EURADOS WG7

Internal Dosimetry

RAMP users meeting,
28th October 2020

B. Breustedt on behalf of EURADOS WG7

CONTENTS

- EURADOS
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EURADOS : European Radiation Dosimetry Group

- "We maintain a network which includes experts, reference and research laboratories, and dosimetry services. This enables appropriate specialist groups to be formed in a timely manner to solve problems or promote research identified within EURADOS or upon request from external bodies."
- **Members**
  - Voting Members (Institutions)
  - Associate Members (Persons)
- **Main bodies**
  - General Assembly
  - Council
  - Executive Board
  - Working Groups

EURADOS (as of October 2020)

- **Voting Members**
  - 80 Voting Members from 31 Countries
- **EURADOS Board of Officers**
  - Chair: F. Vanhavere (SCK-CEN, Belgium)
  - Vice-Chair: P. Olko (IFJ, Poland)
  - Secretary: J.F. Bottolier-Depois (IRSN, France)
  - Treasurer: O. Hupe (PTB, Germany)
- **EURADOS Office**
  - Operated by HMGU, Germany
    W. Rühm, K. Huerkamp
- **EURADOS Council**
  - J.F. Bottollier, I. Clairand, E. Fantuzzi, P. Fattibene, R. Harrison, O. Hupe, P. Olko, V. Olsovcova, W. Rühm, M. Silari, R. Tanner, F. Vanhavere

EURADOS

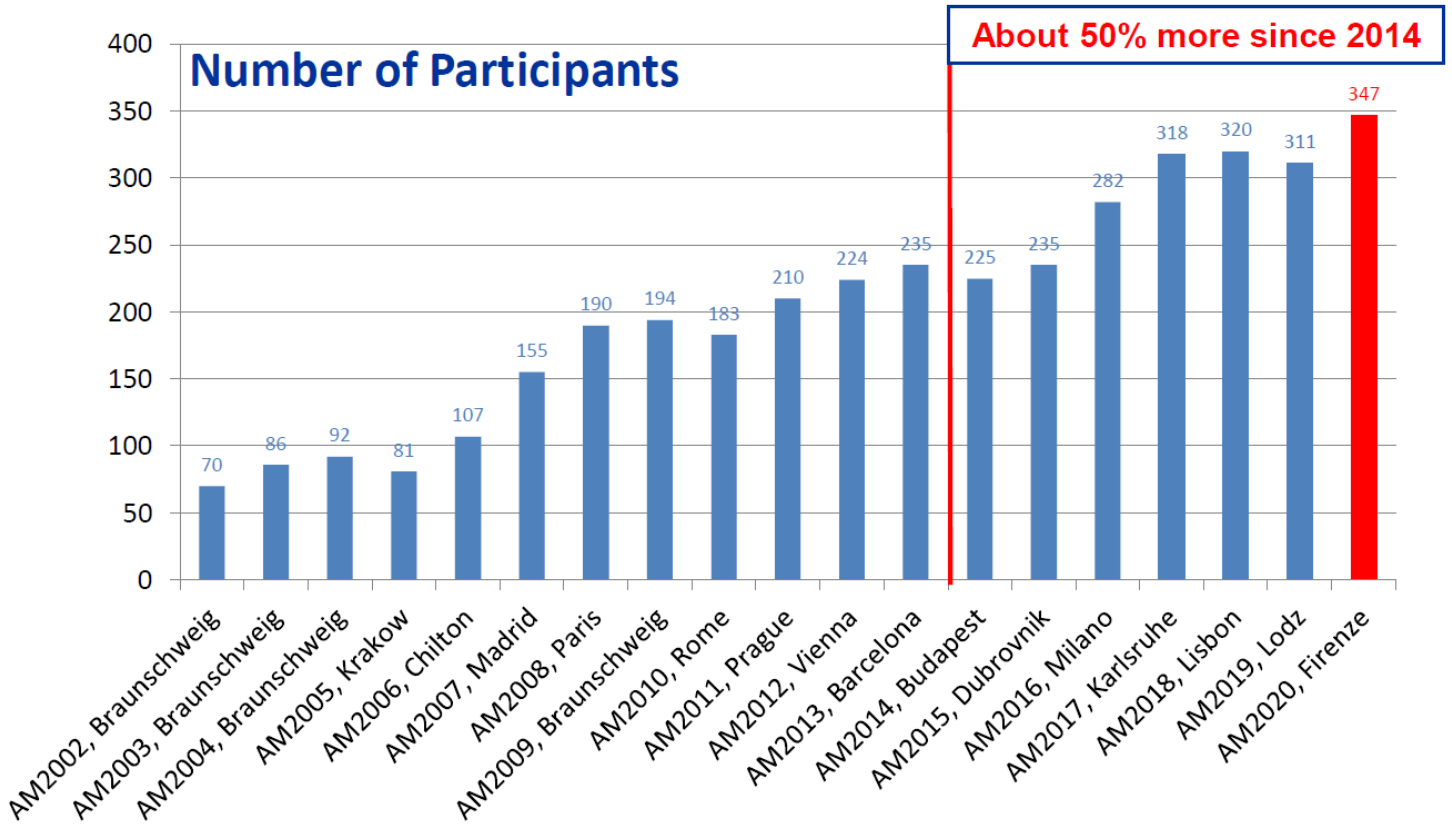
- **Eight EURADOS Working Groups**
  - Feel free to contact the WG Chairs for more information

