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Extra Z-axis Coverage at CT Imaging Resulting in Excess Radiation Dose: Frequency, Degree and Contributory Factors

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Abstract

OBJECTIVE—To assess the degree of extra scanning beyond the prescribed anatomic boundaries for thoracic and body CT scans and to identify associated factors.

METHODS—For 442 consecutive chest, abdomen and/or pelvis CT exams, the length of extra scanning beyond the prescribed anatomic boundaries was determined. Exams were grouped according to the locations/types of the prescribed boundaries and compared with regard to length of extra scanning.

RESULTS—438 of 442 (99%) CT exams included extraneous imaging, showing a mean excess scanning length of 43.2 mm per exam (range 0–180 mm). Significantly more extraneous imaging was performed when soft tissue or vascular structures defined anatomic boundaries compared to when osseous ($p < 0.001$) or air/soft tissue interfaces ($p < 0.0001$) defined the boundaries. Average percent of total scan dose attributable to extra imaging was 8.64–10.38%.

CONCLUSIONS—CT scanning beyond the prescribed anatomic boundaries occurs commonly, resulting in moderate extra radiation dose.

Keywords

Radiation dose; Technology assessment; CT technique

Introduction

The use of CT has risen dramatically during the past decade, and with this has come an increased population radiation burden, possibly accounting for up to 2% of cancers (1) (2) (3). Despite recent technological advances that help to reduce radiation dose, such as automatic tube current modulation (ATCM) and iterative reconstruction techniques, patients undergoing CT scans may incur significant doses of radiation (4) (5) (6). Pending further advances in CT technology, one of the simplest methods of reducing the amount of patient radiation exposure lies in properly confining the scan volume to the correct superior and

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inferior anatomic boundaries. Previous studies (7, 8) have found that approximately 98% of body CT scans exceed the pre-defined anatomic boundaries of their respective scan protocols, producing a significant number of extra, unwarranted images.

The aim of our study was to assess the frequency and degree of extra Z-axis scanning, as it occurs at our institution, and to explore what factors might be associated with such extraneous imaging. If such factors could be elucidated, corrections might be instituted in order to minimize the amount of radiation exposure to patients.

Materials and Methods

Approval for this HIPAA compliant, retrospective study was obtained from the institutional review board, with waiver of informed consent.

All adult chest, abdomen and/or pelvis CT exams performed in our main hospital over a three day period (April 15–17, 2009) were retrospectively identified. These exams were obtained for a variety of indications in patients with neoplastic and non-neoplastic diseases. The CT studies were performed on several different scanners manufactured by GE Healthcare, including LightSpeed VCT 64, LightSpeed 16 Pro, and Discovery CT 750 HD. For each exam, the scanning protocol prescribed by the radiologist (based on clinical indications) was identified from the accompanying paperwork. Subsequently, each exam was analyzed on a workstation by a single investigator (a fourth year medical student who was trained and closely supervised by an experienced senior faculty member) in order to determine the length (in mm) that was scanned above the prescribed top boundary and below the prescribed bottom boundary for the particular clinical scanning protocol that was used; protocols and definitions of the anatomic boundaries are delineated in Table 1. Exams that started or terminated within their preset anatomic boundaries were considered to have exceeded these boundaries by zero millimeters. Whenever the anatomic boundary varied from right to left (e.g. one iliac crest higher than the other), the boundary was chosen so as to maximize CT coverage and minimize the overcalling of extra scanning. After the initial analysis by the student, 50 cases were randomly selected for quality control by the supervising faculty member, including at least two cases from each scanning protocol group listed in Table 1.

Some patients were scanned using a multiscan protocol, such as a malignancy work-up that included the chest and abdomen. For this type of exam, the chest was scanned first, from the lung apices to the lung bases. Subsequently, the scan table was repositioned, and then the abdomen was scanned from the top of the diaphragm to the iliac crests. This type of study was coded as two separate exams (chest CT and abdomen CT), because each had its own prescribed top and bottom boundaries. The reason for the overlap in scanning at the level of the diaphragm was to accommodate the use of different section thicknesses and spacing for the chest and the abdomen studies and to allow for different requirements in intravenous contrast bolus timing. A combined chest/abdomen aortic CT (performed using continuous scanning, with no overlap at the level of the diaphragm) was coded as a single study with one top boundary and one bottom boundary. A combined abdominal/pelvic CT was coded as a single study with one top boundary and one bottom boundary. A pulmonary embolism protocol CT was coded as two separate exams (chest CT and pelvis/lower extremity CT), each with its own top and bottom boundaries.

