EURADOS Work on Internal Dosimetry

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+ members of EURADOS WG7

Bastian Breustedt (KIT, Germany) on behalf of EURADOS Working Group 7

EURADOS Working Group 7 – Who are we?

" 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 Working Group 7 – Who are we?

- Motivation
  - **Harmonization** of methods and tools to obtain the "best estimate" of the intake and dose due to the incorporation of radionuclides into the body;
  - **Normalization** for the establishment of Standards for appropriate quality assurance programs that guarantee reliability of the results of monitoring and dose E(50) and permit accreditation of internal dosimetry laboratories and
  - **Networking** and coordination of research to promote collaboration of internal dosimetry experts, laboratories and services;
  - **Dissemination** of knowledge, education and training.

EURADOS Working Group 7 – Who are we?

- Status October 2017
  - Chair: M.A. Lopez (CIEMAT, Spain)
  - Secretary: B. Breustedt (KIT, Germany)
  - 35 Full Members,
  - 70 Corresponding Members + ~ 50 Observers

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- Status October 2017
  - Chair: M.A. Lopez (CIEMAT, Spain)
  - Secretary: B. Breustedt (KIT, Germany)
  - 35 Full Members,
  - 70 Corresponding Members + ~ 50 Observers
  - 60 Institutions from 24 countries in Europe, America and Asia

- Established Links with
  - EURADOS Council
  - IAEA
  - ICRP
  - ISO
  - WHO REMPAN
  - USTUR (U.S Transuranium and Uranium Registries)
  - ARADOS (Asian Radiation Dosimetry Group)

EURADOS Working Group 7 – How do we work?

- WG7 Meetings
  - 2 plenary meetings per year
    - During EURADOS Annual Meeting (Winter)
    - Invitation by Member Institutions (Autumn)
  - Dedicated Task Group Meetings
    - On demand

- Funding
  - Basis Budget from EURADOS
    - Travel Expenses for Meetings (Full Members)
  - “In kind Contribution” of EURADOS Member Institutions
    - Work and laboratory time, hosting meetings, …
  - Third Party Funding
    - Research Projects (e.g. EJP Concert)
    - Contracts

EURADOS WG7 – Task Groups (Status October 2017)

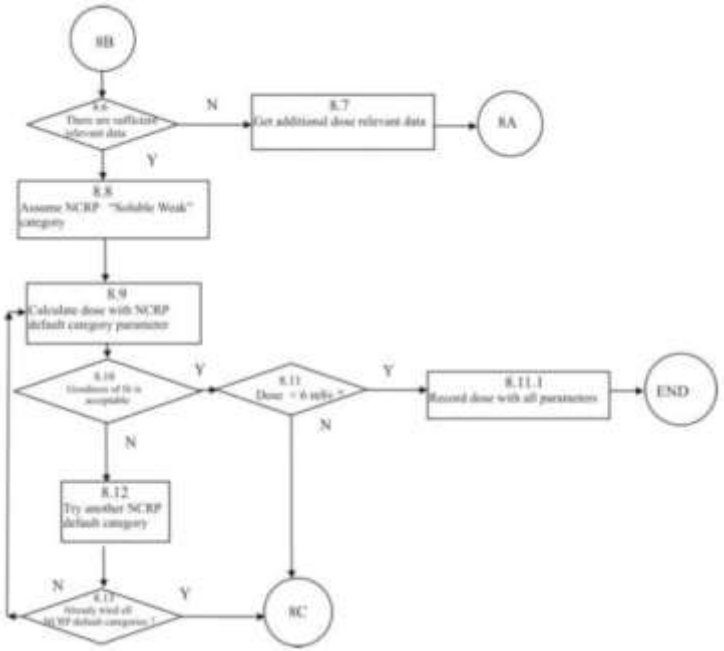
- Task 7.1: EURADOS Intercomparison on Dose Assessments – ICIDOSE
- Task 7.2: Implementation and QA of Biokinetic Models.
- Task 7.3: Towards a DTPA Therapy model
- Task 7.4: Individual Monitoring and application of Monte Carlo methods to in-vivo monitoring
- Task 7.5: Uncertainty on Dose Assessments
- Task 7.6: Training on Internal Dosimetry
- Task 7.7: Internal Micro- and Nanodosimetry
  (Collaboration with EURADOS WG6 “Computational Dosimetry”)
- Task 7.8: Biodosimetry in case of accidental internal exposures
  (Collaboration with EURADOS WG10 “Retrospective Dosimetry”)

