

Abstract

Radiology related epidemiological investigations of cancer risk following medical exposure often starts with the collection of data from hospital information systems like Radiology Information Systems (RIS) and Picture Archiving and Communication Systems (PACS). While RIS data is easy to access, the access to PACS data is more challenging. On the other hand, the use of Digital Imaging and Communications in Medicine (DICOM) metadata brings massive benefits, as it contains more complete and comprehensive dosimetry information, especially after the introduction of Radiation Dose Structured Reports (RDSR).

DICOMInspector is a software system that allows an automatic collection of DICOM metadata including image data from PACS. The easy-to-install package includes all needed components: A DICOM server/node that communicates with the PACS, a database for the collected data in the server package and an R for statistical computing-based interactive Graphical User Interface (GUI) that allows the user to easily explore the data.

Methods and Materials

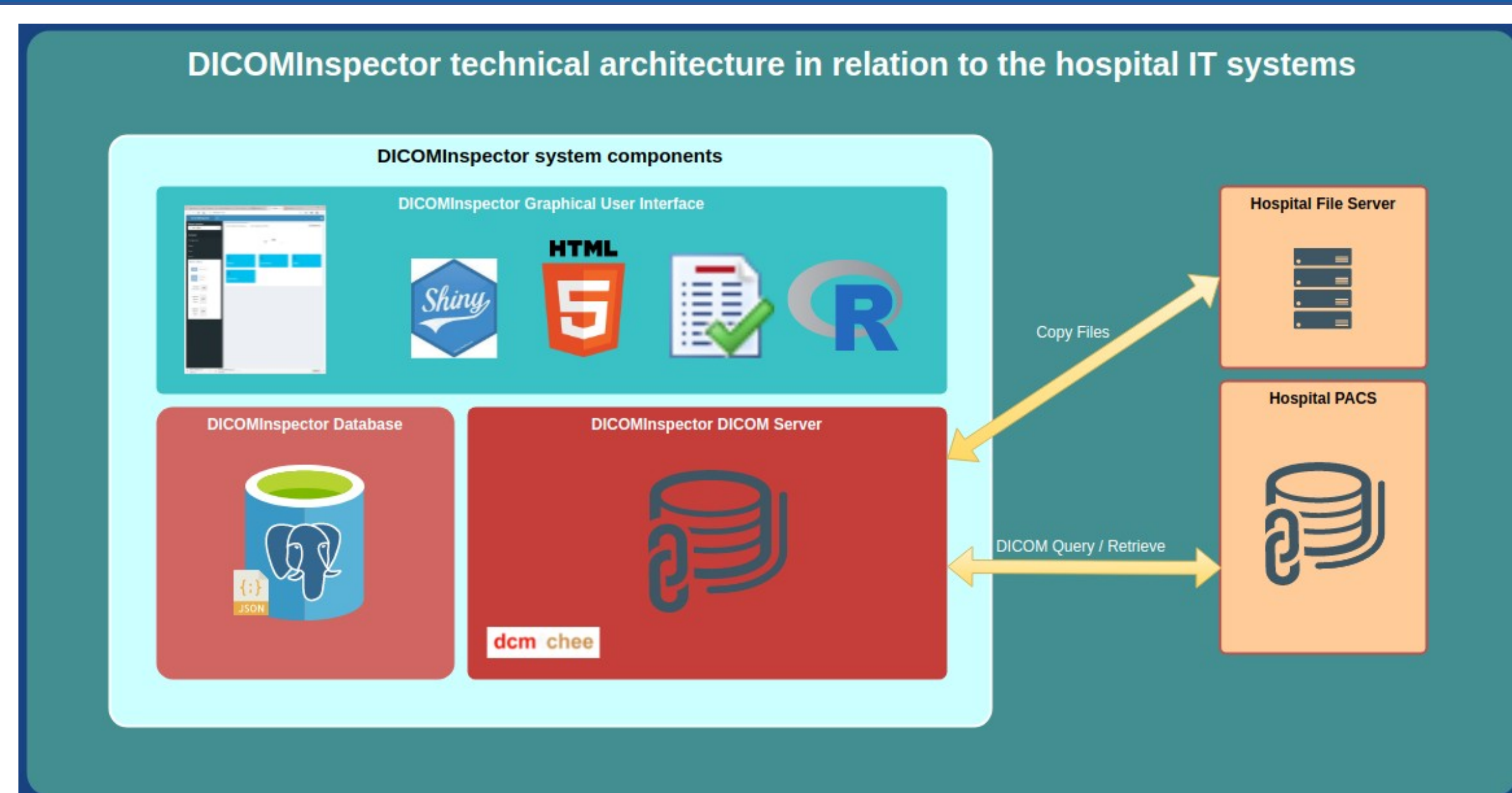


Figure 1. The scalable DICOMInspector system components and how they work together

In order to allow a scalable, flexible and robust system, the framework consists of the following components:

DICOM Server: this component is responsible for the collection of the DICOM files from the hospital PACS (or a file system) and stores the collected metadata in the database. It is based on the DCM4CHEE [1] library and written in Java.

Database: The database mainly stores the collected DICOM metadata, but does as well contain some configuration options. It is based on a PostgreSQL database [2] and implements a relational database schema.

