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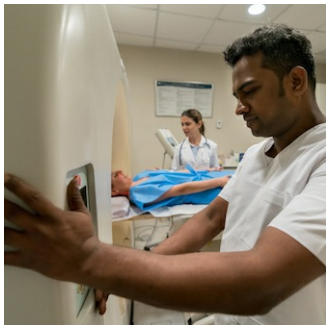
CT radiation doses vary more than 50% due to scanner settings



CT radiation exposure is associated with increased risk of cancer development in patients, as ionising radiation is a known carcinogen agent. Radiologists know it is crucial to limit medical imaging exposure and are increasingly adamant on finding ways to avoid unnecessary testing and reduce CT doses.

In a new study published in the BMJ, researchers find that significantly large differences in radiation doses used for CT scans are mainly the result of how the scanning machines are used and operated by medical staff. The University of California San Francisco led international research team recommends standard protocols for CT scan doses.

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The results suggest that in many cases, the **doses** in CT scans **can be reduced** by **50% or more** without compromising image diagnostic accuracy. The data that were collected and analysed from the University of California San Francisco CT International Dose Registry was used to determine patient, organisation and medical equipment characteristics that contribute to varying radiation doses used for computed tomography scans.

Over **2 million CT scans** of adults who underwent examinations from November 2015 to August 2017, from **151 institutions** in seven countries ((Switzerland, Netherlands, Germany, United Kingdom, United States, Israel, and Japan)provided the standardised data for the study. The University of California San Francisco CT International Dose Registry collects data from participating healthcare institutions worldwide that perform CT scans. In this study, the researchers used the registry data to understand factors that influence CT dose, to inform development of dose optimisation approaches, and to ultimately investigate the need (or lack of) to localise target levels.

The Registry was created to pool **CT dose data** from collaborating institutions on 100% of CT scans performed. Radiation and imaging data stored in digital imaging and communications in medicine (DICOM) format are exported onto a local server directly from the CT machines or through the picture archiving and communication systems (PACS) used to review these exams. Data are stripped of sensitive patient identifying information other than study date and time, and transferred to the dose registry in real time.

The images analysed adjusted data for effective doses and proportions of high dose examinations including abdomen, chest, combined chest and abdomen, and head CT scans; were classified by patient characteristics (sex, age, and size), type of institution (trauma centre, care provision 24 hours per day and seven days per week, academic, private), organisation practice volume, equipment specifications (manufacturer, model), country, and how scanners were used, before and after adjustment for patient characteristics, using hierarchical linear and logistic regression. High dose examinations were defined as CT scans with doses above the 75% defined during a baseline period.

The research team found that most of the factors related to the patients had a very small effect on the variation of CT doses across all the countries. Similarly analysing the data for institution and medical equipment specifications and factors had very little effect on dose differences. When adjusting the data analysis for technical factors- the manner in which the medical scanners were used and operated by medical staff- the researchers found this substantially reduced or eliminated almost all of the dose variation across the countries. The technical factors, therefore, explained virtually all the dose variation (95% relative dose 1.42) and the average doses among the participating countries were similar. Large differences in the relative doses across machines and countries that were reduced or eliminated only after the application of technical parameters.

“Radiation, including radiation from CT, has been shown to be associated with an increased risk of cancer. Therefore, it is important to minimise exposures whenever possible,” said in a statement published online, lead author Dr. Rebecca Smith-Bindman, UCSF professor of radiology, epidemiology and biostatistics, and of obstetrics, gynaecology and reproductive medicine. “Our study indicates that this can be accomplished through the creation and implementation of consistent international technical standards for CT scanners.”

The study included patients as stakeholders in the project who contributed as part of in-person meetings and webinars to help guide the project direction. CT examinations were collected from 290 imaging machines from four equipment manufacturers and 49 imaging machine models.

CT protocols and radiation doses vary greatly across countries and are primarily attributable to local choices regarding technical parameters, rather than patient, institution, or machine characteristics. Thus, CT scan dose differences between countries were not due to patient or institutional characteristics or machine manufacturer or model, but were almost entirely the result of how institutions used the machines, possibly because of the different decisions regarding technical parameters to produce optimal CT images.

These findings suggest that the optimisation of doses to a consistent standard should be possible within a national health system and between different countries by defining the decisions made by radiology teams in developing CT scan protocols for patients.

The study also suggests that future research should focus on understanding why and how different approaches are taken, what factors drive institutions, and scientifically comparing the different approaches in order to optimise CT doses.

Sources: BMJ, The University of California San Francisco
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