Effective and balanced communication of radiation risks requires sufficient background, education and resources to support the risk–benefit dialogue, particularly in pediatric patients. For example, it is important to communicate that risks can be controlled and benefits maximized by selecting an appropriate procedure and using methods to reduce patient exposure without reducing clinical effectiveness. While the fundamentals of risk communication and risk–benefit dialogue are common to all health-care settings, the implementation of an effective communication strategy in nuclear imaging, emergency, oncology, and pediatric imaging often requires unique considerations.

The benefits of many procedures that utilize ionizing radiation are well established and well accepted both by the medical profession and society at large. When a procedure involving radiation is medically justifiable, the anticipated benefits are almost always identifiable and are sometimes quantifiable. On the other hand, the risk of adverse consequences is often difficult to estimate and quantify. In its 1990 and 2007 recommendations, the International Commission on Radiological Protection stated as a principle of justification that “Any decision that alters the radiation exposure situation should do more good than harm.” A stronger position on the justification of medical exposures is often taken to the effect that the “benefit” has to substantially outweigh any risks that may be incurred, in part because of the uncertainty of the risks. The justification for radiation exposure almost inevitably involves a physician familiar with the patient and the medical history. Normally, an appropriately qualified nuclear medicine practitioner takes the responsibility for the conduct of an examination and needs to work in close cooperation with the referring physician to establish the most appropriate procedure for the management of the patient. Responsibility for providing this information could lie with both the clinician requesting the study and the nuclear medicine physician. In some situations, the patient may be referred to a medical physicist for dose estimation.

In spite of concern, some patients may misinterpret radiation risk and may refuse a useful or potentially lifesaving examination for fear of radiation. There is evidence that explaining the risk will not dissuade patients from undergoing the examination, even when the risk is explained to patients in the radiation sensitive age group. However, this may not be universally true and will depend on the local conditions of societal and individual perception of radiation risk. A brief information handout can improve parental understanding of the risk related to exposure to ionizing radiation, without causing patients to refuse studies recommended by the referring physician. Patients are likely to be satisfied more by the availability of quality control and dose management mechanisms being in place rather than by information on radiation doses that he/she may not understand. A program of informing patients/caregivers about the radiation risks associated with relatively high dose procedures and the benefits of the procedure is a good practice. As with other imaging modalities, nuclear medicine studies are required to be rigorously justified. Large individual and population doses arising from nuclear medicine activity in some countries are, at least in part, attributable to some overutilization and to questionable referral patterns. Alternative modalities, such as ultrasonography and magnetic resonance imaging (MRI), have to be considered. However, nuclear medicine studies, including renography and bone scans, continue to be useful and are regularly performed in children. The radiopharmaceutical activity given to pediatric patients has to be the minimum amount necessary to ensure a satisfactory examination. High activity (which does not result in improved diagnostic accuracy or sensitivity) or low activity (which does not permit an adequate scan) are both unacceptable, as they are both likely to give rise to unnecessary radiation exposure.

Today the radiologic investigations are the indispensable diagnostic tools in medical care, especially in emergency, oncology and Pediatric Departments. The imaging has the benefits for the patients follow-up as well as the diagnostic significance. In the past 15 years, the advanced imaging techniques in Neuroradiology provide very important data of the brain such as metabolites with MR spectroscopy, microvascularity with perfusion imaging, the integrity of white matter with diffusion tensor imaging and network of cortex with functional imaging. These techniques are performing for oncologic patient monitoring and preoperative evaluation as well as the early diagnosis of stroke. Advanced techniques also take place in abdominal imaging techniques such as MR spectroscopy, perfusion, diffusion, dynamic contrast imaging, and recently elastography. These are performing to characterize the suspected liver and...
prostate gland lesions. MR elastography and relatively breast MRI are also new modalities improving the diagnosis of malign and benign lesions.

Nuclear medicine imaging uses small amounts of radioactive materials called radiotracers that are typically injected into the bloodstream, inhaled or swallowed. The radiotracer travels through the area being examined and gives off energy in the form of gamma rays which are detected by a special camera and a computer to create images of the inside of your body. Nuclear medicine imaging provides unique information that often cannot be obtained using other imaging modalities and offers the potential to identify diseases in its earliest stages. Two major instruments of nuclear imaging used for cancer imaging are positron emission tomography (PET) and single photon emission computed tomography (SPECT) scanners. The PET scanner is used to detect the distribution of the sugar in the tumor and in the body. By the combined matching of a computed tomography (CT) scan with PET images, there is an improved capacity to discriminate normal from abnormal tissues. A computer translates this information into the images that are interpreted by the physician/clinician. Similar to PET, SPECT uses radioactive tracers and a scanner to record data that a computer constructs into two- or three-dimensional images. SPECT can give information about blood flow to tissues and metabolic reactions in the body.

