MEDIRAD clinical dosimetry study: Results and Conclusions

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The MEDIRAD Consortium

SÉMINAIRE DE RADIOTHÉRAPIE INTERNE VECTORISÉE
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European Project MEDIRAD (H2020)

Objectives

- Developing new tools and methods for research in radiation protection.
- Understand better the risks related to radiological exposure.
- Make new recommendations in the field of radiation protection.

MEDIRAD project

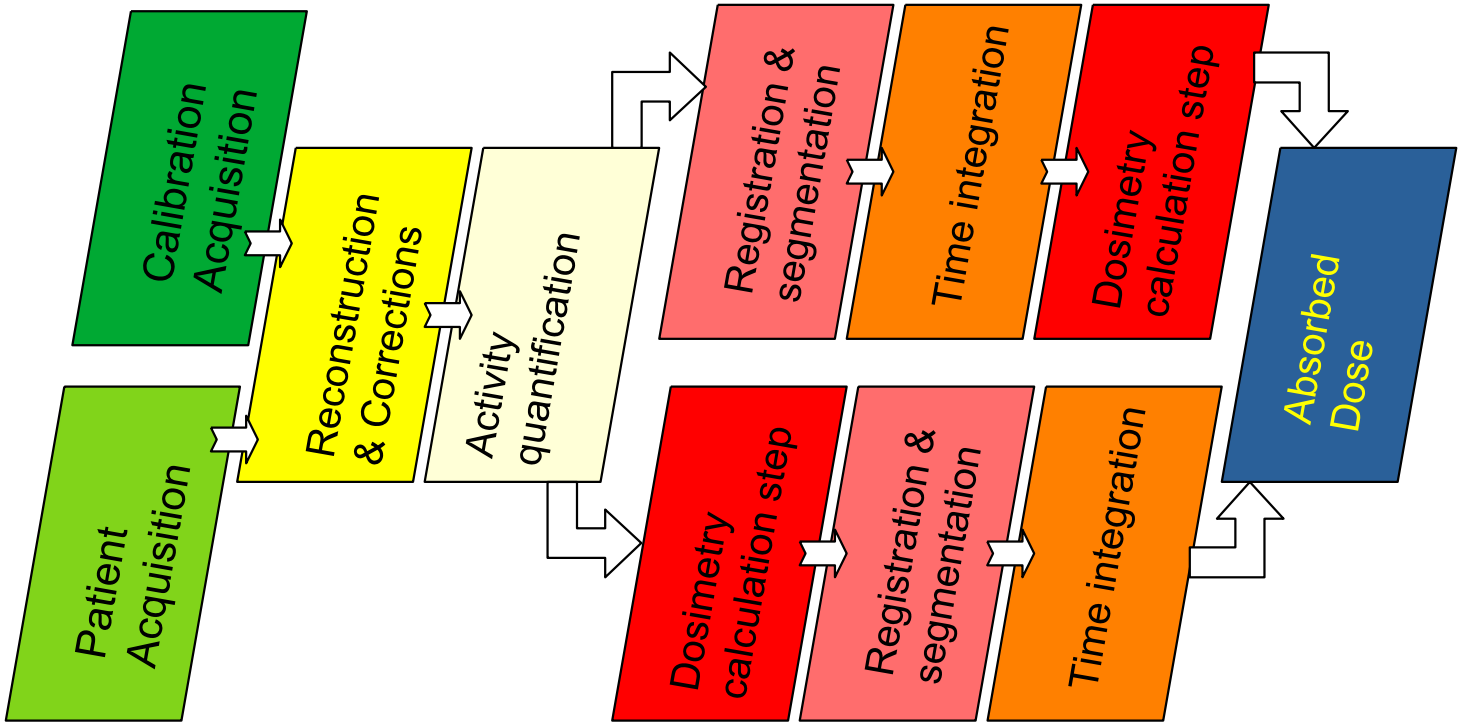
- Composed of 5 work packages

MEDIRAD Work Package 3

- 4 European clinical departments: Toulouse (IUCT-O), Sutton (RMH), Wurzburg (UKW) and Marburg (UKM)
- Collected data from 100 patients with thyroid cancer treated with I-131 post-thyroidectomy
- Dosimetry performed

www.medirad-project.eu

Clinical Dosimetry Workflow (CDW)



Data workflows in the Medirad project:

- Conventional: **Time Integrated Activity** (TIA) workflow
- Alternate: **Absorbed Dose Rate** (ADR) workflow

Data management defined

Modular design (each step has data input and data output that is preserved on saving)

OpenDose Project

Dosimetric database (SAFs, S-values) for Nuclear Medicine:

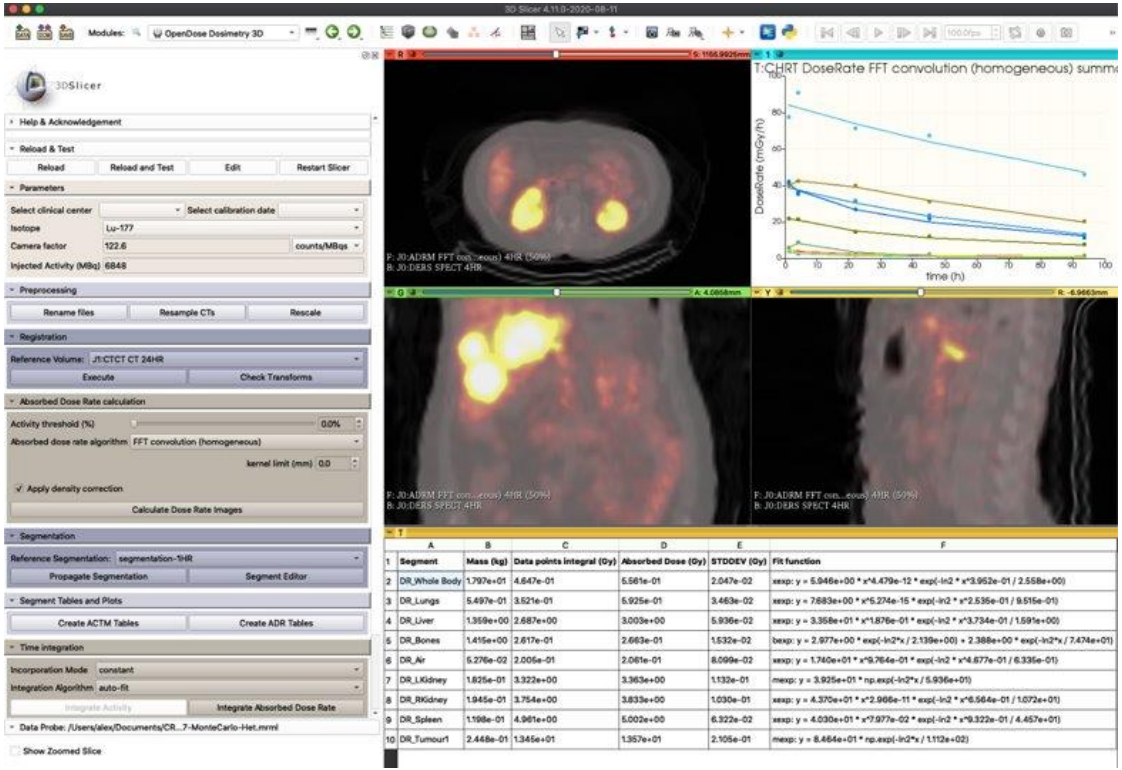
- collaborative data production (18+ teams)
- open and FAIR data
- data associated with (statistical) uncertainties

Dosimetric Solutions:

- OpenDose Calculator (Model Based)
- OpenDose3D (Patient Specific)

http://www.opendose.org

OpenDose3D development



OpenSource + Git
Based on 3D Slicer:

