

# AAPM|COMP Annual Meeting

Session title: Anatomical and Clinical DRLs; An Update

## *The European Perspective*



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# European Clinical DRLs (EUCLID)

## Objectives

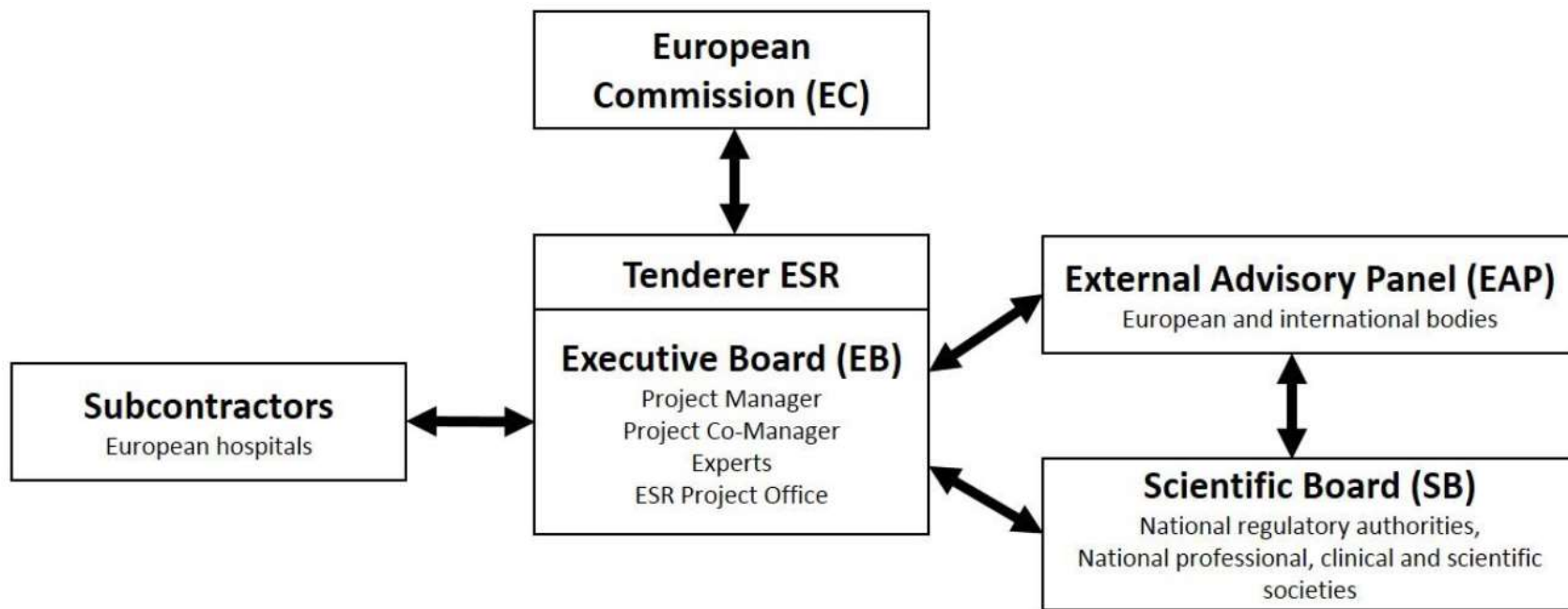
- To conduct a European DRL survey for x-ray imaging of adults following a predefined methodology
- To specify up-to-date **clinical** DRLs for the most important x-ray imaging tasks
- To organize a workshop

**Duration: 33 months (2017-2020)**

## **Anatomical vs. clinical DRLs**

- **Different image quality is needed for different clinical indications of the same anatomical area**
- **The number of phases depends on the clinical indication**
- **The scanning length depends on the clinical indication**

