ESTeSC COIMBRA HEALTH SCHOOL

Infoday – IAEA + EURATOM

MEDIRAD

HORIZON 2020 RIA, WP2016-17

Joana Santos, PhD.

joanasantos@estescoimbra.pt

Gabinete de Promoção do Programa Quadro ID&I

FCT Fundação para a Ciência e a Tecnologia

ANI AGÊNCIA NACIONAL DE INOVAÇÃO

HORIZONTE 2020

IAEA 60 Years Atoms for Peace and Development

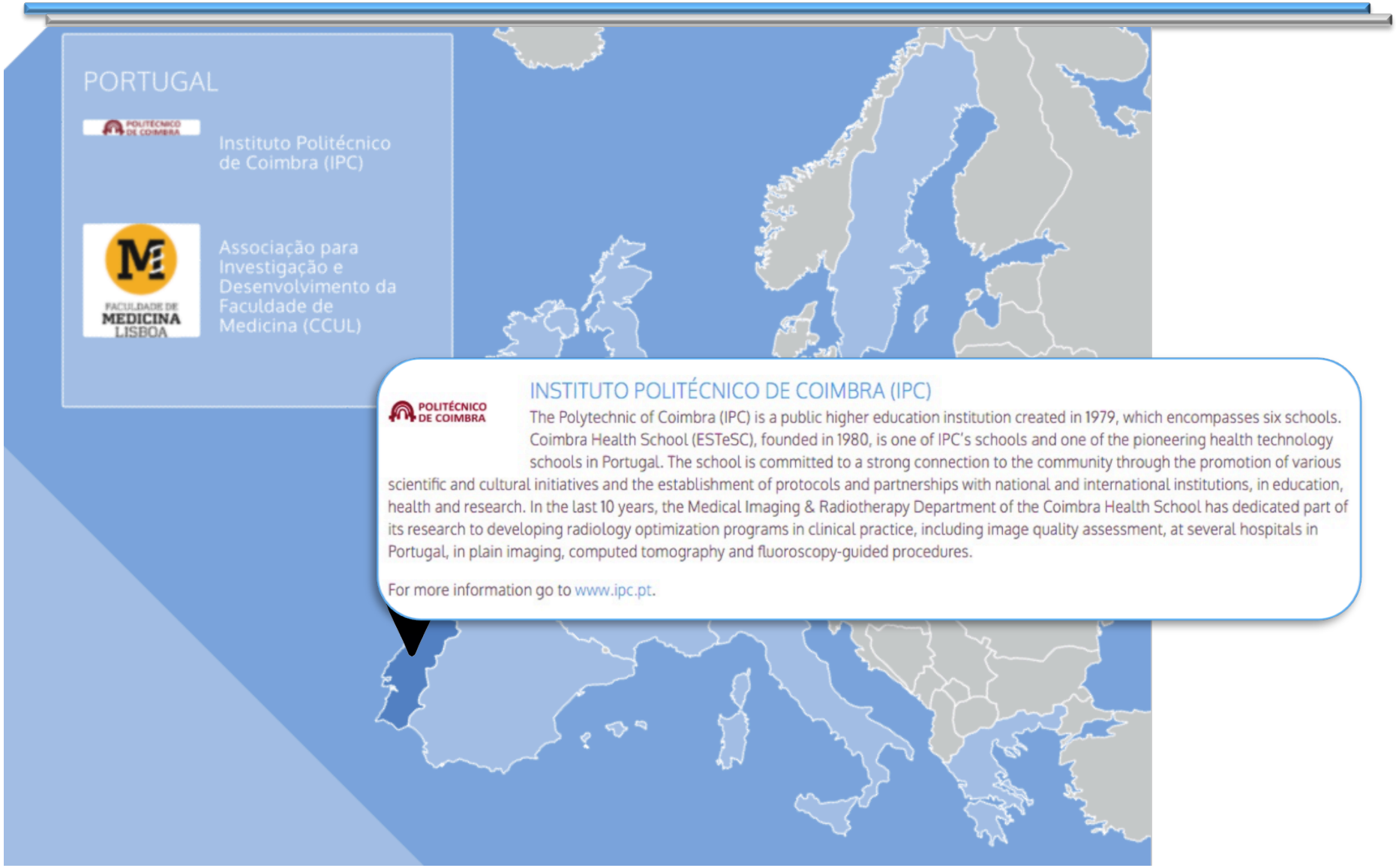
MEDIRAD

- Aims to enhance the scientific bases and clinical practice of Radiation Protection in the medical field;
- Better understand and evaluate the health effects of low-dose ionising radiation exposure from diagnostic and therapeutic imaging and from off-target effects in radiotherapy.