- DICOM RT (I/O)
- Display
- Segmentation
- Registration

+ Specific developments:

- Data workflow
- TAC fitting
- Absorbed dose (rate) calculation:
  a. Local Energy Deposition (LED)
  b. Convolution (VDK)
  c. Monte Carlo

Validation performed:

- SIRT (^{90}Y) - Univ Messina
- MEDIRAD (^{131}I)
- IAEA CRP: (^{177}Lu)*

*OpenDose3D: A free, collaborative 3D Slicer module for patient-specific dosimetry. European Journal of Nuclear Medicine and Molecular Imaging, 47 (SUPPL 1), S314–S315 (2020)

Clinical dosimetry implemented in MEDIRAD

- 4 centres (IUCT-O, RMH, UKW, UKM)
- 4 different protocols (5!)
- OpenDose3D was adapted to cover clinical situations in ¾ institutions

Institut Universitaire du Cancer de Toulouse - Oncopole (IUCT-O):
25/29 patients - One unique SPECT/CT at 96h, 2 FOV (Head-Abdomen)
External probe WB measurements

Royal Marsden Hospital (RMH):
25/25 patients - 2 acquisition protocols:
- Single SPECT/CT at 48h, 1 FOV (Head-Torso)
- + additional SPECT acquisitions aligned with CT at 48h for attenuation correction.

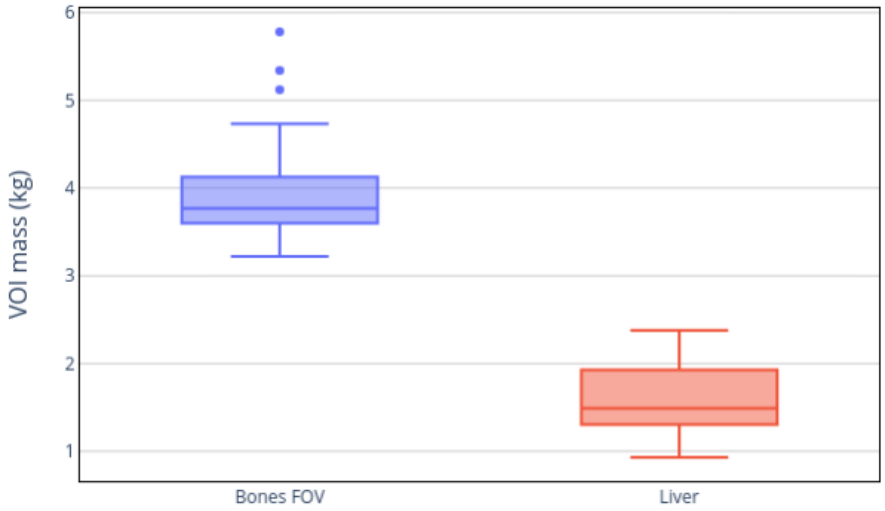
External probe WB measurements.

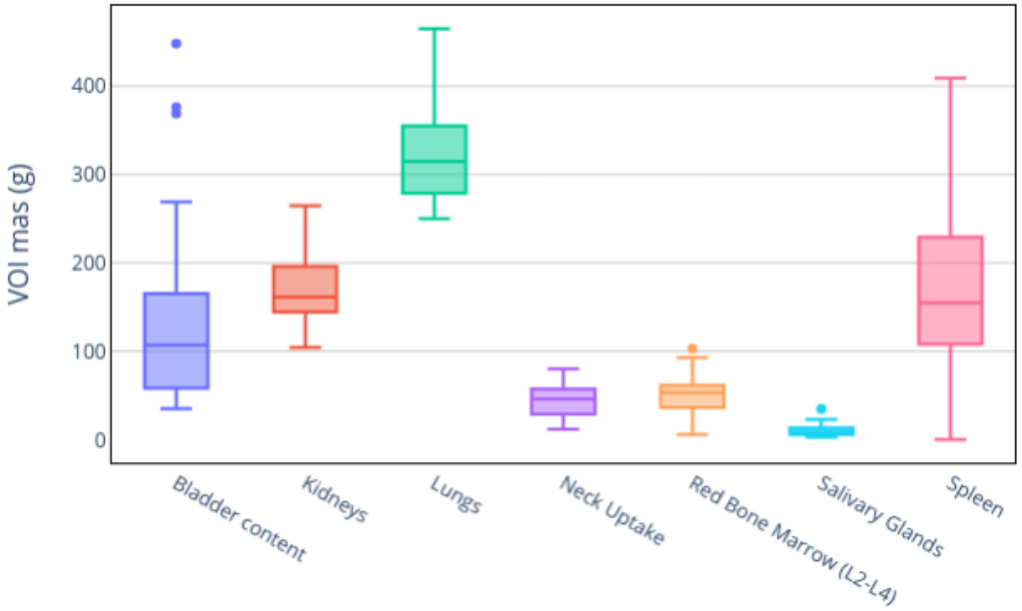
Würzburg University Clinic (UKW)
21/21 patients - SPECT/CT at 48h + additional uncorrected SPECT acquisitions. 2 FOV (Head-Abdomen)

Institut Universitaire du Cancer de Toulouse - Oncopole (IUCT-O)

Mass of segmented structures (kg)

