

Review & Revision of the System of RP Relevant to Medical Applications: Progress and Outlook

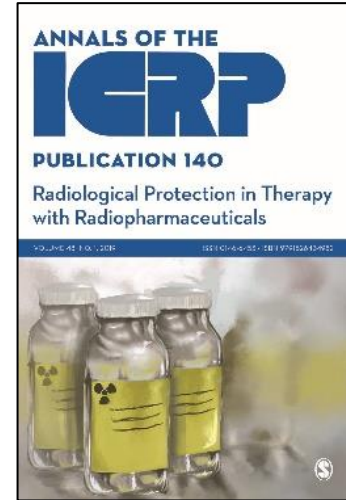
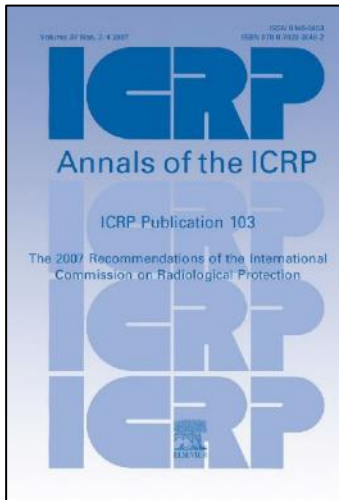
Milano, IT
Oct 3, 2024