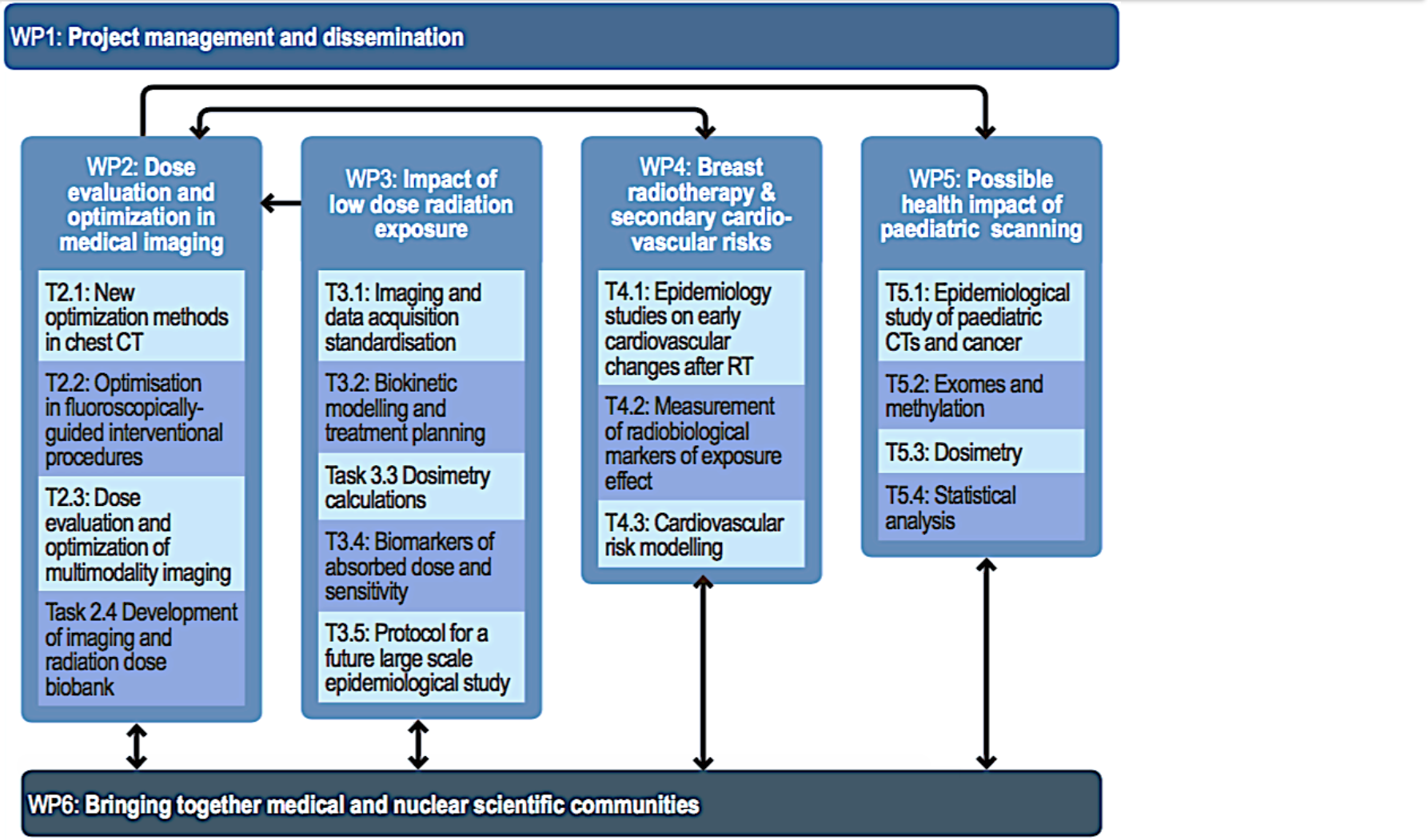
Implications of Medical Low Dose Radiation Exposure