25 patients



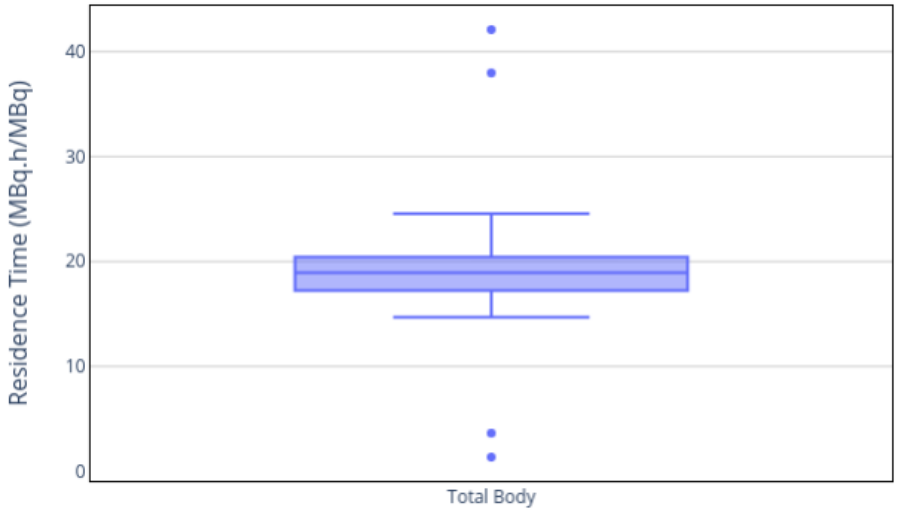


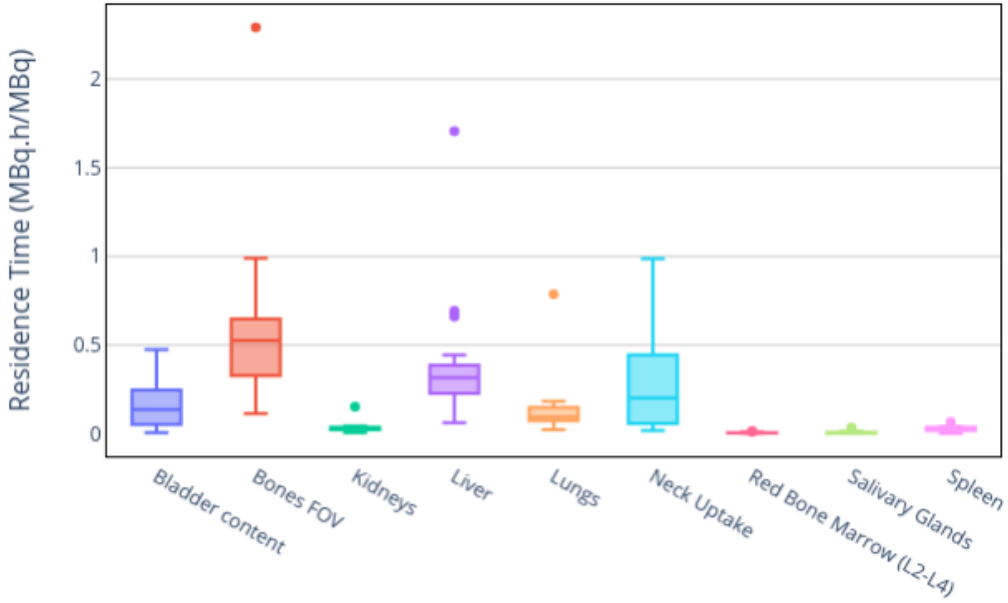
Large FOV, One time-point

Institut Universitaire du Cancer de Toulouse - Oncopole (IUCT-O)

Residence time (h)

25 patients



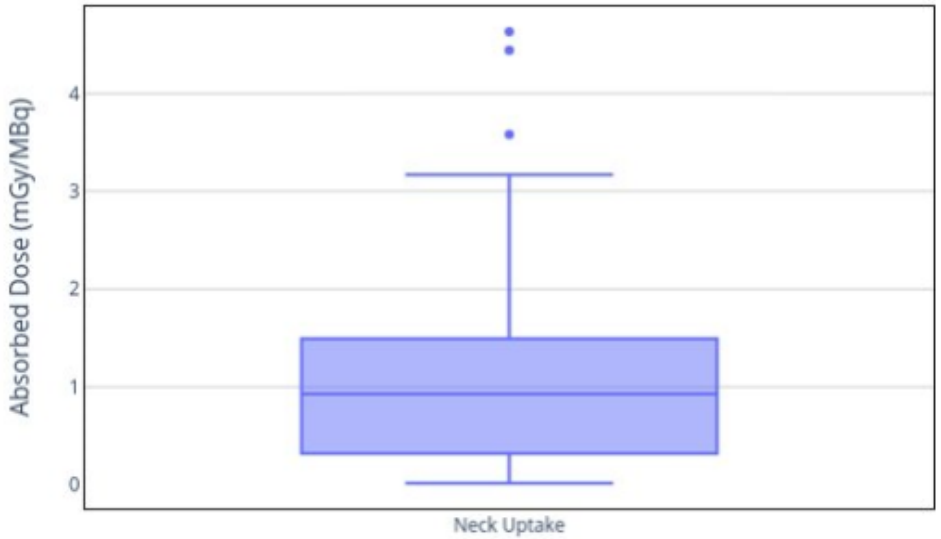


Teff from RMH (except WB from external probe)

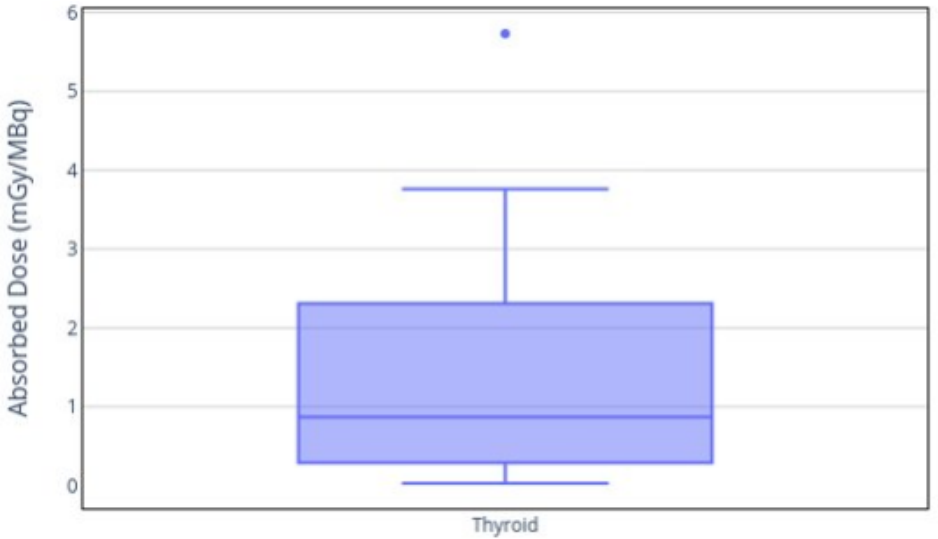
Institut Universitaire du Cancer de Toulouse - Oncopole (IUCT-O)

25 patients

AD1: patient-specific Monte Carlo-based calculation



AD2: Model-based (IDAC 2.1) calculation



Institut Universitaire du Cancer de Toulouse - Oncopole (IUCT-O)

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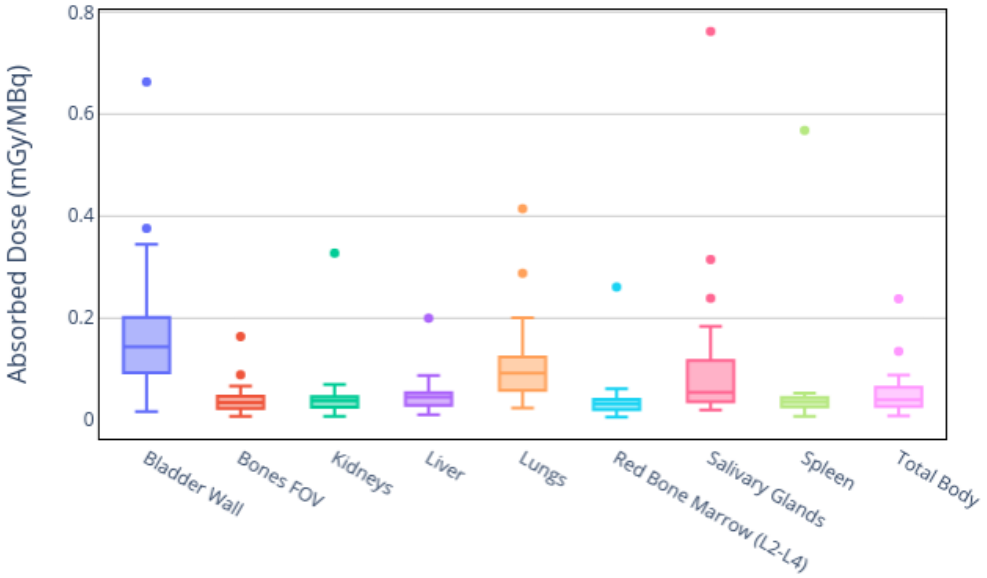
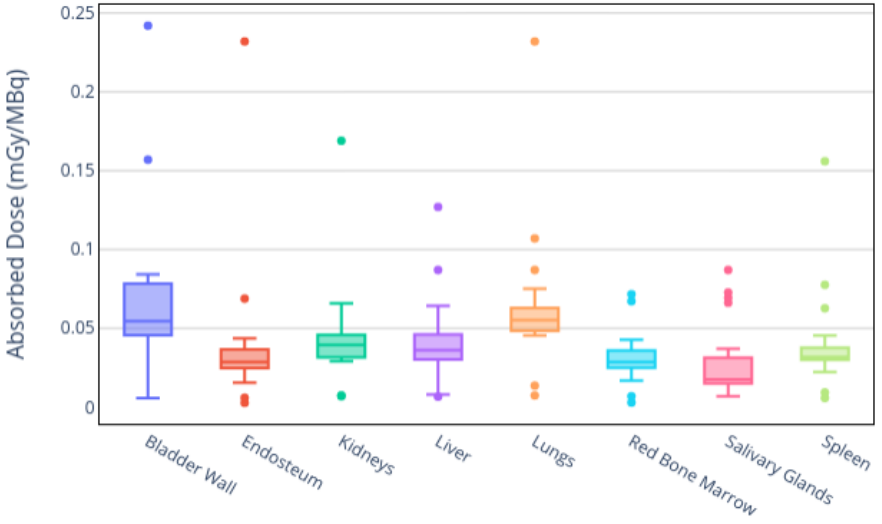
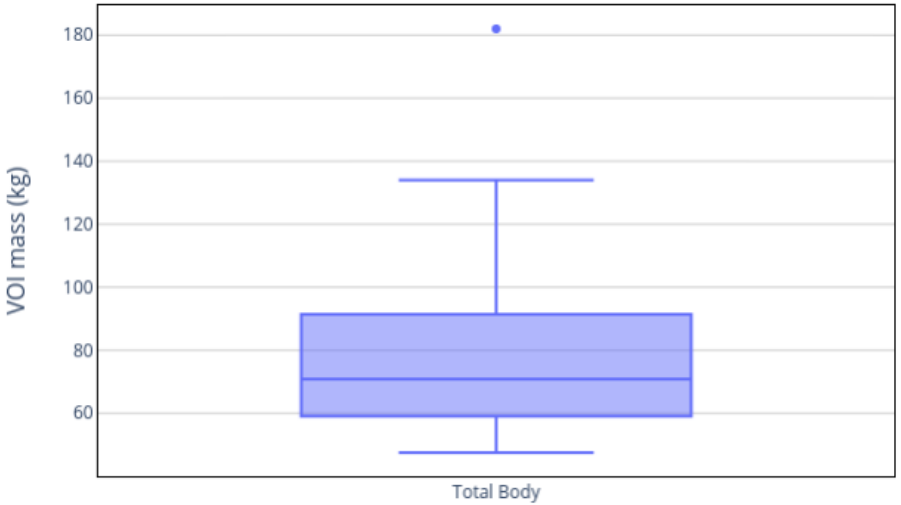