For each exam, the following information about patient characteristics was gathered from the CT requisition form or the patient's electronic medical record: gender, age, height, weight, and patient location (inpatient, outpatient, or emergency room). BMI was calculated using patient height and weight, using the formula:

$$\text{BMI} = \text{patient weight (kgs)} \div (\text{patient height (meters)})^2$$

Other information was obtained from the exam itself, including whether the exam was solitary or part of a multiscan protocol (e.g. chest only or chest/abdomen), and time of day.

The CT dose index volume (CTDI_{vol}) and dose length product (DLP) for each exam were obtained from the scanner generated dose report. $\text{DLP} = \text{CTDI}_{\text{vol}} \times \text{total scan length}$, and extra $\text{DLP} = \text{CTDI}_{\text{vol}} \times \text{extra scan length}$. At the time when these examinations were obtained, Z-axis ATCM had not yet been fully implemented on our 16 slice scanners, and therefore many exams were performed using fixed tube current, optimized for the size of the patient. For scans performed utilizing a fixed Z-axis tube current, the DLP of the extraneous images (extra DLP) was calculated using the following formula:

$$\text{extra DLP} = \text{extra scan length} \div \text{total scan length} \times \text{total DLP}$$

For scans performed using ATCM, the mA for each extraneous image was recorded, and an average mA was calculated for these images. The average mAs was then calculated by multiplying the average mA times the tube rotation time. Pitch, kVp, and table speed were also recorded for these extra images. Collimation was calculated by dividing the product of the table speed and the gantry rotation time by the pitch. To compute the CTDI_{vol} for each of these cases, we noted the scanner that was used and looked up the scanner-specific weighted CTDI (CTDI_w) that had been measured by our physicists at a standard mAs for the collimation and kVp utilized in the case. We then employed the equation:

$$\text{CTDI}_{\text{vol}} = \text{CTDI}_w \times (\text{mAs}(\text{exam}) / \text{mAs}(\text{standard})) / \text{pitch}$$

DLP for the extraneous images was then calculated by multiplying the CTDI_{vol} by the total length of extraneous imaging.

Statistical Analysis

Exams were grouped according to the locations of the respective prescribed top and bottom boundaries for the protocols that were used (location groups) (Table 1). In addition, these groups were combined according to the respective types of boundaries used (boundary groups), including (1) osseous, (2) air/soft tissue interface, and (3) soft tissue or vascular (Table 1). Groups were compared with each other with regard to extent of extraneous scanning. In addition, the degree of extra scanning was compared among various patient characteristics and different times of the day.

Continuous variables were summarized using means and standard deviations, categorical variables were summarized by counts and proportions. Box-plot graphs were produced to display the distribution of continuous variables among the different groups. For the univariate analyses, one way analysis of variance (ANOVA) or linear regression was used to evaluate the effect of each predictor on excess scanning outcome. Post hoc analyses were performed using the Scheffé test in the comparison of extra scanning among the different groups. Stepwise multivariate regression analyses were performed to identify the predictors of top, bottom and total extra scanning. Variables with a P value <0.2, in the univariate analyses, were included in the multivariate analyses. A probability (p) value of 0.05 or smaller was considered significant for all hypothesis tests. The above procedures were done in SAS 9.2.

Results

304 total patients were scanned, resulting in 442 separate CT examinations for analysis. Breakdown of exams according to body part is shown in Table 2. For the 50 cases selected for quality control, the concordance between the faculty member and the student was 100%

with regard to boundary locations, with 95% exact binomial CI of [96 – 100]. 438 out of 442 (99%) exams included extraneous imaging, showing a mean total (top plus bottom) excess scanning length of 43.2 mm per exam (Table 3), with a range from 0 – 180 mm. Of these, 429 exams had additional images at the top, 332 exams had additional images at the bottom, and 323 had additional images both top and bottom.

