The Strategic Research Agenda of EURADOS: research needs and their links to metrology

EURADOS

History of EURADOS

- Founded in 1981 by scientists involved in contracts with the EC
- Aim: To promote European research, development and cooperation in dosimetry
- Financial support from EC
  - General support in the first years
  - Later (only) dedicated support for projects
- In 2008 registered in Germany as “e.V.” (registered society)
- Since 2008: self-sustained network with regular income

EURADOS

- **EURADOS General Assembly**
  83 Voting Members (institutions)
  represented by designated individuals

- **EURADOS Board of Officers**
  Chair: Filip Vanhavere (SCK-CEN, Belgium)
  Vice-Chair: Oliver Hupe (PTB, Germany)
  Secretary: Isabelle Clairand (IRSN, France)
  Treasurer: Zeljka Knezevic (RBI, Croatia)

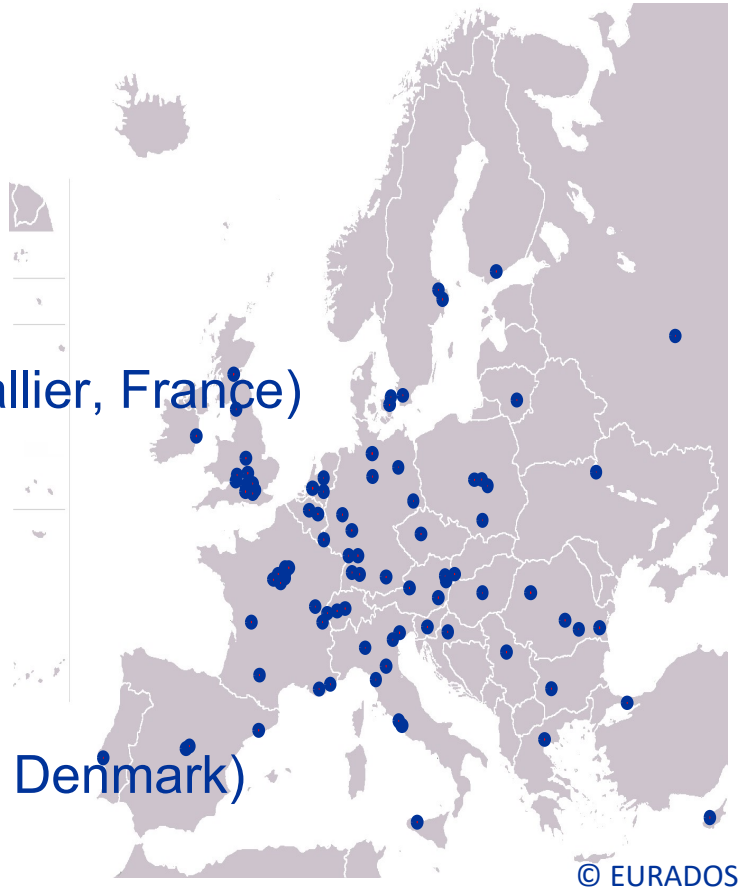
- **EURADOS Council**
  Francesco Rossi (Italy), Veronika Olsovcova (Czech Republic), Rick Tanner (UK), Vadim Chumak (Ukraine), Sebastian Trinkl (Germany), Ruxandra Sapoi (Rumania), Markus Figel (Germany), Agnieszka Szumska (Poland)

EURADOS

- **Associate Members**

  Almost 650 active scientists contributing to the overall EURADOS objectives

- **Eight EURADOS Working Groups**
  - Harmonization of Individual Monitoring (MA. Chevallier, France)
  - Environmental Dosimetry (A. Vargas, Spain)
  - Computational Dosimetry (H. Rabus, Germany)
  - Internal Dosimetry (D. Broggio, France)
  - Radiation Dosimetry in Radiotherapy (L. Stolarcyk, Denmark)
  - Retrospective Dosimetry (L. Ainsbury, U.K.)
  - High-Energy Dosimetry (M. Caresano, Italy)
  - Dosimetry in Medical Imaging (P. Ferrari, Italy)
  - Pilot Group on Nuclear medicine (W. Li,Germany)



Activities of EURADOS

- Activities:
  - Scientific work in the working groups
    - which promote technical development and its implementation in routine work
    - which contribute to harmonization within Europe
    - which perform scientific research
  - organization of intercomparisons and bench mark studies
  - organization of scientific meetings and conferences, training activities, winter schools
  - organization of Annual Meeting (>300 participants)
  - Represent the dosimetry community in different projects and organisations

EURADOS Strategic Research Agenda

- Document that describes the research needs linked to dosimetry for the years to come
  - Organised in 5 visions, each with different challenges, each with different research lines
- Set-up by EURADOS members and working groups (over 60 contributors….)
- Used to direct research of EURADOS working groups
- Used as input for joint roadmap of European research (CONCERT, PIANOFORTE, RnR)
- Started in 2012, first version 2015, second version in 2020
- Published as a EURADOS Report and in the Radiation Protection Dosimetry journal:
  - EURADOS Report 2020-04: “Visions for Radiation Dosimetry over the Next Two Decades - Strategic Research Agenda of the European Radiation Dosimetry Group: Version 2020”,
- Soon we will start preparing a new version

Metrology aspects of the EURADOS SRA

- Dosimetry is quantifying radiation: metrology aspects
- EURADOS is involved in much more than just measuring radiation
  - Harmonization, link with biological effects, concepts, ….
  - Dosimetry/EURADOS is involved in all aspects of radiation protection (medical, NORM, emergency, ecology, biology,…)
- Still, large parts of the EURADOS SRA topics could qualify as part of metrology research, including in support of regulation
- Next: give a short selection of potential topics…

Vision 1 - Towards updated fundamental dose concepts and quantities

- **Challenge 1**: To improve understanding of spatial correlations of radiation interaction events.

