Challenges of Radiological Protection in Research and Society referring to Medical Field, Milan, Italy, 3 Oct 2024

TG 108: Optimisation in digital radiology

Balancing image quality and dose

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ICRP Committee 3 on Protection in Medicine

Nothing to Disclose

ICRP

HUS Diagnostic Center
Helsinki, Finland

Medical physicist background

ICRP Task Group 108

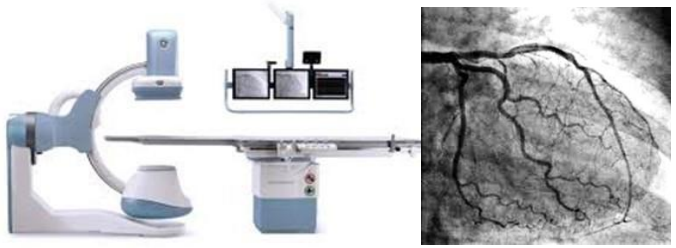
Optimisation of Radiological Protection in Digital Radiography, Fluoroscopy, and CT in Medical Imaging

Part 1 – general aspects (available: ICRP Publication 154)

Part 2 – modality specific aspects

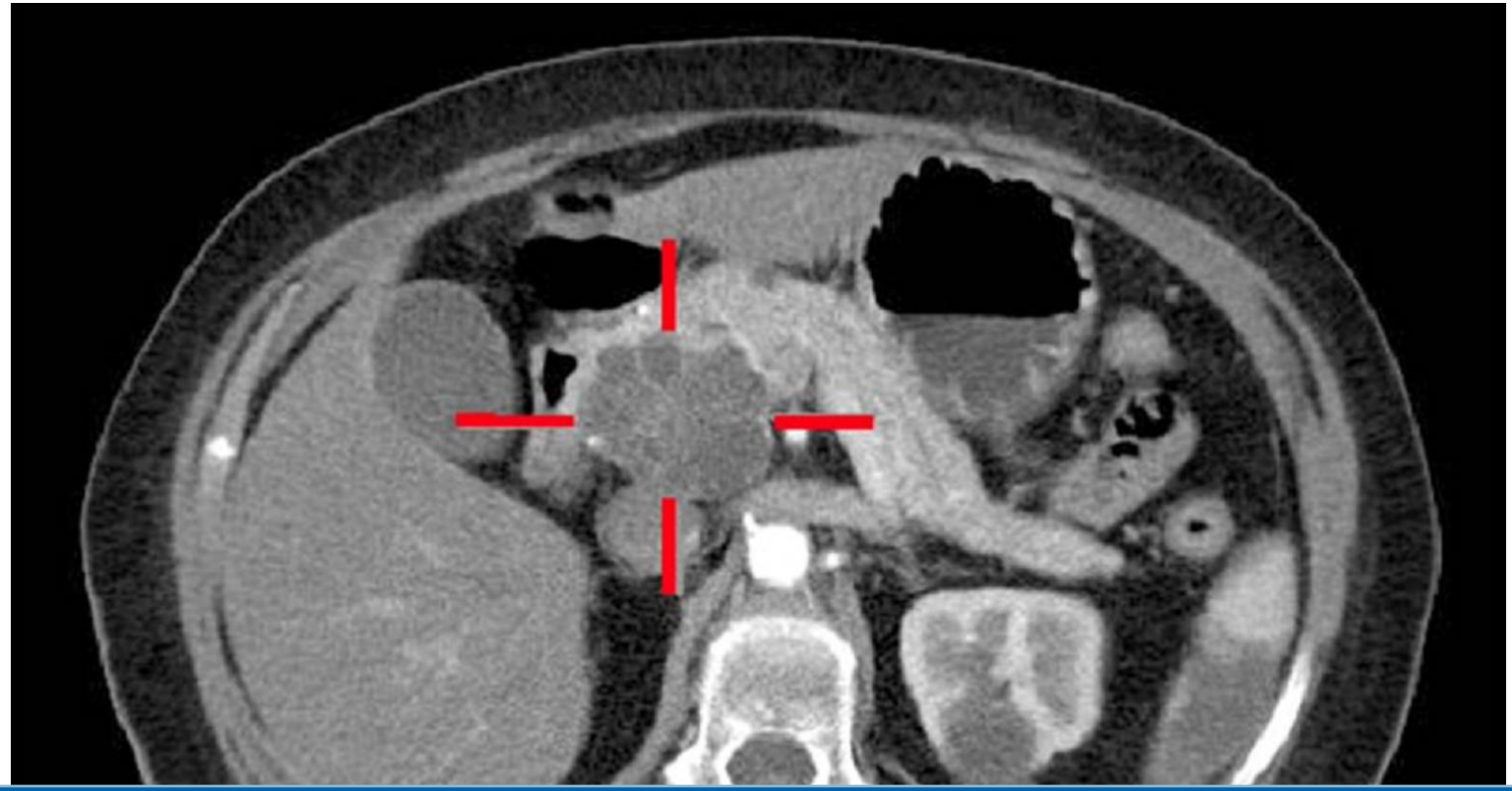
Digital Radiography

Angio/Fluoroscopy



Computed Tomography

Image quality as the main driver of optimisation



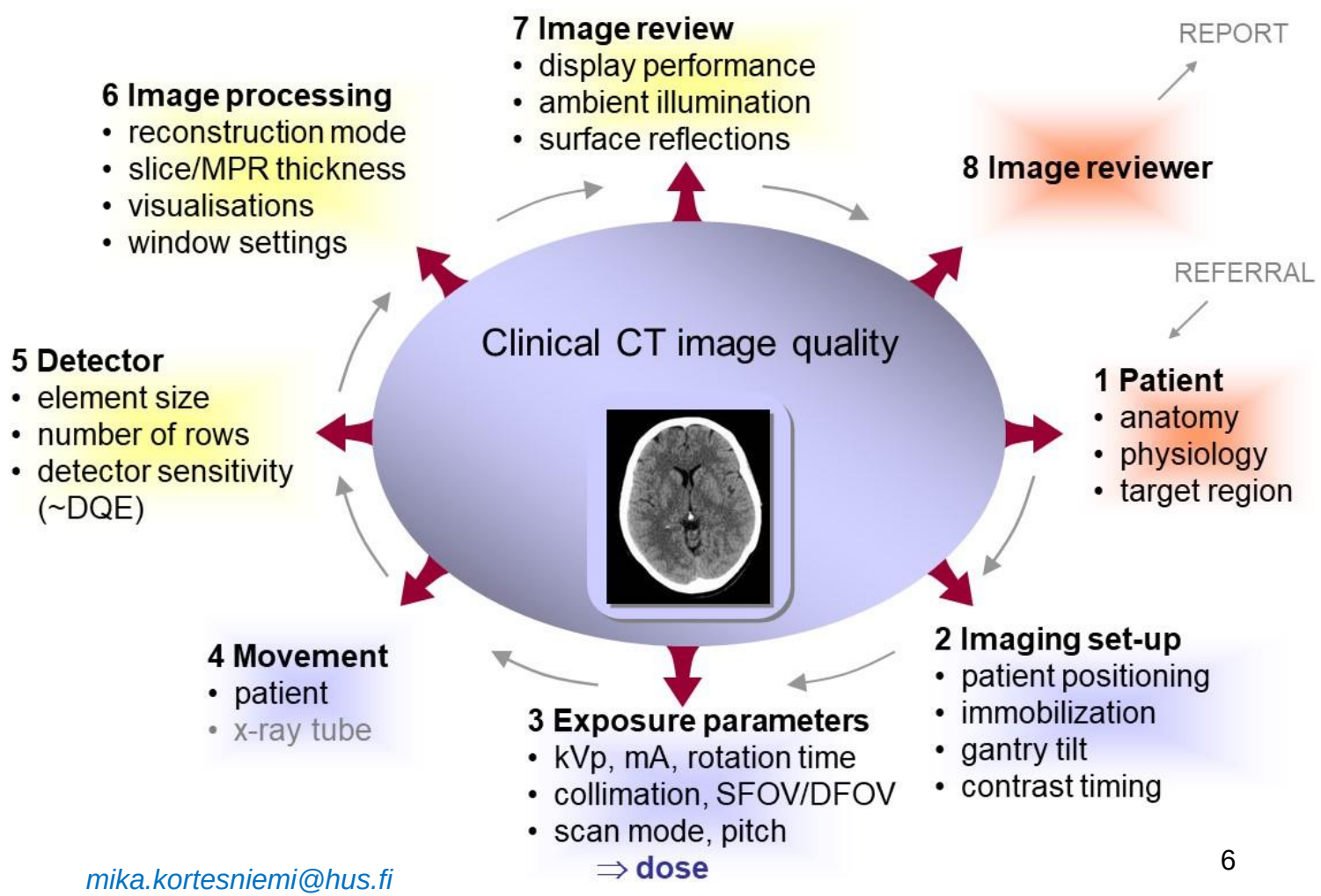
Any general definition of image quality must address the effectiveness with which the image can be used **for its intended task**.

ICRU 54

The whole imaging chain must be evaluated

Factors affecting dose and image quality in digital imaging

The clinical value of images is dependent on physical characteristics of the imaging method (~medical physicist), image capture and presentation system (~radiographer) and the interpreter (~radiologist).



