

Digital analysis and reporting systems for diagnostic radiation doses

Information Paper for Radiology and Medical Physics Staff

Purpose

This information paper is for radiology and medical physics staff buying X-ray/CT equipment, a PACS or a dose data analysis system.

Key recommendation 1: Ensure that any new X-ray/CT equipment, PACS or dose analysis system meets interoperability standards so that digital dose data can be collated on a local, regional or national basis in order to assist optimisation.

Key recommendation 2: That the clinical and scientific validity of some of the features on offer are examined before implementation.

Issue

- Newer X-ray and CT modalities can export digital dose data to PACS or a dose analysis system using the DICOM* standard, facilitating the creation of a comprehensive database of radiation dose data. This will provide a valuable resource that can be used in setting diagnostic reference levels and for carrying out dose optimisation.
- Software is available to store and analyse these data and export them to other systems. The Department of Health (DH) (Health Protection) convened a Working Party in order to gather information on the issue and have concluded that the NHS and Independent Healthcare Providers should be informed about interoperability standards and scientific and clinical limitations to be considered by means of this information paper.
- The Working Party also concluded that a wider stakeholder group needs to be convened to explore broader requirements for the future so that dose data can be collected on a larger scale. The working party has established that in terms of interoperability, an integration profile has already been developed by the Integrating the Healthcare Enterprise (IHE)[†] initiative – the Radiation Exposure Monitoring (REM) profile.
- Connecting for Health has recently published an output-based specification for the second wave of PACS, which includes the requirement for PACS to conform to the IHE REM integration profile. This provides the basis for PACS to be able to store the DICOM Radiation Dose Structured Reports
<http://www.connectingforhealth.nhs.uk/systemsandservices/pacs/transformation>
- Some of the products on the market offer dose alerts and dose accumulation features that could be used inappropriately to the detriment of patient care. The working party wish to inform the NHS and Independent Healthcare Providers of the points they need to consider when comparing features.

Technical Information

In order to make the most of these systems, please take the following technical standards into account when procuring any x-ray modalities, PACS systems or dose analysis and reporting systems:

If buying a PACS

Ensure that the PACS conforms to the IHE Radiation Exposure Monitoring (REM) integration profile as an Image Manager/Archive (in addition to acting as an Image Manager/Archive in any other profiles).

If buying an X-ray or CT modality

Ensure that the X-ray or CT modality conforms to the IHE REM integration profile as an Acquisition Modality.

If buying a dose analysis and reporting system

Ensure that the system conforms to the IHE REM integration profile as a Dose Information Consumer *and* a Dose Information Reporter.

Dose analysis and reporting system features

Dose analysis and reporting software can be a powerful tool to be used in the optimisation of X-ray imaging protocols and techniques, both within a department and on a larger scale. Care must be taken when assessing the suitability of certain features on offer.

The following bullet points describe some of these features, and should be discussed in detail with a local Medical Physics Expert before implementing them in clinical practice.

- Some products offer a view of patient dose history specifically for consideration immediately prior to justifying an exam. However, the justification of any exam should be made on the benefits and risks of that exam in isolation of any previous independent dose burden, with the possible exception of the skin dose history in the immediate past.
- The values submitted to the system will be a mixture of dose indicators making comparisons difficult or impossible. These are measured or calculated dose/dose-length product/dose-area product to air or plastic phantoms, or calculated estimates of dose to skin or organs.
- It is inappropriate and meaningless to add dose indicators from different modalities or parts of the body into a single cumulative value.
- Effective dose has been traditionally used to assess total exposure but is endorsed by ICRP[‡] for use in medicine only in limited situations.
- Estimating effective dose to a patient from any particular exam is a complex task that requires knowledge of the characteristics of the specific x-ray unit involved, the x-ray beam quality and the x-ray projections, the size of the patient and knowledge of the organs exposed, alongside the information submitted in the DICOM Dose Object.
- Effective dose is not a good predictor of risk for a specific patient as it relates to population risk and does not include factors such as age and sex.
- Pre or post exam dose alerts based on a threshold dose for a particular exam are of limited use without taking patient size and/or interventional procedure complexity into account. This is because a large value for a large patient does not necessarily imply a large effective dose, whereas a small value for a small patient might.

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* DICOM (Digital Imaging and Communications in Medicine) is a standard used by all the medical imaging modalities to store and transmit image and patient data. The dose analysis and reporting systems make extensive use of DICOM Radiation Dose Structured Reports.

† IHE (Integrating the Healthcare Enterprise) is an initiative to improve interoperability between healthcare systems by creating Integration Profiles that make use of established standards such as DICOM. For any particular workflow or task, systems that implement the corresponding IHE Integration Profile will play the part of one or more 'actors' to fulfil that particular role. The Integration Profile relevant to dose analysis and reporting is the Radiation Exposure Monitoring (REM) Profile, which is described on their website at http://wiki.ihe.net/index.php?title=Radiation_Exposure_Monitoring.

‡ The International Commission on Radiological Protection (ICRP)