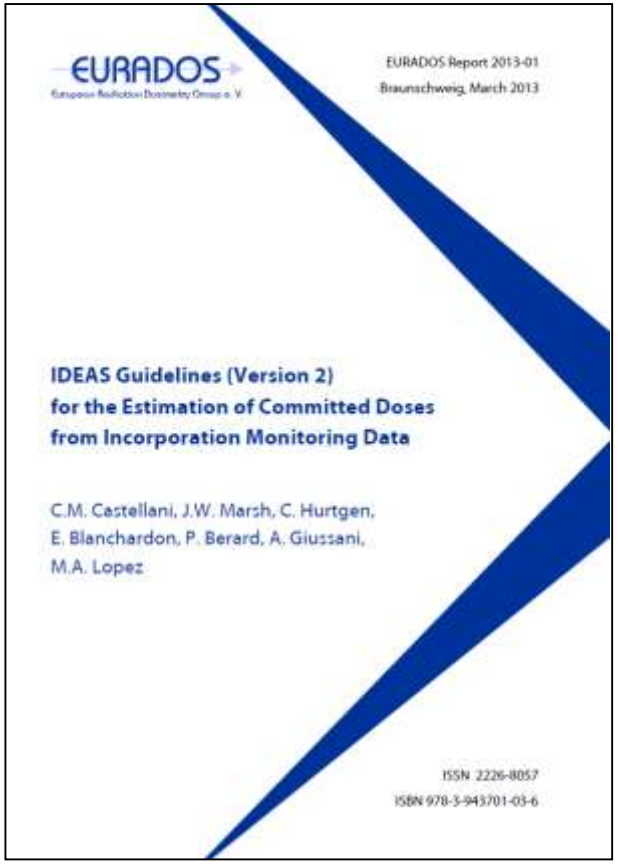
EURADOS WG7 and ICRP (Committee 2)

- Strong Collaboration
  - Formal Relation between ICRP and EURADOS
    - Topics:
      - development and publication of revised (and some new) dose coefficients for internal exposures of workers and members of the public.
      - radiopharmaceuticals
      - dosimetry for emergencies, including addressing tissue reactions
      - dosimetry for non-human biota
  - Several members of EURADOS WG7 are also members of ICRP C2
- EURADOS WG7 work is complementing ICRP work
  - Providing **Feedback and Input to ICRP**
  - Providing **Guidance** on the application of the ICRP methodology **to practitioners**
  - **Dissemination and Training** in Internal Dosimetry

EURADOS WG7 – Selected Activities

- Structured Approach for internal Dose Assessments
  - IDEAS Guidelines (Version 2)
    - Step-by-Step Approach to Dose Assessment
    - Harmonization – Same results from same data
    - Accuracy – Best estimate of internal dose
    - Proportionality – Effort vs. level of dose





EURADOS Report 2013-01, available online
http://eurados.org/en/Documents_Publications/Reports_documents