Working Group	WG Chairperson and email address		Details
WG2 – Harmonisation of individual monitoring	P. Gilvin	Phil.Gilvin@phe.gov.uk	WG02-2019
WG3 – Environmental dosimetry	A. Vargas	arturo.vargas@upc.edu	WG03-2018
WG6 – Computational dosimetry	H. Rabus	Hans.rabus@ptb.de	WG06-2018
WG7 – Internal dosimetry	B. Breustedt	bastian.breustedt@kit.edu	WG07-2019
WG9 – Radiation dosimetry in radiotherapy	L. Stolarczyk	Liliana.Stolarczyk@skandion.se	WG09-2019
WG10 – Retrospective dosimetry	L. Ainsbury	liz.ainsbury@phe.gov.uk	WG10-2019
WG11 – High energy radiation fields	M. Caresana	marco.caresana@polimi.it	WG11-2018
WG12 – Dosimetry in medical imaging	Z. Knezevic	zknez@irb.hr	WG12-2018

- **Associate Members**
  - More than 600 scientists contributing to the overall EURADOS mission

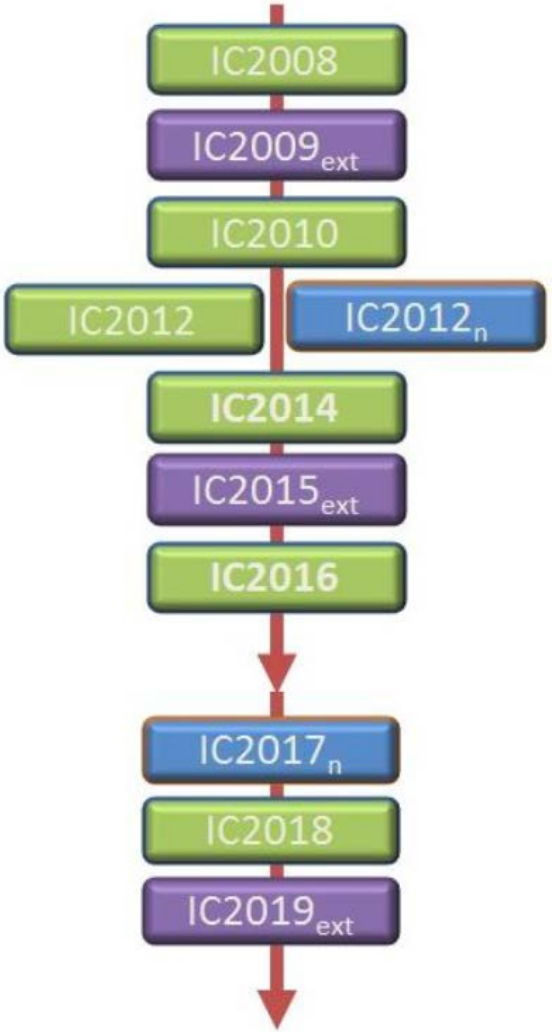
EURADOS – Actions

- **Annual Meetings – January/February**
  - All Working Groups meet in one place
  - Council, General Assembly, Winter School, …