- Research on experimental track structure characterization, including uncertainties
- Development of computational methods and detectors

- **Challenge 2**: To quantify correlations between track structure and radiation damage.

- Studies on the geometrical and temporal correlation of energy deposition and cellular damage
- Automated assays and metrological methods

- **Challenge 3**: To improve quantities used in dosimetry

- Investigation of the effects of a change in operational quantities

Vision 2 - Towards improved dosimetry for radiation risk estimates deduced from epidemiological cohorts

- **Challenge 1**: To improve dosimetric data for epidemiological studies
- Improvement of the basic models used for assessments of external and internal doses.
- **Challenge 2**: To estimate uncertainties and validate the dose results
- Uncertainty analysis in the calculated doses and estimation of their influence on the radiation-risk coefficients.
- **Challenge 3**: To anticipate future epidemiological studies

Vision 3 - Towards an Efficient Dose Assessment in Case of Radiological Emergencies

- **Challenge 1**: To quantify doses from internal emitters after accidents

- Improvement of the calibration of in vivo monitoring systems
- Networking, optimization and development of new methods in case of nuclear accidents
- Development of new biokinetic modelling

- **Challenge 2**: To quantify individual doses from external exposure in emergencies

- To standardize existing markers and methods
- To improve existing methods and to identify new markers and develop new methods

- **Challenge 3**: To improve monitoring, including citizens networks and drones

- To improve aerial measurements using unmanned aerial vehicles
- To harmonized and improve capacity analysis using novel information
- Evaluation of existing dosimetry tools for citizens and development of new tools

Vision 4 - Towards integrated personalized dosimetry in medical applications

- **Challenge 1**: To improve patient and ambient dosimetry in radiotherapy

- Dosimetry for proton and ion beam radiotherapy
- Dosimetry during treatment and for quality assurance of the treatment process

- **Challenge 2: Improving patient dosimetry in nuclear medicine**

- Internal dosimetry within pre-clinical development and evaluation of RPs emitting alpha, beta and Auger radiation
- Accuracy of radionuclide activity measurements with radionuclide calibrators

- **Challenge 3**: Establish reliable patient dosimetry in CT and interventional radiology examinations

- Skin and organ doses in interventional radiology and cardiology
- Patient specific dose estimates in CT imaging

Vision 5 - Towards an Improved Radiation Protection of Workers and the Public

- **Challenge 1**: To improve biokinetic and dosimetric models for internal emitters
- Improvement of *in vivo* measurements, biokinetic and dosimetric models

- **Challenge 2**: To develop more accurate and real time personal dosimetry
- Including a more accurate dosimetry for specific tissues and organs is needed

- **Challenge 3:** To develop neutron dosimetry techniques
- To improve the performance of neutron personal dosemeters and survey meters
- To improve the understanding of neutron workplace fields (direction dependence)

- **Challenge 4**: To improve environmental monitoring
- To improve environmental monitoring for radon
- To develop and adapt infrastructures for calibration and comparison exercises

- **Challenge 5**: To improve dosimetry in space
- Development of Instrumentation, calibration of Instruments and Model verification

Additionally, the SRA includes …

Separate section on the role of computational methods in dosimetry

- Important in all aspects of dosimetry

Separate Chapter on Training and Education

- Implementation of EC directives and technical recommendations into practice
- Training courses on novel or improved dosimetric methods
- Winter schools, workshops and scientific symposia

Separate Chapter on Harmonisation and Practice

- Intercomparison for dosemeters used in individual monitoring
- Intercomparison for early-warning systems used in environmental monitoring
- Surveys on practical dosimetry (to document quality of dosimetric practices)
- Intercomparison of dose assessment in cases of internal exposures

Priorities from the EURADOS Voting Members

- **A voting was organised in 2021: list the top 5 priorities**

1°	To improve patient and ambient dosimetry in radiotherapy
	· Dosimetry for proton and ion beam radiotherapy
2°	Establishment of reliable patient dosimetry in CT and interventional radiology examinations
	· Patient-specific dose estimates in CT imaging
3°	To develop more accurate and real-time external personal dosimetry for workers
	· "Real-time" dose monitoring of workers is encouraged
4°	To quantify correlations between track structure and radiation damage
	· Studies on the geometrical correlation of energy deposition and cellular damage
5°	Improving patient dosimetry in nuclear medicine
	· Internal dosimetry within pre-clinical development and evaluation of RPs
6°	To Improve the protection and operational quantities used in dosimetry
	· To investigate the effects of any change in the protection quantities
7°	To develop neutron dosimetry techniques
	· To evaluate and improve, if necessary, the response of neutron personal dosemeters in high-energy fields
8°	To quantify doses from internal emitters in case of radiological emergencies
	· Improvement of the calibration of in vivo monitoring systems
9°	To improve environmental monitoring
	· To improve the environmental monitoring of radon
10°	To improve dosimetric data for epidemiological studies
	· Improvement of the basic models used for assessments of external and internal doses

Conclusion: metrology aspects of the EURADOS SRA

- Dosimetry is quantifying radiation: metrology aspects
- Sufficient research topic needing attention and improvement
  - To be taken up in EURAMET plans….

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