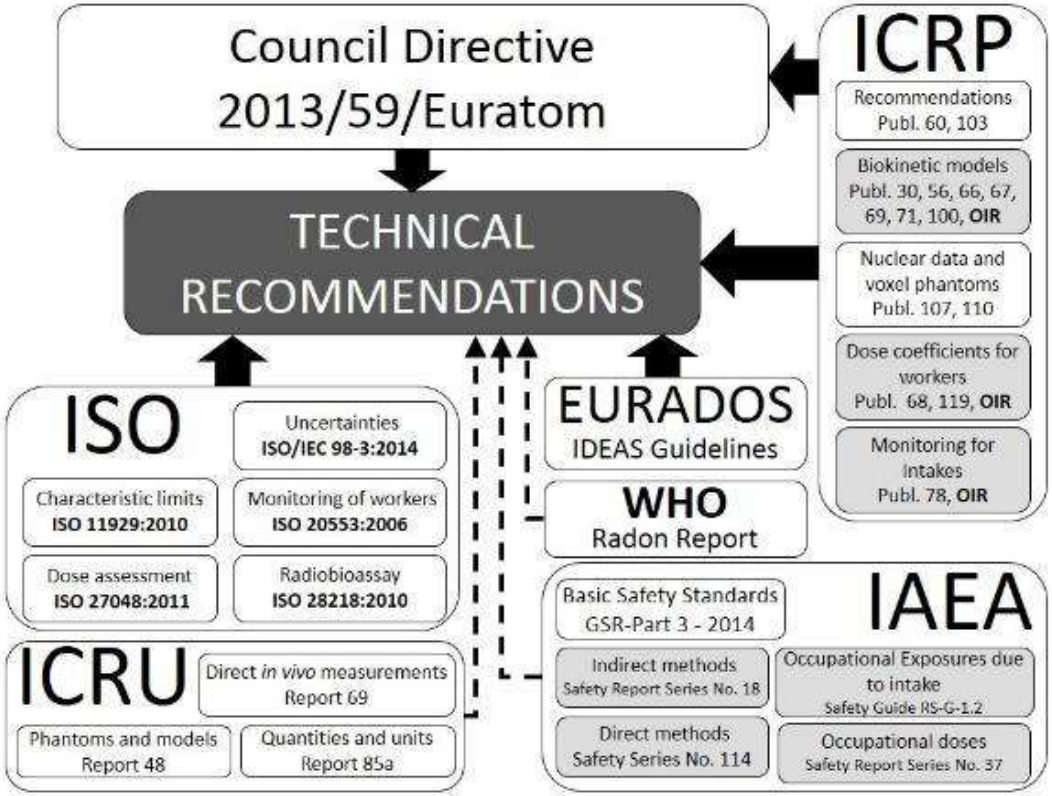
EURADOS WG7 – Selected Activities

- Structured Approach for internal Dose Assessments
  - TECHREC Project (funded by European Commission 2014 - 2016)
    - “Technical Recommendations for Monitoring Individuals for Occupational Intakes of Radionuclides”
    - The final TECHREC report intends
      - to give a complete account of the principles of monitoring for occupational intakes of radionuclides and
      - provide
        - Comprehensive,
        - Detailed,
        - Authoritative and
        - Internally Consistent

      guidance on the <u>practice</u> of individual monitoring and internal dosimetry.

EURADOS WG7 – Selected Activities

- Structured Approach for internal Dose Assessments
  - TECHREC Project (funded by European Commission 2014 - 2016)
    - “Technical Recommendations for Monitoring Individuals for Occupational Intakes of Radionuclides”
    - Why
      -
      -



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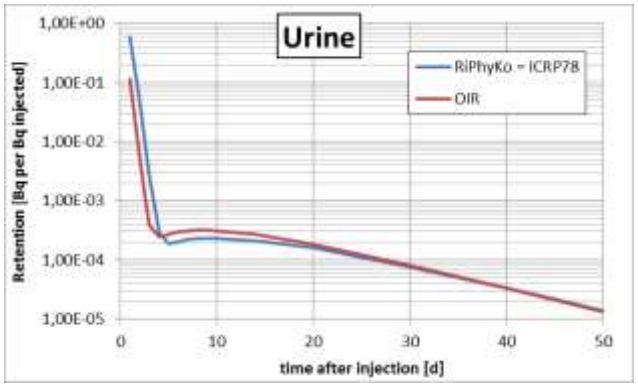
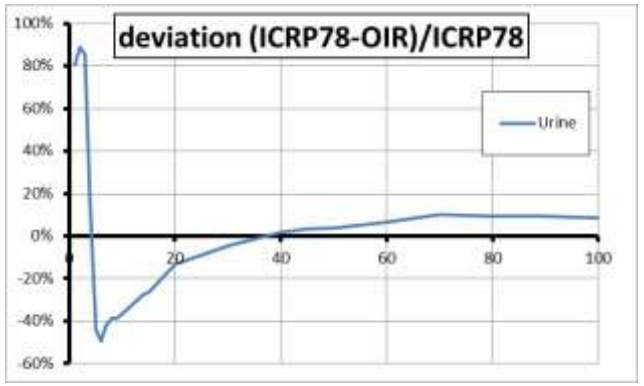
EURADOS WG7 – Selected Activities