Kimberly
Applegate, MD, MS
Chair, Committee 3

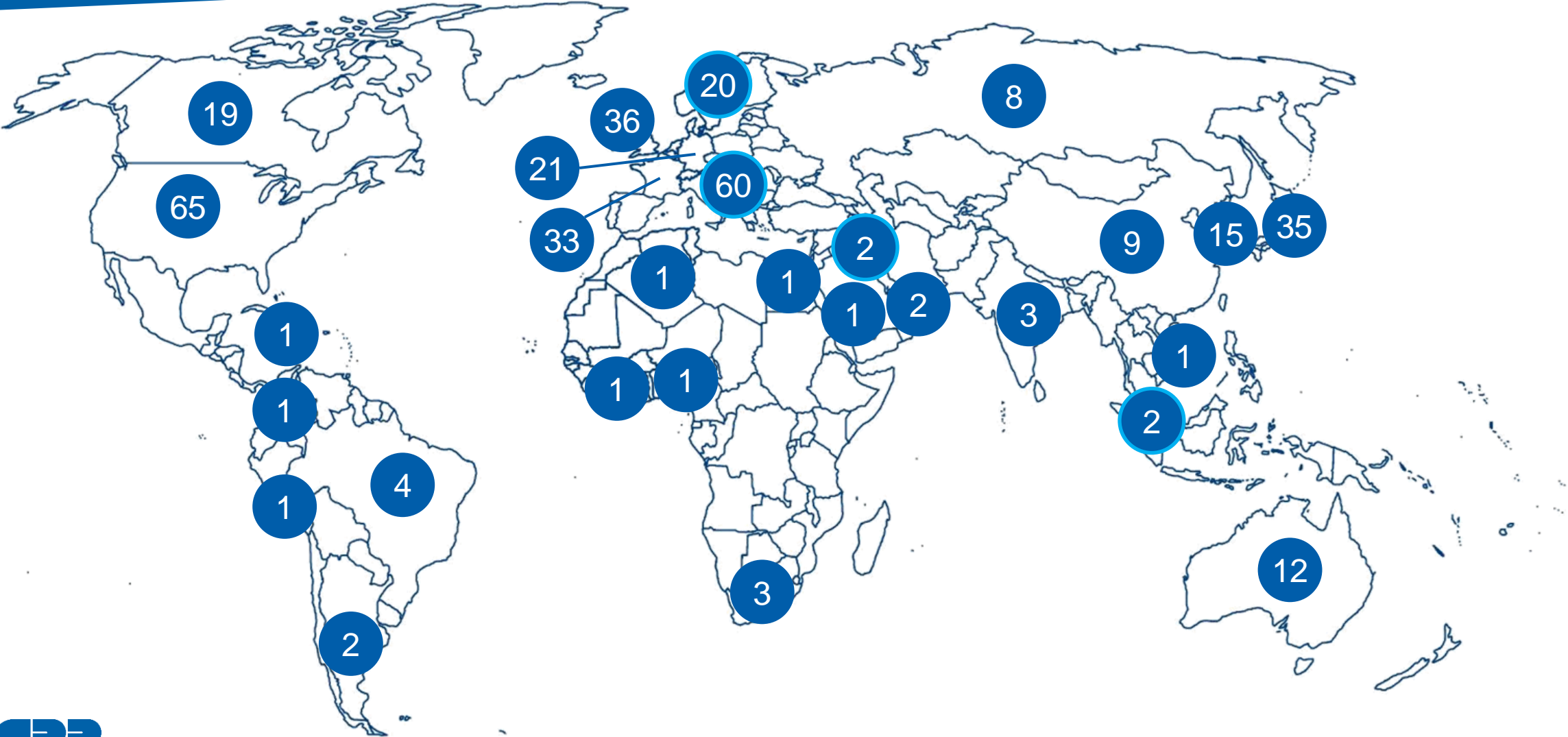
ICRP Mission

Advance for the public benefit the science of radiological protection, in particular by providing recommendations and guidance on all aspects of protection against ionising radiation