# EUCLID Organisational Chart



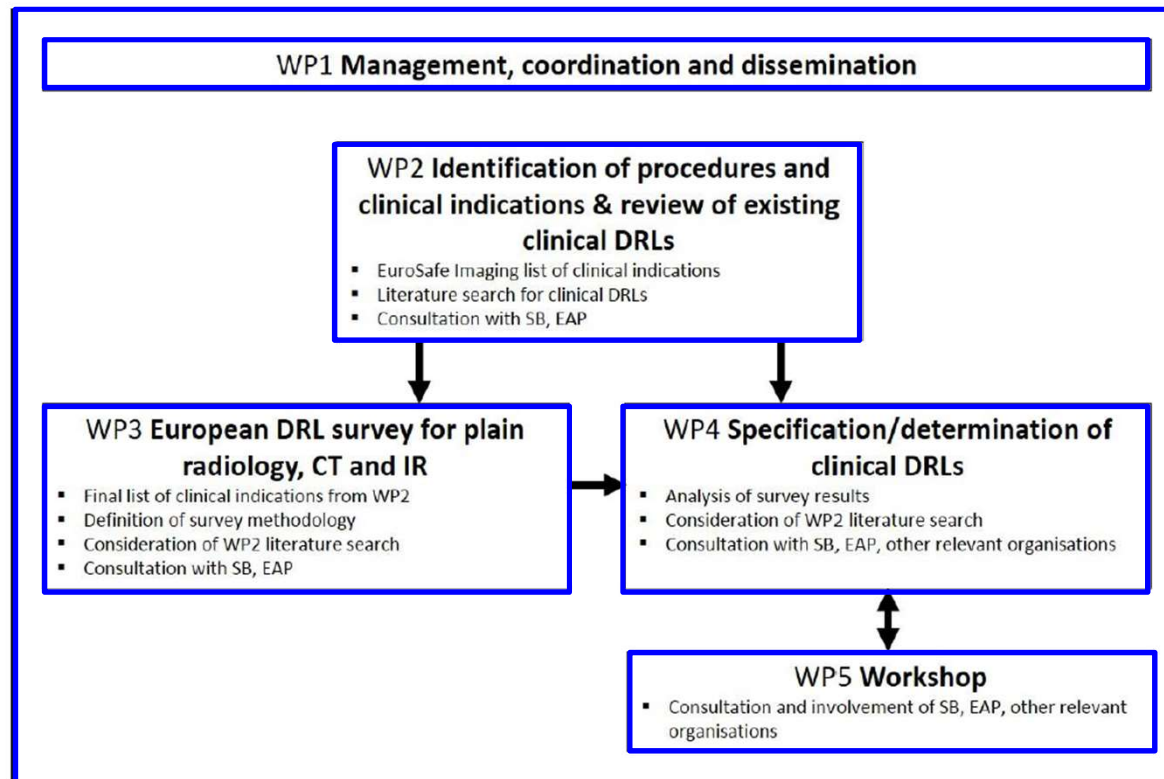
# EUCLID Advisory Panel

- **Cardiovascular and Interventional Radiological Society of Europe (CIRSE)**
- **European Federation of Organisations for Medical Physics (EFOMP)**
- **European Federation of Radiographer Societies (EFRS)**
- **International Atomic Energy Agency (IAEA)**
- **International Commission on Radiological Protection (ICRP)**
- **World Health Organisation (WHO)**
- **European Coordination Committee of the Radiological, Electromedical and Healthcare IT Industry**
- **ESR Patient Advisory Group**
- **Heads of the European Radiological Protection Competent Authorities (HERCA)**

# **EUCLID Scientific Board**

- **Austrian Society of Radiology (OERG), Austria**
- **Dr. Lodewijk Van Bladel, representing the Federal Agency for Nuclear Control (FANC), Belgium**
- **Radiation and Nuclear Safety Authority (STUK), Finland**
- **Institut de Radioprotection et de Sûreté Nucléaire (IRSN), France**
- **Bundesamt für Strahlenschutz (Federal Office for Radiation Protection, BfS), Germany**
- **Hellenic Association of Medical Physicists (HAMP), Greece**
- **Hungarian Society of Radiology, Hungary**
- **Istituto Superiore di Sanità (National Institute of Health, ISS), Italy**
- **National Institute for Public Health and the Environment (RIVM), The Netherlands**
- **Bundesamt für Gesundheit (Swiss Federal Office of Public Health, FOPH), Switzerland**
- **Ministry of Health, Spain**
- **Irish national population dose and optimisation committee of the Ireland's Health Services, Ireland**
- **Portuguese Society of Radiology and Nuclear Medicine, Portugal**
- **Polish Medical Society of Radiology, Poland**

# EUCLID WP Structure



# **EUCLID WP1: Management, coordination, dissemination**

**Lead: J. Damilakis**

**WP1 is responsible for**

- **the overall coordination of the project**
- **the dissemination activities**



## **EUCLID WP2: List of clinical indications**

**Lead: G. Frija**

**WP2 is responsible for**

- **review of existing clinical DRLs**
- **the identification of clinical indications for which DLRs will be established**