- Structured Approach for internal Dose Assessments
  - TECHREC Project (funded by European Commission 2014 - 2016)
    - "Technical Recommendations for Monitoring Individuals for Occupational Intakes of Radionuclides"
    - Why is the report needed now?
      - ***Expertise**:* There is a current need to pass on expertise to younger scientists
      - ***Literature***: There is currently no single document that presents a complete account of the principles and practice of internal dose assessment
      - ***Consensus***: … is needed on a number of practical issues
      - ***Legislative environment**:* **Council Directive 2013/59/Euratom** will be implemented in national legislation by 6 February 2018. Recommendations on translating internal dosimetry principles into practice are needed.
      - ***Scientific environment**:* Publication of ICRP's **Occupational Intakes of Radionuclides** report series has commenced. Recommendations based on the latest scientific developments are needed.
    - Final Report to be published by European Commission (RP Series)

EURADOS WG7 – Selected Activities

- Quality Assurance and Development of Biokinetic Models
  - Draft versions of the new ICRP OIR reference models are implemented and solved for defined scenarios
  - Effects of using new models are studied
    - Example: New Systemic Model for Iodine





  - Feedback provided to ICRP
    - Additional (external) Quality Assurance
    - Ambiguities in the description of the models are discovered before publication

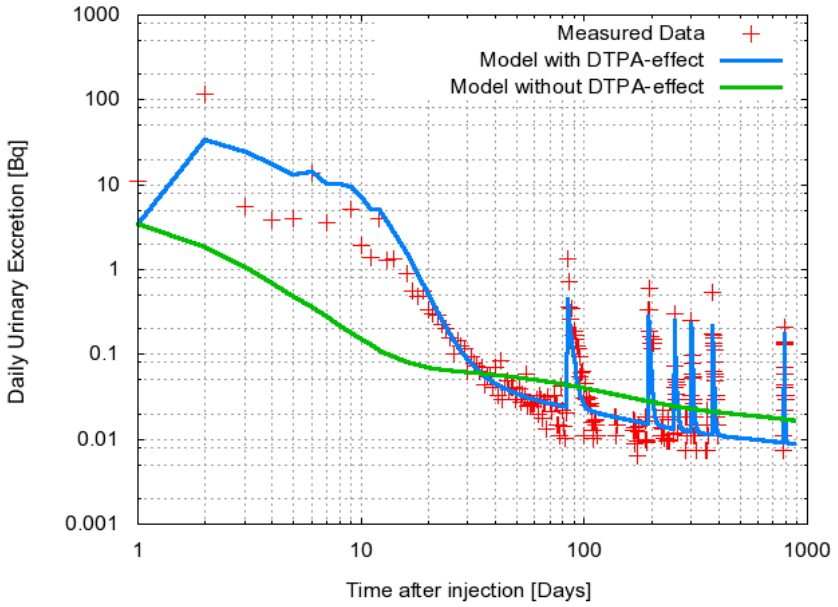
EURADOS WG7 – Selected Activities

- Quality Assurance and Development of Biokinetic Models
  - EURADOS Report “Guidance on application of biokinetic models for individual dose assessments” – current action
  - Chapter on Implementation of biokinetic models
    - Only a short paragraph in ICRP publication 130 (OIR – Part 1) and two pages in ICRP Publication 133 (SAF) are available
  - Elemental Sections
    - Describe the models of the most common radionuclides
    - Provide guidance on their application to specific cases

> “…..
> The OIR model for caesium biokinetics **can be adopted to an observed total body retention half-time by changing the transfer rate from plasma to skeletal muscle** (30 d^{-1}). This is physiologically meaningful because most of total body activity is retained in muscle.
>
> If a biological total body retention half-time T_{obs} (in d) has been detected, the adequate transfer rate λ from plasma to skeletal muscle (in d^{-1}) can approximately be derived by the formula: $\lambda = \frac{T_{obs} - 20}{2.5}$
>
> …..“