As the technology of imaging techniques improves and spreads such as branches of a tree, the choice of most effective one is being difficult day by day. The confused minds might lead to the requests of unnecessary radiologic investigations. Breast specific gamma imaging (BSGI) is complementary imaging to mammography, providing a diagnostic tool that looks at function as compared to the anatomical imaging of mammography and ultrasound. BSGI studies are performed using an injection of the pharmaceutical Sestamibi, an imaging tracer cleared by the Food and Drug Administration in 1991 and commonly used in a variety of medical imaging procedures. Breast imaging was added to the drug data sheet for Sestamibi in 1996 with a recommended dose of 20–30 mCi.[3] Since that time, new detector technologies have been developed opening the possibility of reducing the dose needed for the imaging procedure. Patient-specific, weight-based imaging protocols for fluorodeoxyglucose (FDG)-PET/CT can significantly reduce CT radiation dose without compromising diagnostic image quality. Researchers reduced radiation dose by 43% and achieved double-digit decreases in lifetime attributable risk for cancer by adjusting CT tube current (mAs) modulation based on factors such as a patient’s height, weight, and body mass index. Researchers determined the CT dose index volume, which measures the radiation dose output of a CT scanner to make sure safe levels are maintained for patients. In addition, dose-length product values also were calculated, which pertain to the amount of radiation a patient receives. The implementation of iterative reconstruction can be an important component of overall CT radiation dose reduction – imaging wisely – without compromising diagnostic content in CT studies. Other CT radiation dose reduction factors may include weight-based selection of kVp; X, Y, and Z axis automated tube current modulation with noise indices selected in weight-based categories; organ dose modulation for the breast, eyes, and thyroid; very careful patient centering in the gantry; limitation of Z-axis coverage; and limiting number of passes per CT exam. Considering that iterative reconstruction alone can result in patient dose reductions in the 30%–80% range, it should be an important part of any overall CT radiation dose reduction program.[2] The best way to reduce dose is to order and perform FDG PET/CT only when clinically indicated and use alternative non-ionizing radiation imaging technologies such as ultrasound or MRI whenever possible. To reduce dose, the campaign also recommends physicians consider the use of PET/MRI in place of PET/CT for certain clinical applications and perform routine quality assurance and quality control of all their imaging instrumentation and optimization of their imaging protocols.[4]

The complaint of clinicians may be the easiest way. However what we are doing as nuclear medicine physicians to solve this increasingly complicated problem. As the professionals who have an important role on patients medical management, we have to take the responsibilities of all radiologic investigations in our institution. That means we should be able to decide which radiological examinations is beneficial to the patient in accordance with requests from clinicians. We should also share our experience and knowledge for indications of radiological techniques and evidence-based guidelines with clinicians more frequently. Little is known regarding best methods for reducing unnecessary imaging we should have to improve our dialog with clinicians and help them with evidence-based guidelines. This might avoid unnecessary costs/radiation for the benefits of patients.

Good medical practice encompasses effective communication about benefits and risks of health interventions. In this context, radiation risk communication is an essential component of good practice in medical imaging and has a key role to inform the appropriate risk-benefit dialog between health professionals as well as with their families or caregivers.
Reddy Ravikanth
Department of Radiology, St. John’s Medical College,
Bengaluru, Karnataka, India.
E-mail: ravikanthreddy06@gmail.com

References
1. Brem RF, Petrovitch I, Rapelyea JA, Young H, Teal C, Kelly T. Breast-specific gamma imaging with 99mTc-Sestamibi and magnetic resonance imaging in the diagnosis of breast cancer – A comparative study. Breast J 2007;13:465-9.
2. Liu HL. Model-based iterative reconstruction: A promising algorithm for today’s computed tomography imaging. J Med Imaging Radiat Sci 2014;45:131-6.
3. Murano T, Minamimoto R, Senda M, Uno K, Jinnouchi S, Fukuda H, et al. Radiation exposure and risk-benefit analysis in cancer screening using FDG-PET: Results of a Japanese nationwide survey. Ann Nucl Med 2011;25:657-66.

This is an open access article distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms.