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CT Dose Management: A Pan European Strategy

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Computed Tomography (CT) ranks as one of the top five medical developments of the last 40 years, with its inventors being awarded the Nobel Prize in Medicine in 1979 (Radiologyinfo. org 2011). From the first generation of CT scanners in the 1970s to the fourth generation scanners of today, the technological improvements of CT in speed, resolution and patient comfort have been immense. Owing to technological developments and to broader indications, the use of CT has notably increased around the world and its contribution to the collective dose has risen from five percent to 46 percent from 1996 to 2009 (Fazal et al. 2009). The increase in CT use and in the exposure of the population and patients as well as other factors led to the EURATOM 2013/59 Directive (Council Directive 2013) and the need for dose management.
In March 2014, Affidea, a Dutch holding company, which is one of the largest healthcare investors and operators through Private Public Partnerships (PPP) in Europe, launched a CT Dose Excellence Campaign across its network. The main goals of the campaign are to:

- Make dose awareness a habit;
- Educate radiology personnel, patients and referring clinicians;
- Track, record and analyse CT dosimetric data;
- Justify and minimise the number of high-level dose examinations;
- Standardise and optimise CT protocols and practice;
- Create global network CT Dose Reference Levels (DRLs);
- Promote best practices in CT;
- Comply to the EURATOM 2013/59 Directive (Council Directive 2013).

Materials

- 7 countries: greece, Hungary, Italy, Poland, Portugal, Romania, Switzerland
- Number of multiple detector computed tomography (MDCT) scanners: 39
- CT vendors: Vendor 1 - 82%, Vendor 2 - 13%, Vendor 3 - 5%
- CT scanners: 6 to 128 detector rows
- MDCT models: 17
- MDCT scanners with dose reduction algorithm: 28
- Dose tracking software

Methodology

I. Human Resources

To plan and implement the Dose Excellence Campaign with a broad scope, multidisciplinary teams have been assigned at different levels (see Figure 1). Multidisciplinary teams provide assurance that the strategy, communication between the teams and implementation are clear and straightforward.

II. Steering Committee Role

The Steering Committee defines the Dose Excellence Strategy, drives the project and collaborates with the country, site and third party teams to implement the strategy. The tasks of the Steering Committee are listed in Table 1.

III. Software to Track, Archive, Report and Analyse Dosimetric Data

The software used has proven to be an excellent tool for the handling of dosimetric data. It is compatible with the CT systems of all three vendors, easy to set up and use, and provides the following tools to assist in the Affidea Dose Excellence Campaign:
RadLex® Playbook (rsna.org/ RadLex_Playbook.aspx) to map the CT protocols used in the departments to a specific identification number defined in the Affidea Standardised CT Protocols list.

- Detailed acquisition parameters and dose report for each patient study.
- Database export in Microsoft Excel format for further handling.
- Automated monthly reports that are sent via email.
- Automated alerts for high-level dose studies that assist in the fostering of dose awareness of the CT operators. The system provides a justification process for the alerts that allows the users to assess the centring of the patient, the function of the current modulation and the recording of the cause that produced the alert.

IV. Country/Site initiation process

Step 1: Verify the quality assurance tests of the CT scanners.
Step 2: Connect the CT systems to dose tracking software.
Step 3: Launch a data collection period of at least 4 weeks.
Step 4: Assign the relevant multidisciplinary teams at country, site and third party level.
Step 5: Assess the current department practice, workflow and level of dose awareness.
Step 6: Project kick-off meeting with country team to present the strategy and team tasks.
Step 7: Project kick off with site teams to present the strategy, team tasks and justification, standardisation and optimisation (JSO) results.
Step 8: Launch the educational material.
Step 9: Monthly follow-up by the Steering Committee of the project Progress.
Step 10: Launch monthly site team meetings to discuss the JSO report results.
Step 11: Follow-up site visit in 2 months period from kick off, to physically assess progress.
Step 12: Launch bimonthly country team meetings to discuss the progress of each site.
Step 13: Perform image quality tests on the optimised CT protocols.
Step 14: Introduce the Dose Excellence campaign material for patients and referring doctors, once the goals for JSO have been reached.

Results

Building dose awareness and the acceptance of change in the procedures, practices and protocols of a radiology department is a long and challenging process. The collaboration between the teams inside a department, between teams from different sites in a country, as well as between countries, requires time, trust and effort from all involved parties. Adding to that one needs to take into account:

- Each National Health System's rules and country legislation. For instance, the variations between countries in the reimbursement system that affects the frequency of examinations; the referral criteria that affect the imaging modality choice.
- Differing perceptions of radiologists, referring physicians and patients of CT dose, between countries.
- Differences in workload, study types and patient's condition between private diagnostic centres and public and/or private hospitals.
- Differences in mentality between the generations of radiologists and radiographers.

Through its Dose Excellence Campaign, Affidea is transforming the creation of CT protocols from art to science. Radiologists are called on to change the way a CT image is perceived and accept exchanging 'beautiful', low noise images for diagnostic images. Dose management assists in finding the balance between optimal diagnostic image quality and acceptable dose under the general principle of As Low As Reasonably Achievable (ALARA). Affidea is working towards getting clinical consensus through the establishment of a standardised methodology for evaluation of the clinical value of the image quality and dose optimised protocols.
The volumes of data collected are vast, reaching a monthly average of 22,000 examinations, thus affording Affidea a vast dataset of analysis. The data comprises not only dosimetric but also clinical output. Although this is currently analysed on a site-by-site basis, it offers the opportunity for 'big data' analysis to look at pan-European imaging trends.
With the dose tracking software and the vendor's team collaboration, Affidea has created a monthly data analysis report called JSO, that:

- Records and analyses the percentage of alerted high-level dose studies and the percentage of justified alerts;
- Records and analyses the percentages of examinations performed according to the Standardised CT protocols list rules;
- Records and analyses the percentage of protocols performed that are above, within or below the DRLs.

The JSO report results assist in practice optimisation and protocol parameters optimisation. Affidea is in the process of consolidating the data to a single database that will provide the global network results analysis. The goal is to include all the CT systems of the Affidea network in the Dose Excellence Campaign, with a further 15 systems being currently implemented.

Conclusion

The importance of dose management is unquestionable. But one should not allow oneself to forget that the purpose a CT scan is performed is the diagnosis of a patient's clinical state and that radiologists are the ones who have the legal responsibility for this diagnosis. A dose management strategy has to respect their concerns and proceed with caution in every step.

Key Points

- The amount of ionising radiation exposure from CT is increasing, and there is great variability between patients and geographies for similar examinations.
- A rational strategy is required to both reduce and standardise patient dose over the full range of examination types.
- Affidea, a pan-European medical imaging services provider, has implemented a Dose Excellence Campaign across 7 European countries, involving approximately 190 people.

See Also: Radiation Dose: Communicating with Patients

See Also: Putting Quality and Safety for Patients First: ESR EuroSafe Imaging

See Also: Quality and Safety in Radiology: A Symbiotic Relationship

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