'FOR A BETTER UNDERSTANDING OF LOW DOSE RADIATION RISKS'

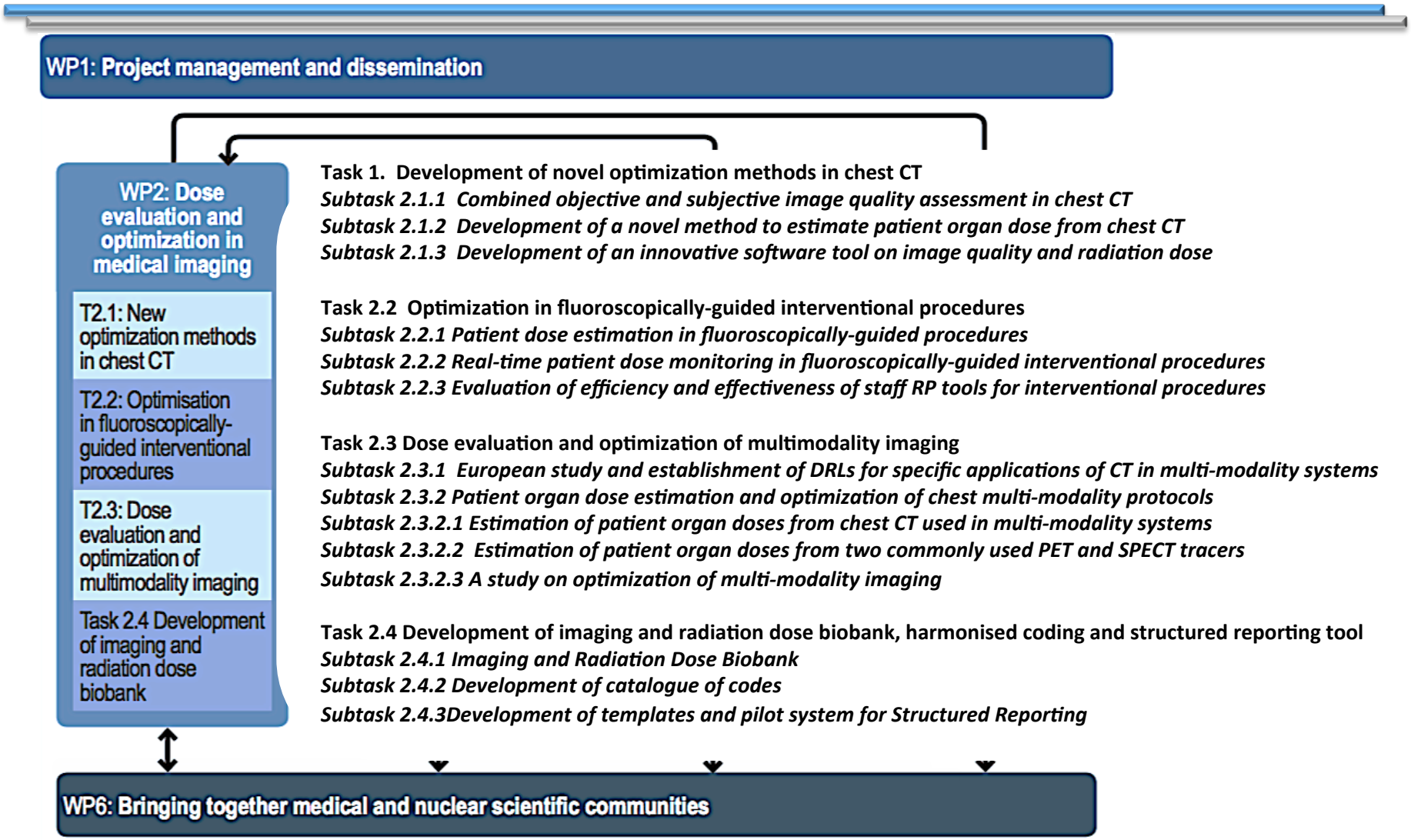
Partners


PORTUGAL
POLITÉCNICO DE COIMBRA
Instituto Politécnico de Coimbra (IPC)
FACULDADE DE MEDICINA LISBOA
Associação para Investigação e Desenvolvimento da Faculdade de Medicina (CCUL)
INSTITUTO POLITÉCNICO DE COIMBRA (IPC)
The Polytechnic of Coimbra (IPC) is a public higher education institution created in 1979, which encompasses six schools. Coimbra Health School (ESTeSC), founded in 1980, is one of IPC's schools and one of the pioneering health technology schools in Portugal. The school is committed to a strong connection to the community through the promotion of various scientific and cultural initiatives and the establishment of protocols and partnerships with national and international institutions, in education, health and research. In the last 10 years, the Medical Imaging & Radiotherapy Department of the Coimbra Health School has dedicated part of its research to developing radiology optimization programs in clinical practice, including image quality assessment, at several hospitals in Portugal, in plain imaging, computed tomography and fluoroscopy-guided procedures.
For more information go to www.ipc.pt.

MEDIRAD work plan



MEDIRAD work plan



MEDIRAD work plan

WP1: Project management and dissemination

WP2: Dose evaluation and optimization in medical imaging

- T2.1: New optimization methods in chest CT
- T2.2: Optimisation in fluoroscopically-guided interventional procedures
- T2.3: Dose evaluation and optimization of multimodality imaging
- Task 2.4 Development of imaging and radiation dose biobank

WP3: Impact of low dose radiation exposure

- T3.1: Imaging and data acquisition standardisation
- T3.2: Biokinetic modelling and treatment planning
- Task 3.3 Dosimetry calculations
- T3.4: Biomarkers of absorbed dose and sensitivity
- T3.5: Protocol for a future large scale epidemiological study

WP4: Breast radiotherapy & secondary cardio-vascular risks

- T4.1: Epidemiology studies on early cardiovascular changes after RT
- T4.2: Measurement of radiobiological markers of exposure effect