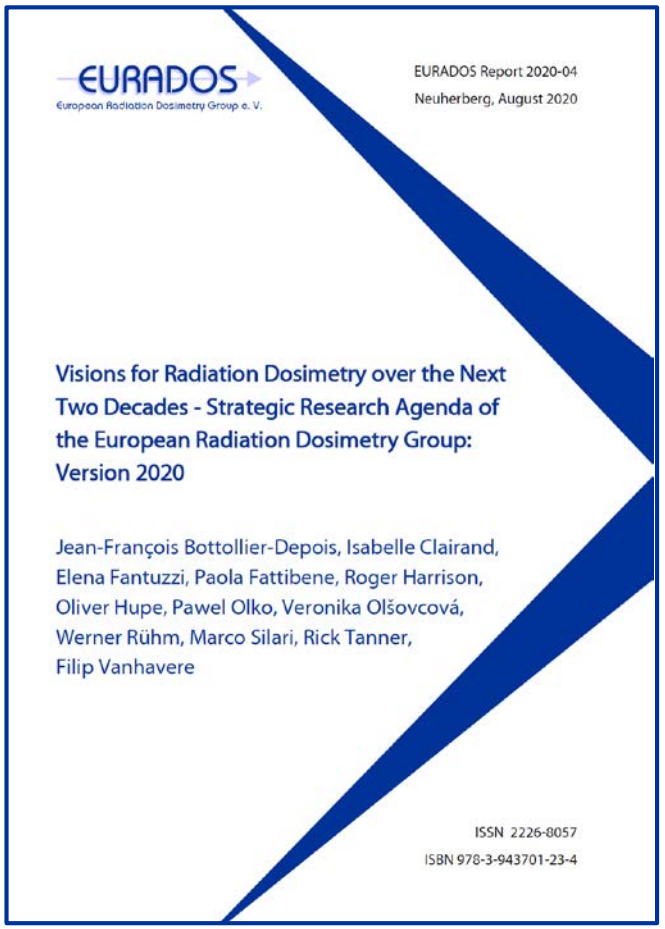
EURADOS – Actions

- **Annual Meetings – January/February**
  - All Working Groups meet in one place
  - Council, General Assembly, Winter School, …
- **Midyear Meetings**
  - Working Groups meet seperately
  - hosted by Insitutes of WG members
- **Intercomparisons**
  - Sustainable QA in Dosimetry for Europe
  - Learning Network for IMS
- **Education and Training**
  - Topical Training Courses
  - 1 day Winter School at Annual Meeting



EURADOS – Work Programme

- **Strategic Research Agenda**
  - Vision 1 – Towards updated fundamental dose concepts and quantities
  - Vision 2- Towards improved radiation risk estimates deduced from epidemiological cohorts
  - Vision 3 – Towards an efficient dose assessment in case of radiological emergencies
  - Vision 4 – Towards integrated personalized dosimetry in medical applications
  - Vision 5 – Towards an improved radiation protection of workers and the public



EURADOS – Work

EURADOS Reports since 2014 > Website

- EURADOS Report 2019-02: O. Ciraj Bjelac, J. Dabin, J. Farah, H. Järvinen, F. Malchair, T. Siiskonen, Ž. Knežević: "Patient maximum skin dose in interventional procedures in radiology and cardiology: summary of WG 12 activities"
- EURADOS Report 2019-01: C.M. Castellani, A. Andrasi, A. Giussani, T. Pázmándi, G. Roberts, G. Etherington: "InterComparison on Internal DOSE Assessment – ICIDOSE 2017 Analysing the intercomparison results"
- EURADOS Report 2018-01: H. Stadtmann, A. F. McWhan, T. W. M. Grimbergen, M. Figel, A. M. Romero, C. Gärtner and C. Hranitzky: "EURADOS Intercomparison 2014 for Whole Body Dosemeters in Photon Fields" Neuherberg, February 2018
- EURADOS Report 2017-03: E. Davesne et al. "Uncertainties in internal d… …ment: Lifetime dose assessment for three example workers occupationally exposed t… …Analysing the intercomparison results" Neuherberg, October 2017
- EURADOS Report 2017-02: W. Rühm, Ž. Knežević, E. Fantuzzi… …, H. Schuhmacher, F. Vanhavere, J. Alves, J.F. Bottollier Depois, P. Fattibene, P. G… …opez, S. Mayer, S. Miljanić, P. Olko, H. Stadtmann, R. Tanner, A. Vargas, C. Woda: "EU… …keholder Workshop on June 30th, 2016"
- EURADOS Report 2017-01: R.M. Harrison, A. Di F… …ordy, S. Miljanić, L. Stolarczyk and Ž. Knežević: "Dosimetry for second cancer risk es… …adiotherapy: measurements in water phantoms" - Neuherberg, April 2017
- EURADOS Report 2016-02: A. Buffler, G… …ttger, F. D. Smit, F. Wissmann (Eds.) "Irradiations at the High-Energy Neut… …t iThemba LABS"
- EURADOS Report 2016-01: "Chall… …ro- and Nanodosimetry for Ion Beam Cancer Therapy (MIND-IBCT)" Report on an Int… …Workshop co-organised by EURADOS, Wiener Neustadt, 2014. Edited by T. Schneide… …eck and H. Rabus
- EURADOS Report 2015-0… …n et al. „Quality Assurance in Individual Monitoring for External – Results of EURADOS …
- EURADOS Report 20… …Järvinen et al. „Technical Aspects on DAP Calibration and CT calibration"
- EURADOS Report 2015-02: A. F. McWhan et al. "EURADOS Intercomparison 2012 for Whole Body Dosemeters in Photon Fields"
- EURADOS Report 2015-01: A. F. McWhan et al. "EURADOS Intercomparison 2010 for Whole Body Dosemeters in Photon Fields"
- EURADOS Report 2014-02: E. Fantuzzi et al. "Eurados intercomparison 2012 for Neutron Dosemeters"
- EURADOS Report 2014-01: W. Rühm et al. "Visions for Radiation Dosimetry over the Next Two Decades – Strategic Research Agenda of the European Radiation Dosimetry Group" (version May 2014)

14 EURADOS Reports since 2014

EURADOS Publications in Peer-Reviewed Journals

January 2020

2020

- Rühm, W., Ainsbury, Breustedt, B., Caresana, M., Gilvin, P., Knežević, Ž., Rabus, H., Stolarczyk, L., Vargas, A., Bottollier-Depois, J. F., Harrison, R., Lopez, M. A., Stadtmann, H., Tanner, R., Vanhavere, F., Woda, C., Clairand, I., Fantuzzi, E., Fattibene, P., Hupe, O., Olko, P., Olšovcová, V., Schuhmacher, H., Alves, J. G., Miljanić, S., **2020.** The European radiation dosimetry group – Review of recent scientific achievements. Radiation Physics and Chemistry 168, 108514 (**EURADOS council**)

