CT Dose Information in DICOM data

The DICOM Standard has defined the **Radiation Dose Structured Report** (RDSR) to handle the recording and storage of radiation dose information from imaging modalities. The RDSR has been developed to incorporate most of the information, including CT Dose Index (CTDI) and Dose Length Product (DLP), needed to obtain the radiation output from imaging devices and this information can then be used to estimate the radiation dose.

> *Note: The CT Dose details of an RDSR are described in DICOM PS 3.16-2011 as TID 10011, 10012, 10013 and 10014. The details of the study and patient to which the RDSR applies are referenced in DICOM PS 3.3-2011 in Section A.35.8 and are similar to most other DICOM objects.*

DICOM RDSR is being made available in most new model CT Scanners. Commercial and open source software is available that can store and read RSDR objects and extract relevant information.

IHE REM Profile
The IHE Radiation Exposure Monitoring (REM) Profile specifies architecture and features for collecting and distributing DICOM RDSR data. A variety of released products have implemented the REM Profile and over 35 vendors have successfully demonstrated interoperability at IHE Connectathon testing events. Some reporting systems may be capable of automatically extracting dose values directly from RDSR objects for insertion into radiology reports.

Other sources
Prior to the adoption of RDSR, many CT systems stored an image containing a screen capture of a dose report, listing CTDI and DLP values for each CT series. Although such reports contain much less information than the RDSR, and the values cannot be normally directly processed, the report can be displayed to a human, and there is commercial and open source software which will attempt to do optical character recognition and text parsing to partially populate an RDSR or other database with what values it can extract. Some CT systems provide DLP value as a private attribute within such images, or/and in the MPPS messages.

CT Image
Finally, each CT image header may contain a specific attribute tag for $CTDI_{vol}$ (0018,9345). The Attribute Description is given as "Computed Tomography Dose Index ($CTDI_{vol}$), in mGy according to IEC 60601-2-44, Ed.2.1 (Clause 29.1.103.4), The Volume $CTDI_{vol}$. It describes the average dose for this image for the selected CT conditions of operation." Since DLP represents dose across multiple images, it does not belong in the header of individual images, although it is available in the RDSR for the exam. Estimation of study dose based on CTDI values in image headers is significantly complicated by the presence of multiple reconstructions from a single acquisition, issues like over-ranging, etc. Handling such issues is one reason for the introduction of RDSR.

Notes
It should be noted that $CTDI_{vol}$ and DLP are calculated based on a phantom of a specified size. While these are good metrics to track and manage dose-related technique, it is important to take into consideration the phantom size indicated by the system. Using these scanner output metrics to

estimate actual dose to a specific patient is complex and should be done in cooperation with a medical physicist.

Further information

For information on addressing the informatics, physics, and clinical practice issues around radiation dose, readers are encouraged to investigate seminars and materials provided by professional societies such as the Society of Imaging Informatics in Medicine, the American Association of Physicists in Medicine, and the American College of Radiology.

http://siim.org/search/node/radiation%20dose
http://www.aapm.org/pubs/CTProtocols/
https://nrdr.acr.org/Portal/DIR/Main/AboutDIR/page.aspx