

An introduction to the 'Third UK National CT Dose Survey'



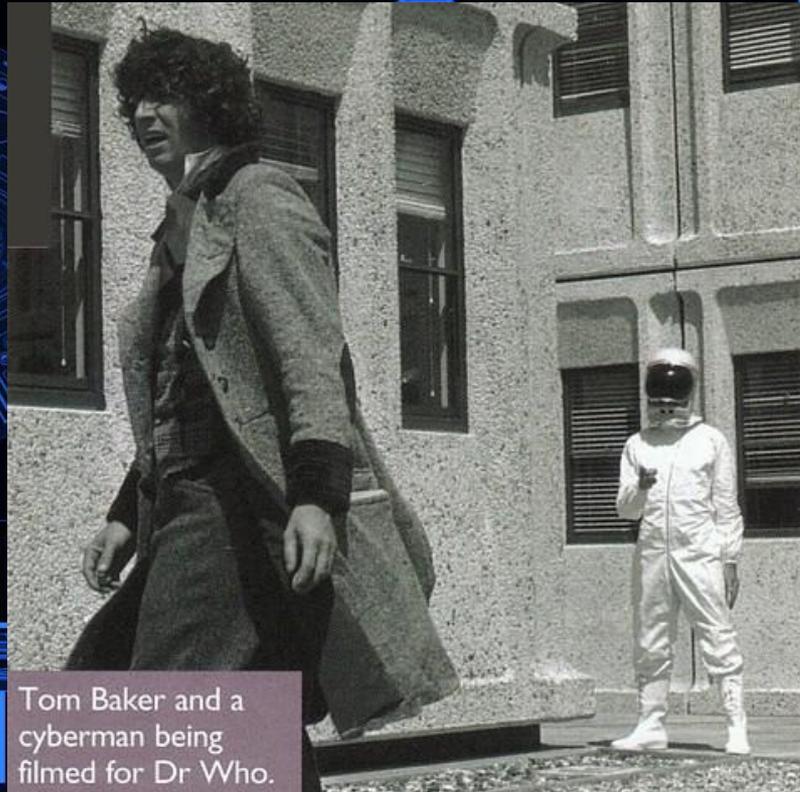
Dr. Stuart Meeson

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Interesting workplace...



Tom Baker and a cyberman being filmed for Dr Who.

© BBC: The Android Invasion [21 Jul 1975]: The Space Defence Station.

Why a new survey?



NRPB-W67

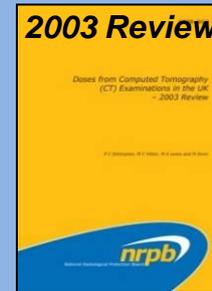
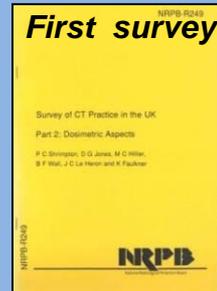
*Doses from Computed Tomography
(CT) Examinations in the UK
– 2003 Review*

P C Shrimpton, M C Hillier, M A Lewis and M Dunn

nrrpb
National Radiological Protection Board

- 2nd dose survey (2003) reviewed practice after the introduction of MDCT
- 3rd dose survey in response to
 - further developments of technology
 - reduction in scan times
 - need for guidance for some new establishing examinations

Evolution of CT



1970

1980

1990

2000

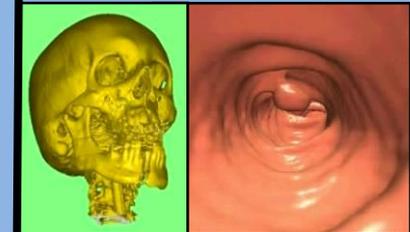
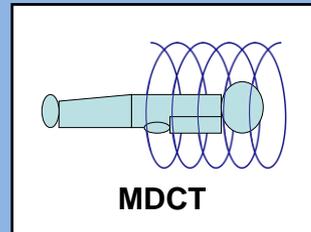
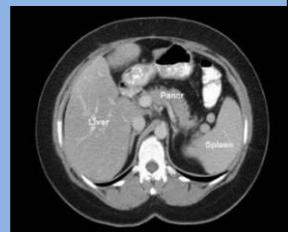
2010