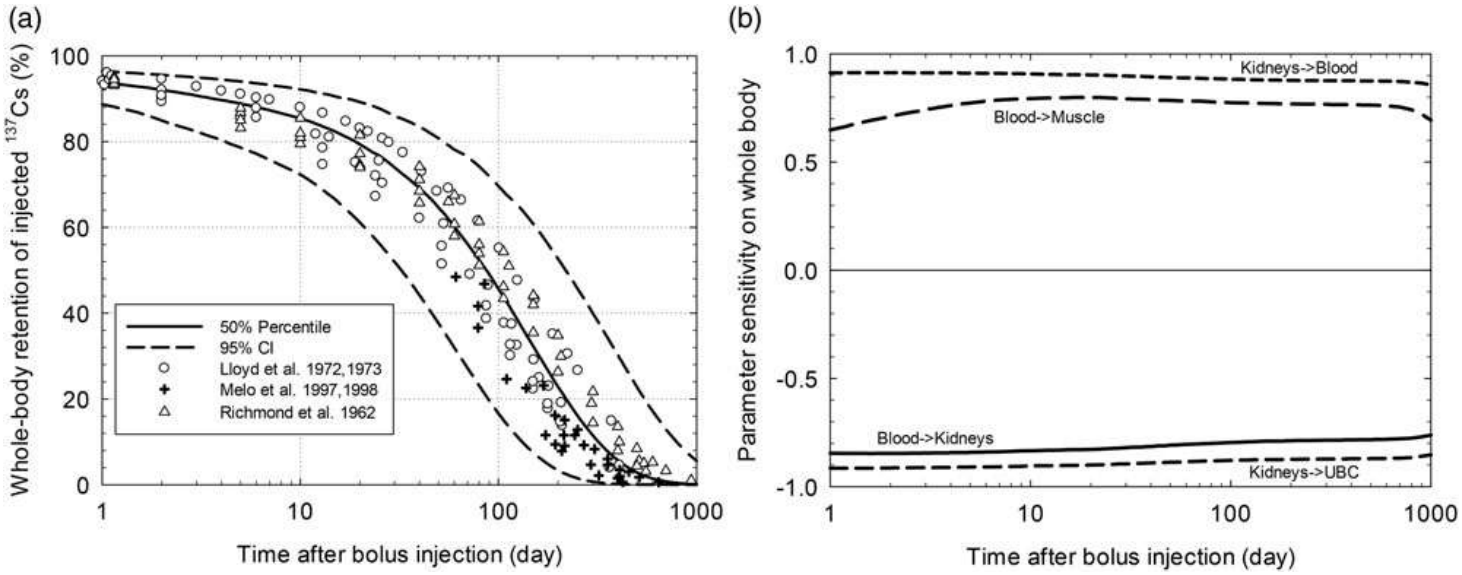
EURADOS WG7 – Selected Activities

- Quality Assurance and Development of Biokinetic Models
  - Development of biokinetic model describing the effects of DTPA decorporation therapy
  - Situation that cannot be described using ICRP reference models
  - CONRAD/EURADOS Approach
    - Coupling of compartmental models for
      - Biokinetics of Actinide
        → ICRP reference model
      - Injected forms of DTPA
        → Based on Stather et al. 1983
      - Complexes DTPA + Actinide (formed in-vivo)
  - Interpretation of data influenced by decorporation therapy possible



EURADOS WG7 – Selected Activities

- Uncertainties in internal Dose Assessments
  - Parameter uncertainties for biokinetic model of Cs were inventoried and evaluated
    - Different, independent methods were applied
  - Sensitivity Analysis of Parameter Importance



