

Justification and Optimization: ICRP's 2 Fundamental Principles of Radiation Protection are Unsuitable Companions for Medical Imaging

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Medical imaging does not produce iatrogenic cancer risk from radiation exposure. Credible evidence of imaging-related low-dose (<100 mGy) carcinogenic risk is nonexistent; it is a hypothetical prediction derived from the demonstrably false linear no-threshold (LNT) hypothesis. Nevertheless, 2 so-called fundamental principles of radiation protection in medicine, first promulgated by the International Commission on Radiological Protection (ICRP) in 1977 and subsequently uncritically accepted up to the present by many professionals in the radiation safety community, are: *justification*—any exposures to ionizing radiation must be justified by an anticipated medical benefit; and *optimization*—justified exposures should be applied using the lowest dose necessary to accomplish the required task. This latter principle, spawned by the LNT hypothesis, is referred to as ALARA (as low as reasonably achievable). Much recent discussion and continued disagreement have centered on these principles, which have led to the creation of, for example, the Image Gently and Image Wisely campaigns. Assumptions about LNT are now not only embedded in the radiation culture but also are responsible for potentially harming patients.

The justification is not arguable. However, it is applicable not only to ionizing radiation but could refer to any medical procedure. The ICRP's optimization is not a fundamental principle but rather a derivative one: it is wholly based on the LNT assumption, which is simply not true and has never had any evidential justification. Thus, the “fundamental” principles of justification and optimization are unsuitable and illogical companions. The former is based on a value judgment that has merit for medical imaging, and the latter is based on a scientific matter of “fact” that is completely erroneous.

Although many radiologists and medical physicists grant that imaging's radiation-associated risks are at worst minute (and may be nonexistent), with benefits far outweighing these putative risks, they nevertheless advocate the “prudence” of dose “optimization.” But this conflates actual prudence (i.e., restricting medical procedures to those clinically indicated) with prejudice-based false prudence (i.e., limiting clinically indicated imaging doses). This unjustified, radiophobia-centered approach falsely vilifies beneficial

imaging without confirmatory data and entails extremely harmful consequences. The LNT theory does not provide “known” imaging-associated cancer risks, and its use is therefore neither evidence nor science based.

The usual justification for ALARA dosing is that it errs on the side of caution. This is an example of the precautionary principle, which is only applicable if action to control the feared agent has no or fewer harmful side effects than the agent itself. However, for medical imaging, significant collateral negative consequences arise from lowering dose. Reducing patient doses to mitigate purely hypothetical and nonexistent cancer risks increases other well-known risks resulting from fear of imaging. These include imaging avoidance, subdiagnostic image quality, and use of alternative imaging procedures, such as a longer-duration MR imaging study, requiring risk-incurring sedation for young children, or even exploratory surgery. The risks of misdiagnoses from inadequate dose could be much higher than the cancer risks that the LNT theory falsely predicts and that are putatively avoided by ALARA-based dose-reduction strategies. True iatrogenic risk arises not only from such alternative procedures but also from misdiagnoses that are secondary either to patient refusal of medically indicated imaging or to nondiagnostic scans resulting from insufficient exposures.

Eliminating any and all diagnostic medical procedures that are not clinically warranted is important. But attempting to lessen fictitious risk by lowering doses in studies that are clinically warranted—and often the least hazardous procedures—is a misapplication of the principles of justification and optimization. Medical imaging is designed to achieve a diagnostic purpose and should be governed by the highest science-based principles and policies (such as use of proper procedures and appropriately calibrated equipment). The LNT and ALARA principles are responsible for misguided concerns and uninformed policies promoting radiophobia that lead to actual risks far greater than the hypothetical carcinogenic risk purportedly avoided, all while ignoring imaging's benefits. Radiophobia can no longer be ignored: medical imaging's low-dose radiation exposure has no documented pathway to harm, whereas LNT and ALARA most assuredly do.