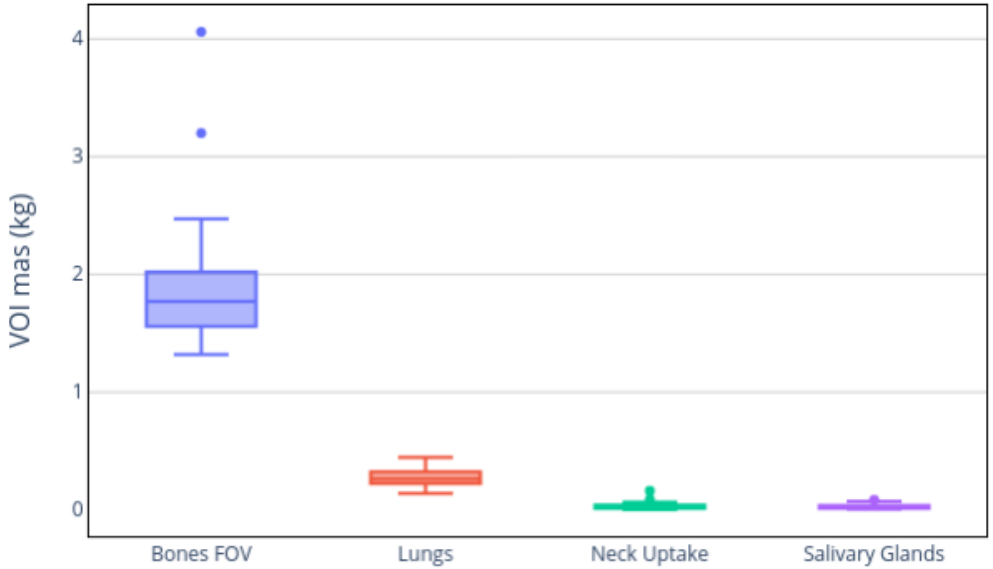


Royal Marsden Hospital (RMH)

25 patients

Mass of segmented structures (kg)



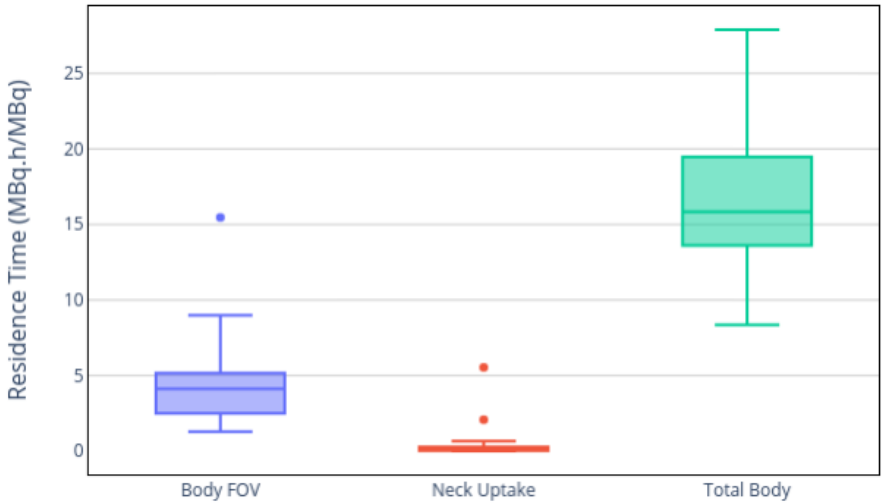


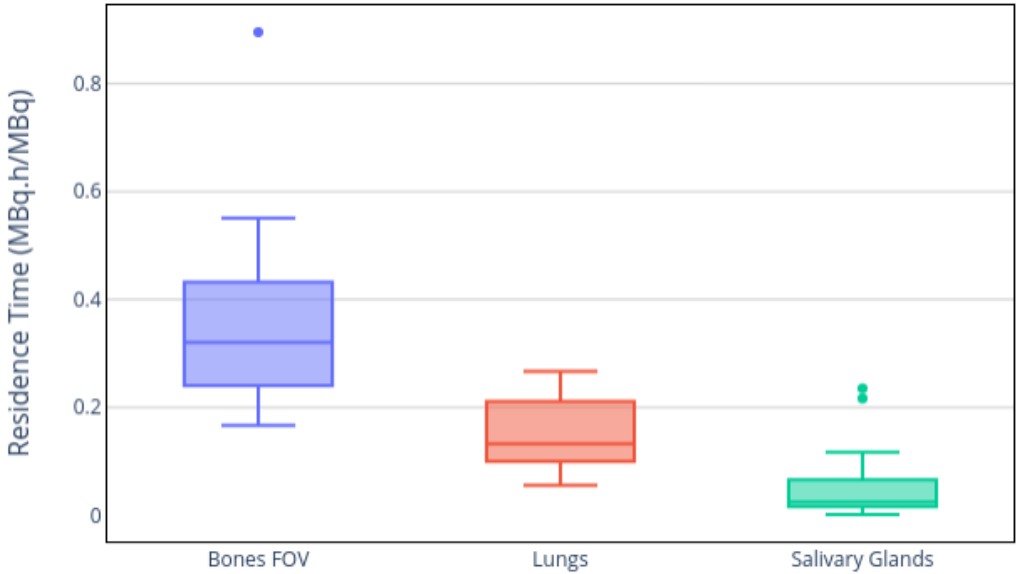
1 FOV, several time-points

Royal Marsden Hospital (RMH)