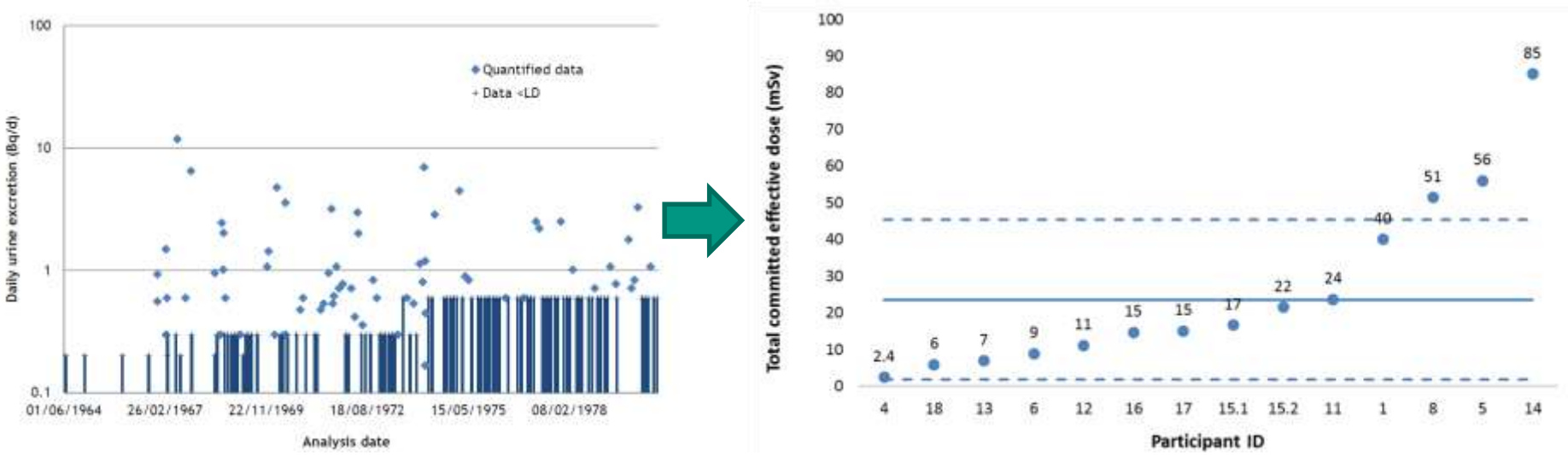
Example: Whole Body Retention of Cs-137

- Next step: Propagate uncertainty as probability distributions on biokinetic and dosimetric input parameters to dose quantities per unit intake.

Image Source: W.B. Li et al. Radiation Protection Dosimetry, 163, 37-57 (2015)