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Multiprofessionality in optimisation

Indication ⇒ Clinical image quality

Radiologist

Sensitivity

Specificity

Quality assurance

Exam workflow

OPTI MISA TION

Medical physicist

Imaging parameters
⇒ resolution, contrast, noise, dose

Dosimetry

Patient safety

Radiographer

Imaging equipment & work methods

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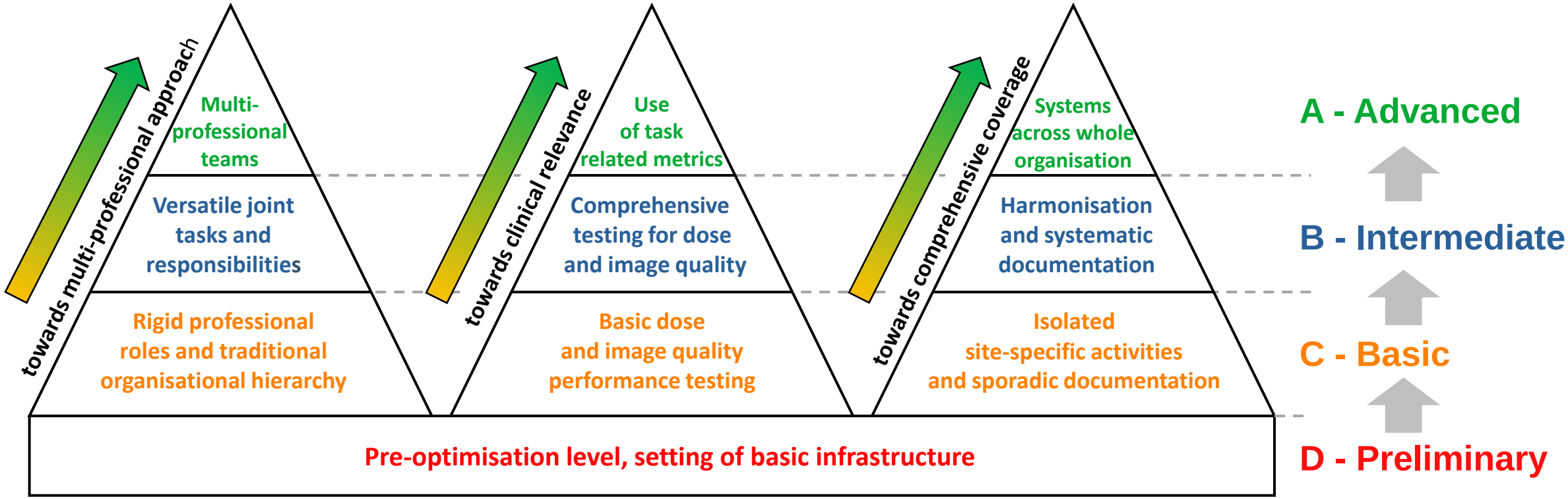
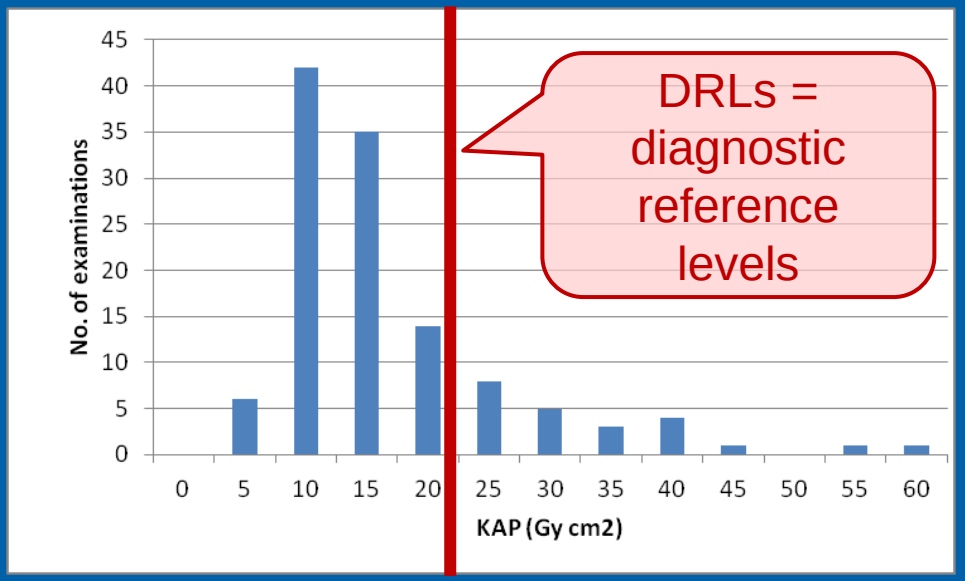
Components and levels required for continuously improving optimisation by ICRP (graded approach)