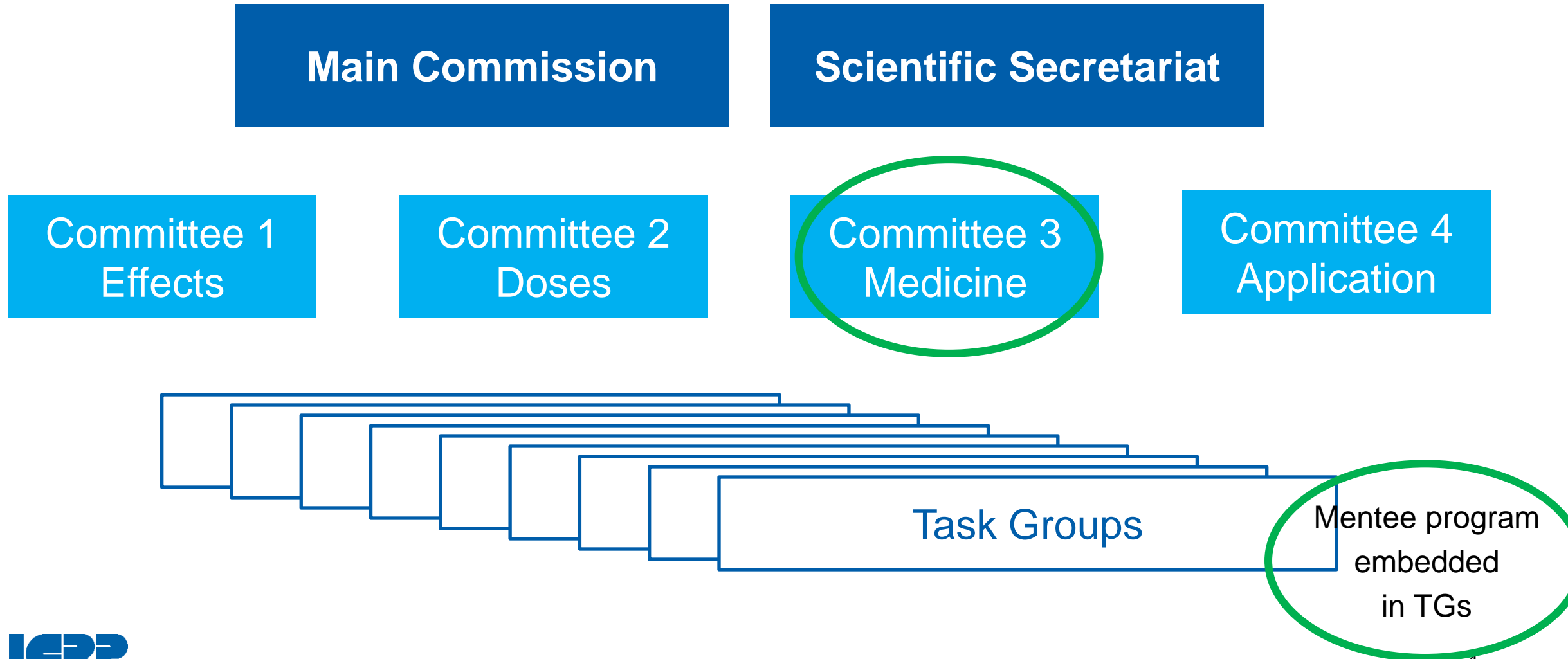


360 Members from 49 Countries

as of 04 February 2023



ICRP Structure



Review & Revision of the System of RP



Commit to a more transparent and inclusive process



Develop building blocks through ICRP Task Groups

Rühm W, Applegate K, Bochud F, Laurier D, Schneider T, Bouffler S, Cho K, Clement C, German O, Hirth G, Kai M, Liu S, Mayall A, Romanov S, Wojcik A. **The system of radiological protection and the UN sustainable development goals.** Radiat Environ Biophys. 2024 Sep 10. doi: 10.1007/s00411-024-01089-w. Epub ahead of print

about a decade

Key Considerations: Simplification and Clarification

The System of Radiological Protection must be:

- **Easier to understand**
- **Easier to communicate**
- **Easier to use**

Nonetheless, the underlying basis of the system must be **robust**, to handle **complex problems** and consider **complex scientific, ethical, and practical issues**

Initial Key Milestones (open access papers)

Keeping the ICRP recommendations fit for purpose

Clement et al 2021 J. Radiol. Prot. 41 1390
www.doi.org/10.1088/1361-6498/ac1611

Thoughts from ICRP &
invitation to contribute



Areas of research to support the system of radiological protection

Laurier et al 2021 Radiat Environ Biophys 60, 519-530
www.doi.org/10.1007/s00411-021-00947-1



Summary of the 2021 ICRP workshop on the future of radiological protection

Rühm et al 2022 J. Radiol. Prot. 42 023002
www.doi.org/10.1088/1361-6498/ac670e



Cross-cutting work of the Main Commission

- **Vancouver Call for Action to strengthen expertise in RP worldwide.**

Ruhm W et al. REBS 2023

- **The system of radiological protection and the UN sustainable development goals.**

Ruhm W et al. REBS 2024 Sept.

- **Guidance on considering and communicating uncertainties in ICRP activities (draft).** *Working party of the MC.*

Committee 3

- Committee 3 addresses protection of persons and unborn children when ionising radiation is used in medical diagnosis, therapy, and biomedical research, as well as protection in veterinary medicine.
- 35 mentees (55% of total ICRP mentees!)



18 members from 13 countries, 2 emeritus members, 4 SLOs

The work of C3

- History
- Current Work
 - Publications in press
 - Task Groups
 - Working Parties
- Potential Future Work

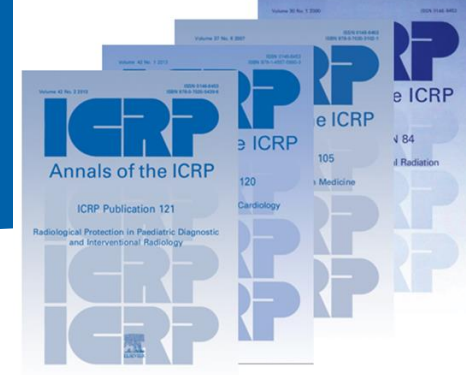
25 ICRP Publications on RP in Medicine since 2000