- T4.3: Cardiovascular risk modelling

WP5: Possible health impact of paediatric scanning

- T5.1: Epidemiological study of paediatric CTs and cancer
- T5.2: Exomes and methylation
- T5.3: Dosimetry
- T5.4: Statistical analysis

WP6: Bringing together medical and nuclear scientific communities

Partners to task WP2

Experience with simulation, dosimetry especially in the medical context, image quality descriptors and general RP	OvGU is involved in Task 2.1, with expertise in clinical chest CT investigations and high quality equipment standards but also in terms of medical technology staff and measurements and simulation of image quality parameters.
Expertise in developing radiology optimisation programs in clinical practice.	IPC main task focuses on building the currently lacking relevant tools for dosimetry optimisation, image quality, image biobanking and dose exposure repositories, in WP2.
Experienced in medical imaging science and thoracic radiology and improving and optimizing image quality of thoracic images	VGR participates in WP2 by adjusting and optimizing ViewDEX for chest CT applications, creation of clinical criteria of image quality for chest CT, providing clinical chest CT cases and performing subjective image quality assessment on patient studies.
Medical physics, with specific expertise in medical dosimetry and RP research and data analysis.	UoC covers innovative CT dosimetry, including: establish cohort of thorax CT examinations, develop 3D dose distributions, estimate organ doses, develop software package (for calculation of organ doses and radiogenic risks) and a CT dose repository pilot.
Expertise in RP research, in particular with the clinical approach of optimisation and justification, as well as biobanks.	UPDescartes as the clinical coordinator of the project, ensures that the research undertaken in the project has a significant clinical impact in term of practice quality enhancement, transferring the main results into practical recommendations to the EC. Partner in WP1, WP2 (clinical aspects of image quality) and WP4 (clinical studies)