PROFESSIONALISM **METHODOLOGY** **PROCESSES**

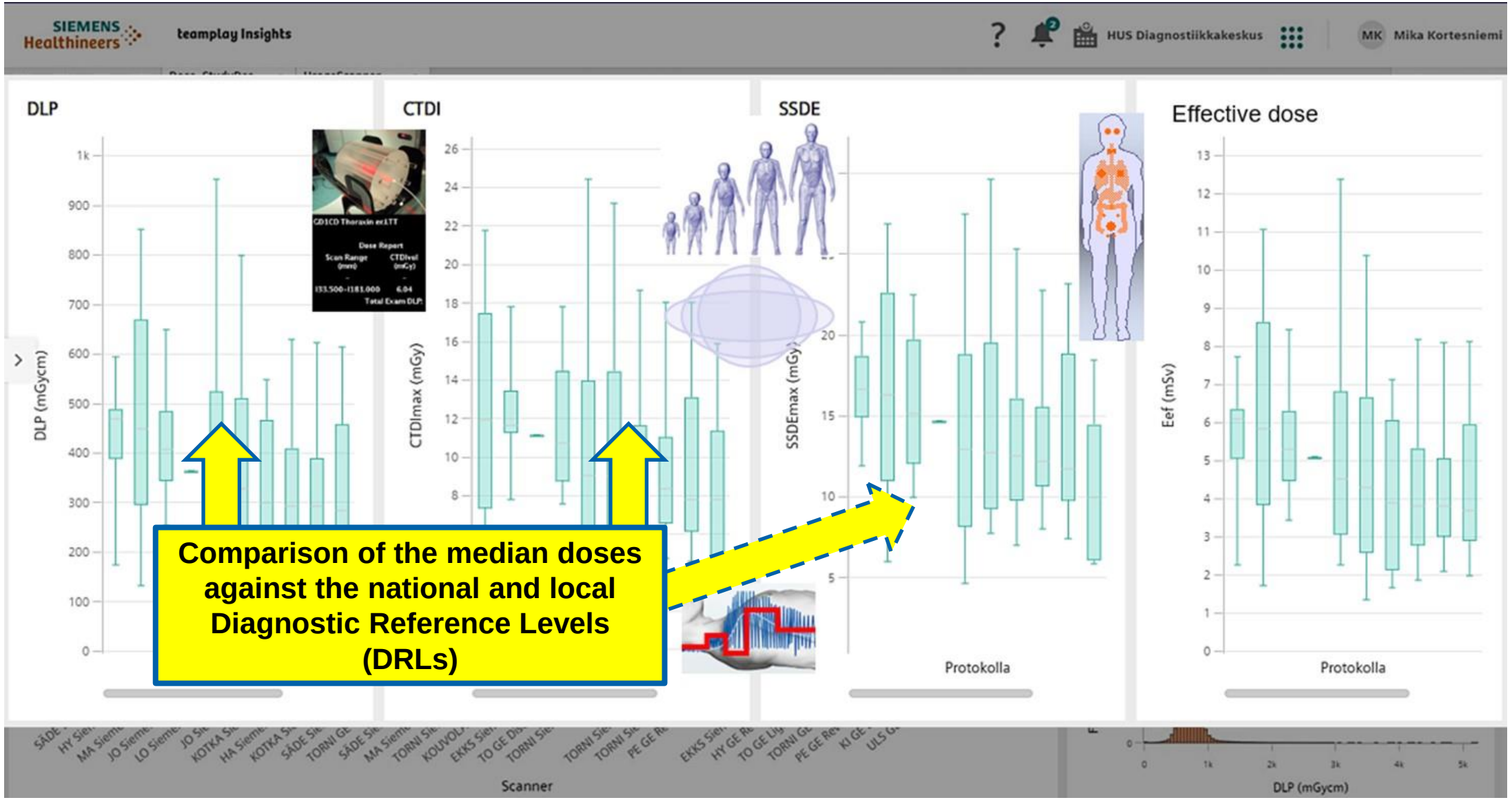
ICRP 154

Patient dose audits



- Knowledge of the radiation doses delivered to patients is the first step in the optimisation process and personnel performing the exams should be involved in the process of **dose audit**.
- Multi-professional team helps to ensure that results of dose surveys are fed back to operators who make appropriate changes to imaging parameters.
- The radiation doses used to produce the images should have been adjusted to the minimum level required to provide an **adequate image quality.**

CT dose parameter views in patient dose monitoring system



CT dose estimate for fetus in late pregnancy (pulmonary embolism scan)