25 patients

Residence time (h)





Royal Marsden Hospital (RMH)

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25 patients

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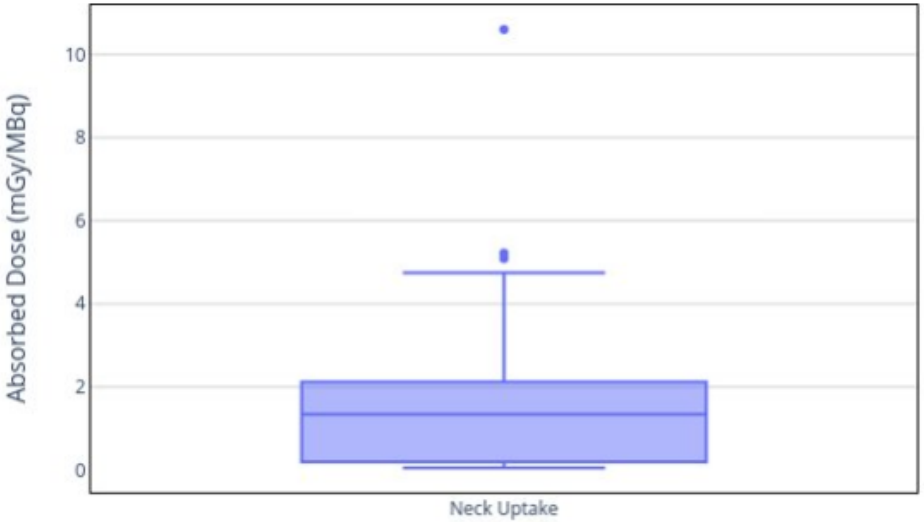

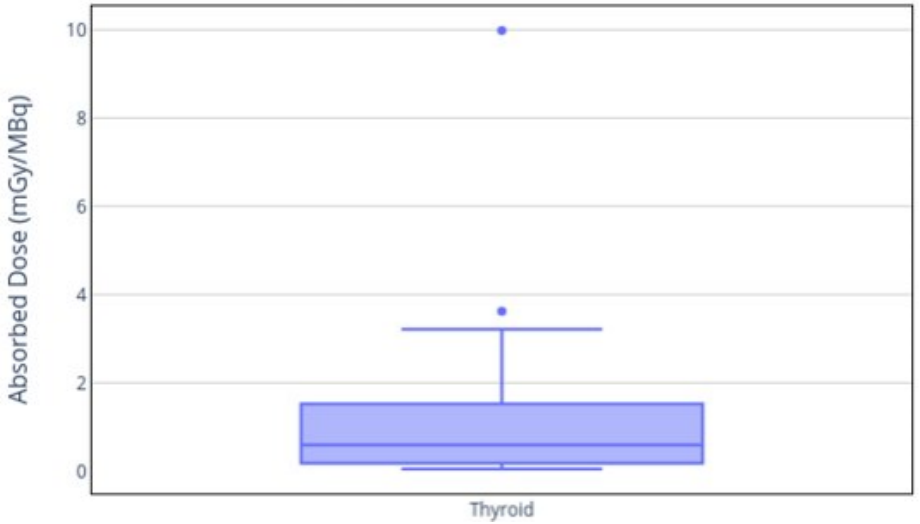

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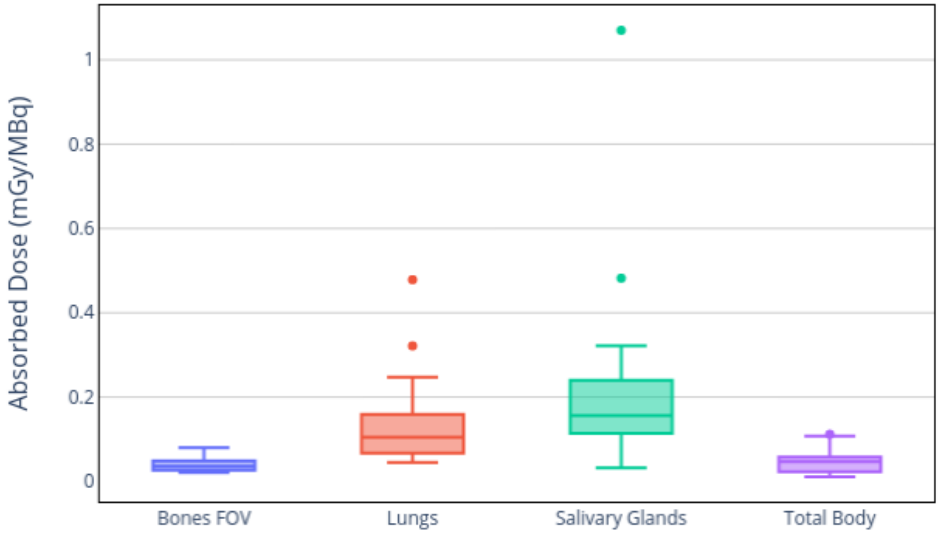
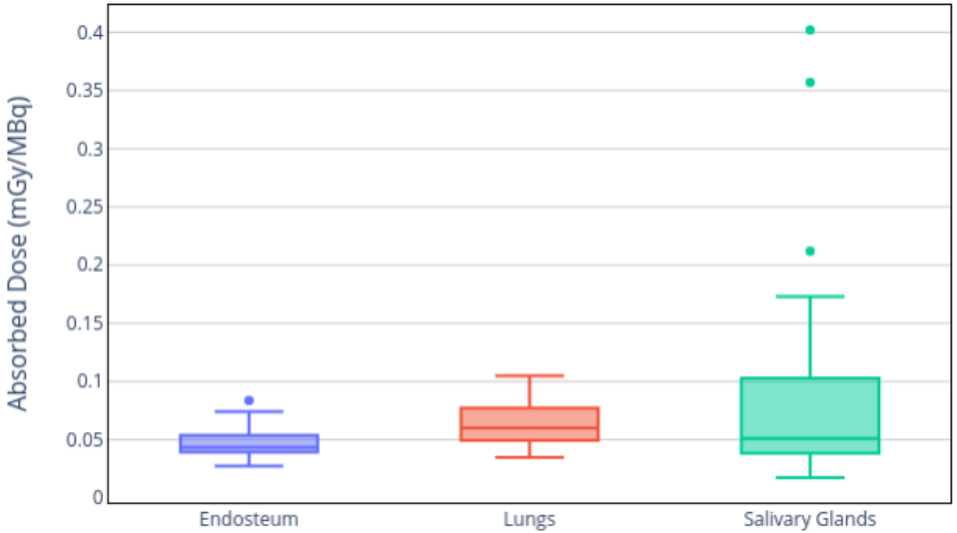
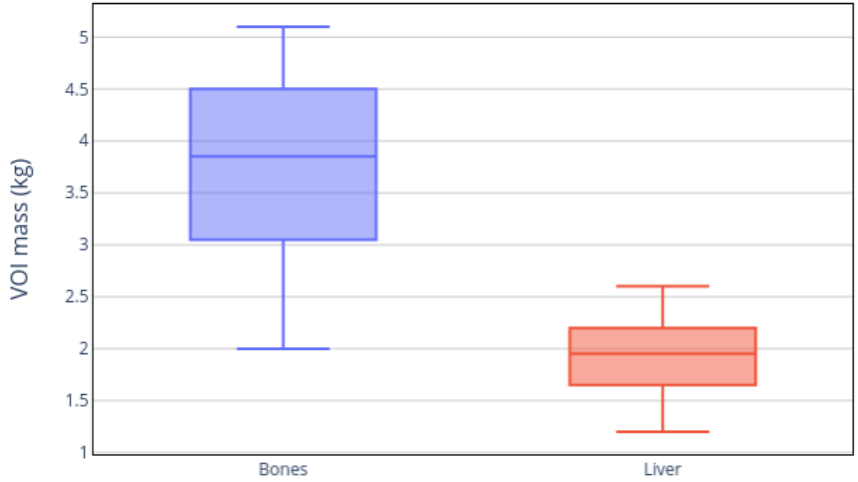