2019

- Alves, J. G., Fantuzzi, E., Rühm, W., Gilvin, P., Vargas, A., Tanner, R., Rabus, H., Lopez, M. A., Breustedt, B., Harrison, R., Stolarczyk, L., Fattibene, P., Woda, C., Caresana, M., Knežević, Ž., Bottollier-Depois, J. F., Clairand, I., Mayer, S., Miljanić, S., Olko, P., Schuhmacher, H., Stadtmann, H., Vanhavere, F., **2019.** EURADOS education and training activities. Review. J Radiol Prot. 39, 126-135 (**EURADOS council**)

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Year	Number
2014	19
2015	13
2016	16
2017	16
2018	24
2019	8

Six-year average:

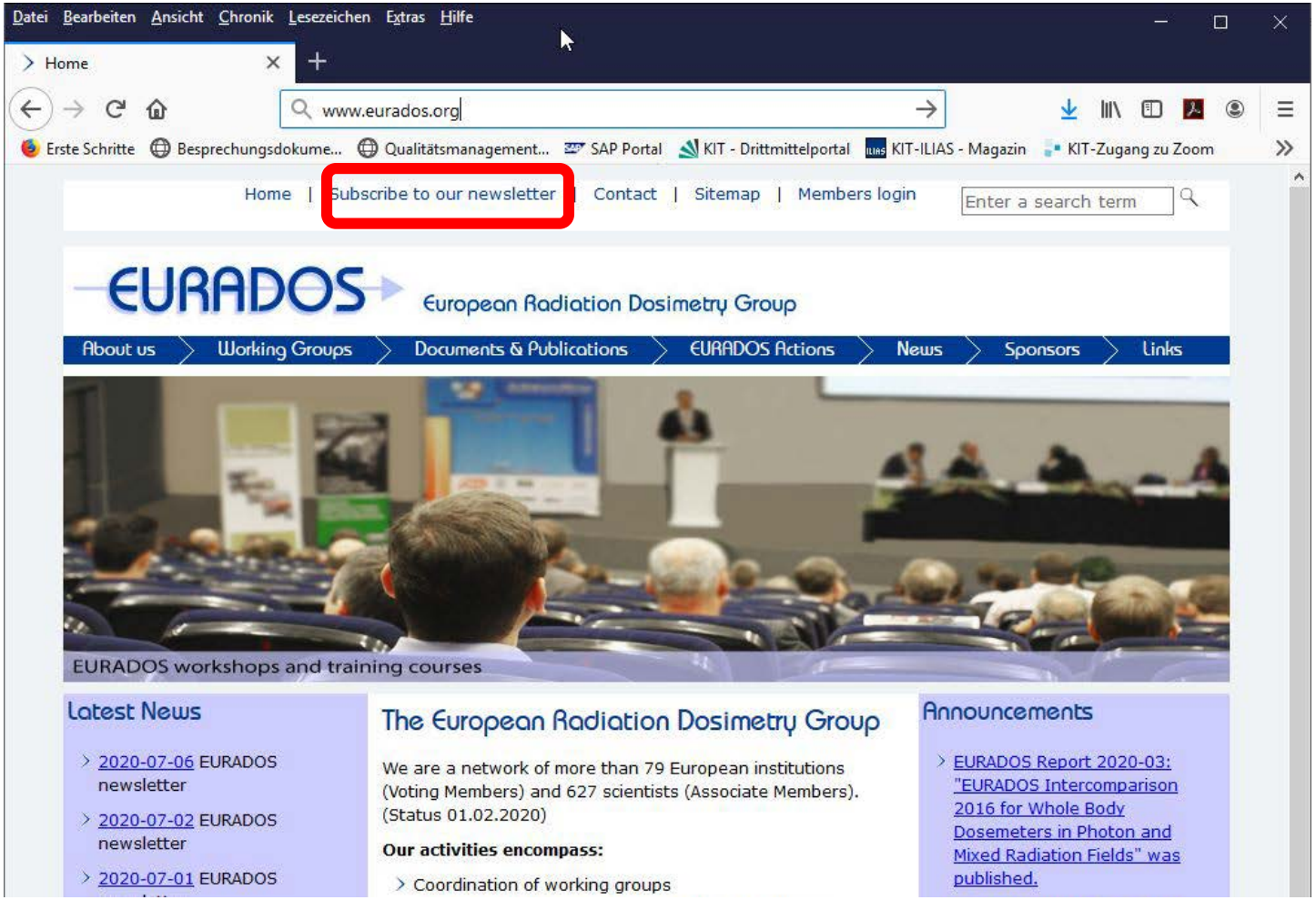
Every 3 weeks one peer-reviewed publication!

EURADOS – Where do I find more information?