Graphical User Interface: The User interface allows the interaction with the data collection process and is used to configure and control the system. The dynamic reports can be created, displayed and downloaded. It is coded R [3], using the R Shiny framework [4] and reports written in RMarkdown/Quarto [5] for communication/reporting.

The software operates locally: no data is exposed to the Internet or transferred. There are options to analyze patient data for applications where this is needed, but most of the available reports work with anonymous data.

Acknowledgements

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Results

Research questions, that include patient characteristics and other parameters like radiological modality type and period of the study, can be easily configured by the user in the GUI. The software then works in 3 steps.

Step 1: the PACS is automatically queried for the available patient data.

Step 2: the DICOM metadata is collected.

Step 3: The user can extract the the desired data. This is done using reports. The following report types are available:

- CT Technical Parameters:** the most relevant technical parameter related to CT dosimetry are extracted.
- CT Patient Information:** for each patient, CT procedure information, like number and kind of CT examination, scan length and contrast media are extracted.
- Cohort Member Details:** Details about the cohort members are extracted.
- XA Dosimetry Information:** the most relevant technical parameter related to XA dosimetry are extracted.
- NCICT Dose Calculator:** This reports prepares a batch file for NCICT [6]
- NCIRF Dose Calculator:** This report prepares a batch file for NCIRT [7]; (in planning)
- DICOM RDSR Report:** Support for DICOM Radiation Dose Structured Reports is build into DICOMInspector. Different reports are in development.
- Mammography Quality Assurance Report:** looks at different parameters of Mammography systems. (in planning).
- DEMO Report:** default for a new research question. Contains help information.