# EUCLID WP2: List of clinical indications

| Clinical task  | Anatomical location      |
|--|--------------------------|
| <u>Stroke</u><br>Detection or exclusion of haemorrhage             | Head                     |
| <u>Chronic sinusitis</u><br>Detection or exclusion of polyps       | Neck                     |
| <u>Cervical spine trauma</u><br>Detection or exclusion of a lesion | Spine                    |
| <u>Pulmonary embolism</u><br>Detection or exclusion                | Thorax                   |
| <u>Coronary calcium scoring</u><br>Risk stratification             | Coronary Arteries        |
| <u>Coronary angiography</u><br>Vessels assessment                  | Coronary Arteries        |
| <u>Lung cancer</u><br>Oncological staging<br>First and F-up        | Brain<br>Thorax<br>Liver |
| <u>Hepatocellular carcinoma</u><br>Oncological staging             | Liver                    |
| <u>Colic /abdominal pain</u><br>Exclusion or detection of a stone  | Abdomen                  |
| <u>Appendicitis</u><br>Detection or exclusion                      | Abdomen                  |

| Clinical task  | Anatomical location | Procedure   |
|--|---------------------|---|
| <u>Arterial occlusive disease of iliac arteries</u><br>Angiographic diagnosis and endovascular treatment of arterial stenosis or occlusion causing Intermittent claudication or ischemia           | Pelvis              | Recanalisation & Stenting   |
| <u>Localization and treatment of hepatocellular carcinoma</u><br>TACE: transarterial chemoembolisation   | Liver               | Transarterial (chemo)embolisation of tumor vasculature and feeding hepatic arteries |
| <u>Arterial occlusive disease of femoropopliteal arteries</u><br>Angiographic diagnosis and endovascular treatment of arterial stenosis or occlusion causing intermittent claudication or ischemia | Lower extremity     | Recanalization and angioplasty +- stenting  |
| <u>Biliary drainage</u><br>Localization of biliary obstruction and percutaneous treatment of biliary obstruction   | Abdomen             | Percutaneous transhepatic cholangiography and biliary drainage                      |

## **EUCLID WP3: Data collection**

**Lead: J. Damilakis**

**The objective of WP3 is to develop and implement a survey to collect data from European hospitals following a methodology in accordance with the most up-to-date international recommendations.**

# EUCLID hospitals and SB members: Geographical distribution

Hospitals (Subcontractors)



Scientific Board members



EUCLID | European Study  
on Clinical DRLs

# EUCLID network of hospitals

| Abbreviation | Hospital/Centre   | Country     |
|--------------|---|-------------|
| APH          | European Georges Pompidou Hospital                        | France      |
| BMC          | Bravis Medical Centre                                     | Netherlands |
| CHUC         | Centro Hospitalar e Universitário de Coimbra              | Portugal    |
| EMC          | Erasmus MC  | Netherlands |
| FCB          | Fundació Clínic per a la Recerca Biomèdica                | Spain       |
| GVA          | La Fe Health Research Institute                           | Spain       |
| HHH          | H.-Hart Hospital  | Belgium     |
| HRH          | Humanitas Research Hospital, Rozzano                      | Italy       |
| IRS          | Institut de Radiologie de Sion                            | Switzerland |
| KUH          | Kuopio University Hospital, Diagnostic Imaging Centre     | Finland     |
| LUX          | Lux Med, Warsaw   | Poland      |
| MUH          | Mercy University Hospital                                 | Ireland     |
| MUI          | Medical University Innsbruck                              | Austria     |
| PSH          | Affidea Hungary Péterfy Sándor Hospital and Trauma Center | Hungary     |
| UMM          | Johannes Gutenberg University Mainz University Med Center | Germany     |
| UoC          | Panepistimio Kritis - University of Crete                 | Greece      |
| UOR          | University of Rome "A. Gemelli"                           | Italy       |
| USB          | University Hospital Basel                                 | Switzerland |
| UZA          | Antwerp University Hospital                               | Belgium     |