- **Papers prepared by EURADOS Council providing an overview of EURADOS**
  - EURADOS Education and Training Activities
    - J. Alves et al., J. Radiological Protection, 39(4), R37-R50, 2019
  - The European radiation dosimetry group – Review of recent scientific achievements
    - W. Rühm et al., Radiation Physics and Chemistry, 168, 2020 (March issue)
  - Work programme of EURADOS on internal and external dosimetry
    - W. Rühm et al., Annals of ICRP 47, 20-34, 2018
  - EURADOS Strategic Research Agenda: Vision for Dosimetry of Ionising Radiation.
    - W. Rühm et al., Radiat. Prot. Dosim. 168, 223-234, 2016

EURADOS – Where do I find more information?

- **EURADOS Webpage: www.eurados.org**



EURADOS – WG 7 Internal Dosimetry

"EURADOS WG7 acts as a network of

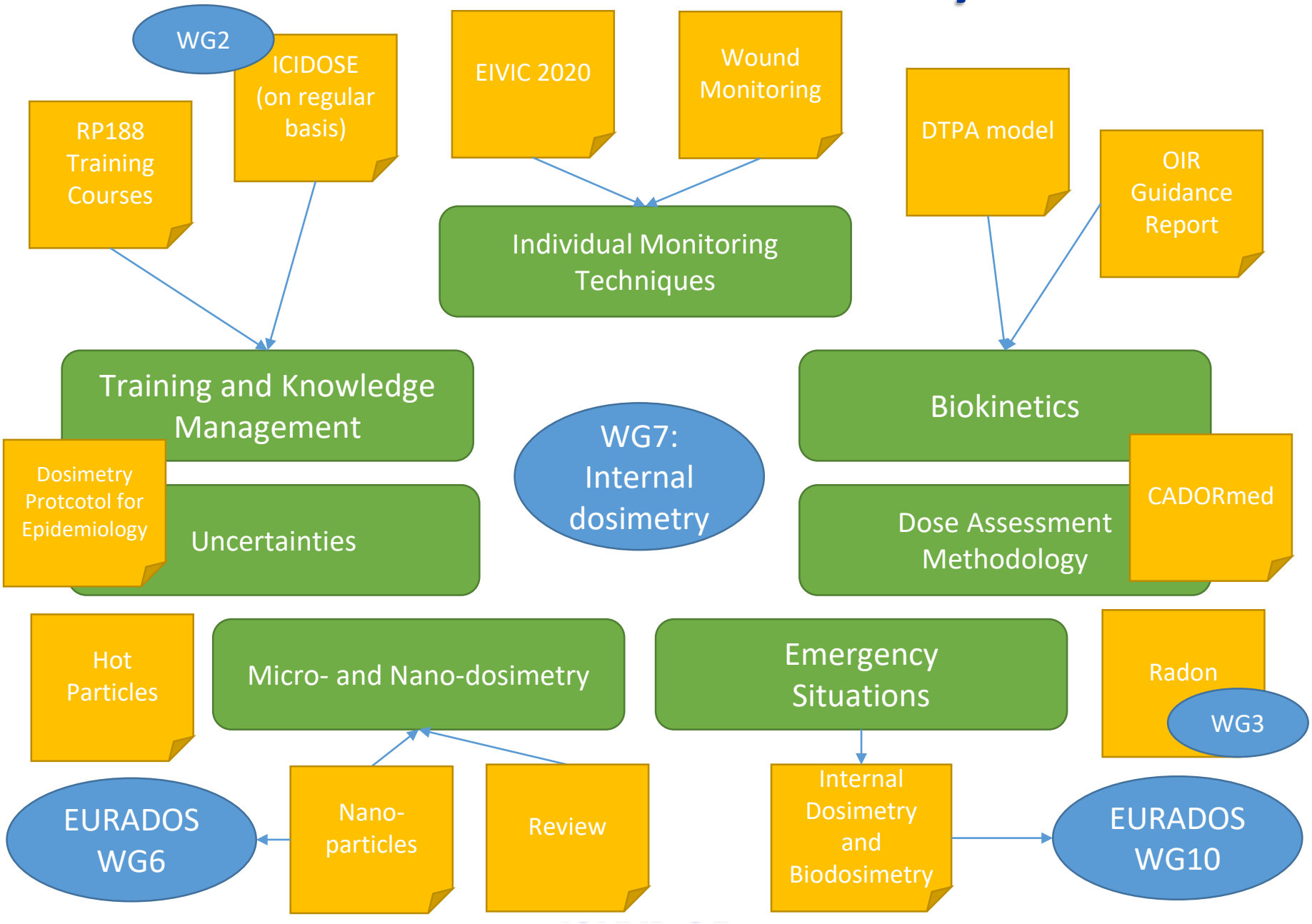
- Scientists,
- Services,
- Regulators and
- Laboratories

collaborating for the coordination of research and the dissemination of knowledge for the assessment of doses due to intakes of radionuclides."