Purpose

Task 2.1

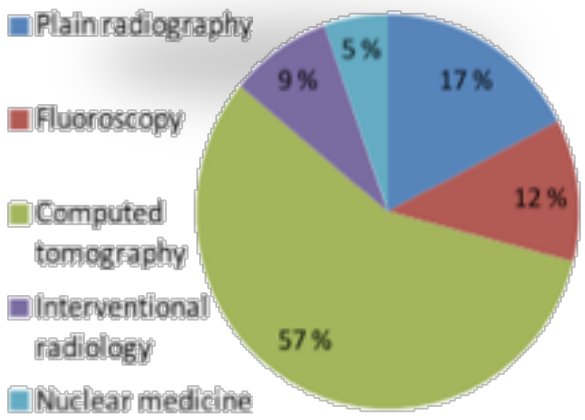
- Development of novel optimisation methods in chest CT

Subtask 2.1.1 Combined objective and subjective image quality assessment in chest CT
Subtask 2.1.2 Development of a novel method to estimate patient organ dose from chest CT
Subtask 2.1.3 Development of an innovative software tool on image quality and radiation dose

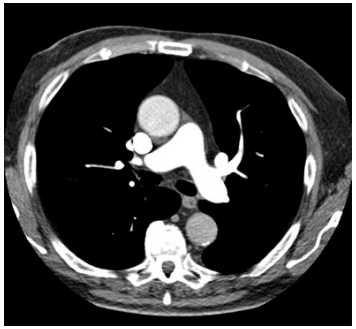
Combined objective and subjective image quality assessment in chest CT

Chest CT

- Chest CT is the 2nd most frequent imaging modality for lung diseases diagnosis;
- HRCT improve interstitial lung disease diagnosis acuity;
- CT can also be use for virtual bronchoscopy, angio-CT and in guiding procedures;

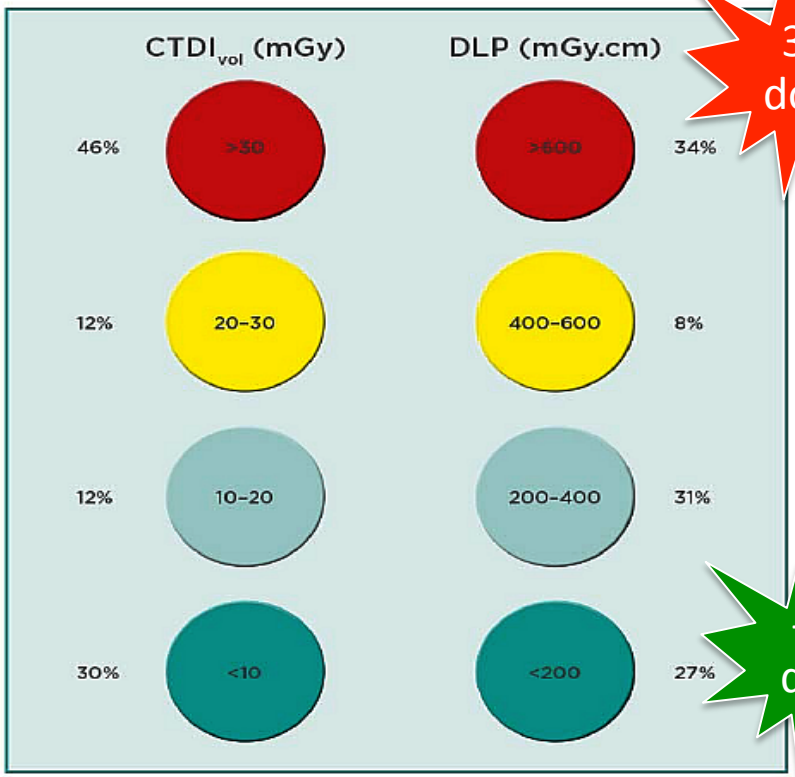


CT dose values



Body Region	CTDIvol (mGy) DLP (mGy.cm) EU DLP 1999 CTDI 2004	NCRP 2012	EU RP 180 2014	UK 2014
Chest	10 650	21 -	**10** **500**	12 610