2

4

16

64



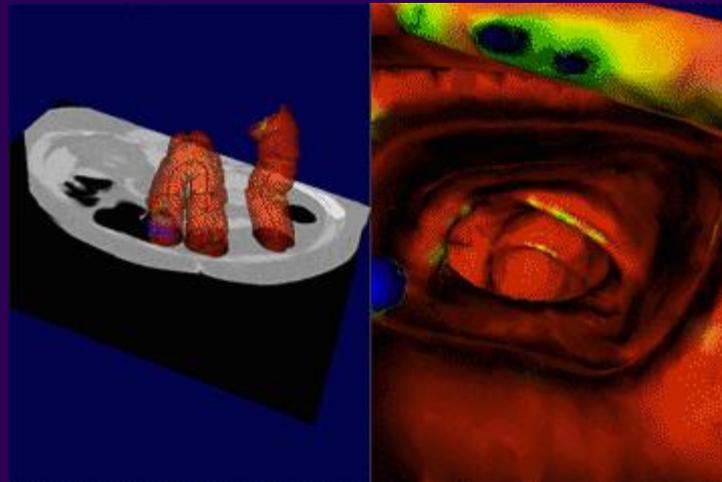
Hounsfield scanner

Widespread use

Multi-detector advances

3-D imaging applications

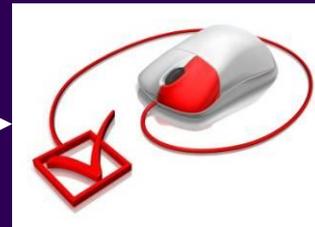
- Review current practice
- Assess changes since last survey
- Update examination specific national reference doses
- Provide guidance for some recently established applications



1



2



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Data acquisition sheet



CT dose survey data acquisition form



CT Protocol				page 2	<input type="checkbox"/>
<input type="checkbox"/> CT Head (acute stroke)	<input type="checkbox"/> C-spine (fracture)				
<input type="checkbox"/> Chest (lung cancer)	<input type="checkbox"/> Chest High-Res. (interstitial lung disease)				
<input type="checkbox"/> CTA (blood vessels)	<input type="checkbox"/> CTPA (PE)				
<input type="checkbox"/> Abdomen (liver metastases)	<input type="checkbox"/> Abdomen and pelvis (abscess)				
<input type="checkbox"/> Virtual Colonoscopy (polyps/tumour)	<input type="checkbox"/> Enteroclysis (Crohn's disease)				
<input type="checkbox"/> CT KUB (stones/colic)	<input type="checkbox"/> CT Urogram (tumour or stones/colic)				
<input type="checkbox"/> Paediatric head (trauma)	<input type="checkbox"/> < 1 yr	<input type="checkbox"/> 1 – 4 yrs	<input type="checkbox"/> 5 – 12 yrs		
Exam Accession Number			Sample Number	/20	
Health Care Facility			Scanner ID		
Age at time of scan (years)		Gender	<input type="checkbox"/> M <input type="checkbox"/> F	Body Mass	<input type="checkbox"/> kg <input type="checkbox"/> st
Scanner Make	<input type="checkbox"/> GE	<input type="checkbox"/> Philips	<input type="checkbox"/> Siemens	<input type="checkbox"/> Toshiba	<input type="checkbox"/> Other
Number of Detector Rows	<input type="checkbox"/> 16	<input type="checkbox"/> 64	<input type="checkbox"/> 128	<input type="checkbox"/> Other	

Data acquisition sheet 2



Parameters	Sequence 1	Sequence 2	Sequence 3
Tube Voltage (kV)			
Fixed mA or Auto mA's available range			
Tube Current Modulation brand used			
Auto mA quality factor			
IV contrast used	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Beam collimation (mm)			
Scan field of View (mm)			
Patient transverse width (mm)			
Patient anteroposterior (AP) width (mm)			
Axial (A) or Helical (H) scan	<input type="checkbox"/> A <input type="checkbox"/> H	<input type="checkbox"/> A <input type="checkbox"/> H	<input type="checkbox"/> A <input type="checkbox"/> H
No. of slices or pitch			
Scan length (mm)			
CTDI _{vol} (mGy)			
DLP (mGy.cm)			
DLP for total examination (mGy.cm)			
<input type="checkbox"/> mean mAs/slice or mean mA (if given)			
<input type="checkbox"/> total mAs (if given)			