EURADOS – WG 7 Internal Dosimetry

- **Status October 2020**
  - Chair: B. Breustedt (KIT, Germany)
  - Secretary: E. Davesne (IRSN, France)
  - 35 Full Members,
  - ~70 Corresponding Members + ~50 Observers
  - 60 Institutes from 24 countries in Europe, Asia and the Americas

EURADOS – WG 7 Internal Dosimetry



EURADOS WG7 work – examples

- **"Technical Recommendations for Monitoring Individuals for Occupational Intakes of Radionuclides"**
  - Published by European Commission as Radiation Protection Series 188
  - https://ec.europa.eu/energy/sites/ener/files/rp_188.pdf

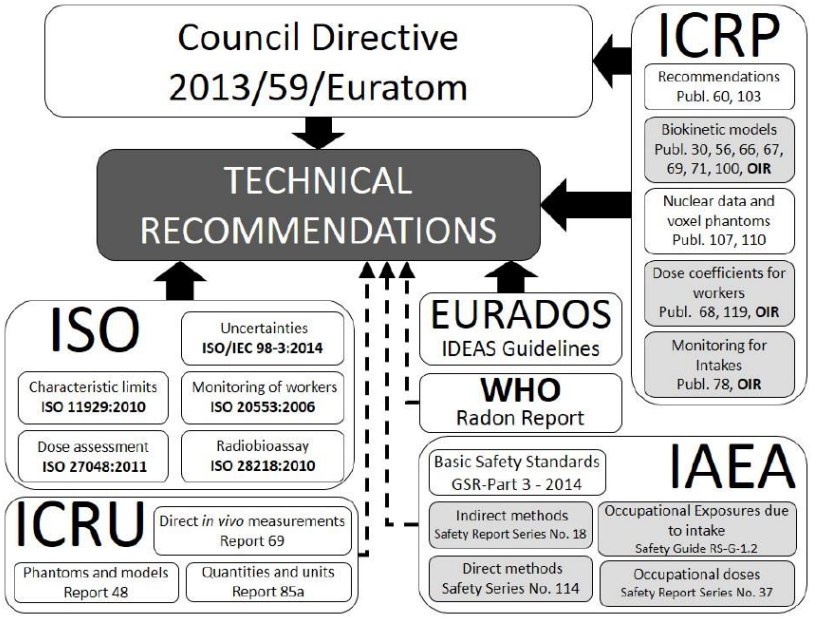
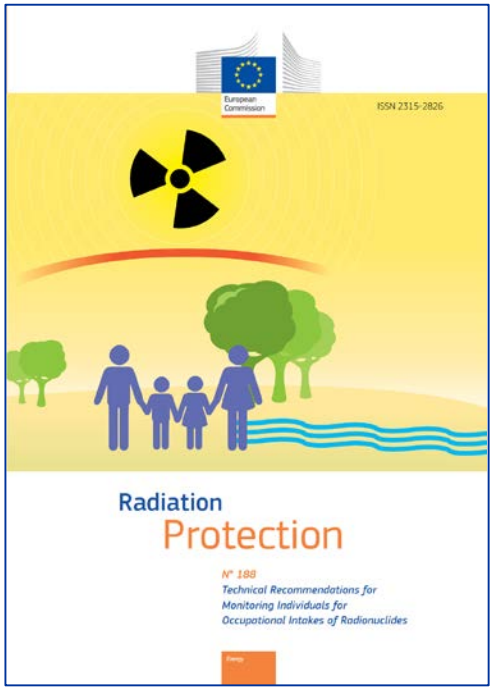


Figure A.1 The main source documents used in developing the Technical Recommendations (Arrows indicate flow of information. Solid arrows indicate the primary sources.)



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Q4: How should the need for an individual monitoring programme be determined and what type of monitoring programme should be selected?		
C08	A	The basis of the evaluation should be available **data from earlier monitoring programmes** (individual or workplace monitoring) and/or results of dedicated **measurements currently performed at the workplace to characterise radiological conditions**. If no such data are available, the **decision factor approach** [IAEA 1999a] should be employed.

EURADOS WG7 work – examples

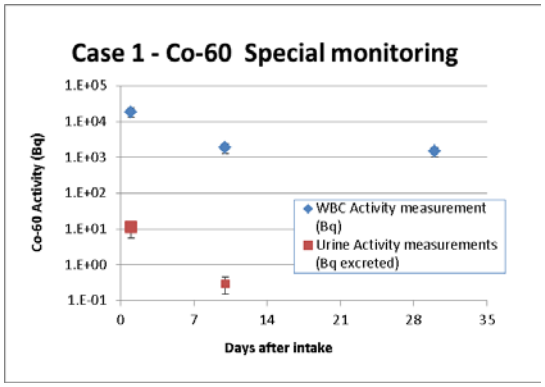
- **"Technical Recommendations for Monitoring Individuals for Occupational Intakes of Radionuclides"**
  - Published by European Commission as Radiation Protection Series 188
  - https://ec.europa.eu/energy/sites/ener/files/rp_188.pdf

- **Training course on EC RP 188**
  - 1st Edition, March 2019, hosted by IAEA in Vienna
  - 29 Participants, positive response
  - Covering all aspects of internal dosimetry
  - Further editions ….

