The right dose for accurate diagnosis: tracking patient radiation doses and using diagnostic reference levels

By Aabha Dixit

"With the patient being the focus for any medical diagnosis, dose evaluation and diagnostic reference levels for patients are recognized as important tools for optimization of patient radiation protection."

— Ehsan Samei, Professor of Radiology and Medical Physics, Duke University Hospital, United States

Evaluating radiation dose levels during diagnostic radiological procedures and using this data to improve the quality of diagnostic exams and patient safety are vital when carrying out radiation therapy and treatment.

Approximately 3.6 billion diagnostic radiological procedures are performed around the world each year. Although the use of ionizing radiation for medical purposes offers many benefits, it can also increase the risk of cancer later in life. Where more radiation is used than is necessary to provide a clinical diagnosis, the patient can incur an increased risk but no additional benefit. Ideally, medical imaging procedures should be performed only when well justified and should use the lowest possible amount of radiation necessary to provide an image quality that is sufficient for diagnosing disease or injury.

"With the patient being the focus for any medical diagnosis, dose evaluation and diagnostic reference levels for patients are recognized as important tools for optimization of patient radiation protection," said Ehsan Samei, Professor of Radiology and Medical Physics at Duke University Hospital in the United States.

"In some cases the patient receives an incorrect dose, which can jeopardize the quality of diagnosis. The doses used in radiation procedures therefore need to be regularly evaluated to ensure the patients' safety and the quality of medical images," he added.

Analysis of radiation doses to patients during diagnostic radiological procedures is key to improving patient safety.
(Photo: Tokuda Hospital, Bulgaria)

What are diagnostic reference levels?

Diagnostic reference levels serve as a practical tool that allows health professionals to compare diagnostic imaging procedures across a country. They apply for a specific patient group, such as adults or children of different ages or weight, and relate to specific types of medical examinations such as X-rays, computed tomography or image-guided interventional procedures.

To ensure effective and accurate imaging, each hospital should compare local doses to the nationally- or regionally-set diagnostic reference levels, Samei said. "To achieve this goal, we need to have purpose-specific diagnostic reference levels." Diagnostic reference levels should relate to the purpose of the imaging. For example, cancer and cardiovascular imaging may have different diagnostic reference levels. The aim is to have a universally-agreed methodology for setting and using diagnostic reference levels, he added.

The practical implementation of diagnostic reference levels is a complex task, requiring thorough knowledge of the medical technology and technical skills to perform patient dosimetry and analyse image quality. It requires effective coordination between the health authority, relevant professional bodies, the nuclear regulatory body, and medical facilities motivated to participate in data collection, said Peter Johnston, Director of the IAEA Division of Radiation, Transport and Waste Safety.

A comprehensive regulatory and legal framework, a sustained awareness-building programme and effective evaluation tools to implement internationally-agreed safety standards on radiation protection for patients are also vital, he added.

Why track radiation dose data?

Accurate and regular recording, reporting and analysis of patient radiation doses in medical centres can help improve practice and reduce doses without loss of diagnostic quality. This information can be used to establish diagnostic reference levels at the national or regional level. Tracking exposure information for each patient can also help to prevent unnecessary exposure.

