A question of dose

Dose management from the perspective of a medical physicist

Dr. Nagel, please introduce yourself in a few sentences.

Dr. HD Nagel: After studying physics at the University of Hamburg, I joined one of the major manufacturers of diagnostic imaging equipment in 1978. I worked for them until the end of 2009, the majority of the time as a clinical scientist. My main focus is X-ray imaging and computed tomography, especially everything pertaining to dose and image quality. For about 15 years, I also worked on a voluntary basis for the German Electrical and Electronic Manufacturers' Association (ZVEI) and served as its representative on various committees. At the beginning of 2010, I started my own business as a scientific and application technology consultant.

How long have you been in your profession?

Dr. Nagel: I have now been in the profession for a good 40 years and I am equally familiar with both sides (manufacturing and application). In the mid-1990s, when it became obvious where the real problems in medical radiation protection lie (CT and interventional X-ray), dose management became my real focus. The first time I optimized the protocols of a CT machine was 20 years ago. Since already 2013, I have been serving as a medical physics expert (MPE) for a radiology practice that hired me long before MPE became mandatory for high-dose devices. I currently manage six facilities with a total of ten CT and five interventional X-ray units, among which all manufacturers are represented.

How did you come to use a dose management system?

Dr. Nagel: The amount of radiation exposure received by the patient is essentially determined by two factors: the available technology and the adequate, situation-appropriate use of it. In the case of technology, the possibilities are widely known in terms of device specifications, device settings and quality control results. What happens in everyday life, however, is at best a guess. Often enough there are significant differences between what should be (or could be) and what actually takes place. This is common in interventional radiology especially, but also occurs in CT, whenever device operators leave the routine and run freestyle, so to speak. Without a system that records all relevant data and presents it in suitable form, it is more or less left to chance whether these discrepancies would even be noticed.

Do you think it makes sense to perform dose management without dedicated software, e.g. only with Excel?

Dr. Nagel: Usually, as an MPE, you often do not initially have a dose management system (DMS) available and therefore you have to work with substitute solutions until DMS procurement, in order to conduct dose monitoring. I have had relevant experience in this. In order to monitor patient exposure, one has to limit oneself to random sampling because of the considerable time involved. This is something that is exciting only the first time, but after that becomes a chore, and is always a waste of resources. As far as monitoring significant violations of dose limits, organizational measures (workplace protocols, reporting chains) have not proven to be reliable.

A DMS is therefore an absolute must in order to succeed as an MPE. In the meantime, dose management systems are now used in all the facilities I supervise. The only exception is a neurosurgical practice with a CT scanner, which can do without one due to the very limited range of examinations (only PRTs of the spine) and the low dose values that are applied.

Why did you deliberately choose the dose management system DOSE?

Dr. Nagel: My interest in DOSE initially stemmed from the fact that the manufacturer (Qaelum) is a spin-off from the medical physics department at the University of Leuven headed by Prof. Bosmans. Many DMS solutions suffer from the fact that their footprint is recognizably IT-heavy and lacks sensitivity for the application. The decisive criterion for me is practicability:

How well does the DMS allow me to perform my tasks? From the start DOSE appeared more likely to meet these requirements, as compared to systems from other vendors.

If considering specifications alone, then one could consider all DMS solutions to be almost equivalent. However, their practicability and ability to cope with the local infrastructure (incl. radiological equipment, PACS) only becomes apparent when they are used on site. Due to numerous unpleasant surprises with other DMS, I was able to convince Dedalus HealthCare to set up a test installation in one of the institutions I support two years ago. The experience I had, and especially the quick and successful implementation of my suggestions for DMS improvement by Qaelum, have led to the fact that DOSE now largely corresponds to my expectations of a practical DMS.

Have you also worked with other dose management systems?

Dr. Nagel: Yes. So far, I have been able to thoroughly test four DMS in a similar way to DOSE. In order to be able to reject an inexpensive, but largely unusable DMS, I developed a specific test scheme three years ago. It covers a total of almost 100 aspects - all from the point of view of practicability. Similar to school, I have differentiated between major, minor and elective subjects - from indispensable to very important to "nice to have". The decisive factor is how many "major subjects" receive an F (non-existent or unusable) or a E grade (usable only with considerable additional effort). The differences in quality that emerged were significant. Currently, I am working with three of the tested DMS: three of my "customers" have DOSE, and the other two have less practical DMS solutions. In one case, this is due to the fact that it was procured some time ago. In the other, it is the very limited spectrum of examinations that allows to perform dose monitoring even on a minimal level, despite the considerable weaknesses.

What do you like about DOSE compared to other systems?