Bulleted instructions for using form

3rd UK CT Survey
Association by
cpd now
The College of Radiographers

Health Protection Agency

CT Protocol page 2

CT Head (acute stroke) C-spine (fracture)
 Chest (lung cancer) Chest High-Res. (interstitial lung disease)
 CTA (blood vessels) CTPA (PE)
 Abdomen (liver metastases) Abdomen and pelvis (abscess)
 Virtual Colonoscopy (polyps/tumour) Enterodysis (Crohn's disease)
 CT KUB (stones/colic) CT Urogram (tumour or stones/colic)
 Paediatric head (trauma) < 1 yr 1 – 4 yrs 5 – 12 yrs

Exam Accession Number Sample Number

Health Care Facility Scanner ID

Age at time of scan (years) Gender M F Body Mass kg st

Scanner Make GE Philips Siemens Toshiba Other

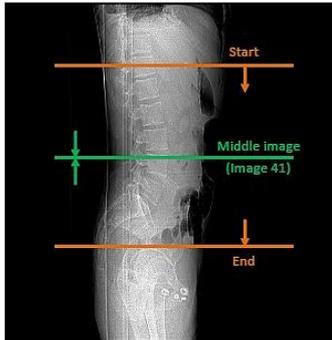
Number of Detector Rows 16 64 128 Other

Parameters	Sequence 1	Sequence 2	Sequence 3
Tube Voltage (kV)			
Fixed mA or Auto mA's available range	}		
Tube Current Modulation brand used			
Auto mA quality factor			
IV contrast used	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Beam collimation (mm)			
Scan field of View (mm)			
Transverse width (mm)			
Anteroposterior (AP) width (mm)			
Axial (A) or Helical (H) scan	<input type="checkbox"/> A <input type="checkbox"/> H	<input type="checkbox"/> A <input type="checkbox"/> H	<input type="checkbox"/> A <input type="checkbox"/> H
No. of slices or pitch			
Scan length (mm)			
CTDI _{vol} (mGy)			
DLP (mGy.cm)			
DLP for total examination (mGy.cm)			
<input type="checkbox"/> mean mAs/slice or mean mA (if given)			
<input type="checkbox"/> total mAs (if given)			

Bulleted instructions:

Form Note	Description
	CT protocols are listed along with their key clinical indications in parenthesis. Further details are included below, including keywords and generic search strings for RIS searches. Examples of typical CT protocols are also included below, including referral notes, anatomical markers and showing regions under investigation. Details of typical contrast use and number of sequences/phases are also given. <u>However, please provide data on your equivalent protocols that are in use at your centre.</u>
	Indicate here if this is the second sheet for the same patient and scanner attendance, required if more than three image sequences were employed.
	Accession number is used as an anonymous scan ID reference, held locally only, that can be used to find examinations on RIS and PACS. Accession number is linked to sample number on this form, to facilitate help with any further queries after data have been submitted. The target for data collection is 20 different patients per CT protocol (tick sheet included at the end of the document), on a single scanner. Sample number out of 20 must be recorded here. Only sample number will be added to the spreadsheet later.
	Please supply age at the time of scan in years. NB. For paediatric scans record the age to the nearest half year. However, for paediatric patients under 1-year of age, please supply age in months (traceable from CT protocol selection).
	If available please supply body mass to the nearest half kilogram or stone.
	Many scanners are now in use with automatic tube current modulation. To help to assess how these systems are being used please record the range of mA that the automatic system can select between. (This is the range for the protocol not for each patient.) Please also record the auto mA brand (e.g. "Smart mA", "CareDose") and the actual quality factor (e.g. "noise index" of x, "quality reference mAs", "mAs/slice") used.
	Please supply the collimation product for multi-slice systems, e.g. 64x0.5mm.
	To get a measure of patient size, other than body mass and that can be calculated retrospectively, cross-sectional area is being used. To estimate this, using the middle image in the main scan sequence, measure the major (transverse) and minor (anteroposterior (AP)) patient widths using your PACS viewer (shown graphically below). These will be used to estimate the cross-sectional area, approximating the patient to be an ellipse. These measurements are only needed from one image sequence per patient.