Chest CT - Pulmonary embolism



EUR CT 1999, 2004
RP 180, 2014

PHE UK survey, 2014

EuroSafe Imaging 2016 / ESI-0034 - DRL's based on clinical indications

Adequate dose values

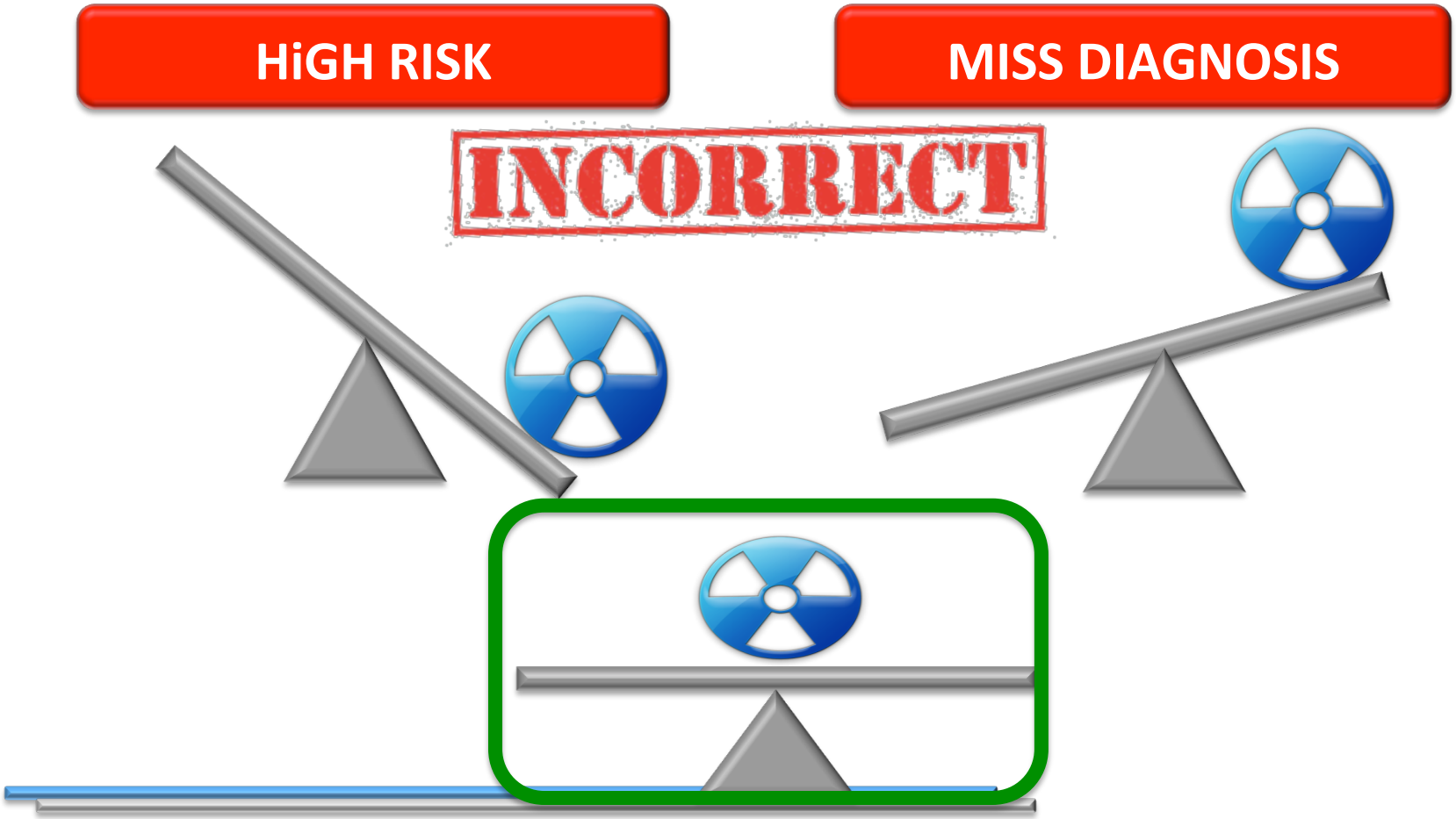
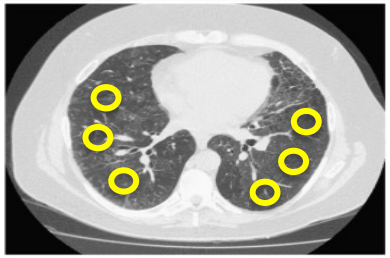
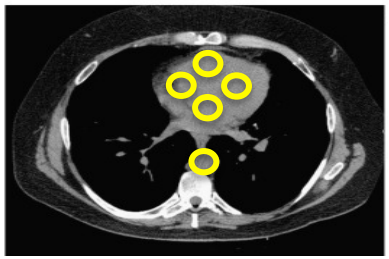


