Activities of the EuroSafe Imaging Appropriate Image Quality Subgroup

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Background/introduction

In clinical routine, different imaging tasks require different levels of image quality - depending on indication, image data of the highest quality achievable are not always essential for confident diagnosis. Instead, the level of image quality needed should be based on the indication as well as on the individual patient characteristics [5]. For imaging modalities relying on the use of ionizing radiation such as computed tomography (CT), correct selection of the image quality "appropriate" for each specific diagnostic task will thus result in an optimum use of radiation and in a reduction of exposure to ionizing radiation for most patients [5].

Determining the image quality "appropriate" for a certain diagnostic purpose, however, is a complex task, as both quantitative metrics (e.g. noise, spatial resolution, etc. [6, 7, 8]) and qualitative observer perceptions (fine structure discernibility and low-contrast detail detectability) are involved and need to linked to each other [5, 9].

As part of the EuroSafe Imaging campaign, which is the flagship radiation protection initiative of the ESR launched in 2014, its Appropriate Image Quality subgroup is aiming at the development of definitions of indication-specific "appropriate image quality" by a panel of experts for those CT examinations deemed to be clinically most relevant ("relevant exams"). To this end, the group is working toward the identification and standardization of suitable criteria (arising from clinicians’ requirements by subspecialty) for judging the "appropriateness" of image quality for specific clinical CT imaging tasks in view of diagnostic confidence.

In the long term, it is envisaged that such standardized indication-specific image quality appropriateness criteria may be linked to measurable quantitative image quality metrics [6, 7, 8], aiming at an automated grading or rating of completed CT examinations with regard to the appropriateness of IQ achieved in view of diagnostic confidence.
Description of activity and work performed

Goals:

- Identification and standardization of sets of indication-specific clinical criteria for judging the "appropriateness" of image quality for certain CT imaging tasks
- Establish guidelines of up-to-date clinical image quality criteria specific to the most relevant clinical indications for CT examinations

Idea/approach proposed & currently discussed (ongoing):

1. Compilation of a list of already existing guidelines for quality assurance in radiodiagnostics with special focus on CT, e.g.
   - "European guidelines on quality criteria for computed tomography" [2]
   - "Guidelines of the German Medical Association for quality assurance in computed tomography" [3]
   - "Guidelines of the German Medical Association for quality assurance in radiodiagnostics - quality criteria of radiodiagnostic examinations" [4]
   - etc.

2. Systematic analysis of these guidelines for listed clinical criteria of image quality, e.g. in terms of
   - Characteristic image features (anatomical structures and attenuation differences typical for a specific organ and its tissues)
   - Important image details (fine detail structures and attenuation patterns whose detectability is important for diagnostic assessment)
   - Critical image features/structures (image structures and subtle differences in attenuation imperative for the detection of discrete pathological change)

   While some clinical criteria of image quality are listed, most existing guidelines are subject to the following limitations:
   # having been compiled one or two decades ago, they are outdated
   # inasmuch as state-of-the art CT imaging technology and techniques are not accounted for
   - clinical criteria of image quality are given per body region / target anatomy instead of an indication-specific compilation

3. Consolidation of the existing clinical image quality criteria comprehensively compiled per body region / target anatomy
4. Update of the consolidated clinical image quality criteria accounting for state-of-the art CT imaging technology and techniques
5. Assignment of sets of up-to-date clinical image quality criteria to specific indications
Activities at the European Congress of Radiology - ECR 2018:

- Poster entitled "Activities of the EuroSafe Imaging Appropriate Image Quality Subgroup" as part of the EuroSafe Imaging poster exhibition
- EuroSafe Imaging Session 2 entitled "Strategies for dose reduction in computed tomography: from technical concepts to clinical practice" on Thursday, March 1\textsuperscript{st}, 10:30-12:00 (Room X)
Conclusion and recommendations

Conclusion:

The level of image quality that is deemed "appropriate" for answering a particular clinical question with high diagnostic accuracy and confidence is specific for each clinical indication. For imaging modalities relying on the use of ionizing radiation, e.g. CT, achieving "appropriate image quality" for a particular examination implies having minimized associated radiation exposure.

For judging the "appropriateness" of image quality of radiological exams, standardized sets of indication-specific clinical criteria derived from and driven by clinical practice are needed. However, most currently existing criteria are outdated inasmuch as state-of-the-art CT imaging technology and techniques are not accounted for. In addition, existing criteria are not indication-specific. Establishing guidelines of up-to-date clinical image quality criteria specific to the most relevant clinical indications for CT examinations therefore is an important task that should be pursued, e.g. as an integral part of future research in medical radiation protection in order to maximize optimization of imaging procedures [1].

However, a successful and sustainable approach for establishing standardized sets of indication-specific clinical criteria for judging the "appropriateness" of image quality of CT examinations as the basis for up-to-date guidelines will require a mid- to long-term commitment.

Recommendations:

In order to avoid duplication of efforts, exploit synergies between projects, and ensure swift adoption in clinical practice a coordinated approach for establishing sets of indication-specific clinical criteria for judging the "appropriateness" of image quality in CT seems advisable:

- Exchange with the EC project "EUCLID - European Study on Clinical Diagnostic Reference Levels for X-ray Medical Imaging" aiming at providing up-to-date clinical DRLs for the most important x-ray imaging tasks in Europe, from a radiological perspective

  # Aims: Work on common or similar list of clinical indications / Use of a common terminology
• Exchange and coordination with the efforts to develop a tool for determining image quality to maximize optimization in medical imaging within WP 2 of the Horizon 2020 project "MEDIRAD - Implications of Medical Low Dose Radiation Exposure", and support thereof

# Aims: Avoidance of duplication of efforts & exploitation of synergies / Application tests of the quantitative metrics developed within the MEDIRAD project for assessing sets of indication-specific clinical image quality appropriateness criteria and vice versa

For the efforts of the *Appropriate Image Quality* subgroup outlined in the section "Description of Activity & Work Performed" above to yield short- to mid-term results, allocation of suitable funding seems necessary in view of the amount of work the outlined idea implies.
**Personal/organisational information**

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