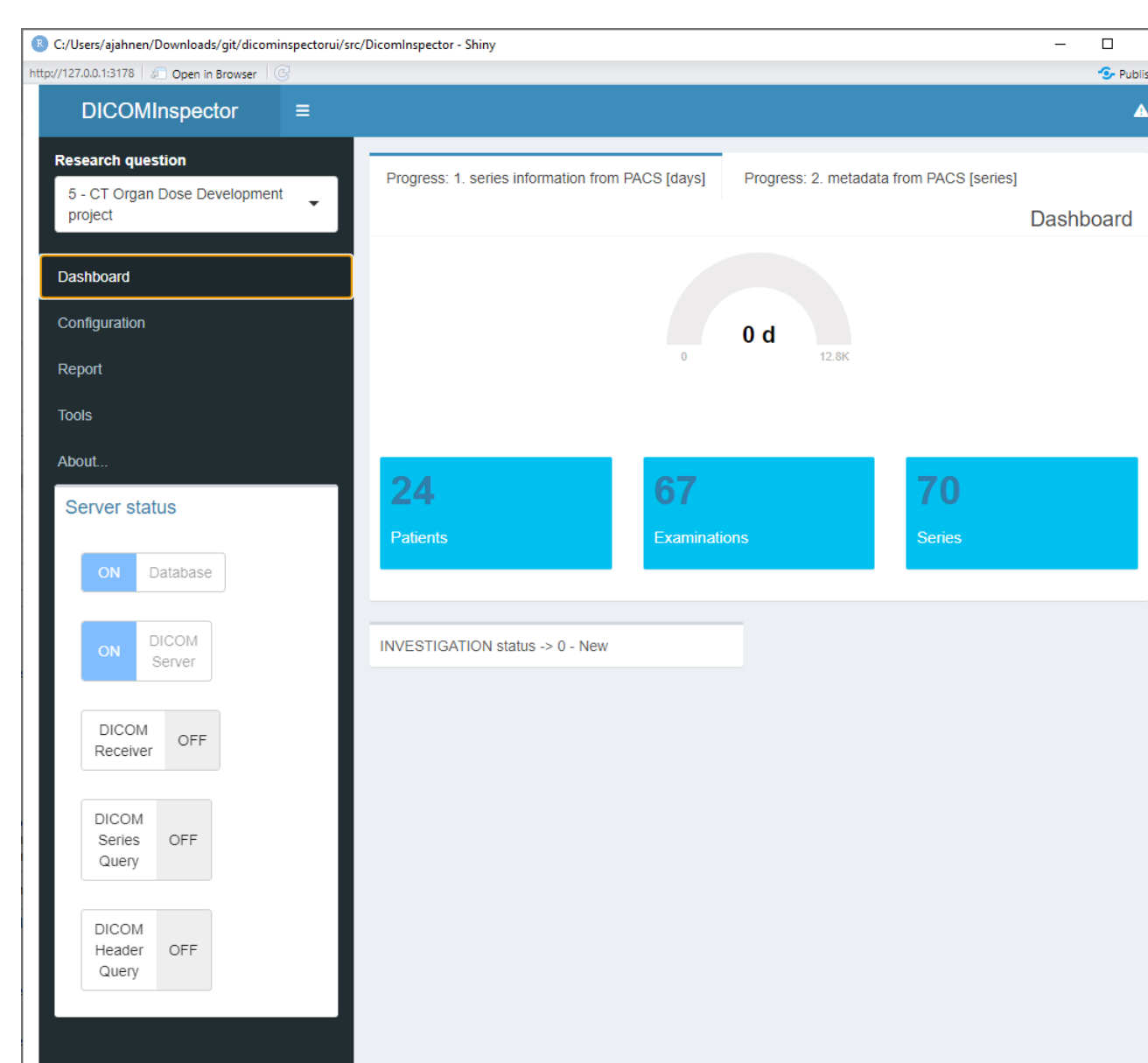


Figure 2. DICOMInspector Dashboard, which gives an overview of the collected data in the selected research question. The menu bar on the left makes it easy to navigate different research questions and other functions of the software.