# EUCLID questionnaires

| CT procedures  |      | Page 1 of 4   |  |
|--|------|---|--|
| Record ID  | 6-23 | <p><b>Note: for anterior-posterior and lateral width, select an image in the middle of the scan region and measure the maximum lateral and anterior-posterior diameters.</b></p>                                  |  |
| <p>General instructions:</p> <p><b>General instructions:</b></p> <p><b>1. For each clinical indication, record all exams of adult patients (age &gt;18 y) performed during the study period, but not less than 20 patients. For body clinical indications please collect data only for standard-size (Body Mass Index 18.5 to 25 kg/m<sup>2</sup> or weight 70+/-15 kg if height is not available) patients.</b></p> <p><b>2. For each examination, please we encourage you to provide the anonymized Radiation Dose Structured Report or any other DICOM report available in your scanner (e.g. DICOM image) at least for few examinations. This report will be used for verification of data collected for the establishment of clinical DRLs.</b></p> |      | <p>Patient anterior-posterior diameter</p> <p>23.7<br/>(in cm)</p>  |  |
| <p><input type="radio"/> Appendicitis - Detection or exclusion</p>   |      | <p>Patient lateral diameter</p> <p>(in cm)</p>  |  |
| <p>A. PATIENT DATA</p> <p>Internal Patient ID</p> <p>Weight</p> <p>Height</p> <p>PUOC98627</p> <p>70<br/>(in kg)</p> <p>(in cm)</p>  |      | <p>Was CTDI, as displayed, verified by measurements?</p> <p>If yes, please provide the agreement</p> <p>D. DRLs</p> <p><input checked="" type="radio"/> Yes<br/><input type="radio"/> No</p> <p>20<br/>(in %)</p> | <p>Have you taken into consideration local or national diagnostic reference levels (DRLs) in the design of this clinical indication-based CT protocol?</p> <p><input checked="" type="radio"/> Yes, I have taken into consideration local/national DRLs in the design of the protocol<br/><input type="radio"/> No, I have not taken into consideration local/national DRLs in the design of the protocol<br/><input type="radio"/> Protocol developed by manufacturer</p> <p>E. PROTOCOL</p> <p><b>If the examinaion consists of more than one series, please provide information separately for each phase (max. 4). Please indicate the name/label of each one (e.g. contrast-enhanced phase, arterial phase, venous phase, delayed phase etc.) Bolus tracking and scout views are excluded.</b></p> <p>Number of series/phases</p> <p><input checked="" type="radio"/> 1<br/><input type="radio"/> 2<br/><input type="radio"/> 3<br/><input type="radio"/> 4</p> <p>FIRST SERIES/PHASE</p> <p>Name of the series/phase</p> <p>Mode</p> <p>Table increment</p> <p>Scan range</p> <p>Automatic Exposure Control (AEC)</p> <p>Tube voltage adaption</p> <p>Organ based modulation</p> <p>FBP or iterative reconstruction</p> <p>CTDIvol for this series/phase</p> <p>(Please provide the value without the inclusion of dose from the scout views)</p> <p>2<br/>Sequential<br/>Helical</p> <p>20<br/>(in mm)</p> <p>20<br/>(in cm)</p> <p><input checked="" type="radio"/> Activated<br/><input type="radio"/> Non-activated</p> <p><input type="radio"/> Activated<br/><input checked="" type="radio"/> Non-activated</p> <p>IR ASIR50%<br/>(FBP or IR and type name)</p> <p>5,74<br/>(in mGy)</p> |

# EUCLID Data collection platform

The screenshot displays the REDCap interface for the EUCLID project. The left sidebar contains navigation menus for 'My Projects', 'Data Collection', 'Applications', 'Reports', and 'Help & Information'. The main content area shows the project title 'EUCLID - CT procedures DRL survey' and its status as 'Development'. Three primary sections are visible: 'Main project settings' (marked 'Complete!'), 'Design your data collection instruments' (marked 'Not started'), and 'Enable optional modules and customizations' (marked 'Optional').

**REDCap**  
Logged in as UOCTest | Log out

**EUCLID** | European Study on Clinical DRLs

**EUCLID - CT procedures DRL survey**

Project status: Development Completed steps 2 of 7

**Main project settings** (Complete!)

- Enable  Use surveys in this project? [VIDEO: How to create and manage a survey](#)
- Enable  Use longitudinal data collection with defined events? [?](#)

Modify project title, purpose, etc.

**Design your data collection instruments** (Not started)

Add or edit fields on your data collection instruments. This may be done by either using the Online Designer (online method) or by uploading a Data Dictionary (offline method).