Scan Parameters	
Protocol	Chest
CT Scanner	Siemens Definition Edge
kVp	100
Collimation	38.4 mm
Bowtie filter	body
mAs	200
nCTDIw	3.86 mGy
Pitch	1
TCM applied	Yes
CTDIvol	**7.72 mGy**

Organ Dose	
Organ/Tissue Name	**Dose (mGy)**
Adrenals	4.96
Bladder	0.06
Bone Surface	5.43
Brain	0.15
Breast	11.93
Colon	0.63
Extrathoracic Region	3.96
Fetal brain	0.09
Fetal skeleton	0.92
Fetal soft tissue	0.34
Fetus total	0.31
Gonads	0.14
Heart	8.22
Kidneys	1.59
Lens of the eye	0.33
Liver	8.77
Lung	8.29
Oesophagus	4.28
Pancreas	1.65
Skin	2.25
Small intestine	1.44
Spleen	7.13
Stomach	6.88
Thymus	7.32
Thyroid	1.51
Uterus/Cervix (female) or Prostate (male)	1.17

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Gradual unification of core RP components by data-driven methods and processes

PATIENT SPECIFIC PARAMETERS WITH CLINICAL FOCUS

AUTOMATED REFERRAL GUIDELINES (CLINICAL DECISION SUPPORT)

WIDE SCALE ON-LINE DATA ACCESS & MONITORING

HARMONIZED IMAGING PARAMETERS & PROTOCOL RULES

Evolved QA methods enable more effective patient-specific optimisation with clinical relevance

Automated referral guidance and procolling connect optimisation and justification more closely together

Clinical Decision Support (CDS) example: ESR iGuide (with >1600 indications)

ESR iGUIDE
EUROPEAN SOCIETY OF RADIOLOGY

Logged in as esrmembers

51 year old Female Edit

Service: Not Selected Edit

Indication(s): Non-acute chest pain Edit

Appropriateness rankings for a 51 year old Female

Appropriateness	Service	Cost	RRL	Display Evidence...
8	CT, angiography, heart, coronary arteries	€€€	☢☢☢☢	Select this service
8	CT, angiography, heart, coronary arteries	€€€	☢☢☢☢	Select this service
8	MR, function, heart, wo/w iv contrast, str	€€€€		Select this service
8	NUC, myocardial perfusion, heart, SPEC	€€€	☢☢☢☢☢☢	Select this service
8	US, echo, heart, transthoracic stress	€€		Select this service
7	INV, angiography, heart, coronary	€	☢☢☢☢	Select this service
7	MR, function, heart, wo iv contra	€€€€		Select this service
7	PET, myocardial perfusion, heart	€€€	☢☢☢☢	Select this service
7	US, echo, heart, transthoracic re	€€		Select this service
7	XRAY, chest	€	☢	Select this service

- Right exam
- To the right patient
- At the right time

From referrals (CDS) to automated protocoling

AJR Am J Roentgenol. 2024 Jan 17. doi: 10.2214/AJR.23.29806. Online ahead of print.

Implementation of an Institution-Wide Rules-Based Automated CT Protocoling System

Ryan Chung [1], John P Demers [2], Roberta Tiberio [2], Cristy A Savage [3], Frederick McNulty [3], Markus Stout [2], Avinash Kambadakone [1], Matthew D Gilman [1], Amita Sharma [4], Tarik K Alkasab [5]

