Health Physics Society
Specialists in Radiation Safety

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CT Imaging Information Sheet

Risks Associated with Diagnostic Imaging Using Computerized Tomography (CT)

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A CT scan—also called computerized tomography or just CT—is an x-ray technique that produces images of your body to visualize internal structures in cross section rather than the overlapping images typically produced by conventional x-ray exams. Conventional x-ray exams use a stationary x-ray unit to focus beams of radiation on a particular area of your body to produce two-dimensional images on film or a digital detector, much like a photograph. CT scans use an x-ray unit that rotates around your body, producing many cross-sectional images of the inside of your body.

CT Scanner *photo courtesy of UConn Health Center*

Collective radiation dose to the public as a result of increased use of CT imaging has increased substantially over the past decade, although the dose for an individual scan has decreased because of better technology. The National Council on Radiation Protection and Measurements (NCRP) published Report 160 (NCRP 2009), which delineates the magnitude of radiation doses to the U.S. population.

The detailed assessment of anatomy and function that CT imaging provides requires the use of x rays, which results in a small, but not zero, risk to patients. There have been a number of CT-related items in the media since publication of NCRP Report 160 pertaining to radiation risk; however, some of the published information contains misleading statements made with respect to radiation hazards from CT scanning. Since doses from typical CT scans are below the recommended threshold for quantitative estimation of health risks, the Health Physics Society (HPS) asserts that risk estimates for CT imaging in the United States are speculative (HPS 2010).

We know that high doses of radiation have a greater potential to cause harmful effects. This fact is not controversial. However, the supposition that much smaller radiation exposures (such as those received from CT and other medical imaging exams) to many individuals can cause substantial increases in cancer incidence is controversial and not universally accepted in the scientific community.

The establishment and use of risk factors to estimate public health effects from individual or population exposures must consider uncertainties in these factors. It is essential that all uncertainties, assumptions, and inferences used in the assessment process be stated and that any biases in the assessments for the purpose of ensuring prudent public health protection be noted. The estimate of public health effects should be expressed as a

range—low to high—with assumptions, safety margins, and uncertainty factors clearly noted (HPS 1995).

In accordance with current knowledge of radiation health risks, the HPS recommends against quantitative estimation of health risks below an individual dose of 50 mSv in one year or a lifetime dose of 100 mSv above that received from natural sources (HPS 2010). There is substantial and convincing scientific evidence for health risks following high-dose exposures (UNSCEAR 2000). However, below 50-100 mSv (which includes most diagnostic imaging procedures), risks of health effects are either too small to be observed or are nonexistent. Estimation of health risk associated with radiation doses that are of similar magnitude as those received from natural sources (about 3 mSv per year) should be strictly qualitative and encompass a range of hypothetical health outcomes, including the possibility of no adverse health effects at such low levels.

The following table shows the dose a patient might receive if undergoing a CT scan (Mettler 2008). Since these doses are below the recommended threshold for quantitative estimation of health risks, the HPS asserts that risk estimates propagated in many popular publications and in the media are quite speculative. In fact, the number of cancer deaths attributable to CT scans could range from the popularly quoted large numbers to zero. Once again, there is no verifiable scientific evidence that doses of the magnitude received from typical CT scans actually cause cancer.

Procedure/Exam	Typical Dose—mSv
CT Head	2.0
CT Pelvis	6.0
CT Chest	7.0
CT Abdomen	8.0

Dose Justification

Technological advances and innovations in medicine have produced significant benefits for society, including cost-cutting medical care that saves lives (MITA 2012). Early disease diagnosis and some disease treatments involve imaging exams that expose us to radiation. With radiation, physicians have the capability to see inside the human body, to determine if any organ is not functioning properly, to determine if a growth is cancer, to treat disease, and to see if our disease is gone after treatment. Timely detection and treatment of disease is critical to improving outcomes.

Opportunities for Dose Reduction

Although the absolute risk from an individual CT scan may be indeterminate at this time, the HPS believes it is still prudent to minimize radiation doses to patients. In 2006, Americans were exposed to more than seven times as much ionizing radiation from medical procedures as was the case in the early 1980s, according to NCRP. The increase was due mostly to the higher utilization of CT and nuclear medicine.

There are many opportunities for the medical profession to reduce doses without losing the benefit of the new CT technologies. For a patient undergoing a specific CT scan, the factors that need to be considered for reducing dose include (1) the scanned area should be limited to the region of the body where the suspicion exists, (2) the CT technique factors should be adjusted according to the size of the patient's body (for CT imaging studies undertaken on pediatrics, pediatric techniques should be used as applicable), (3) repeat CT scans should be avoided whenever possible, and (4) CT scans should be performed only when a physician believes they will have an impact on the patient's health and health care decisions.

The HPS is concerned that medical exams involving radiation known to be useful for persons at high risk of disease are being used on persons with low disease risk or no disease symptoms and without regard for the radiation risks imposed. Because of potential radiation risks, the HPS, in consonance with guidance from the U.S. Food and Drug Administration (FDA) (U.S. FDA 2010) recommends that the practice of using whole-body CT screening for self-referred, healthy individuals with no disease symptoms be discontinued until scientific studies demonstrate its effectiveness (HPS 2007). Medical examinations involving radiation should be used only when the radiation dose is justified. Additionally, the FDA is requesting medical facilities review CT protocols and other issues related to patient dose (U.S. FDA 2009).

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