Go to [Online Designer](#) or [Data Dictionary](#)

You may also browse for pre-built data collection instruments in the [REDCap Shared Library](#)

Have you checked the [Check For Identifiers](#) page to ensure all identifier fields have been tagged?

**Enable optional modules and customizations** (Optional)

- Modify  Repeatable instruments [?](#)
- Disable  Auto-numbering for records [?](#)
- Enable  Scheduling module (longitudinal only) [?](#)
- Enable  Randomization module [?](#)
- Enable  Designate an email field to use for invitations to survey participants [?](#)

Additional customizations

**EUCLID** | European Study on Clinical DRLs

## Data verification

- **Each member of the SB was given the clean data of his/her country's hospitals for verification purposes**
- **SB members checked for data completeness, inconsistencies, compared selected data with DICOM reports, checked consistency between data submitted and information available from experience, literature, measurements in the same hospital etc.**



## CT: Exams per clinical indication

| Hospital/Centre | Initial number of patients | Submitted number of patients | %   |
|-----------------|----------------------------|------------------------------|-----|
| APH             | 200                        | 187                          | 94  |
| BMC             | 180                        | 165                          | 92  |
| CHUC            | 200                        | 208                          | 104 |
| EMC             | 140                        | 208                          | 149 |
| FCB             | 200                        | 200                          | 100 |
| GVA             | 180                        | 166                          | 92  |
| HHH             | 200                        | 1258                         | 629 |
| HRH             | 200                        | 201                          | 101 |
| IRS             | 120                        | 103                          | 86  |
| KUH             | 140                        | 140                          | 100 |
| LUX             | 200                        | 70                           | 35  |
| MUH             | 180                        | 131                          | 73  |
| MUI             | 200                        | 238                          | 119 |
| PSH             | 180                        | 180                          | 100 |
| UMM             | 180                        | 213                          | 118 |
| UoC             | 200                        | 209                          | 105 |
| UOR             | 200                        | 194                          | 97  |
| USB             | 120                        | 121                          | 101 |
| UZA             | 200                        | 200                          | 100 |
| <b>Total</b>    | <b>3420</b>                | <b>4392</b>                  |     |

## IR: Exams per procedure

| Hospital/Centre | Initial number of patients | Submitted number of patients | %   |
|-----------------|----------------------------|------------------------------|-----|
| APH             | 90                         | 62                           | 69  |
| BMC             | 0                          | 0                            | 0   |
| CHUC            | 120                        | 134                          | 112 |
| EMC             | 120                        | 85                           | 71  |
| FCB             | 120                        | 79                           | 66  |
| GVA             | 120                        | 90                           | 75  |
| HHH             | 0                          | 0                            | 0   |
| HRH             | 120                        | 42                           | 35  |
| IRS             | 0                          | 0                            | 0   |
| KUH             | 60                         | 64                           | 107 |
| LUX             | 120                        | 60                           | 50  |
| MUH             | 60                         | 63                           | 105 |
| MUI             | 120                        | 135                          | 113 |
| PSH             | 90                         | 90                           | 100 |
| UMM             | 120                        | 96                           | 80  |
| UoC             | 90                         | 95                           | 106 |
| UOR             | 120                        | 96                           | 80  |
| USB             | 60                         | 69                           | 115 |
| UZA             | 60                         | 60                           | 100 |
| <b>Total</b>    | <b>1560</b>                | <b>1320</b>                  |     |

# EUCLID WP4: Data analysis

**Lead: V. Tsapaki**

**The main responsibility of WP4 is to**

- **Define data analysis methodology**
- **Collate and analyse data**
- **Determine clinical DRLs**