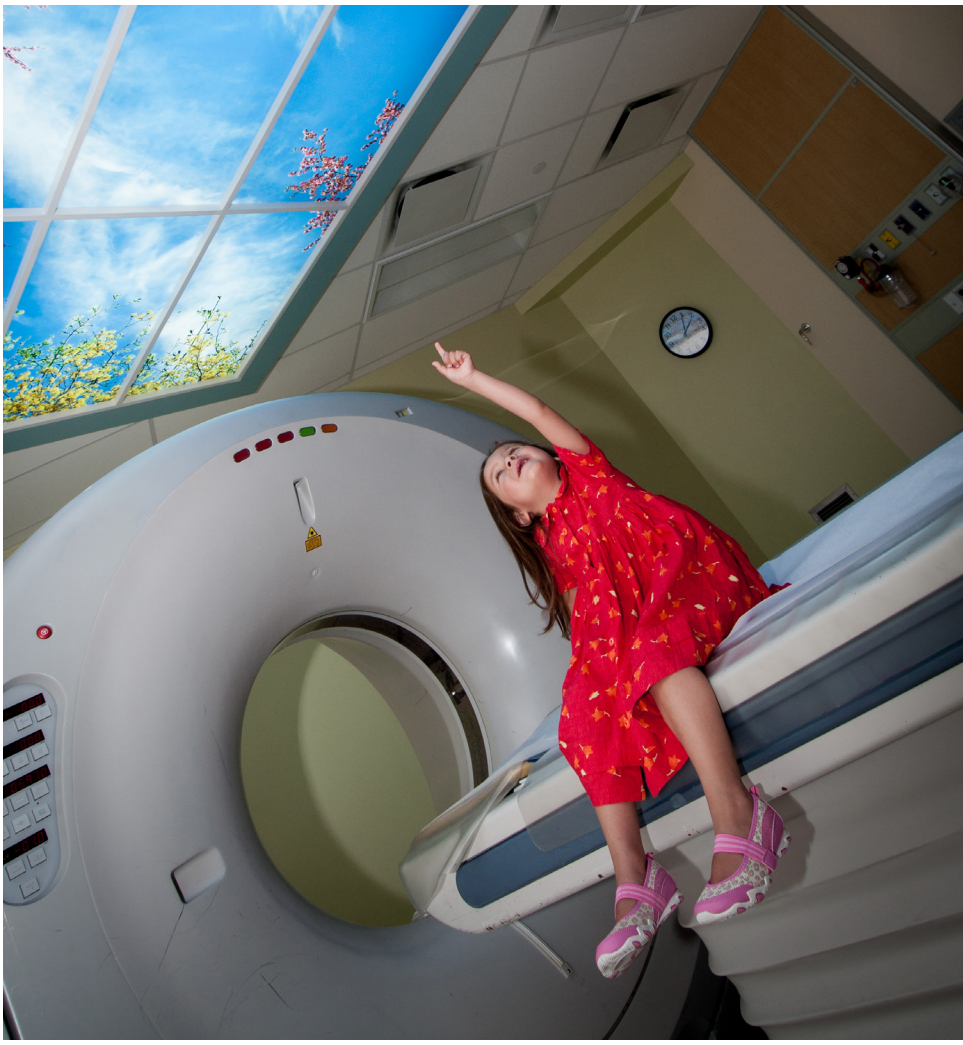
Medical staff have to follow strict rules and are trained to ensure the safety of those patients who are given radioisotopes for diagnostic or therapeutic purposes.

Patients sometimes move from one imaging facility to another. New tests are done, involving duplication of radiation examinations, said Simone Kodlulovich, President of the Latin American Medical Physics Association (ALFIM). “What is lacking in many countries is a data system that tracks doses. We need to be more consistent and follow established guidelines consistently.”

Another area that needs special attention by health professionals when performing exams is imaging of children, whose sensitivity to radiation is higher. Monitoring of doses to children in medical facilities helps to improve clinical outcomes and reduce risks. Without proper and specialized guidance, the advanced technology has the potential to significantly increase patients’ exposure to ionizing radiation, said Kodlulovich.

Cooperate, coordinate to prevent overuse

Fast-moving technological developments in medical imaging are providing new opportunities to automatically track and benchmark patient doses. Early evidence in some countries with more advanced electronic systems is very promising, said Samei. Furthermore, closer involvement of medical equipment manufacturers and developers of specialized dose tracking software is needed to establish proper standards as well as to coordinate further improvements.



Children are more sensitive to radiation doses than adults.
(Photo: McMaster Children’s Hospital, Canada)

What do I need to know?

Two general principles of radiation protection — justification and optimization — apply to the exposure of patients undergoing medical radiological procedures.

Justification of medical exposure entails weighing the diagnostic or therapeutic benefits of exposure against the potential for harm, taking into account the benefits and risks of available alternative techniques that do not involve ionizing radiation exposure.

Optimization of protection and safety in diagnostic and interventional medical exposure entails limiting the exposure of patients to the minimum necessary to achieve the required diagnostic or interventional objective.

Dose limits do not apply to medical exposure, as they could limit the benefits for the patient.