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Implementing Dose Monitoring Software In A Radiology Department

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MEETING THE CHALLENGES

Implementation Considerations

Before planning implementation of dose monitoring software you should be aware of some challenges that need to be met. This is a tool, which offers many options, but the available features may not match your department's expectations and requirements. Awareness of what exactly the department's needs are is essential at the beginning. Furthermore, one should be conscious of the fact that the software indeed is able to register dose data, but it cannot check for plausibility of data.

Step 1: Determine Technical Strategy

If these challenges are accepted the next step is to determine your technical strategy, which includes choosing the right dose monitoring software for your requirements. Consideration of the different modalities that should be linked to the software is important, because not all software allows for connection with all modalities. Moreover, to ensure high quality of data input it should be verified that the software can communicate with the hospital information system (HIS) and radiology information system (RIS) and can also be integrated in the local network.

Step 2: Define Organisational Strategy

Then you need to define your organisational strategy, which comprises not only assigning the modalities, but also specifying the scanners/units that ought to be connected with the software to ensure interoperability. This includes considerations about installation of the dose monitoring tool outside the radiology department, where x-rays are used as well (eg, coronary angiography suite).

To successfully implement the software in clinical routine it is advisable to start with one modality only, which preferably should be computed tomography (CT), because CT scans are more standardised than, for example, fluoroscopy-guided procedures, at which various levels of difficulties need to be considered. Moreover, in most countries national defined dose reference levels (DRLs) for indication-based CT examinations are available, which facilitate setting dose thresholds.

Dose Team

To promote implementation of the software, represent dose culture and have contact persons, formation of a dose team is recommended. Ideally this should be composed of one or two radiographers, one board-certified radiologist and the department's IT specialist. Together with the head of the department the dose team should define a few appropriate, measurable, and achievable goals. As particularly at the beginning the dose team faces many tasks, including becoming familiar with the software, they should have protected time for their work.

One of their first challenges is to set reasonable dose reference levels; in our department we either used Swiss DRLs, so far available for 21 indication-based CT examinations (Swiss Federal Authority of Healthcare, 2010), or we derived thresholds by determining the 75th-percentile of the distribution of a defined dosimetric quantity.

Lessons Learnt

After we had installed the dose monitoring software and had started dose data analysis of our CT scanners, we had to solve unanticipated problems.

1. Data Output Relates to Input Quality

Although we knew that a dose monitoring tool is software, we weren't aware that data output depends extensively on the quality of the input. One of our main challenges was to match our own CT protocols with the available national DR Ls. For example, our abdominal CT protocols comprise "abdomen and pelvis: unenhanced", "abdomen and pelvis: contrast media-enhanced", "liver protocol", "pancreas protocol" etc., and national DRLs are separated into "abdomen 1: liver, spleen, pancreas, vessels" or "abdomen 2: standard, abscess, emergency". Thus our internal processes required intensive adaptation at the beginning, which included cleaning our CT protocol list with removal of no longer employed CT protocols (eg, from former scanners), definition of precise protocol descriptions and uniform usage of protocol names. Thereafter, the different CT protocols were assigned to the national DRLs, if available, or to our own set thresholds.

2. Protocol Changes Not Recognised

When we started with data analysis, we frequently encountered the problem that the software did not recognise changes of protocol made after scanning had already started. For example, a patient with rectal carcinoma was enrolled for a CT of the abdomen and, based on this indication, the CT protocol "abdomen standard (single phase)" was chosen. But due to a so far unknown liver lesion a second phase was ordered by the radiologist on approval of the scan. However, in this case the software compares the scan's dose data with the DRL for "abdomen standard", unless the protocol name is changed manually to "abdomen portal-venous and delayed phase". This modification of protocol name is possible within the software as part of the post-processing, and considerably enhances quality of data analysis by limiting the number of false-positive dose alerts.

3. Change Resistance

Particularly at the beginning, resistance to change is often encountered, based on perceived nuisance and extra work, but also due to neglect when a task was not part of clinical routine before. To overcome this resistance and improve compliance it is important to integrate dose monitoring into the daily workflow and to establish a dose culture. We therefore placed an additional computer next to the CT console, on which the software was permanently running. By immediately displaying the patient dose data, the radiographers' awareness regarding radiation safety increased.

4. Optimisation Processes

After having successfully implemented the software in clinical routine, dose data should be collected for several months before optimisation processes are started. The reason is that optimisation ought to be based on valid data, which are the premise to achieve effective and efficient improvements. It is better to first focus on one modality as well as on the most frequent protocols, as too many changes made at one point may cause confusion, data disorder, and excessive demands of the staff, ultimately leading to failure of the whole dose

monitoring project.

5. RIS Integration

Despite being challenging at the beginning there are several advantages that compensate for the efforts to integrate the dose monitoring tool into the RIS. Among these especially the automatic registration of protocol changes during the scanning is valuable, because it considerably alleviates dose data post-processing and analysis (no manual change of protocol name is required) and improves quality of data output. The RIS integration also allows for an automatic display of dose data on each radiological exam report and would enable the use of only one single master IT system, thus significantly enhancing the convenience when dose monitoring software is applied.

Conclusions

Dose monitoring software is a valuable tool for internal and external quality control of dose data. It can be successfully integrated in clinical routine and increases patient and business safety. However, implementation of a dose monitoring tool is a demanding task that requires the support of the head of the department. It is advisable to build a multidisciplinary dose team, which assists in software integration in daily routine and accomplishes a dose culture. It should always be kept in mind that the tool is a software with the quality of data output largely relying on data input. Because of that, dose culture and processes have to be created and implemented by the users, which needs time and resources.

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