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# Radiation Dose in Computed Tomography (CT)

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## How Computed Tomography (CT) works

- Computed Tomography (CT) uses rotating x-ray beams and digital detectors to create detailed cross-sectional images for rapid diagnosis in emergency and elective care.
- Although essential in modern medicine, CT contributes significantly to population radiation dose; continued high use may lead to over 100,000 future cancers in the U.S. (Sterne, 2025).
- Children face higher risk due to developing tissues and longer lifespans (Bosch de Basea et al., 2023).
- Following the As Low As Reasonably Achievable (ALARA) principle and using the American College of Radiology (ACR) Appropriateness Criteria help ensure justified imaging (Tsega et al., 2024).
- Dose optimization through automatic exposure control and iterative reconstruction maintains image quality while lowering radiation exposure (DeMaio, 2026).

## Radiation doses

**Radiation Dose to Adults From Common Imaging Examinations**

| Procedure | | Approximate effective radiation dose | Comparable to natural background radiation for |
|---|---|---|---|
| ABDOMINAL REGION | Computed Tomography (CT) — Abdomen and Pelvis | 10 mSv | 3 years |
| | Computed Tomography (CT) — Abdomen and Pelvis, repeated with and without contrast material | 20 mSv | 7 years |
| | Computed Tomography (CT) — Colonography | 6 mSv | 2 years |
| | Intravenous Pyelogram (IVP) | 3 mSv | 1 year |
| | Radiography (X-ray) — Lower GI Tract | 8 mSv | 3 years |
| | Radiography (X-ray) — Upper GI Tract | 6 mSv | 2 years |
| BONE | Radiography (X-ray) — Spine | 1.5 mSv | 6 months |
| | Radiography (X-ray) — Extremity | 0.001 mSv | 3 hours |
| CENTRAL NERVOUS SYSTEM | Computed Tomography (CT) — Head | 2 mSv | 8 months |
| | Computed Tomography (CT) — Head, repeated with and without contrast material | 4 mSv | 16 months |
| | Computed Tomography (CT) — Spine | 6 mSv | 2 years |
| CHEST | Computed Tomography (CT) — Chest | 7 mSv | 2 years |
| | Computed Tomography (CT) — Lung Cancer Screening | 1.5 mSv | 6 months |
| | Radiography — Chest | 0.1 mSv | 10 days |
| DENTAL | Intraoral X-ray | 0.005 mSv | 1 day |
| HEART | Coronary Computed Tomography Angiography (CTA) | 12 mSv | 4 years |
| | Cardiac CT for Calcium Scoring | 3 mSv | 1 year |
| MEN'S IMAGING | Bone Densitometry (DEXA) | 0.001 mSv | 3 hours |
| NUCLEAR MEDICINE | Positron Emission Tomography — Computed Tomography (PET/CT) | 25 mSv | 8 years |
| WOMEN'S IMAGING | Bone Densitometry (DEXA) | 0.001 mSv | 3 hours |
| | Mammography | 0.4 mSv | 7 weeks |

**Note:** This chart simplifies a highly complex topic for patients' informational use. The effective doses are typical values for an average-sized adult. The actual dose can vary substantially, depending on a person's size as well as on differences in imaging practices. It is also important to note that doses given to pediatric patients will vary significantly from those given to adults, since children vary in size. Patients with radiation dose questions should consult with their radiation physicists and/or radiologists as part of a larger discussion on the benefits and risks of radiologic care.

RadiologyInfo.org — The radiology information resource for patients — RSNA Radiological Society of North America — ACR American College of Radiology, Quality is Our Image

For the most current information, visit radiologyinfo.org.

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(FWRadiology, n.d.)

- CT dose is measured in millisieverts (mSv) and varies by exam type.
- A head CT averages 2 mSv, a chest CT 7 mSv, and an abdomen/pelvis CT about 10 mSv.
- These levels are far higher than standard x-rays, making CT a major source of medical radiation.
- Repeated or multiphase exams can raise lifetime cancer risk, especially in children, whose tissues absorb more radiation per exposure (Bosch de Basea et al., 2023).
- Modern scanners use automatic exposure control and iterative reconstruction techniques to reduce radiation dose while maintaining image quality (Moghadam et al., 2025).
- Following the ALARA principle and campaigns such as Image Gently and Image Wisely helps ensure every scan is justified and optimized (Aziz et al., 2025).