The following variables were each independent, significant predictors of excess scan length beyond the prescribed top boundary: scan protocol location group ($p < .0001$), time of day ($p = .001$), male gender ($p = .047$), and height ($p = .01$). When considered as part of a multivariate model, scan protocol location group ($p < .0001$), time of day ($p < .0001$), and height ($p = .004$) were the variables that were most predictive of excess scan length. Scans in the “celiac artery” location group had the highest mean top extra scanning length in comparison to other location groups (Figure 1). Exams performed between 1500 and 2300 hours were more likely to have extraneous top images compared to exams performed between 0700 and 1500 hours or between 2300 and 0700 hours. In addition, the taller the patient, the greater the chance that the scan would surpass its prescribed upper anatomic boundary.

In the univariate analysis, the following variables were each independent, significant predictors of excess scan length beyond the prescribed bottom boundary: scan protocol location group ($p < .0001$), time of day ($p = .01$), and outpatient location of the patient ($p = .02$). Scans in the “aortic bifurcation” location group demonstrated the highest mean bottom extra scanning length in comparison to other location groups (Figure 2). Exams performed between 0700 and 1500 hours were more likely to have extraneous bottom images than exams performed at any other time. When considered as part of a multivariate model, scan protocol location group was most predictive of excess scan length ($p < .0001$).

The following factors were significant when analyzing the total amount of extraneous scanning (top and bottom, combined) using univariate analysis: scan protocol location group ($p < .0001$) and time of day ($p = .01$). Exams in the “celiac artery” top location group and exams in the “aortic bifurcation” bottom location group were more likely than other types of exams to exceed their prescribed limits. Scans performed between 2300 and 0700 hours had significantly less extraneous scanning compared to exams performed at other times of the day. Using multivariate analysis, BMI also had a significant effect when controlling for height and weight ($p = .03$): higher BMI correlated with an increased chance of extra scanning.

Significantly more extraneous images were obtained when soft tissue/vascular structures defined the anatomic boundaries as compared to when osseous ($p < 0.001$) or air / soft tissue interfaces ($p < 0.0001$) defined the boundaries (Figures 3 and 4). There were more extraneous images for exams performed using a multiscan protocol compared to exams using a single scan protocol, although this difference was not statistically significant ($p = 0.3$).

There were 131 exams that used z-axis ATCM, and 311 exams that used fixed tube current. For exams that used z-axis ATCM, the average DLP of the extraneous images (top and bottom) was 64.07 mGy*cm (milliGray centimeter) and the average total DLP for these exams was 617.3 mGy*cm, resulting in an average of 10.38% extra radiation (range 0–50.9%). For exams that used a fixed mA, the average DLP for the extra images (top and bottom) was 59.02 mGy*cm and the average total DLP was 682.8 mGy*cm, resulting in an average 8.64% extra radiation (range 0–33.2%) Breakdown of the degree of extra radiation according to boundary location groups is shown in Table 4.

Discussion

As the number of clinical applications for CT scanning continues to expand, so too does concern about collective and individual radiation doses incurred by this increased utilization. One source of extra, unnecessary radiation is the routine practice of obtaining CT images beyond the prescribed anatomic boundaries of the body part needing examination. There is little data on this phenomenon in the medical literature. In one study by Campbell et al., 148 consecutive chest CT examinations were evaluated, reporting that the 97% had extra supraapical images and 98% had extra infrapulmonary images (7). An average of 14.5 extra images were obtained per exam (range 0–32, median 14.5), presumably corresponding to a mean extra scan length of 72.5 mm. Additional findings were identified only on infrapulmonary extra images, and most clinically important extra findings, such as adrenal nodules or liver lesions, were found in patients with a history of malignancy. This study differed from ours by considering all infrapulmonary images as “extra.” We considered images to be “extra” on a chest CT if they were obtained below the prescribed lower scan boundary, which varied according to the clinical scan protocol used. In this study extra images contributed a 20.9% increase in DLP on examinations performed using a fixed tube current and 56.9% increase in DLP on examinations performed using z-axis ATCM (7). These figures were larger than those in our study, possibly due to the difference in defining the lower boundary between “non-extra” and “extra” images. In addition, many of our examinations included longer z-axis coverage (e.g. chest-abdomen-pelvis exams) compared to the chest-only CT examinations in the report of Campbell et al., thus leading to a potentially smaller percent increase in extra scanning length and DLP for our study.