Image quality





- Noise
- CNR
- SNR
- Spatial Resolution
- Low Contrast
- Uniformity
- Artefact Index
- Geometric
- Accuracy

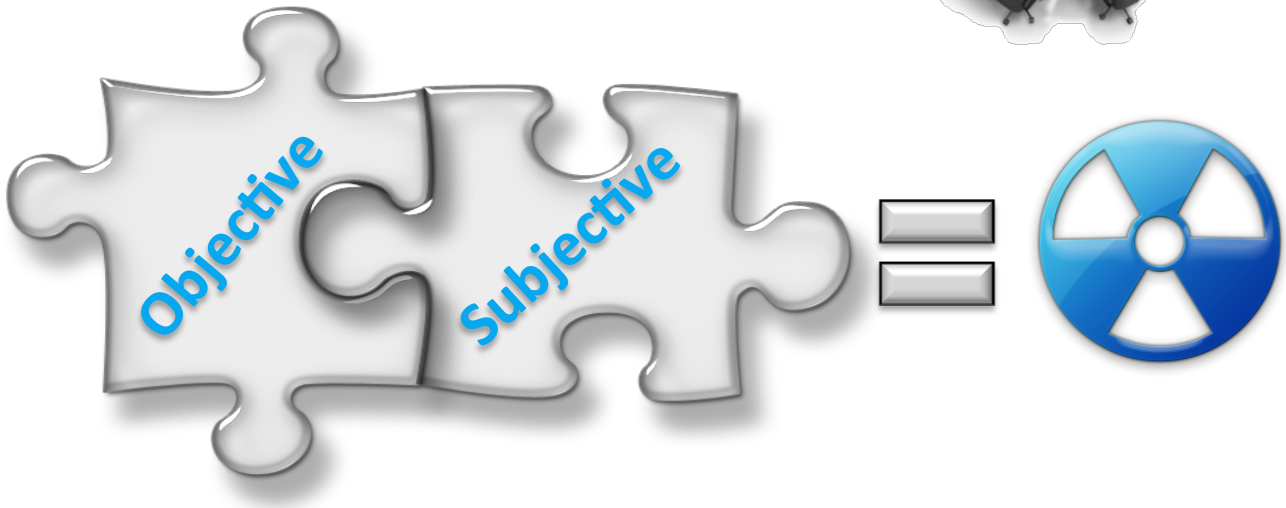
General assessment:
Acceptable noise .....
Acceptable spatial resolution
Diagnostic acceptability .....

Image quality criteria
Visualization of 1. Entire field of lung parenchyma
Critical reproduction 1. Visually sharp reproduction of the lung parenchyma
2. Visually sharp reproduction of pulmonary fissures
3. Visually sharp reproduction of secondary pulmonary lobular structures such as interlobular arteries
4. Visually sharp reproduction of large and medium sized pulmonary vessels
5. Visually sharp reproduction of small pulmonary vessels
6. Visually sharp reproduction of large and medium sized bronchi
7. Visually sharp reproduction of small bronchi
8. Visually sharp reproduction of the pleuromediastinal border
9. Visually sharp reproduction of the border between the pleura and the thoracic wall