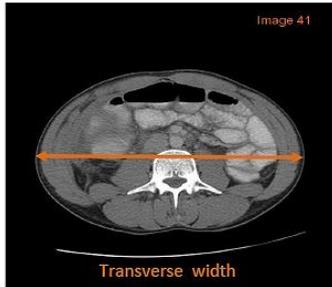
Transverse and Anteroposterior (AP) patient width measurements:



Schematic showing a scout scan used to identify the middle image in the sequence.

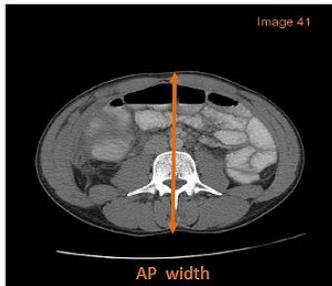
NB. For C-spine examinations, select an image close to the middle of the sequence that avoids the shoulders.

One set of width measurements per patient.



Transverse width (mm) measured using the image from the middle of the sequence.

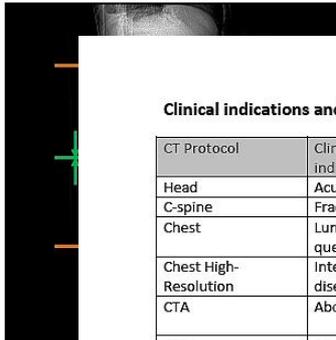
NB. If axial images do not show the full extent of the patient, try other image views.



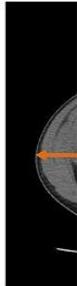
Anteroposterior (AP) width (mm) measured using the image from the middle of the sequence.

- Bull...
- f
- CT Hei
- Chest
- CTA (I
- Abdor
- Virtua
- CT KU
- Paedie
- Exam Ac
- Health Ca
- Age at tir
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- Number c
- Tube Volt
- Fixed mA
- Tube Curr
- Auto mA
- IV contra
- Beam coll
- Scan field
- Transvers
- Anteropo
- Axial (A)
- No. of slic
- Scan leng
- CTDI_{vol} (m
- DLP (mGy
- DLP for tc
- mean
- total n

Transverse and Anteroposterior (AP) patient width measurements:



Schematic showing a scout scan



Clinical indications and keywords:

CT Protocol	Clinical indications	Keywords for electronic searches
Head	Acute stroke	Stroke, CVA, haemorrhage
C-spine	Fracture	Fracture, #, dislocation, trauma
Chest	Lung cancer query	Lung: cancer, metastases, malignancy, tumour, neoplasm
Chest High-Resolution	Interstitial lung disease	Emphysema, pulmonary fibrosis, bronchiectasis
CTA	Abdominal aorta	AAA, aorta, peripheral vessels, aneurysm, atherosclerosis, stent, ischaemia, leak
CTPA	PE	Pulmonary embolism, PE
Abdomen	Liver metastases	Liver: cancer, metastases, malignancy, tumour, neoplasm
Abdomen and pelvis	Abscess	Abscess, infection, infected fluid
Virtual Colonoscopy	Polyps/tumour	Polyp, cancer, malignancy, tumour, neoplasm
Enteroclysis	Crohn's disease	Crohn's, small bowel inflammation
KUB	Stones/colic	Renal, kidney, ureter, stones, colic, haematuria, calculi
Urogram	Stones/colic or tumour	Renal, kidney, ureter, stones, colic, haematuria, calculi, cancer, malignancy, tumour, neoplasm
Paediatric Head (x3)	Trauma	Trauma, injury, NAI, haemorrhage, fracture

Generic RIS search examples for retrospective data collection:

The screenshots included below provide examples of searches that may be undertaken on RIS to locate suitable CT examinations as required for the HPA CT dose survey.