Publication 84 Pregnancy	Publication 85 Radiation Injuries Interventional	Publication 86 Accidents in Therapy	Publication 87 CT	Pub 153 Veterinary RP (2023)
Publication SG 2 Radiation and your Patient— (2018)	Publication 93 Digital Radiology	Publication 94 Release of Patients	Publication 97 HDR Brachy- therapy Accidents	Pub 154 Dig Imaging Optimisation
Publication 98 Prostate Brachy- therapy	Publication 102 Multi-detector CT	Publication 106 Radiopharma- ceuticals	Publication 112 External Beam RT Accidents	Pub 157 Ethics in Patient RP
Publication 113 Education and Training	Publication 117 Fluoroscopy	Publication 105 RP in Medicine	Publication 120 Cardiology	
Publication 121 Paediatric Radiology	Publication 127 Ion Beam Radiotherapy	Publication 128 Radiopharmaceuti- cals Compendium	Publication 129 Cone Beam CT	
Pub 135 DRLs Med Imaging	Pub 139 Occupational RP Intervent Fluoro	Pub 140 RP in Therapy with Radiopharmaceuticals	Pub 147 Dose Quantities in RP	

Top cited publications from 2010 to present are:

- ICRP Publication 118: ICRP Statement on Tissue Reactions and Early and Late Effects of Radiation in Normal Tissues and Organs - Threshold Doses for Tissue Reactions in a Radiation Protection Context (2012) 938 citations
- ICRP Publication 116: Conversion Coefficients for Radiological Protection Quantities for External Radiation Exposures (2010) 400 citations
- **ICRP Publication 135: Diagnostic Reference Levels in Medical Imaging (2017)** 321 citations
- ICRP Publication 115: Part 1: Lung Cancer Risk from Radon and Progeny (2010) 297 citations
- **ICRP Publication 128: Radiation Dose to Patients from Radiopharmaceuticals: A Compendium of Current Information Related to Frequently Used Substances (2015)** 241 citations

Publications in press



- **Publication 154 Optimisation of Radiological Protection in Digital Radiology Techniques for Medical Imaging-- just published from TG108 part 1!**
- Publication 155 Specific Absorbed Fractions for Reference Paediatric Individuals
- Publication 156 Paediatric Mesh-type Reference Computational Phantoms
- **Publication 157 Ethics in Radiological Protection for Patients in Diagnosis and Treatment (approved Nov 2023)**
- Publication 158 Radiological Protection in Surface and Near-Surface Disposal of Solid Radioactive Waste
- Publication 159 Dose Coefficients for Intakes of Radionuclides by Members of the Public: Part 1

In addition to approved TG108 pt 2 and TG117 (March 2024)

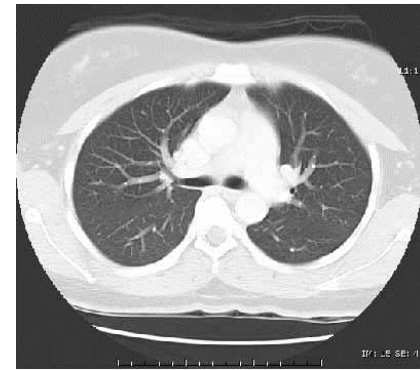
New Contents in Each of the Reports

- To help clarify (*to understand, communicate, use*) and standardize, each report contains sections on:
 - Education and training recommendations
 - Quality assurance and dose management program
 - Equipment life cycle
 - Artificial intelligence (subsection)
 - Uncertainties and definitions where appropriate (subsection)

TG108 Optimisation of Radiological Protection in Digital Radiology Techniques for Medical Imaging Pt 1

C. J. Martin, K. Applegate, I. Hernandez-Giron, D. Husseiny, M. Kortensniemi, M. Del Rosario Perez, D.G. Sutton, J. Vassileva

- 1) INTRODUCTION
- 2) THE X-RAY INSTALLATION AND EQUIPMENT LIFE CYCLE
- 3) THE OPTIMISATION PROCESS
- 4) ANALYSES OF PATIENT DOSES
- 5) EVALUATION OF IMAGE QUALITY
- 6) **TRAINING OF STAFF IN OPTIMISATION**



Pt 2: DR, FL, CT, PEDS, and Pregnant women imaging



Children



TG 109 report aims

- Introduce core and procedural values in the **context of diagnostic radiology and radiation therapy**
- **When these ethical values may be practical and useful:**
 - lack of scientific evidence about patient care
 - disagreement between patient/family and care team
 - disagreement within care team
- Promote **an evaluation method to analyse specific clinical situations** from an ethical point of view (11 imaging, 10 therapy cases)
 - Tabulate paired ethical values for compliance/non-compliance in scenarios