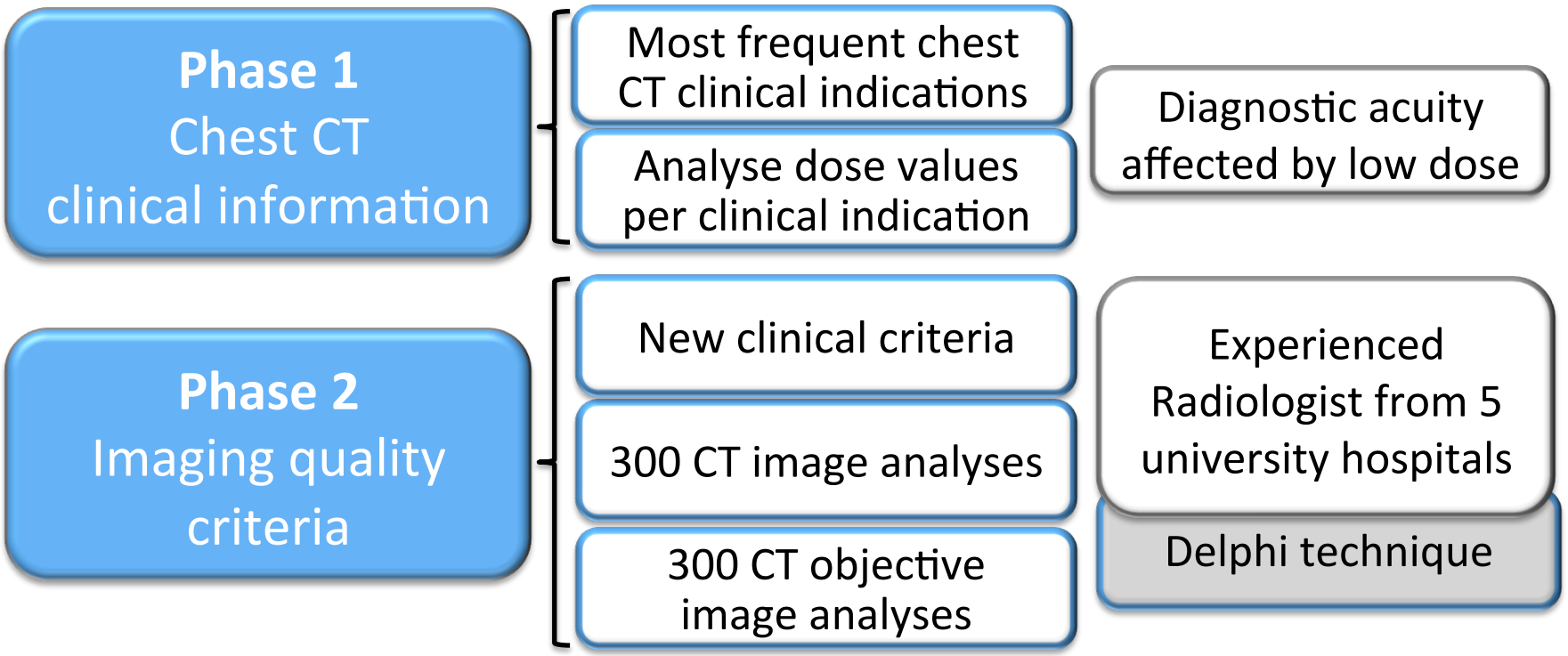
Scale
1. Confident that the criterion is not fulfilled;
2. Somewhat confident that the criterion is not fulfilled;
3. Indecisive whether the criterion is fulfilled or not;
4. Somewhat confident that the criterion is fulfilled;
5. Confident that the criterion is fulfilled.

Actual problems

- Radiologist low interest in objective image analyses;
- Subjective image criteria is time consuming – anatomical;
- Results are not combined;
- No direct relation with CT dose values.



Subtask 2.1.1 - work plan



Method

Phase 3
Image quality levels

- Assess image quality levels
- Combined subjective and objective
- Chest CT protocols for defined indications

Phase 4 - Optimisation

Patient image
Noise, noise structure, contrast and sharpness

Exposure parameters
tube potential, current, modulation, noise suppression, filtering and reconstruction

Dose + Image
Per clinical information

Conclusion

- ✓ **Determine image quality:**
  combining objective and subjective image analysis
- ✓ Maximising **optimisation**
- ✓ Without compromising **diagnosis**.

Radiation saves lives

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WHO Collaborating Centre for Radiation Protection and Health

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GPPQ Gabinete de Promoção do Programa Quadro ID&I | FCT Fundação para a Ciência e a Tecnologia | ANI Agência Nacional de Inovação | Horizonte 2020 | IAEA 60 Years Atoms for Peace and Development