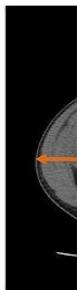
In Screenshot 1 the Selections screen includes fields that may be used to refine a search of the RIS. These include:

- date range – typically a 3 month window, but longer for low frequency examinations and up to 1-year retrospectively
- modality
- site
- examinations – multiple exam code may be used to include examinations of a body part with and without contrast
- text found in a report – multiple key words may be used in a single search

Transverse and Anteroposterior (AP) patient width measurements

Bull
f

<input type="checkbox"/> CT Hei
<input type="checkbox"/> Chest
<input type="checkbox"/> CTA (I
<input type="checkbox"/> Abdor
<input type="checkbox"/> Virtua
<input type="checkbox"/> CT KU
<input type="checkbox"/> Paedie
Exam Ac
Health Ca
Age at tir
Scanner M
Number c
Tube Volt
Fixed mA
Tube Curr
Auto mA
IV contra
Beam coll
Scan field
Transvers
Anteropo
Axial (A)
No. of slic
Scan leng
CTDI _{vol} (m
DLP (mGy
DLP for tc
<input type="checkbox"/> mean
<input type="checkbox"/> total n



Clinical indications and

CT Protocol	Clinical Indication
Head	Acu
C-spine	Fra
Chest	Lun que
Chest High-Resolution	Inte dist
CTA	Abc
CTPA	PE
Abdomen	Live
Abdomen and pelvis	Abs
Virtual Colonoscopy	Poh
Enteroclysis	Cro
KUB	Sto
Urogram	Sto tun
Paediatric Head (x3)	Tra

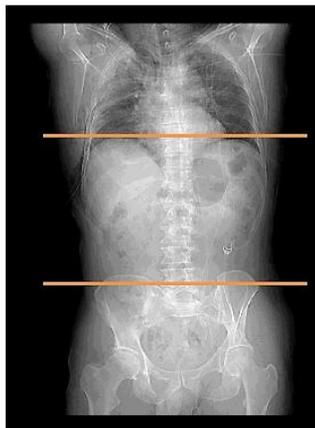
Generic RIS search exa

The screenshots included in RIS to locate suitable CT ex

In Screenshot 1 the Select the RIS. These include:

- date range – typical and up to 1-year re
- modality
- site
- examinations – mu part with and with
- text found in a rept

Abdomen – typical protocol



Clinical indication: liver metastases

Typical scan justification: query liver cancer/metastases/malignancy/tumour/neoplasm

Could include: *abdominal pain, jaundice, abnormal liver lesions on ultrasound for further assessment, liver enlarged on ultrasound.*

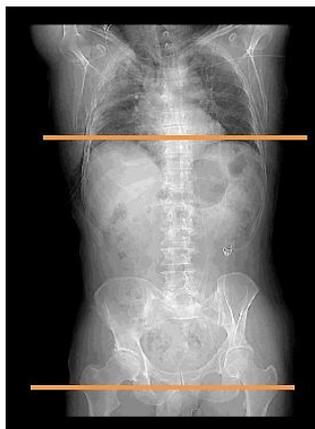
Other existing/treated sites of malignancy.

Scan: abdomen

Sequences/Phases for examination: 3

Contrast used: Y or N

Abdomen and pelvis – typical protocol



Clinical indication: abscess

Typical scan justification: query abscess/infection/infected fluid

Could include: *abdominal distension, tenderness/pain/guarding, sepsis. Fever, leukocytosis and surgery in the last four weeks.*