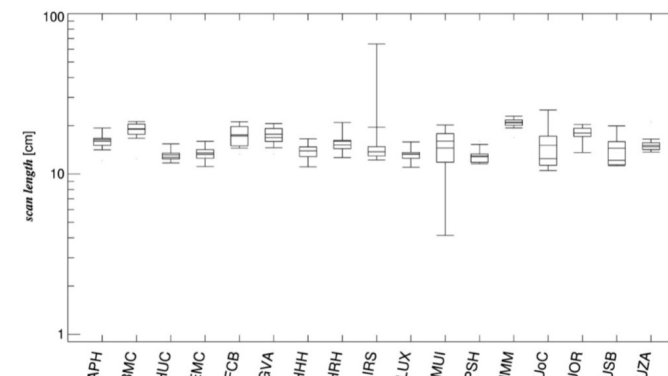
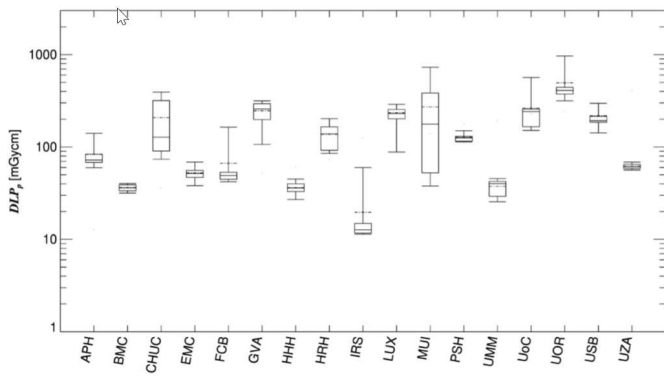
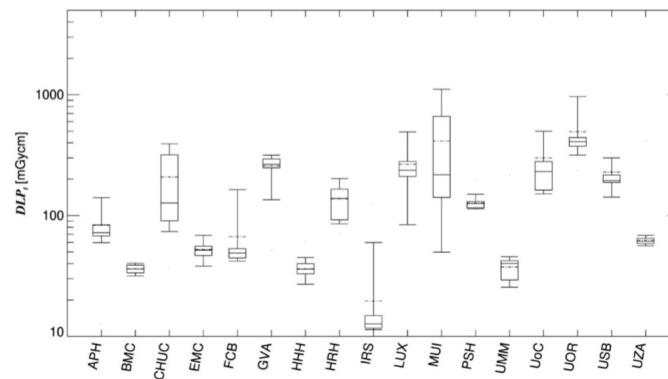
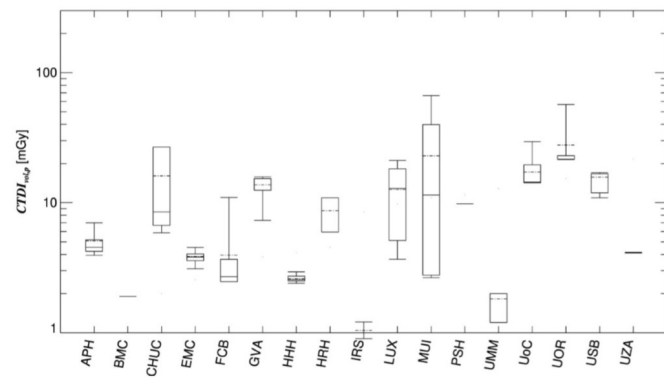
## EUCLID WP4: CT DRLs

| CI | clinical indication  | CTDI <sub>vol,p</sub><br>(mGy)* | DLP <sub>p</sub><br>(Gycm) | DLP <sub>t</sub><br>(Gycm) | scan<br>length<br>(cm) |
|----|--|---------------------------------|----------------------------|----------------------------|------------------------|
| 1  | Stroke - Detection or exclusion of a haemorrhage           | 48                              | 807                        | 1386                       | 18                     |
| 2  | Chronic sinusitis - Detection or exclusion of polyps       | 11                              | 188**                      | 211                        | 16                     |
| 3  | Cervical spine trauma - Detection or exclusion of a lesion | 17                              | 455                        | 495                        | 23                     |
| 4  | Pulmonary embolism - Detection or exclusion                | 9                               | 307                        | 364                        | 35                     |
| 5  | Coronary calcium scoring - Risk stratification             | 4                               | 72                         | 81                         | 17                     |
| 6  | Coronary angiography - Vessels assessment                  | 25                              | 415                        | 459                        | 17                     |
| 7  | Lung cancer - Oncological staging, First and F-up          | 8                               | 348                        | 628                        | 47                     |
| 8  | Hepatocellular carcinoma - Oncological staging             | 9                               | 354                        | 1273                       | 37                     |
| 9  | Colic / abdominal pain - Exclusion or detection of a stone | 8                               | 436                        | 480                        | 48                     |
| 10 | Appendicitis - Detection or exclusion                      | 9                               | 498                        | 874                        | 49                     |

