Developing an Index of Harm (FREE PDF) |
| ICRP Publication 26 | Recommendations of the ICRP (FREE PDF) |
| ICRP Publication 25 | The Handling, Storage, Use and Disposal of Unsealed Radionuclides in Hospitals and Medical Research Establishments (FREE PDF) |
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| ICRP Publication 23 | Report on the Task Group on Reference Man (FREE PDF) |
| ICRP Publication 22 | Implications of Commission Recommendations that Doses be Kept as Low as Readily Achievable (FREE PDF) |
| ICRP Publication 21 | Data for Protection Against Ionizing from External Sources - Supplement to ICRP Publication 15 (FREE PDF) |
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| ICRP Publication 5 | Handling and Disposal of Radioactive Materials in Hospitals and Medical Research Establishments (FREE PDF) |

## A new way to visually convey level of dose

Table 4.1. Typical patient dose levels (rounded) from vascular surgical procedures.

| Procedure | Relative mean effective dose to patient (0 mSv 35) | Relative mean radiation dose to patient* | Reported values: Fluoroscopy time (min) | Entrance skin dose (mGy) | Dose-area product (Gy.cm²) | Effective dose (mSv) |
|---|---|---|---|---|---|---|
| EVAR | | F,G | 21 | 330-850 | 60-150 | 8.7-27 |
| Venous access procedures | | B | 1.1-3.5 | 8-24 | 2.3-4.8 | 1.2 |
| Renal/visceral angioplasty (stent/no stent) | | G | 20.4 | 1442 | 208 | 54 |
| Iliac angioplasty (stent/no stent) | | G | 14.9 | 900 | 223 | 58 |

Rehani et al. ICRP Publication 117. Radiological protection in fluoroscopically guided procedures performed outside the imaging department. 2010



Table 4.2. Typical patient dose levels (rounded) from Urological procedures.

| Procedure | Relative mean effective dose to patient (0 mSv 35) | Relative mean radiation dose to patient* | Reported Fluoroscopy (min) |
|---|---|---|---|
| IVU/IVP | | C,D | na** |
| Cystometrography | | B | n |
| Cystography | | B | n |
| Excretion urography/MCU | | C | n |
| Urethrography | | B | n |
| PCNL | | A | 6-12 |
| Nephrostomy | | D | 1.3-20 |
| ESWL | | B | 2.6-3.4 |
| Kidney stent insertion | | E | / |
| Ureteric stent placement | | | |

Table 4.6. Typical patient dose levels (rounded) from gastroenterology and hepato-biliary

| Procedure | Relative mean effective dose to patient (0 mSv 35) | Relative mean radiation dose to patient* | Reported Fluoroscopy (min) |
|---|---|---|---|
| ERCP (diagnostic) | | C,D | 2-3 |
| ERCP (therapeutic) | | E,F | 5-10 |
| Biopsy | | C | na** |
| Bile duct stenting | | E | na** |
| PTC# | | D | 6-14 |
| Bile duct drainage | | F,G | 12-26 |
| TIPS*** | | F,G | 15-93 |
| Transjugular hepatic biopsy | | D | 6.8 |

*A=<1 mSv; B=1 to<2 mSv ; C=2 to <5 mSv ;D=5 to <10 mSv ;E=10 to<20;F=20 to 35 mS
** not available

Table 4.5. Typical patient dose levels from gynaecological procedures (

| Procedure | Relative mean effective dose to patient (0 mSv 35) | Relative mean radiation dose to patient* |
|---|---|---|
| Pelvimetry, conventional | | |
| Pelvimetry, digital fluorography | | |
| CT Pelvimetry | | |
| HSG | | |
| UAE*** | | |

*A=<1 mSv; B=1 to<2 mSv ; C=2 to <5 mSv ;D

Table 4.4. Typical patient dose levels (rounded) from various orthopaedic procedures