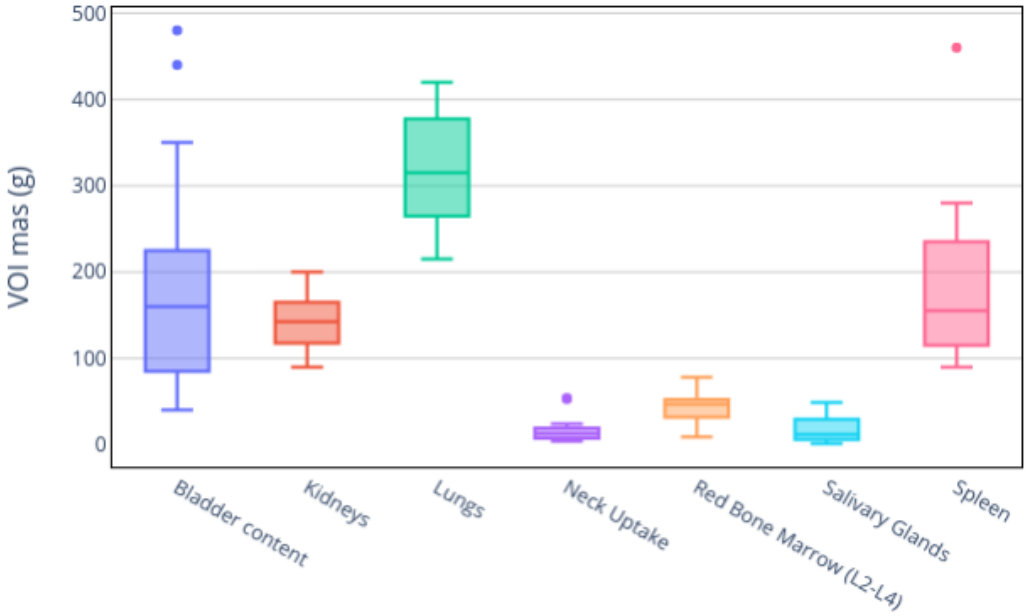


Würzburg University Clinic (UKW)

21 patients

Mass of segmented structures (kg)



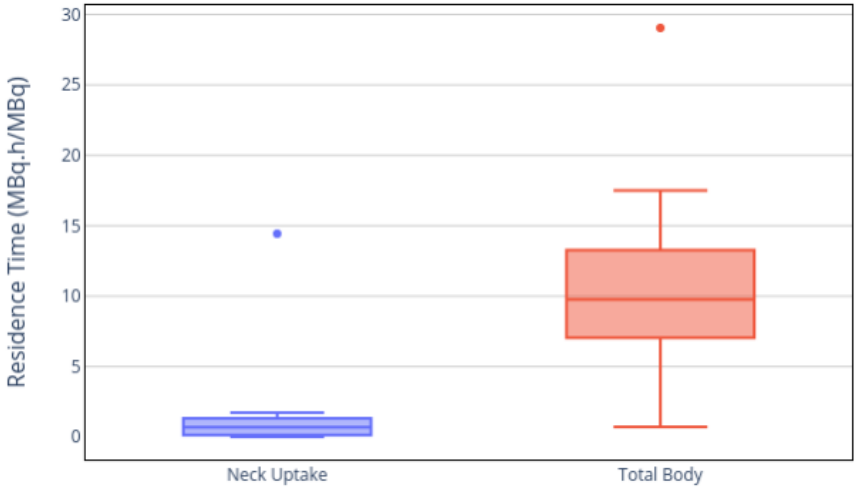


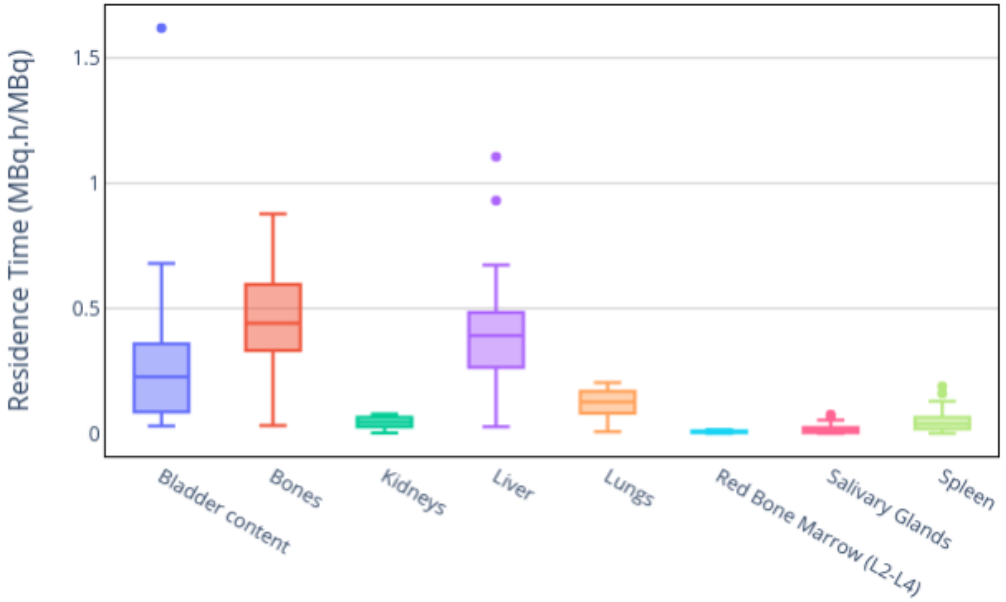
2 FOV, several time-points

Würzburg University Clinic (UKW)

21 patients

Residence time (h)





Würzburg University Clinic (UKW)

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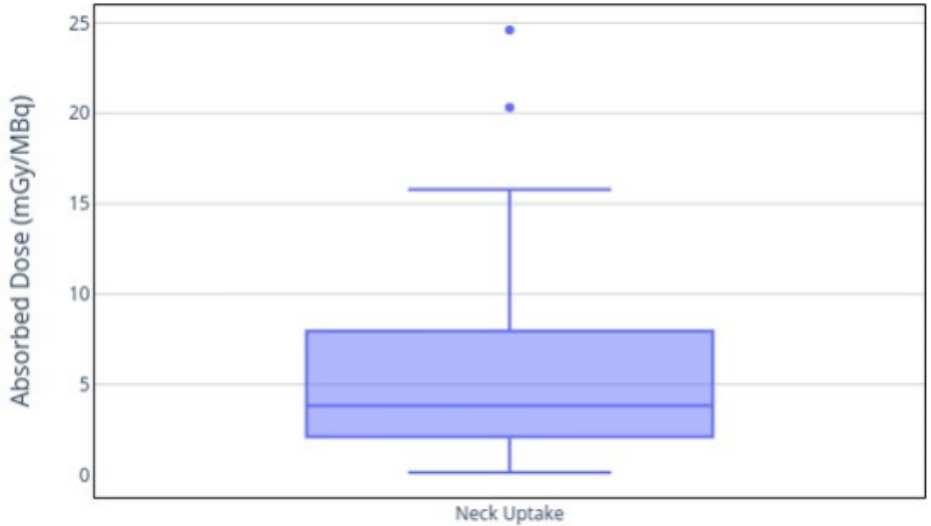