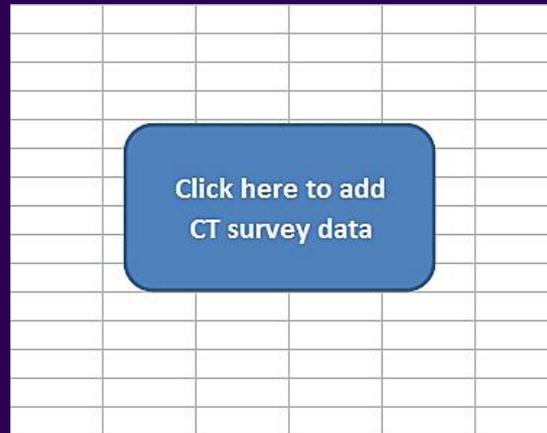
Scan: abdomen and pelvis

Sequences/Phases for examination: 1

Contrast used: Y or N

Breath held: Y or N

Excel spreadsheet



Excel spreadsheet 2



CT Survey

Pre-scan parameters

CT protocol Sample Number

Health Care Facility Scanner ID

Age at scan (yrs) Gender: Male Female Body mass kg st

Scanner Make Detector Rows

Imaging parameters

	Sequence 1	Sequence 2	Sequence 3	
Tube Voltage (kV)	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="checkbox"/> Page 2
mA - for auto mA give range (min to max)	<input type="text"/>	<input type="text"/>	<input type="text"/>	
Tube Current Modulation brand used	<input type="text"/>	<input type="text"/>	<input type="text"/>	
Auto mA image quality factor	<input type="text"/>	<input type="text"/>	<input type="text"/>	
Contrast used	<input type="checkbox"/> Y	<input type="checkbox"/> Y	<input type="checkbox"/> Y	
Beam collimation (mm)	<input type="text"/>	<input type="text"/>	<input type="text"/>	
Field of View (cm)	<input type="text"/>	<input type="text"/>	<input type="text"/>	
Transverse & AP width (cm)	<input type="text"/>	<input type="text"/>	<input type="text"/>	
Axial (A) OR Helical (H)	<input type="checkbox"/> A <input type="checkbox"/> H	<input type="checkbox"/> A <input type="checkbox"/> H	<input type="checkbox"/> A <input type="checkbox"/> H	
Number of slices OR pitch	<input type="text"/>	<input type="text"/>	<input type="text"/>	
Scan length (mm)	<input type="text"/>	<input type="text"/>	<input type="text"/>	

Dose report parameters

CTDIvol (mGy)	<input type="text"/>	<input type="text"/>	<input type="text"/>
DLP (mGy.cm)	<input type="text"/>	<input type="text"/>	<input type="text"/>
DLP for total examination (mGy.cm)	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="checkbox"/> Total mAs <input type="checkbox"/> Mean mA	<input type="text"/>	<input type="text"/>	<input type="text"/>

Add data Close form

Excel spreadsheet 3



	A	B	C	D	E	F	G	
1	Your contact details, scanner and protocol information					(Return to main data entry here)		
2								
3	Physicist	Name	<input type="text"/>					
4		E-mail						
5		Tel. No.						
6		Healthcare site						
7								
8	Radiographer	Name						
9		E-mail						
10		Tel. No.						
11		Healthcare site						
12								
13	Scanner info	Scanner ID	(local identifier that is also used on the data acquisition form, e.g. CT1)					
14		Make	(e.g. GE)					
15		Model	(e.g. LightSpeed 16)					
16		Upgrade	(device modifications from standard issue e.g. software upgraded to version)					
17		AEC type	(type (e.g. x-y modulation) and brandname (e.g. auto mA))					
18		Notes	(e.g. main clinical scanner, installed spring 2005)					
19								
20	Scanner 1	Scanner ID						
21		Make						
22		Model						
23		Upgrade						
24		AEC type						
25		Notes						
26								
27	Scanner 2	Scanner ID						
28		Make						
29		Model						
30		Upgrade						
31		AEC type						
32		Notes						
33								
34	Scanner 3	Scanner ID						
35		Make						
36		Model						



CT dose survey files for download

1. Registration

Before downloading the PDF and Excel spreadsheet (MS Office 97-2007, PC-compatible) files, please answer the three questions below:

* 1. Name

* 2. Organisation

* 3. E-mail address

Next

Download files...



Register and download two files to take part in the survey using:

www.ctug.org.uk/ctsurvey.html