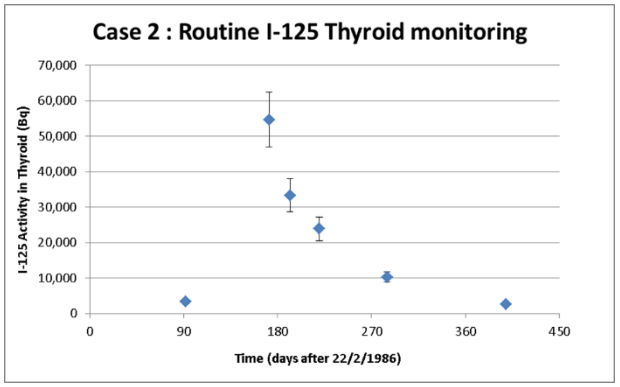
EURADOS WG7 work – examples

- **InterComparison on Internal DOSE Assessment – ICIDOSE 2017**
  - Four Cases were presented

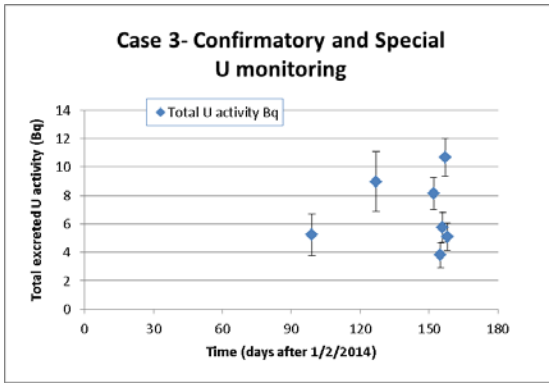
Case 1: Artificially created



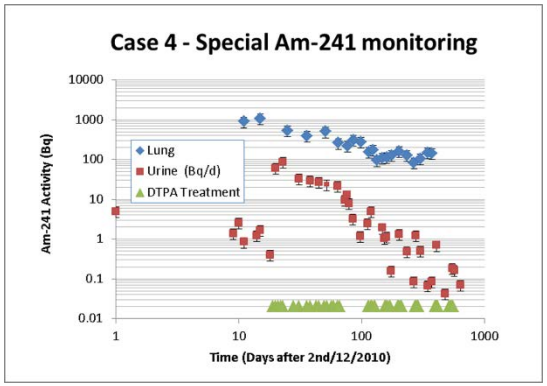
Case 2 : Real



Case 3 : Real



Case 4 : Real



EURADOS WG7 work – examples

- **InterComparison on Internal DOSE Assessment – ICIDOSE 2017**
  - Four Cases were presented
  - Reference Solutions are using EC RP 188 approach
  - 66 Participants (51 European = 77%)
  - Presentation and Discussion of Results at Workshop
  - Collection of „Lessons Learned“ to be used for improvement of EC RP 188.

Case number	1	2	3	4
Number of submissions	58	56	38	31
Number of outliers	7	12	8	1
Parameters without outliers				
Geometric Mean (mSv)	0.925	6.44	6.36	381.6
Geometric Std. Dev. (mSv)	1.07	1.035	1.62	1.43
Robust mean	0.910	6.56	5.6	388.1
Robust standard deviation	0.077	0.41	4.4	145.5
Relative RSD (%)	**8.5**	**6.3**	**79.0**	**37.5**
Ratio max/min	5.1	3.15	4487	10.9
Note	Estimation using data from OIR Part 2	Results refer to total committed effective dose for all intakes	GM and GSD exclude result reported as zero	Reported ‘best estimate’

EURADOS WG7 work – examples

- **InterComparison on Internal DOSE Assessment – ICIDOSE 2017**
  - EURADOS Report 2019-01
  - Papers
    - RPD 183(4), 535-541, 2019
    - J Radiol Prot, 2020 Jun;40(2):444-464
  - Presentations
    - PROCORAD Workshop (C.M. Castellani)
    - HEIR 2018 (A. Giussani)
- **Organization of next ICIDOSE**

EURADOS WG7 work – examples

Literature study comparing

- dose evaluations with „routine“ internal dosimetry methods
- dose evaluations with retrospective methods
  - Radiat Environ Biophys 59, 357–387 (2020)

Radiation and Environmental Biophysics (2020) 59:357–387
https://doi.org/10.1007/s00411-020-00845-y

