International study shows that large variation in radiation doses in CT are due to how scanners are used by medical staff rather than by patient characteristics or machine manufacturer or model

The findings of a recent study shows that large differences in radiation doses used for CT scans are mainly due to how the scanners are used by medical staff rather than differences in the patients scanned or the machines used. (*Smith-Bindman R, et al. International variation in radiation dose for computed tomography examinations: prospective cohort study BMJ. 2019 Jan 2;364:k4931. doi: 10.1136/bmj.k4931)*

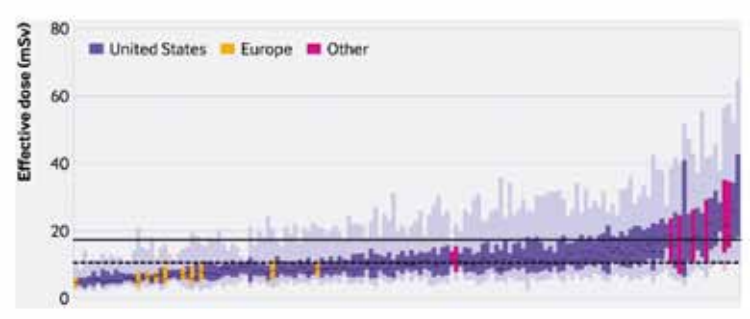

Fig 1 Distribution in effective radiation dose by institution for abdomen CT, after adjustment for patient characteristics. Each column signifies one institution, ranked by mean effective dose. Light purple columns=5th and 95th percentiles of effective dose; dark purple, pink, and yellow column sections=25th and 75th percentiles of effective dose; lines=medians; horizontal solid line and dashed line=benchmark and target doses for abdomen, defined as the 75th and 50th percentiles of dose for all abdominal scans performed before 30 April 2016. Image reproduced from Smith-Bindnam *et al. BMJ 2019 Jan 2; 364:k4931.* Image courtesy of BMJ.

Radiation doses for computed tomography (CT) vary substantially across patients, institutions, and countries. Ionizing radiation is a known carcinogen, and CT radiation is associated with increased cancer incidence so it is important to minimize exposure from medical imaging and reduce unnecessary variation by optimizing examination protocols. Evidence suggests that in many instances, CT doses can be reduced by 50% or more without reducing diagnostic accuracy. Setting more consistent dose standards should therefore be possible and will ensure that patients are not exposed to unnecessary radiation risks. However, differences in patient populations and inconsistencies in data collection and analysis have challenged both accurate quantification of dose variations. The recently published study was designed to determinate if dose variability is driven primarily by patient characteristics (patient size, indications for imaging), institution type (eg, academic, private, trauma facility, or 24 h/day provider of CT), machine factors (eg, machine age, specific manufacturer and model, or use of updated software that permits dose reduction), or regional choices that affect dose optimization or image quality (or both).

To do this, the international research team analysed standardized dose data data from over 2.0 million CT examinations of adults who underwent CT between November 2015 and August 2017 in 151 institutions, across seven countries. They included scans of the abdomen, chest, combined chest and abdomen, and head from 1.7 million adults. The data were analyzed for a range of variables related to the patient (e.g. sex and size), institution (e.g. trauma centre, academic or private), and machine (e.g. manufacturer and model).

The researchers found that most of these factors had only a small effect on dose variation across countries.

For example, after adjusting for patient characteristics, there was still a fourfold range in mean effective dose for abdominal scans and a 17-fold range in proportion of high dose scans (4-69%). Similar variation persisted for chest scans, and combined chest and abdomen scans.

"... adjusting for technical factors (how scanners were used by medical staff) substantially reduced... all the dose variation..."

Adjusting for institution and machine factors also had little effect on dose variation.

However, adjusting for technical factors (how scanners were used by medical staff) substantially reduced or eliminated nearly all the dose variation across countries.

The researchers conclude that the variation in doses used for CT scanning of patients is primarily driven by how CT scanners are used, rather than to underlying differences in the patients scanned or the machines used. The study was an observational study, and as such, can't establish cause, in addition, as the researchers point out, the study inevitably had some limitations that may have influenced the results.

Nevertheless, they say these findings suggest that optimising doses to a consistent standard should be possible. The researchers also call for more education and international collaboration to set benchmarks for optimum target doses.

Smith-Bindnam R et al. paper doi: 10.1136/bmj.k4931.