Implementing a Radiation Dose Monitoring System in CT Scans

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Computed Tomography, abbreviated as “CT,” is highly influential in the medical imaging field, using x-rays at different angles to detect bones, blood vessels, and soft tissue. While important for the imaging department, CT scans require the use of ionizing radiation. Used as an energy to penetrate X-rays through the body and produce an image, this energy creates the problem of increased radiation doses in patients. As the number of patients that need CT scans continue to grow, the demand to ensure the safety of individuals also rises. Thus, radiation dose monitoring needs to be implemented in computed tomography systems. This proposal delves into the problem at hand, as well the solution, and its plan to implement in imaging departments.

In a CT exam, patients will receive multiple scans in order to produce images for the physician to analyze and diagnose. According to authors John Boone and James Brunberg, “80% of patients had 9 scans or less” (2008). In a computed tomography scan, the dosage can be as low as 3 millisievert (mSv), and as high as 10 mSv. Millisievert is a unit of measurement on radiation dose. While one CT exam does not pose a threat, if the individual needs to return to the imaging department for another CT scan, cumulative exposure will, as there is no history of the amount of ionizing radiation used. Without a written history, individuals may accumulate a high dosage of radiation, thus raising the risk of cancer.

The lack of radiation dose history in patients' medical records can be resolved through the use of radiation dose monitoring systems (RDMS). In *Radiation dose monitoring in computed tomography: Status, options and limitations*, the authors explain that RDMS “facilitate data collection and processing, statistical comparisons, reporting and management of radiation dose related information” (Tsalafoutas, Kharita-Naemi, & Kalra, 2020). By using this software, patients’ radiation exposure is gathered and stored in their medical records. In doing so, benefits can be seen through enhanced patient safety and effective reduction of radiation dose. It is important to note that the goal is to not only reduce the radiation dose, but to maintain image quality.

Usually, in interventional radiography, radiation dose can be challenging due to the dependence on a patient’s size, disease complexity, and the radiographer’s use of the machine. On the other hand, CT scans are more controllable as it is “mainly determined by the imaging protocol, CT scanner, and patient size” (Inoue, 2023). In Japan, a hospital uses an automatic exposure control (AEC), a type of radiation dose monitoring system. This system works by evaluating X-ray strength for each patient and area using localizer images, then it automatically adjusts the tube power. Body size is considered in the AEC system by analyzing the radiation dose for each imaging protocol. Executing radiation dose monitoring systems needs proper preparation.

To implement RDMS, there first needs to be participation from medical imaging staff, as well as training on using the software. In *Radiation Dose Management in Computed Tomography*, the author suggests that technologists make “dose-related records…during each examination to support efficient and effective radiation dose management” (Inoue, 2023). Before setting the system, a training program should consist of CT technologists to develop the skills needed to use the RDMS. Communication is vital in the healthcare realm to ensure patients are receiving the best care safely, especially when there is advanced technology. In *Strategies for Dose Optimization: Views from Health Care Systems*, the authors state, “Clear, effective communication builds relationships and enhances staff involvement in change efforts” (Whitebird, Solberg, Chu, and Bindman, 2022). Moreover, having a team to examine and review radiation doses is critical for the RDMS to properly manage data. In this team, there will be a team leader, lead CT technologist, and a CT physicist. This team will play the role of “identify[ing] examinations for dose reduction, perform image quality review, and communicate changes with radiologists” (Hara, A., Mahesh, M., Mayo-Smith, W., Pavlicek, W., & Sahani, D., 2014.). Monitoring radiation dose can be challenging with the many different protocols in practice. However, by reviewing the specific RDMS model on the American College of Radiology, the team can compare their dose to other practices and modify it for the examination. Furthermore, having a list of protocols set into the system can facilitate staff with working the machine. During the CT exam, it is important that the technologist pays attention to the protocol list, as it contains information on the scan range and amount of contrast media. After reviewing staff participation, the time frame is also considered.

The length to implement this system depends on several factors. Training staff can take several weeks as professionals need to know how to effectively use the system. Finding the right RDMS system will also cost time. The software must be in line with protocols of the institution. It is important that imaging professionals “maintain and follow written protocols for every medical radiological procedure, reviewing them when necessary and examining them against agreed standards” (Fitousi, 2017). The process to implement the RDMS can be a long process, a year long even. However, execution of this plan will benefit patients who receive CT scans.

In the radiography field, computed tomography is a highly used machine that not only involves the imaging of an individual’s bones, blood vessels, and soft tissue, but also a large amount of ionizing radiation. With insufficient records of cumulative radiation exposure, patients are at risk of receiving too much, and developing health risks. Implementing the radiation dose monitoring system is crucial in ensuring the safety of patients, as the demand for CT scans increases. The RDMS is a step to this goal as it records and monitors radiation exposure, as well as optimizes dose levels according to data put in by the CT team. In order for the implementation of the RDMS to be successful, the training and commitment from medical imaging staff must exist. Selecting the right system to match institution protocols also requires time. Although challenging, prioritizing the safety of patients and maintaining quality of care by reducing ionizing radiation exposure is vital.

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