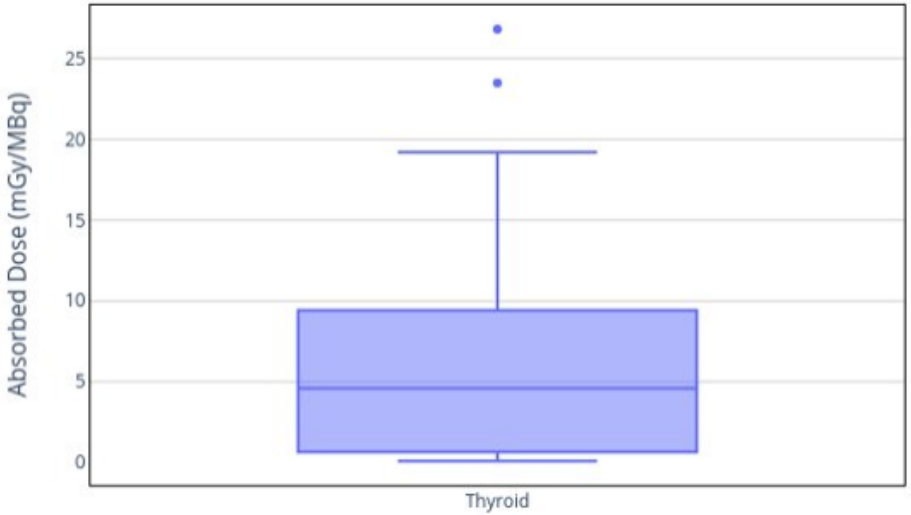

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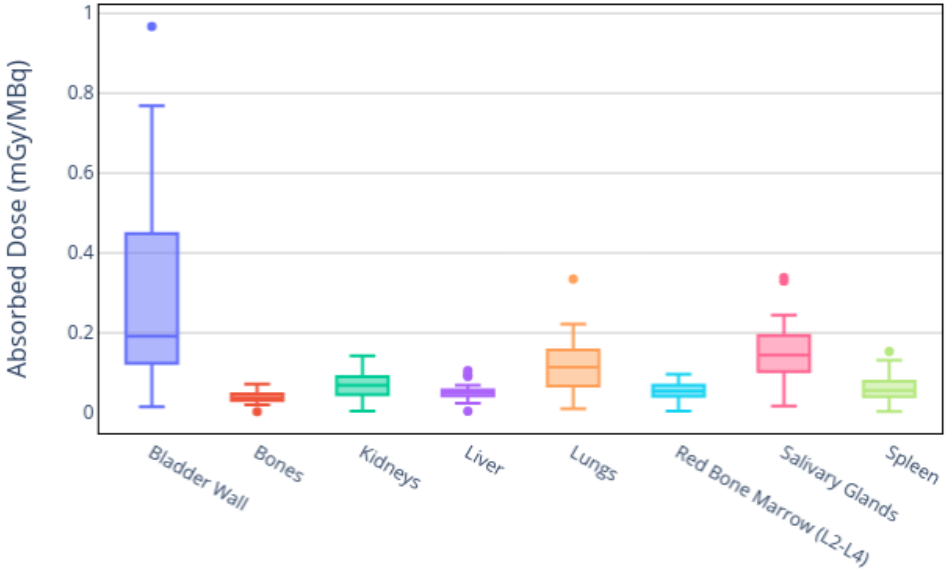
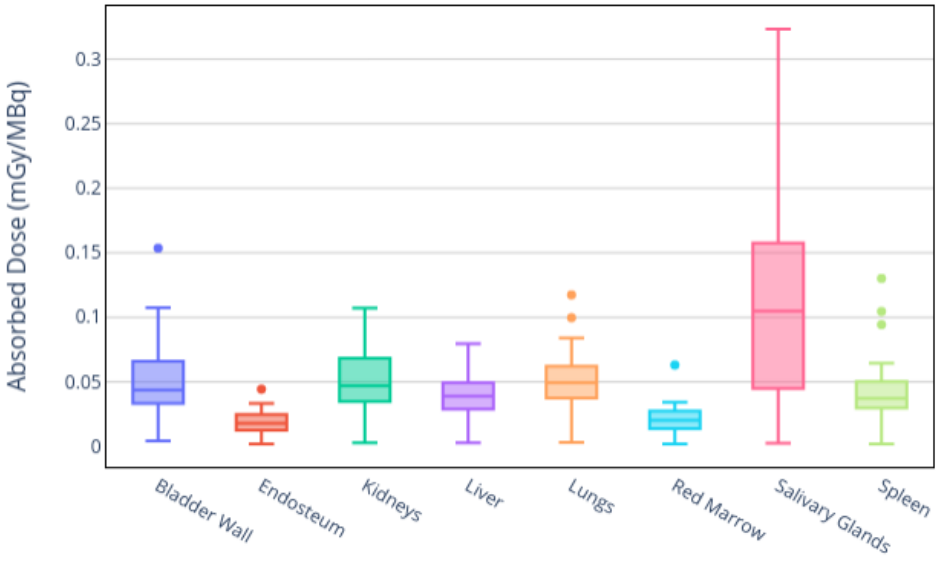
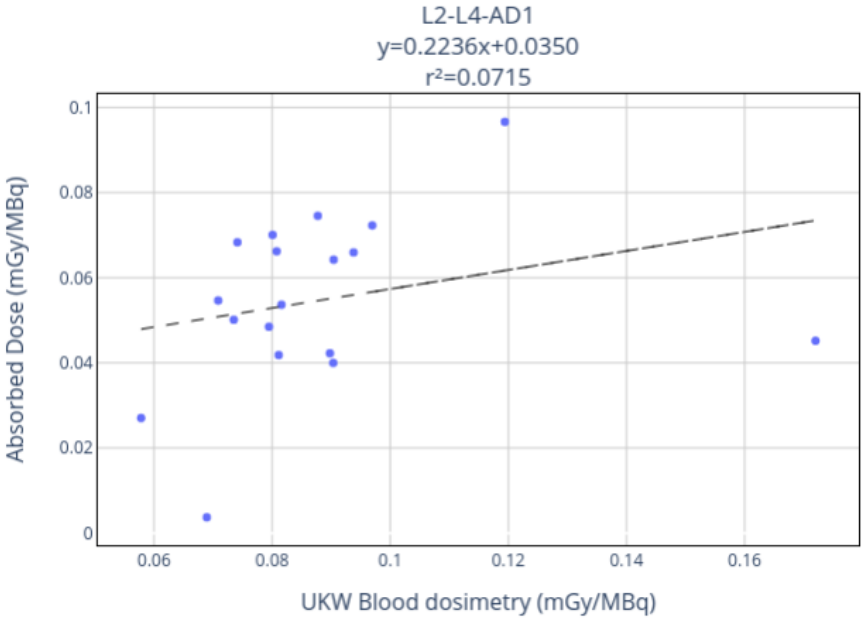
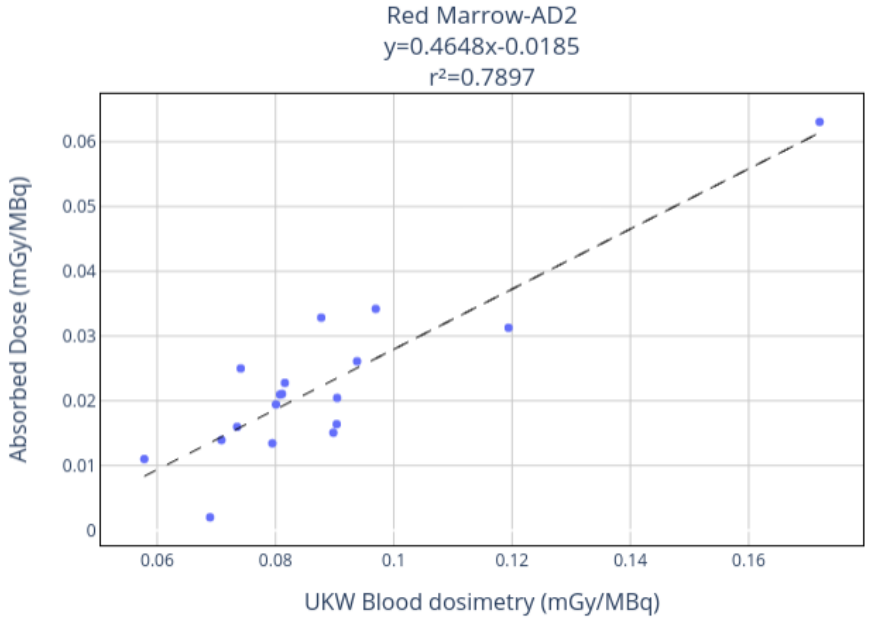