Affiliations + expand

PMID: 38230904 DOI: 10.2214/AJR.23.29806

FULL TEXT LINKS

Full Text Am J Roentgenol

ACTIONS

Cite

Collections

Abstract

Background:
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system on ex
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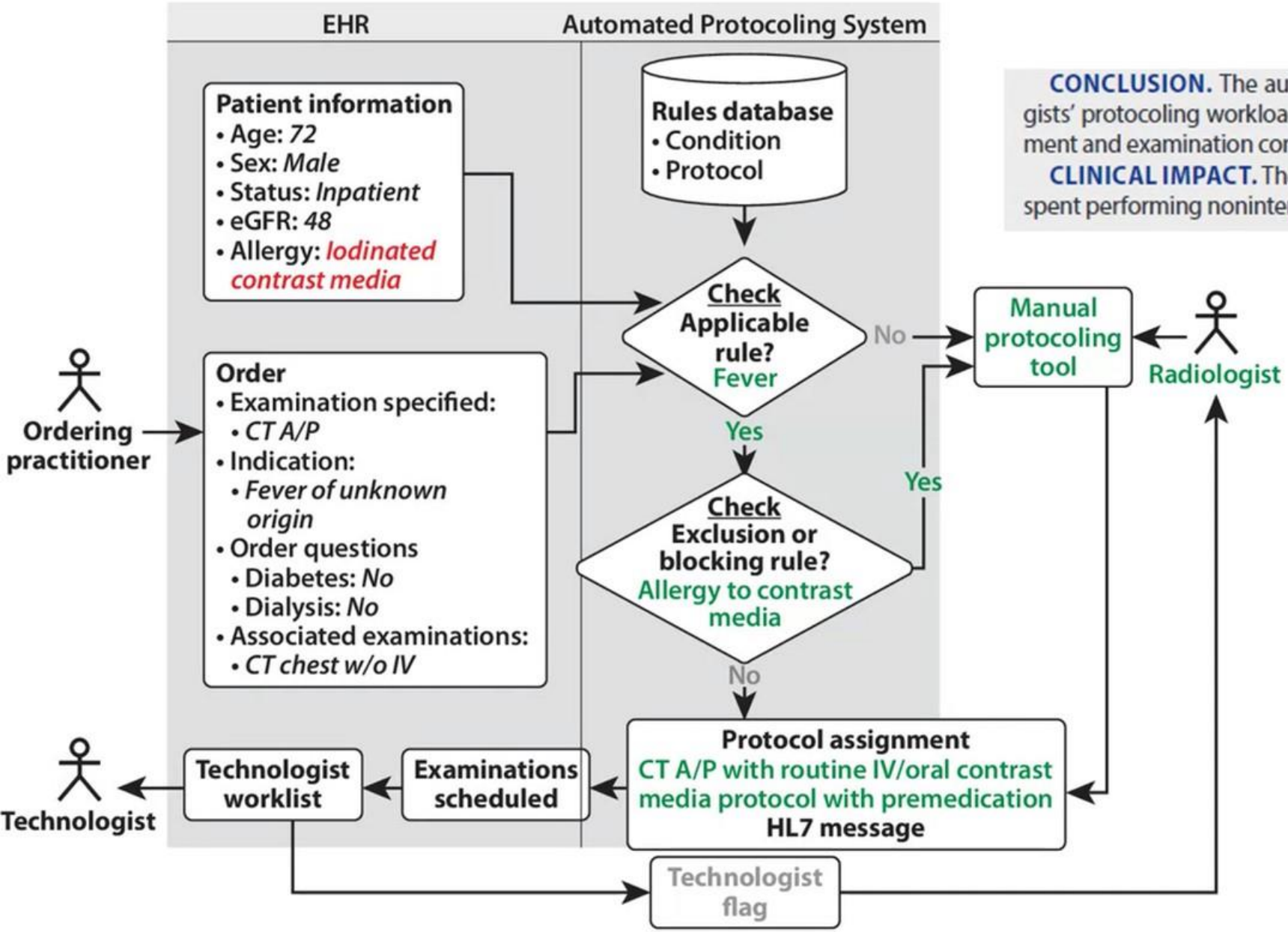
Comparison of manual and automatic exam protocoling for CT imaging by place of service

Mean times from order entry to protocol assignment (in hours)	Manually protocoled exams	Automatically protocoled exams
Emergency department exams	2.1	0.2
Inpatient exams	3.5	0.5
Outpatient exams	1,289 (about 53 days)	361.7 (about 15 days)

Chung et al 2024

From referrals (CDS) to automated protocoling



CONCLUSION. The automated protocoling system substantially reduced radiologists' protocoling workload and decreased times from order entry to protocol assignment and examination completion; protocol errors and recalls were infrequent.

CLINICAL IMPACT. The system represents a solution for reducing radiologists' time spent performing noninterpretive tasks and improving care efficiency.