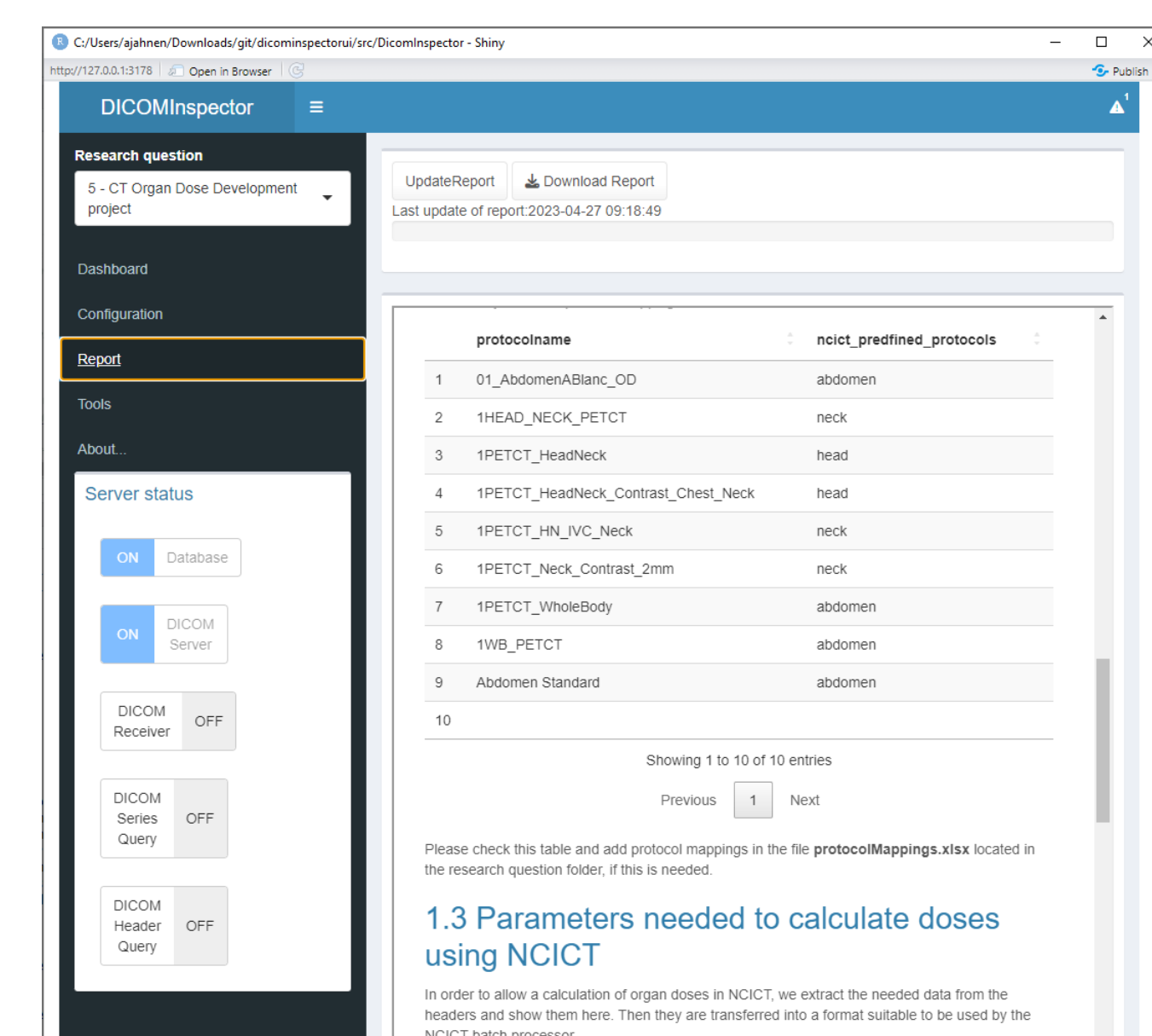


Figure 2. DICOMInspector showing a report, based on the selection criteria for the selected research question, this report is generated dynamically based on the collected data.

The system has applications in epidemiological studies, quality assurance and optimization of procedures. DICOMInspector is successfully used for data collection within the HARMONIC project to extract data for organ dose reconstruction following cardiac catheterization. All reports are open source and can be shared easily between installations.

For other study designs, the software can be used as well. It can work with a patient list or without a PACS connection on a set of images/DICOM data.

Conclusions

The DICOMInspector platform facilitates the secure collection and analysis of DICOM metadata for multipurpose clinical (cohort) studies without the need to introduce complex and expensive Dose Management Systems (DACS) into clinical routine. The software is currently used in the framework of the H2020 HARMONIC project [8] to collect exposure parameters and related data from DICOM for XA and CT modalities.

A software license for research purposes is available on request.

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