A second published study evaluated extra scanning in 106 abdominal and pelvic CT scans (8). 103 (97%) of 106 examinations showed extra images above the dome of the diaphragm and 100 (94%) showed extra images below the symphysis pubis. An average of 12 extra images were obtained per exam (range 1–36, median 11), presumably corresponding to a mean extra scan length of 60 mm. Most of the extra images contributed no additional clinical information. Extra images contributed a 13.1% increase in DLP on examinations performed using a fixed tube current and 16.7% increase in DLP on examinations performed using z-axis ATCM.

In addition to documenting the amount of extra scanning and resulting extra radiation dose in our department, we attempted to elucidate patient and/or systemic factors that might correlate with the degree of extraneous imaging. Our results were, for the most part, unsurprising. Scanning protocols with boundaries that were easily identified on scout radiographs, e.g. osseous landmarks, showed the lowest extra scanning lengths. Protocols with boundaries that were not identifiable on scout radiographs, e.g. soft tissue or vascular landmarks such as the aortic bifurcation or the top of the kidneys, showed the highest extra scanning length. Protocols with boundaries at air/soft tissue interfaces, such as lung apices or diaphragmatic dome, showed extra scanning lengths measuring between the other two groups (osseous group and soft tissue or vascular group). Patients with larger BMI values showed significantly more extra scanning, probably because large body habitus tends to obscure landmarks on the scout image. These findings confirm that technologists rely heavily upon the scout radiograph for determining start and end scanning locations. Thus, for boundaries not easily seen on the scout images, it might be helpful to obtain a very low dose localizer image, in order to confirm the anatomic level before performing the diagnostic exam.

Not all of our results, however, were quite so straightforward. One unexpected finding involved the time of day during which the scan was performed. Total excess scanning length decreased significantly for scans performed between 2300 hours and 0700, in comparison to

scans performed during the rest of the day. There are several possible explanations for this phenomenon. Firstly, fewer scans tend to be performed during this night time period, resulting in a lower workload and potentially less stressful working environment; this might allow technologists working the late night shift to have more time to carefully set up the scan parameters for each individual examination. Moreover, there is probably a smaller variability in the types of scan protocols that are used during this shift, confined mostly to emergency cases, thereby allowing the technologists to develop greater expertise in performing such studies.

One possible reason for extra scanning, even with well defined boundaries that are visible on scout radiographs, is reluctance on the part of the technologist to run the risk of missing any of the relevant anatomy. Thus, it may be impossible to eliminate all extra imaging, particularly at boundaries like the diaphragm that may move between acquisition of the scout image and the axial sections. In addition, technologists may obtain extra images if they believe that there is a pathologic finding on the lowest (or highest) image of the exam; this practice is of doubtful clinical usefulness and may account for some of the outliers in our study, in which the prescribed boundaries were exceeded by as much as 18 cm. Often, including extra imaging is perceived by technologists (and radiologists) as being without penalty, forgetting the real and potential risks of radiation exposure to the patient. These problems should be ameliorated with continuing education.

One factor that leads to excess z-axis radiation and patient dose is overranging, defined as the difference between the planned scan length and the exposed scan length. Overranging is an integral feature of helical CT and is affected by collimation, pitch and section width (9). Overranging, however, does not result in an increase in the number of CT images (i.e. no images are generated at table positions that are exposed outside the imaged length (9)), and therefore this phenomenon would not affect the results from our study.

Limitations of our study included our inability to distinguish between inadvertent extra imaging and purposeful extra imaging on the part of the technologist; however, we believe that the latter phenomenon was likely infrequent. The large number of technologists in our department, with varying levels of experience, may be a limitation; however, on the other hand, this reflects real world radiology practice.

Our study shows that CT scanning beyond the prescribed anatomic boundaries is a common occurrence, resulting in moderate extra total radiation exposure to patients; elimination of these extra images is a relatively easy way of reducing radiation dose. Awareness of the scope of the issue and contributing factors is important in order address the problem. Adequate technologist training and increased vigilance on the part of the technologist and the supervising radiologist are key factors in helping to avoid unnecessary exposure.

Acknowledgments

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Extraneous Scanning by Top Boundary Location Group

Figure 1.

Box and whisker plot showing length of extraneous scanning according to top boundary location group. The celiac artery boundary group demonstrated the greatest length of extraneous scanning, while the iliac crest boundary group demonstrated the least amount of extraneous scanning.

Extraneous Scanning by Bottom Boundary Location Group

Figure 2.