## Image Gently & Image Wisely

- Image Gently (pediatrics) promotes "child-size" techniques using reduced kVp and mA, minimized z-axis coverage, and shielding when possible. It also encourages use of ultrasound or MRI as radiation-free alternatives for children (Aziz et al., 2025).
- Image Wisely (adults) focuses on justification and ALARA principles, promotion of automatic exposure control (AEC), standardized protocols, and dose-tracking systems to monitor cumulative exposure (DeMaio, 2026).
- The Choosing Wisely campaign involves collaboration between radiologists and referring physicians to avoid unnecessary imaging, limit repeat CT exams, and improve communication through evidence-based guidelines.
- Hospitals are also implementing clinical decision-support tools and interdisciplinary review processes to reduce inappropriate scans and reinforce justification (Tsega et al., 2024).
- Ongoing education for technologists improves protocol optimization, ensures consistent dose reduction, and enhances patient understanding of radiation risks (Kwee et al., 2024).

## Excessive Ordering of CT Scans

- A large portion of CT exams are low-value or unnecessary, often ordered due to diagnostic uncertainty or defensive medicine (Kwee et al., 2024). This contributes to rising healthcare costs and exposes patients to avoidable radiation.
- Among frequently admitted patients, only about 4% of repeat head CTs reveal new, clinically significant findings, showing high rates of imaging overuse (Owlia et al., 2014). Repeated scans are often performed because of limited access to prior images or provider caution.
- Multiple CTs are linked to a higher risk of hematologic malignancies, especially in children who are more sensitive to radiation. Studies show that pediatric patients undergoing several scans may face up to a threefold increase in cancer risk (Bosch de Basea et at., 2025).
- To prevent unnecessary exposure, providers should use structured clinical decision rules such as Pediatric Head Injury/Trauma Algorithm (PECARN) for pediatric head trauma, which help identify when imaging is truly warranted and support the ALARA principle.
- Promoting awareness and education among healthcare professionals is essential to reducing overuse. Encouraging collaboration between radiologists, referring physicians, and technologists ensures CT imaging is used appropriately and safely, optimizing diagnostic benefit while minimizing risk to patients (Aziz et al., 2025).

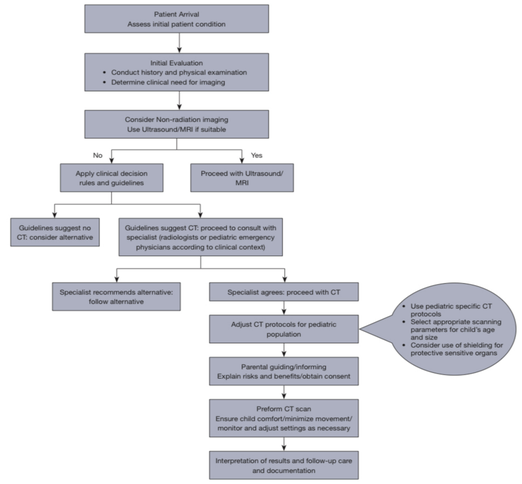


Figure 1. Flowchart showing how to reduce CT scans in pediatric population (Aziz et al., 2025, p. 9)

## Dose Optimization

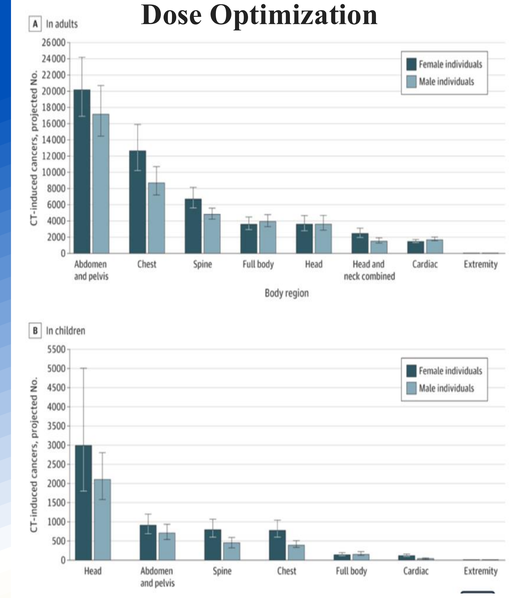


Figure 3. Projected number of CT-induced cancers by body region (Smith-Bindman et al., 2025, p. 716)

- CT dose reduction follows ALARA through evidence-based protocols such as adjusting tube current, applying weight-based settings, and using AEC to reduce radiation & ensure image quality (Moghadam et al., 2025).
- In pediatrics, Image Gently and PECARN guidelines guide appropriate CT use and promote safer options like MRI or ultrasound (Aziz et al., 2025).
- Higher cumulative radiation increases cancer risk, reinforcing justification and optimization (Smith-Bindman et al., 2025).

## Conclusion

- Computed Tomography (CT) remains an essential diagnostic tool, but its growing use highlights the need for radiation safety and justification.
- Modern CT provides rapid, high-quality imaging yet contributes to population radiation exposure.
- Dose-reduction strategies such as automatic exposure control, iterative reconstruction, and weight-based protocols maintain image quality while minimizing risk.
- Campaigns such as Image Gently and Image Wisely reinforce the ALARA principle, ensuring scans are justified and optimized through ongoing education and evidence-based practice.

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