EURADOS WG7 – Selected Activities

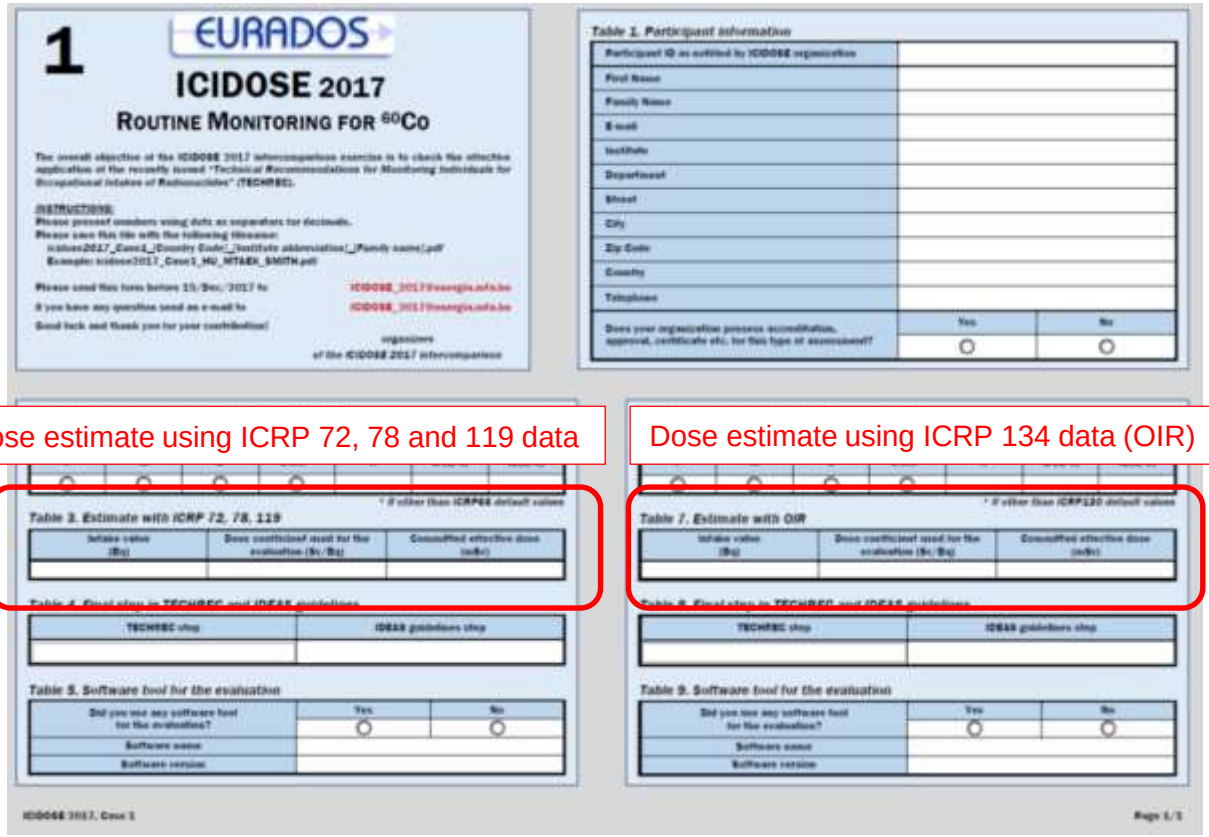
- Uncertainties in internal Dose Assessments
  - Dosimetry for epidemiology studies – Intercomparison exercise Uranium Workers
    - validate the dose assessment protocol,
    - identify sources of uncertainty,
    - discuss the assessment of uncertainty on dose.



  - Presentation of Estelle Davesne et al. (ERPW Session 6, Wednesday 12:00h)
  - EURADOS Report about exercise and its implications in preparation

EURADOS WG7 – Selected Activities

- Dissemination and Training Actions
  - Intercomparison Exercises
    - In-vivo counting (Measurements and Monte Carlo Simulations)
    - Case studies on Dose Assessment (ICIDOSE 2017)



EURADOS WG7 – Selected Activities

- Dissemination and Training Actions
  - Intercomparison Exercises
    - In-vivo counting (Measurements and Monte Carlo Simulations)
    - Case studies on Dose Assessment (ICIDOSE 2017)
  - Winter Schools at EURADOS Annual Meetings
    - 2010: Radiological Emergencies – Internal exposures
    - 2017: Internal dosimetry for radiation protection and medicine
    - + Contributions to other EURADOS winter schools
  - Training Courses
    - 2009: EURADOS/IAEA Regional Training Course on Advanced Methods for Internal Dose Assessment
    - 2013: EURADOS WG7 - KIT Training Course on Monte Carlo Methods for calibration of body counters
    - + Contributions to other EURADOS training courses

Save the Date:

EURADOS Training course on the Application of Monte Carlo Methods for Dosimetry of Ionizing Radiation

March 12 – 16, 2018
KIT Karlsruhe, Germany

EURADOS WG7 – Future Activities (a Selection)

- Improvement of Biokinetic Models
  - Understand and implement physiological processes and mechanisms in the models
  - Implement modifications due to decorporation agents
- Uncertainties in internal dosimetry
  - Sources of uncertainties and their propagation
    - Parameters of biokinetic and dosimetric models
    - Assumptions in the interpretation of data
- Internal Micro- and Nanodosimetry
  - Study track structures and dose distribution of energy deposition at micro/nanoscale
    - Better understanding of biological effects of internal emitters
- Internal Dosimetry of Radon and Progeny
- Application of Monte Carlo Methods in internal dosimetry
  - New Surface Based Phantoms
- Training and Dissemination

EURADOS Working Group 7 – Future

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EURADOS Working Group 7 – Future

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Thank you
for your attention