Box and whisker plot showing length of extraneous scanning according to bottom boundary location group. The aortic bifurcation boundary group demonstrated the greatest length of extraneous scanning, while the iliac crest boundary group demonstrated the least amount of extraneous scanning.

Extraneous Scanning by Top Boundary Type Group

Figure 3.

Box and whisker plot showing length of extraneous scanning according to top boundary type group. The soft tissue/vascular boundary type group demonstrated the greatest length of extraneous scanning, while the osseous boundary type group demonstrated the least amount of extraneous scanning.

Extraneous Scanning by Bottom Boundary Type Group

Figure 4.

Box and whisker plot showing length of extraneous scanning according to bottom boundary type group. The soft tissue/vascular boundary type group demonstrated the greatest length of extraneous scanning, while the osseous boundary type group demonstrated the least amount of extraneous scanning.

Table 1

Boundary Locations and Groupings for CT Examination Protocols

Scanning Protocol	Prescribed Top Boundary Location	Top Boundary Location Group	Top Boundary Type Group#	Prescribed Bottom Boundary Location	Bottom Boundary Location Group	Bottom Boundary Type Group#
Routine chest; low dose Lung nodule; HRCT ^a ; PE ^b	Lung apices ^f	Apices	2	Lung bases ^j	Lung base	2
Lung cancer	Lung apices ^f	Apices	2	Adrenals ^m	Adrenals	3
Chest aorta without contrast	2 cm above aortic arch ^g	Aortic arch	2	2 cm below celiac axis ⁿ	Adrenals	3
Chest aorta with contrast	Lung apices ^f	Apices	2	2 cm below celiac axis ⁿ	Adrenals	3
Chest-abdomen aorta without contrast	2 cm above aortic arch ^g	Aortic arch	2	2 cm below aortic bifurcation ^o	Aortic bifurcation	3
Chest-abdomen aorta with contrast	Lung apices ^f	Apices	2	2 cm below aortic bifurcation ^o	Aortic bifurcation	3
Chest-abdomen-pelvis aorta with contrast	Lung apices ^f	Apices	2	Lesser trochanters ^p	Lesser trochanters	1
Routine abdomen; AV liver ^c ; AV pancreas ^d	Diaphragm ^h	Diaphragm	2	Iliac crest ^q	Iliac crest	1
Renal mass	2 cm above kidneys ⁱ	Celiac artery	3	1 cm below iliac crest ^q	Iliac crest	1
Renal stone	2 cm above kidneys ⁱ	Celiac artery	3	Symphysis pubis ^s	Lesser trochanters	1
CTU ^e without contrast	2 cm above kidneys ⁱ	Celiac artery	3	Symphysis pubis ^s	Lesser trochanters	1
CTU ^e with contrast	Diaphragm ^h	Diaphragm	2	Symphysis pubis ^s	Lesser trochanters	1
Routine abdomen and pelvis; Appendicitis; Enterography; Mesenteric	Diaphragm ^h	Diaphragm	2	Lesser trochanters ^p	Lesser trochanters	1

Scanning Protocol	Prescribed Top Boundary Location	Top Boundary Location Group	Top Boundary Type Group#	Prescribed Bottom Boundary Location	Bottom Boundary Location Group	Bottom Boundary Type Group#
Aorta abdomen and pelvis	2 cm above celiac axis ^j	Celiac artery	3	Lesser trochanters ^p	Lesser trochanters	1
Pelvis and lower extremities (PE ^b protocol)	Iliac crest ^k	Iliac	1	Tibial plateau ^s	Tibial plateau	1
Routine pelvis	1 cm below Iliac crest ^k	Iliac	1	Lesser trochanters ^p	Lesser trochanters	1

Boundary Type Groups:

- 1) osseous
- 2) air/soft tissue interface
- 3) soft tissue or vascular

^aHigh resolution chest CT

^bPulmonary embolism

^cArteriovenous phase liver

^dArteriovenous phase pancreas

^eCT urogram

^fTop of higher lung

^gTop of aortic arch

^hTop of higher hemidiaphragmatic dome

ⁱTop of higher kidney

^jTop of celiac axis origin

^kTop of higher iliac crest

^lBottom of lower lung

^mBottom of lower adrenal

ⁿBottom of celiac axis origin

^oBottom of aortic bifurcation

p Bottom of lesser trochanter

q Top of lower iliac crest

r Bottom margin of symphysis pubis

s Top of tibial plateau

Table 2

Breakdown of 442 individual CT exams according to body part

No. of patients	Body part
171	Chest
8	Chest plus abdomen ^a
34	Chest plus abdomen plus pelvis ^a
65	Abdomen
143	Abdomen plus pelvis ^b
1	Pelvis
20	Pelvis plus lower extremities ^c