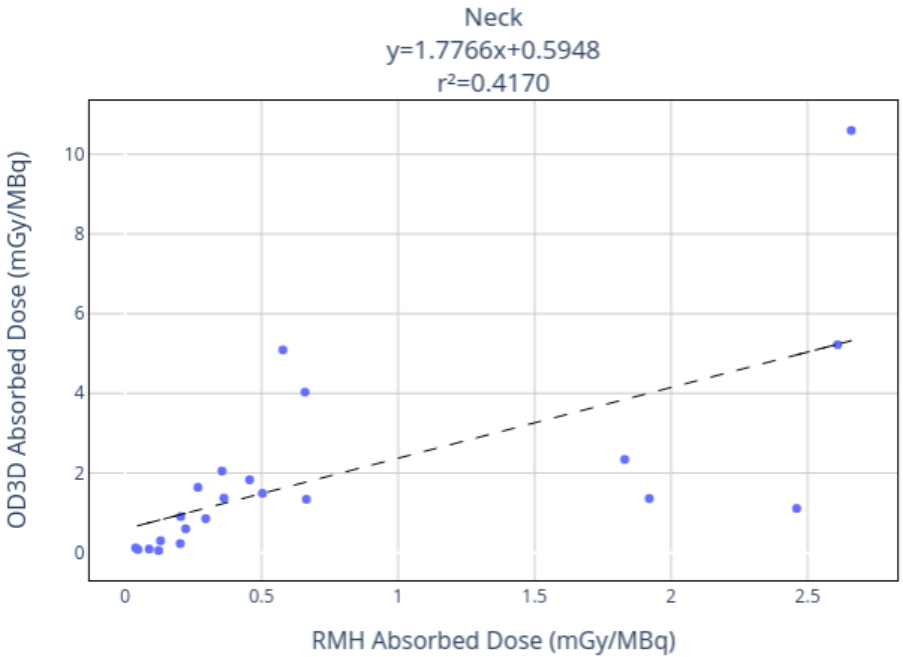


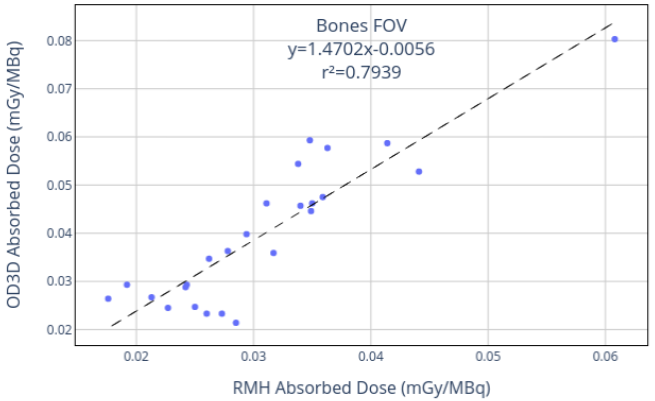
Comparison with blood based dosimetry

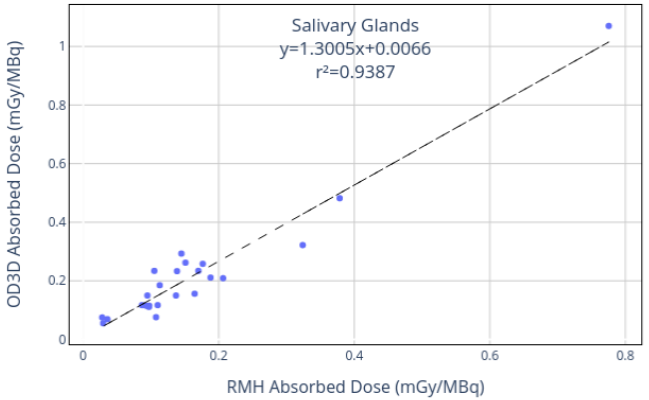




Comparison with RMH dosimetry

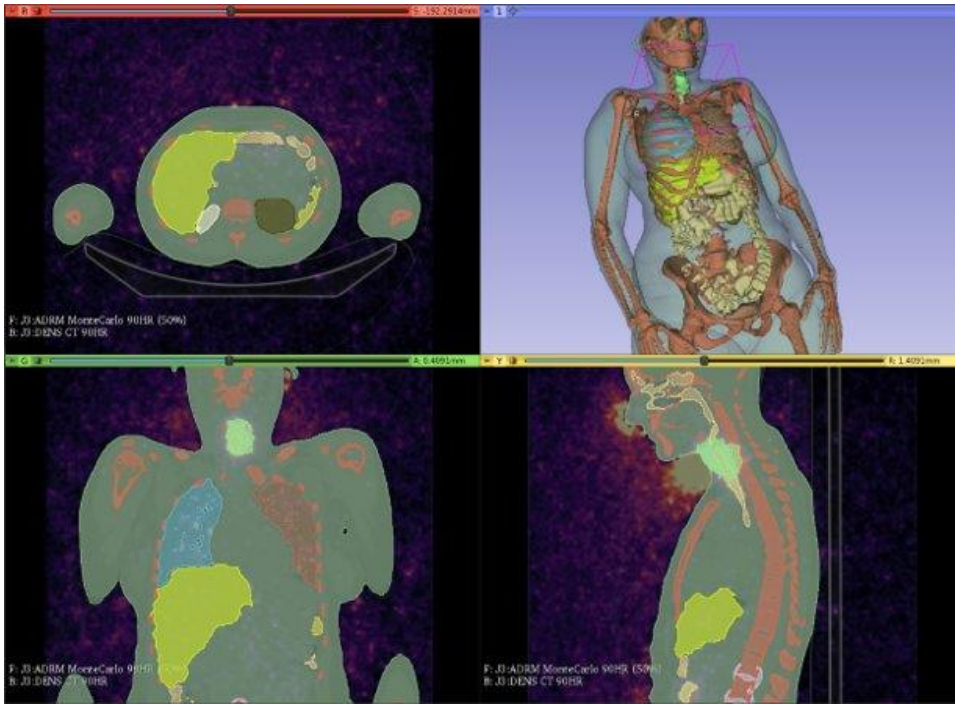






Conclusions

- The dosimetry of three centres was performed using OpenDose3D.
- The software had to be specifically adapted to each protocol, yet results obtained were quite comparable.
- During the validation phase, most observed differences between dosimetry codes applied to the same patients for comparison could be explained.
- Dosimetry shows large inter patient variability.
- The quality and reliability of dosimetric results largely depends on the quality of the clinical protocol implemented.



Thanks for your Attention !!!