The role of dose tracking systems in radiation safety programs

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In 2009 dozens of patients undergoing CT head examinations were accidentally overexposed leading to hair epilation and concerns for cancer induction. These events were an eye-opener for the radiology industry, as up to this point no other significant diagnostic radiology incident had occurred. This drove the need for far more attention on how to manage radiation exposure for patients, not necessarily from a clinical image quality perspective, but from a patient safety perspective. What the industry quickly realized is that within the current healthcare framework there is no clear owner of managing cumulative radiation dose to patients and how this information should be used throughout their care. The goal of this whitepaper is to drive this conversation and offers the Philips perspective on how we use the data available from radiation dose tracking solutions to contribute to patient care.
It is likely that these standards and regulations will continue to normalize exam protocols (and dose) across their enterprise. As of 2015, the Joint Commission requires routine analysis to continue. Texas, have begun to add local State requirements for CT a first in the nation. Other states, such as New York and heightened awareness of radiation exposure in general, in response to the overexposure events and also due to medical patient radiation exposure were specifically for authority over radioactive materials (called “Agreement is the regulating authority for all radioactive materials In the United States, the Nuclear Regulatory Commission Regulatory requirements and standards in the United States, the Nuclear Regulatory Commission is the regulatory body that oversees the purchasing, use, and disposal of radioactive materials such as X-ray machines and linear accelerators. In many instances, States have also been delegated the authority by their State legislature to control their own radioactive materials. The Nuclear Regulatory Commission has regulatory authority over radioactive materials used in medicine, research, and industry as well as radioactive waste produced by these facilities. The Nuclear Regulatory Commission requires that radioactive materials be used only when necessary and that the radiation exposure is managed for the desired end point. This is done through a formal process that includes the evaluation of the risks and benefits of using radioactive materials. The process is designed to ensure that the benefits of using radioactive materials outweigh the risks associated with their use. Regulatory requirements and standards in the United States, the Nuclear Regulatory Commission is the regulatory body that oversees the purchasing, use, and disposal of radioactive materials such as X-ray machines and linear accelerators. 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Methods of analyzing data

The RSC is responsible for ensuring that the use of radiation for diagnostic purposes in the hospital is purchased, used and disposed of according to applicable regulations, and that the safety of workers, the public, and now patients are appropriately managed. The collected data is used for two purposes. The first are as quality measures — to ensure that the programs and procedures are being performed as intended and that the outcomes are consistent with the respective design goals. The second is to identify outliers, i.e., those instances where things did not go as expected.

Dose monitoring and tracking is extremely useful for both purposes. For example, the patient-specific radiation dose metric for CT scans (i.e., Dose Length Product, volumetric Computed Tomography Dose Index or Size Specific Dose Estimate) can be aggregated by protocol type (e.g., head scan, abdomen scan, etc.) and described and compared through statistics. Comparing actual values to appropriate benchmarks can reveal whether the institution is comparable to other institutions performing the same types of scans on the same types of patients. The data can also be used to identify outliers. Dose metrics used on the individual level can be used to identify those patients that received far more radiation than the protocol or other controlling factors can explain. This can help Medical Physicists to identify areas of improvement, or unknown operational practices, that could help manage equipment use and normalize dose per exam across the patient population.

Because DRLs and Achievable Dose work within the concept of “percentile” of the dose distribution, the statistical boxplot graph is a very effective method of analyzing the data. A boxplot indicated the distribution of data with a min/max/median while also identifying the 75th percentile and also the 25th percentile. If you participate in the American College of Radiology’s Dose Index Registry (DIR) then you are probably already familiar with this type of graph, as this is what they use to distribute data to participants. See Figure 1 below for an example of a box plot.

Goals/Review of progress

Healthcare institutions are expected to manage patient exposure having probably never done it before, so where do you start?

The concept of dose management is one that entails patient safety, risk, regulatory compliance and now facility accreditation. As such, it is important that hospital executives “buy-in” to this philosophy to ensure that staffing, funding and other adequate resources are available with accountability established. A robust hospital infrastructure builds the foundation for success. This is where the concept of the CDOT, as mentioned above, comes into play. The CDOT should serve as the central owner of patient dose that reports into the Radiation Safety Committee for that institution. Vendors and manufacturers are keen on the needs of users and can also help provide training, content and support for developing your patient radiation safety program. Education of stakeholders is key after programs are established and infrastructure is complete. Of course all relevant staff should be educated on the processes and teams established to monitor dose, but patients should also be included. Patients have never been as educated on dose as they are today. The reality is that the internet is full of content that may be either too technical, or misleading based on the source, for patients to educate themselves. A proactive and transparent patient education campaign with factual data is a good path to follow.

The first step to managing patient dose is data. Using a commercial dose tracking software, or data mining from your PACS or RIS, allows you to benchmark yourself with retrospective data. Set goals to understand your current dose results against DRL values and make modest targets to improve aggregate dose. Reviewing the data will also identify unknown practices, such as variation among Technologists, and help standardize ways of working in an environment with equipment from multiple vendors and with different levels of technology due to age.

The path forward for patient dose management will take some time, but small steps with some organizational support will begin to yield successful results. This is the expectation from organizations such as Joint Commission as well as individual States as they promulgate more regulation in this area.