Scan Parameters	
Protocol	Chest
CT Scanner	Siemens Definition Edge
kVp	100
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Bowtie filter	body
mAs	200
nCTDIw	3.86 mGy
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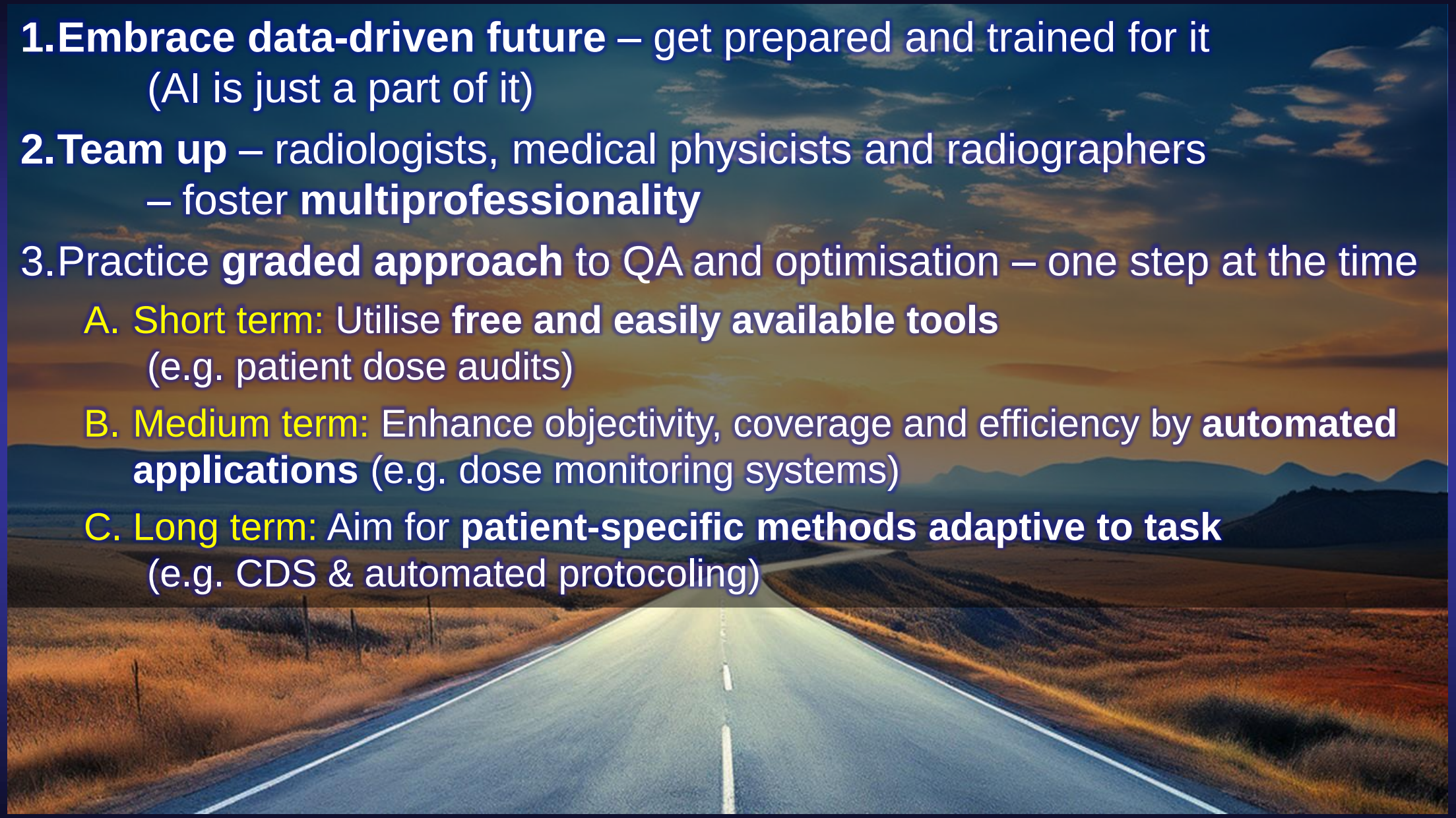

1. **Embrace data-driven future** – get prepared and trained for it
   (AI is just a part of it)
2. **Team up** – radiologists, medical physicists and radiographers
   – foster **multiprofessionality**
3. Practice **graded approach** to QA and optimisation – one step at the time
   A. Short term: Utilise **free and easily available tools**
      (e.g. patient dose audits)
   B. Medium term: Enhance objectivity, coverage and efficiency by **automated applications** (e.g. dose monitoring systems)
   C. Long term: Aim for **patient-specific methods adaptive to task**
      (e.g. CDS & automated protocoling)

Components and levels required for continuously

Now Available!