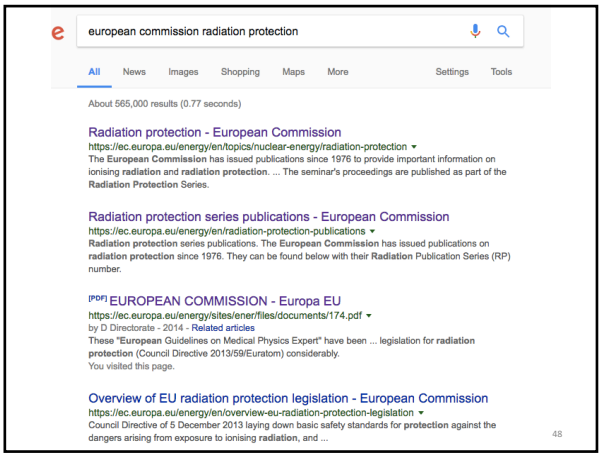
| Procedure | Relative mean effective dose to patient (0 mSv 35) | Relative mean radiation dose to patient* | Reported Fluoroscopy (min) |
|---|---|---|---|
| Skull | | A | na** |
| Cervical Spine | | A | 0.2-0.8 |
| Thoracic Spine | | B | 0.85 |
| Lumbar Spine | | B | 0.10-1.4 |
| Pelvis | | A | na** |
| Hip | | A | 0.020-1.1 |
| Shoulder | | A | na** |
| Knee | | A | na** |
| Other extremities | | A | na** |
| Hand/wrist | | B,C | 0.20-0.55 |
| Distal radius plate osteosynthesis | na** | na** | 1.8*** |
| Osteosynthesis of malleolar fracture | na** | na** | 1.5*** |
| Plate osteosynthesis of tibial plateau fracture | na** | na** | 1.2*** |
| Arthroscopy for ACL reconstruction | na** | na** | 0.9*** |
| Tibial intramedullary nailing | na** | na** | 5.7*** |
| Intramedullary nailing of diaphyseal femoral fracture | na** | na** | 6.3*** |

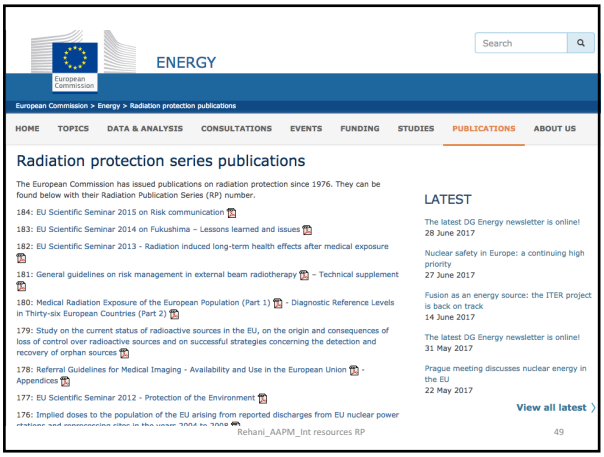


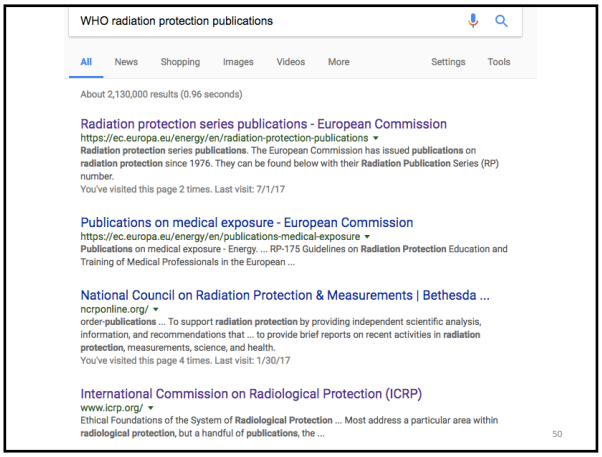
## International Resources from

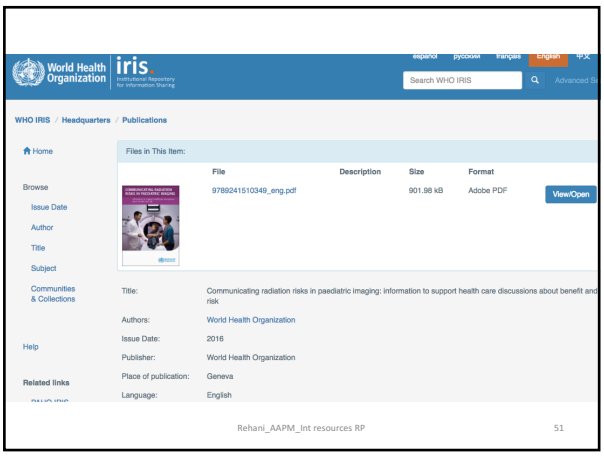
- **IAEA**
- **ICRP**
- **European Commission (EC)**
- **WHO, UNSCEAR**
- **Some professional societies: IOMP/IRPA/EFOMP**