Dr. Nagel: What all dose management systems struggle with is the scope, completeness and quality of the data provided by the devices. Each device manufacturer has its own peculiarities. In some cases, there are obvious shortcomings. Of all the DMS solutions I have worked with so far, DOSE copes best with these hurdles.

Secondly, the "Achilles's heel" of

Translated into English based on the German original from Dedalus DIREKT magazine November 2021

every DMS, which is the configuration. This refers to the dose reference and limit values that can be configured, their link to the studies being performed, and the alert options for their violations, including automatic e-mail notifications. DOSE is characterized by high flexibility, with which one can accommodate manufacturer-specific peculiarities. Moreover, the import of the basic data required for configuration to DOSE is ingeniously simple.

Thirdly, how well the DMS helps in identifying the causes of dose reference and limit value violations - a very decisive point from a MPE's point of view. In the CT application area, DOSE is almost perfect: all questions can be answered with the data archived in DOSE or prepared by DOSE - provided that the required "raw data" are supplied by the device. In interventional radiology applications, on the other hand, there is still significant potential for improvement - just as with the other DMS solutions.

What advantages do you see in your everyday work with DOSE?

These are especially the insights that can be gained with the help of DOSE in order to be able to take measures for problem solving and quality improvement in a targeted manner. It is important to be able to distinguish between serious and less important problems, as well as frequent and rare ones. In this respect, a practical DMS makes a great contribution - but nothing more. After all, it is up to the MPE to draw the right conclusions about what needs to be done to solve the problem. Then, of course, there is the time saved, without having to compromise, as in the case of random sampling. In most cases, a practical DMS such as DOSE provides the required parameters at the push of a button. Alternatively, there is of course - as with any other DMS - the possibility to export the archived data and e.g. evaluate further in Excel. However, these costs additional time and is required comparatively less often with DOSE. And finally, the reliable and prompt identification of dose reference and limit value violations. This is the only chance to fulfil the obligation to report significant incidents to the supervisory authority "without delay".

Which functions are you particularly impressed with?

Dr. Nagel: First and foremost, there are the configuration options, because that's where everything stands and falls. This is followed by the ability to identify and separate studies where the study protocols have been modified on a case-by-case basis – a very important function in terms of data quality. And finally, the "StudyCheck" function, which allows daily comparison between DMS and PACS data. Identifying and, if necessary, re-entering missing studies is an absolute must from my point of view. So far, I that know this function only from DOSE. And finally, there are many other functions should be a matter of course for a DMS, but are not available in other DMS solutions or have been poorly implemented.

In DOSE, we can integrate web viewers from various image archiving systems (PACS). Have you already come into contact with this function? Does it make your everyday life easier?

Dr. Nagel: Not yet. It would make everyday life easier in all cases where the data and results available in DOSE are not sufficient for root cause analysis. However, not for the analysis of image quality problems, because web viewers are generally not made for this. Some web viewers do not even allow to look into the metadata of the images. In such cases, only the download of the image data and the subsequent analysis with dedicated software solutions designed for this purpose can help.

At the beginning, we always conduct training sessions with our customers. How did you like the training? Were your questions answered?

Dr. Nagel: I can only give limited information on this. I myself received a basic briefing from an application specialist at the beginning of the test phase and was able to contact this person in the event of subsequent uncertainties. For the total of three DOSE installations that took place in my area in spring 2021, I decided to train the users (i.e., physicians and assistants) myself. Since I have set up the appropriate dashboards and presets depending on the user group and area of application (CT and/or interventional radiology), the training can be better targeted than with a general standard training.

DOSE is developed by the innovative software company Qaelum and in the context of a close cooperation between Dedalus HealthCare. How do you see the cooperation between us and the manufacturer Qaelum in general and with regard to the further development of the products in particular?

Dr. Nagel: My experience so far has been consistently positive. In the test phase, I have seen that Qaelum listens to its customers and implements well-founded suggestions for improvement. With the other DMS manufacturers, with whose solutions I have been able to work with, this was not the case. The fact that changes cannot always be implemented immediately, but usually within the planned development cycle, is normal. The promises that I have been given so far have been kept to the greatest extent possible. My impression so far is that the complaints or suggestions I have made on behalf of Dedalus customers have been received and implemented by Qaelum.

How satisfied are you with DOSE and our service?

Dr. Nagel: As far as DOSE is concerned: on a scale between 0 and 100, currently at least 90 %. As far as service: so far, consistently competent and helpful.

Thank you very much for the interview, Dr. Nagel.

Interview: Bernhard Kahle

Translated into English based on the German original from Dedalus DIREKT magazine November 2021