Education and Training--key messages

- Investment in an adequate staffing level, with trained healthcare staff and a commitment to their continuous professional development (CPD) are essential when considering investment in new imaging equipment and software.
- Knowledge, skills and competencies—more recently termed attitudes and behaviors-- (KSCs or KSAs) should start at undergraduate level and continue throughout RP career
- KSCs should be supported by employers, audited by appropriate authorities, and focused for each RP group
- Establish national standard credentialing and accreditation for curriculum and feedback from students



Status of TGs

- TG36 (with C2) RP to patients undergoing dx nuclear med: undergoing further calculations of dose coefficients and QA for submission later this year (Nov) to MC for public consultation; [Web Dose Viewer](#)
- **TG111 (with C1) Individual response to radiation: draft near complete for MC to review in Iwaki (Nov); 4 publications to date**
- TG113 (with C2): Ref Organ/Dose coefficients for DR, Fluoro—peds and IGFP, and CT common exams in children and adults with [Web Dose Viewer!](#)
 - Digital Radiography report to be submitted to MC for publication in Nov

Status of TGs and other

- TG116 Radiological Protection Aspects of Imaging in Radiotherapy, chair Colin Martin
- TG126 (2022-) Radiological Protection in Human Biomedical Research, chair Isabelle T-Chef
- Multiple current TGs have C3 member involvement:
TG114 (reasonableness and tolerability), TG118, TG119, TG121 (IR effects to the germ cell and fetus*), **TG124** (justification*), TG125
- Working Parties:
 - New Radiotherapies (Aurelie)
 - Role of AI in medical RP (John)

TG 128 - Individualisation/Stratification in Radiological Protection – Implications and Areas of Application



Chair Simon Bouffler with members from C1, C2, C3, and C4

Mandate: Consider whether and for which situations the system of protection should adopt a more individualised/stratified approach, particularly when considering low dose, low dose-rate and chronic exposures

Background

- Medicine is adopting a personalised approach through genetics
- **There is an interest within the imaging community in having better indicators of risk from procedures for individual patients***
- Recent developments in dosimetry with libraries of phantoms that encompass age, sex, height, weight and posture make more precise organ/tissue-specific doses feasible
- A review of the method of calculation of the radiation-related detriment has been performed recently

*note for example: Bosch de Basea Gomez, M., Thierry-Chef, I., Harbron, R. *et al.* Risk of hematological malignancies from CT radiation exposure in children, adolescents and young adults. *Nat Med* (2023).

*SINFONIA project, chair: John Damilakis.

The Future...potential TGs

Cross-cutting topics:

- Role of AI in the System of RP
- Communication
- Role of ICRP in achieving the UNSDG
- How to express uncertainty

C3 focused

- **Justification in Medicine** (start around 2025-6)
 - To use the learnings and feedback from TG124
 - What we know and don't know about low dose patient exposures: rad epi reviews since 2000
 - UNSCEAR report on second primary cancers (2024)
- **Dx radionuclide imaging RP for pregnant women, breastfeeding women and their infants**
 - To build on TG36 (start on 2025-2026)
- **New Pub105** to summarize the new general recommendations specific to medicine (to start 2028-2029?)

Some remaining key issues for the application of the ICRP System

Fundamental principles

- Medicine has long embraced a holistic approach, so that C3 may share its experience with others in RP, revisiting the principle of optimization with deliberative processes
- Medicine has also faced patients and families, clinical colleagues requiring communication on risk; we might consider a cross-cutting document on communication on benefit/risk with use of radiation
- Revisiting the concepts of limits, e.g., TG126 in research volunteers
- The underappreciated importance of ongoing education of all stakeholders, learning from misses and near miss events, and for including ethical considerations in the implementation of the RP System (P157)
- Addressing the application of the UN Sustainable Development Goals—the younger generation has embraced ways to address these goals in medicine/radiology

THANK YOU

ICRP

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