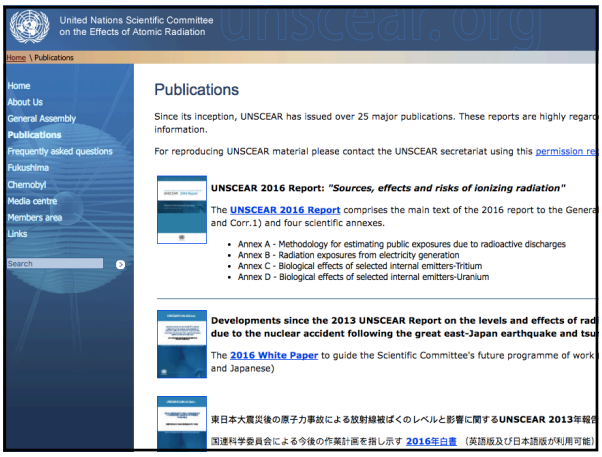




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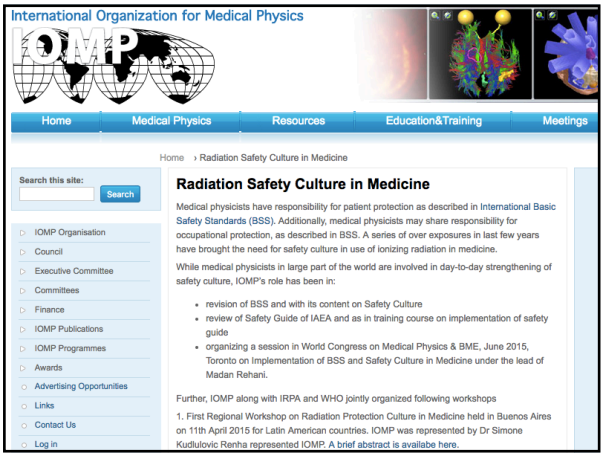


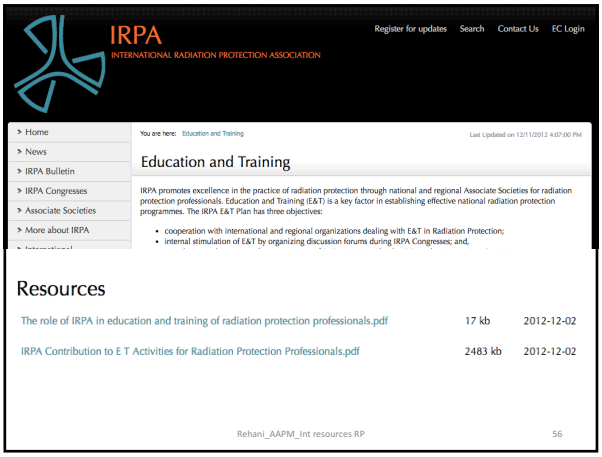


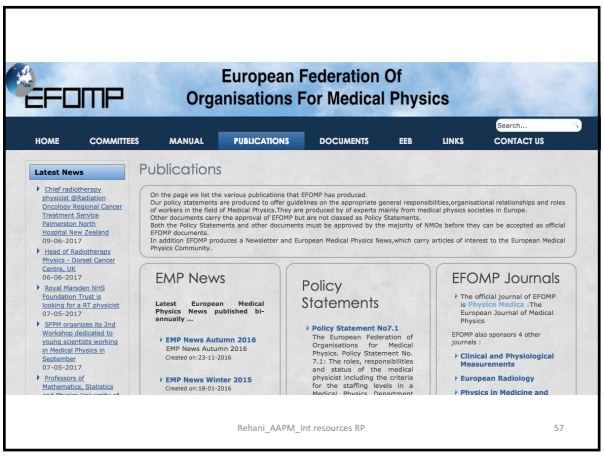


## Recap

- **RPOP versus ORP**
- **Resources from IAEA: Free .ppt slides, posters, eLearning material, webinars**
- **ICRP: Free till P28, some others. Free Educational ppt slides, CD material**
- **European Commission (EC): Free downloads**
- **WHO, UNSCEAR: Free downloads**
- **Some professional societies: IOMP/IRPA/EFOMP: Free material**