REVIEW

Check for updates

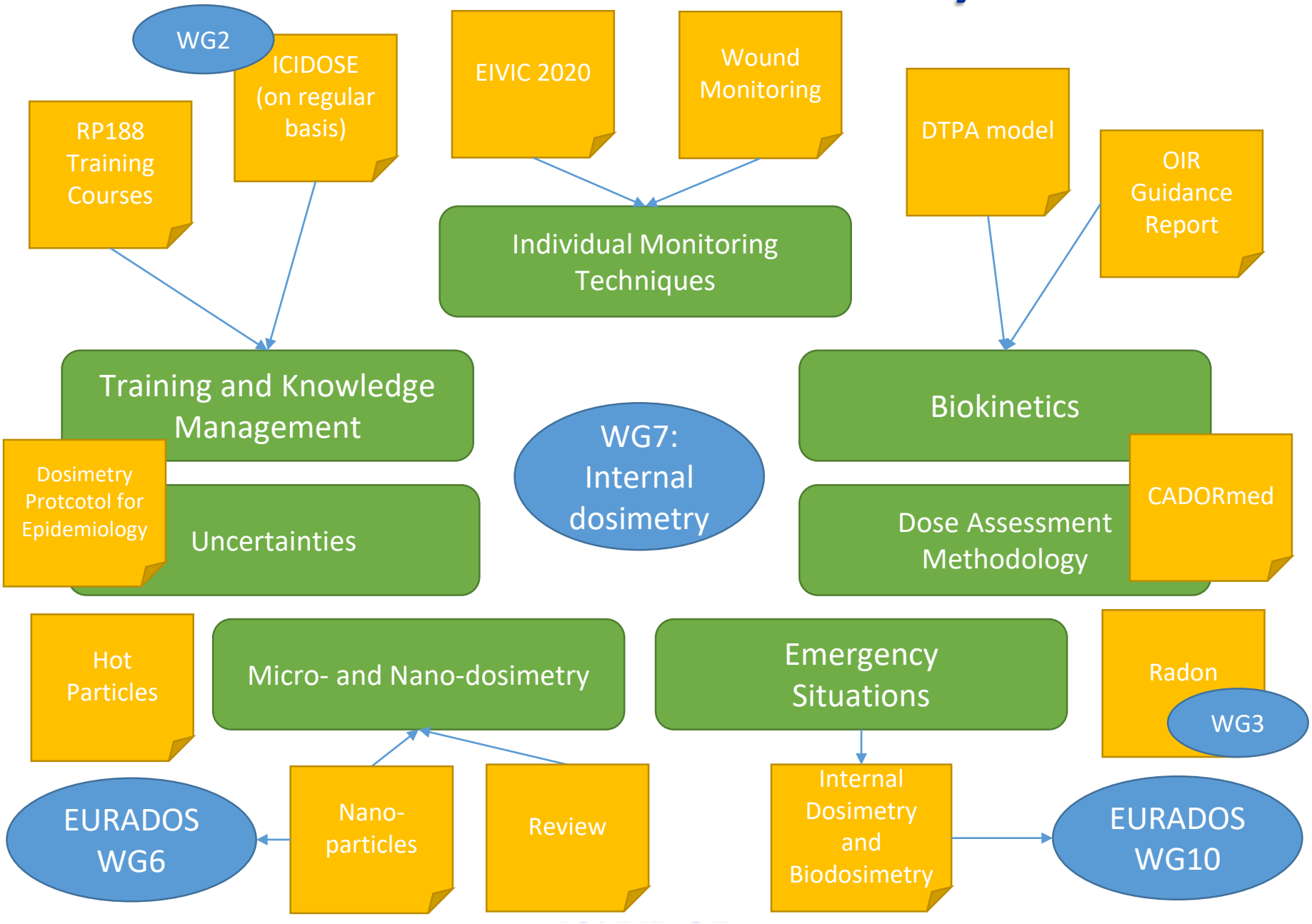
Eurados review of retrospective dosimetry techniques for internal exposures to ionising radiation and their applications

A. Giussani[1] · M. A. Lopez[2] · H. Romm[1] · A. Testa[3] · E. A. Ainsbury[4] · M. Degteva[5] · S. Della Monaca[6] · G. Etherington[4] · P. Fattibene[6] · I. Güclu[7] · A. Jaworska[8] · D. C. Lloyd[4] · I. Malátová[9] · S. McComish[10] · D. Melo[11] · J. Osko[12] · A. Rojo[13] · S. Roch-Lefevre[14] · L. Roy[14] · E. Shishkina[5,17] · N. Sotnik[15] · S. Y. Tolmachev[10] · A. Wieser[16] · C. Woda[16] · M. Youngman[4]

Received: 8 November 2019 / Accepted: 15 April 2020 / Published online: 5 May 2020

Abstract
This work presents an overview of the applications of retrospective dosimetry techniques in case of incorporation of radionuclides. The fact that internal exposures are characterized by a spatially inhomogeneous irradiation of the body, which is potentially prolonged over large periods and variable over time, is particularly problematic for biological and electron paramagnetic resonance (EPR) dosimetry methods when compared with external exposures. The paper gives initially specific information about internal dosimetry methods, the most common cytogenetic techniques used in biological dosimetry and EPR dosimetry applied to tooth enamel. Based on real-case scenarios, dose estimates obtained from bioassay data as well as

EURADOS – WG 7 Internal Dosimetry



Thank you for listening

- Thank you to all WG members contributing to EURADOS WG 7 work and making WG7 successful

- Questions/Comments/Ideas: bastian.breustedt@kit.edu