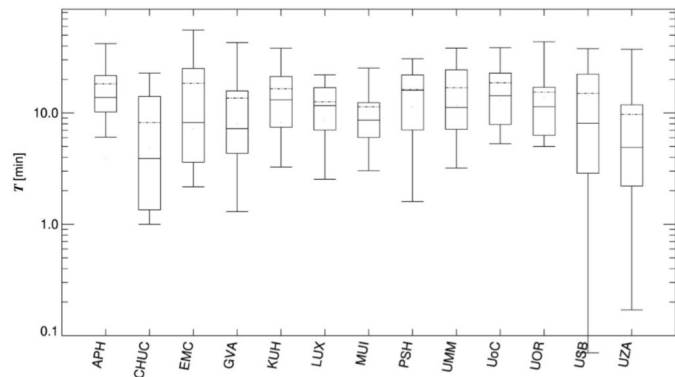
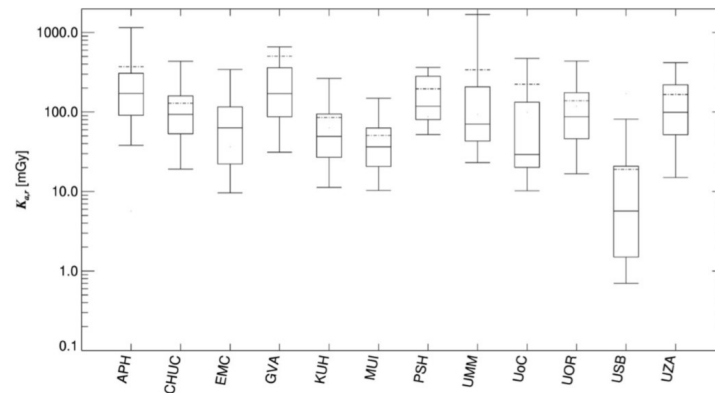
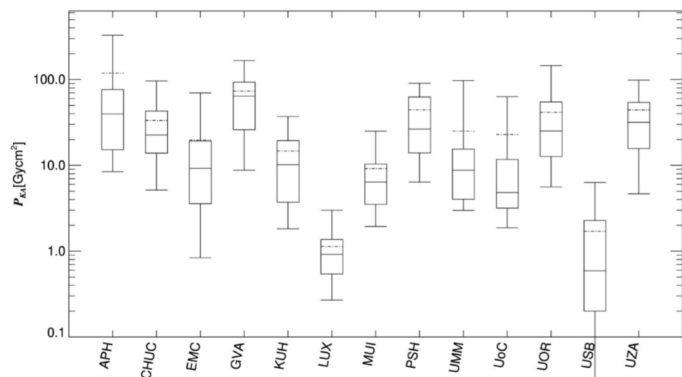
## EUCLID WP4: IR DRLs

| Clinical indication                                    | P <sub>KA</sub> (Gy.cm <sup>2</sup> ) | T (min) | Ka,r (mGy) |
|--|---------------------------------------|---------|------------|
| Arterial occlusive disease of iliac arteries           | 57                                    | 10      | 251        |
| TACE   | 241                                   | 18      | 1867       |
| Arterial occlusive disease of femoropopliteal arteries | 26                                    | 12      | 99         |
| Biliary drainage                                       | 22                                    | 10      | 194        |

# CT: Chronic sinusitis – Detection or exclusion of polyps



# IR: Arterial occlusive disease of femoropopliteal arteries



## EUCLID Results

- **The installable base of CT and IR equipment in Europe is old**
- **Data cleaning and data verification were shown to be vital**
- **Guidelines on data protection are needed**
- **Guidance on a common lexicon is needed**
- **Guidance on whether CT DRLs should be reported per phase or for total values**



# EUCLID WP5: Workshop

**Lead: J. Damilakis**

**The main responsibility of WP5 is to**

- **organise the workshop**
- **identify the need of further national and local actions on DRLs**

# EUCLID Team

**J. Damilakis**

**G. Frija**

**V. Tsapaki**

**G. Paulo**

**W. Jaschke**

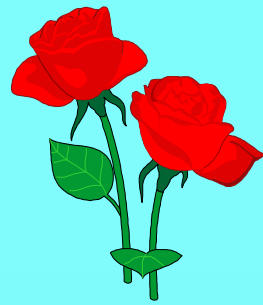
**Jacques Repussard**

**Alexander Schegerer**

**Monika Hierath**

**Jonathan Clark**

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on Clinical DRLs



*Thank you !*