^a continuous aortic exams with no gaps or overlap between chest portion and abdomen portion

^b continuous exams with no gaps or overlap between abdomen portion and pelvic portion

^c continuous exams with no gaps or overlap between pelvic portion and lower extremity portion

Table 3
Breakdown of excess imaging according to patient and examination characteristics

Characteristic	Total Number	Mean extra scan length (mm)		
		Overall	Top	Bottom
All scans	442	43.2 ± 26.8	24.0 ± 14.1	19.2 ± 23.9
Excess imaging	438	45.0 ± 26.1		
Excess top imaging	429		24.7 ± 13.6	
Excess bottom imaging	332			27.4 ± 22.7
Gender				
female	207	41.2 ± 25.5	22.5 ± 13.9	18.6 ± 23.0
male	235	44.2 ± 25.2	25.2 ± 14.1	19.0 ± 21.9
Location				
ER	67	37.3 ± 23.8	24.3 ± 16.0	12.9 ± 20.2
Inpatient	79	41.4 ± 23.9	25.2 ± 12.8	16.3 ± 21.6
Outpatient	296	44.4 ± 25.9	23.6 ± 13.9	20.8 ± 22.8
Time of Exam				
07:00 – 15:00	266	43.3 ± 26.8	22.4 ± 13.0	20.9 ± 23.7
15:00 – 23:00	145	44.7 ± 23.7	27.5 ± 15.9	17.2 ± 21.1
23:00 – 07:00	31	29.7 ± 15.3	21.2 ± 11.1	8.5 ± 9.4
Top Boundary Location Groups				
celiac artery	21		37.2 ± 29.3	
aortic arch	16		32.5 ± 15.6	
diaphragm	187		27.0 ± 13.2	
lung apices	197		19.9 ± 10.2	
iliac crest	21		15.0 ± 9.3	
Bottom Boundary Location Groups				
aortic bifurcation	25			40.9 ± 37.2
lung bases	156			28.2 ± 20.5
tibial plateau	20			18.0 ± 14.1
adrenal glands	19			15.9 ± 20.6
lesser trochanters	199			10.1 ± 17.9
iliac crest	23			9.7 ± 14.2

Characteristic	Total Number	Mean extra scan length (mm)		
		Overall	Top	Bottom
Top Boundary Type Groups				
Osseous	21		15.0 ± 9.3	
Air / Soft Tissue interface	384		23.4 ± 12.3	
Soft tissue or Vascular	37		35.2 ± 24.2	
Bottom Boundary Type Groups				
Osseous	242			10.7 ± 17.4
Air / Soft Tissue interface	156			28.2 ± 20.5
Soft tissue or Vascular	44			30.1 ± 33.2

Table 4
Breakdown of Average, Extra CTDI_{vol} and Average Extra DLP by Boundary Location Groups

Top Boundary	Average Exam CTDI _{vol}	Average Exam DLP	Average Extra Top Images CTDI _{vol}	Average Extra Top Images DLP	Average % of total radiation dose due to extra images	Body parts at risk
Apices or arch	12.99	528.6	17.86	33.58	6.35	Thyroid, neck
Diaphragm	14.84	768.9	13.69	38.03	4.95	Breasts, lungs, heart
Kidneys or iliac crests	12.35	596.3	11.65	26.95	4.52	Abdominal organs
Bottom Boundary	Average Exam CTDI _{vol}	Average Exam DLP	Average Extra Bottom Images CTDI _{vol}	Average Extra Bottom Images DLP	Average % of total radiation dose due to extra images	Body parts at risk
Lung bases/adrenals/ celiac/kidneys	11.76	367.2	11.14	30.16	8.21	Abdominal organs
Aortic bifurcation/iliac crests	15.29	716.9	14.61	40.89	5.70	Pelvic organs
Lesser trochanters	15.37	846.7	14.91	18.85	2.23	Testicles