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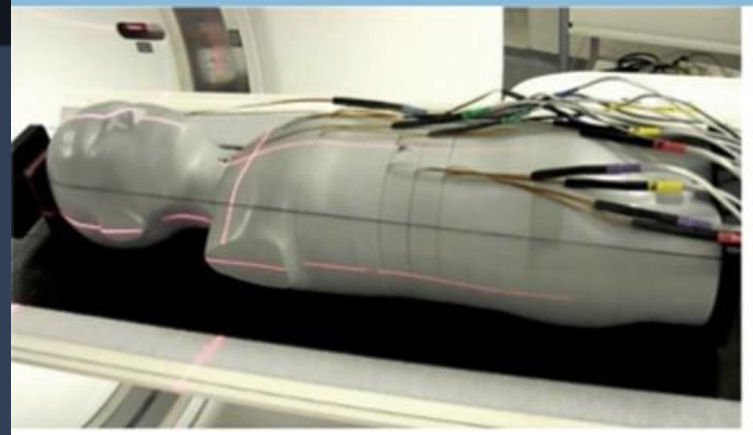
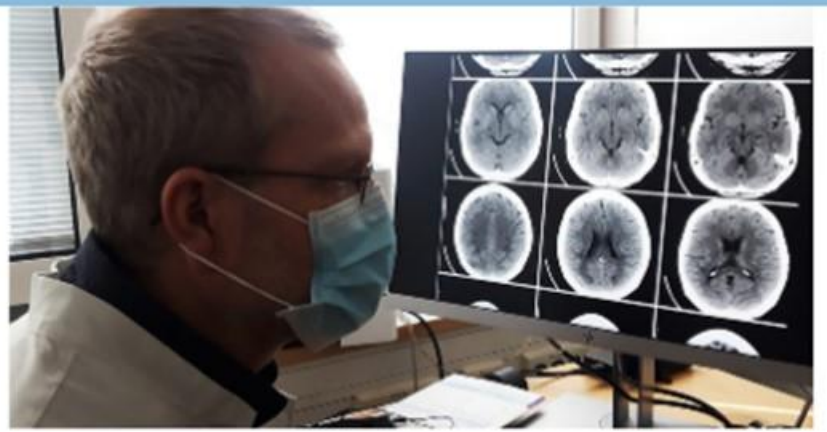
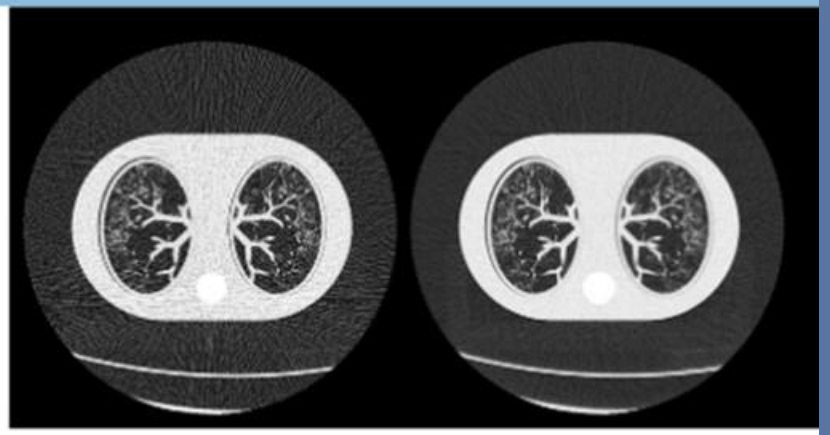
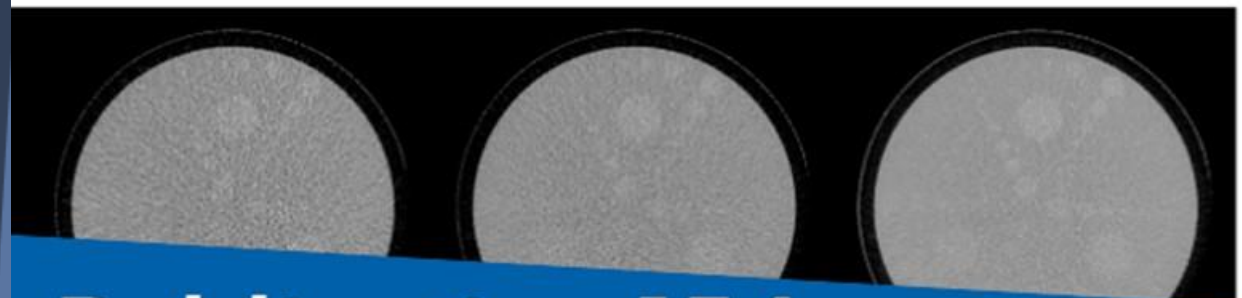

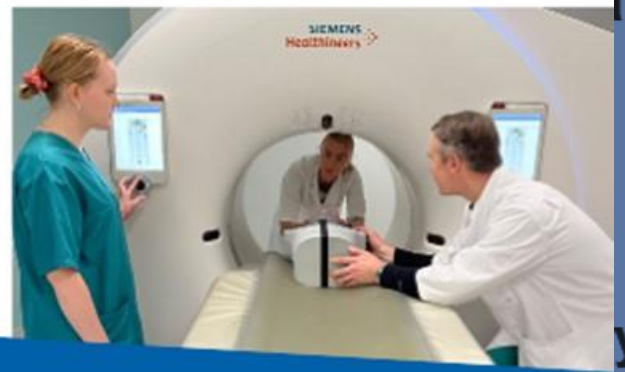

Publication 154

Optimisation of Radiological Protection in Digital Radiology Techniques for Medical Imaging

I acknowledge contributions from the other members of

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Thank you for your attention

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