Patient dose audit with OpenREM

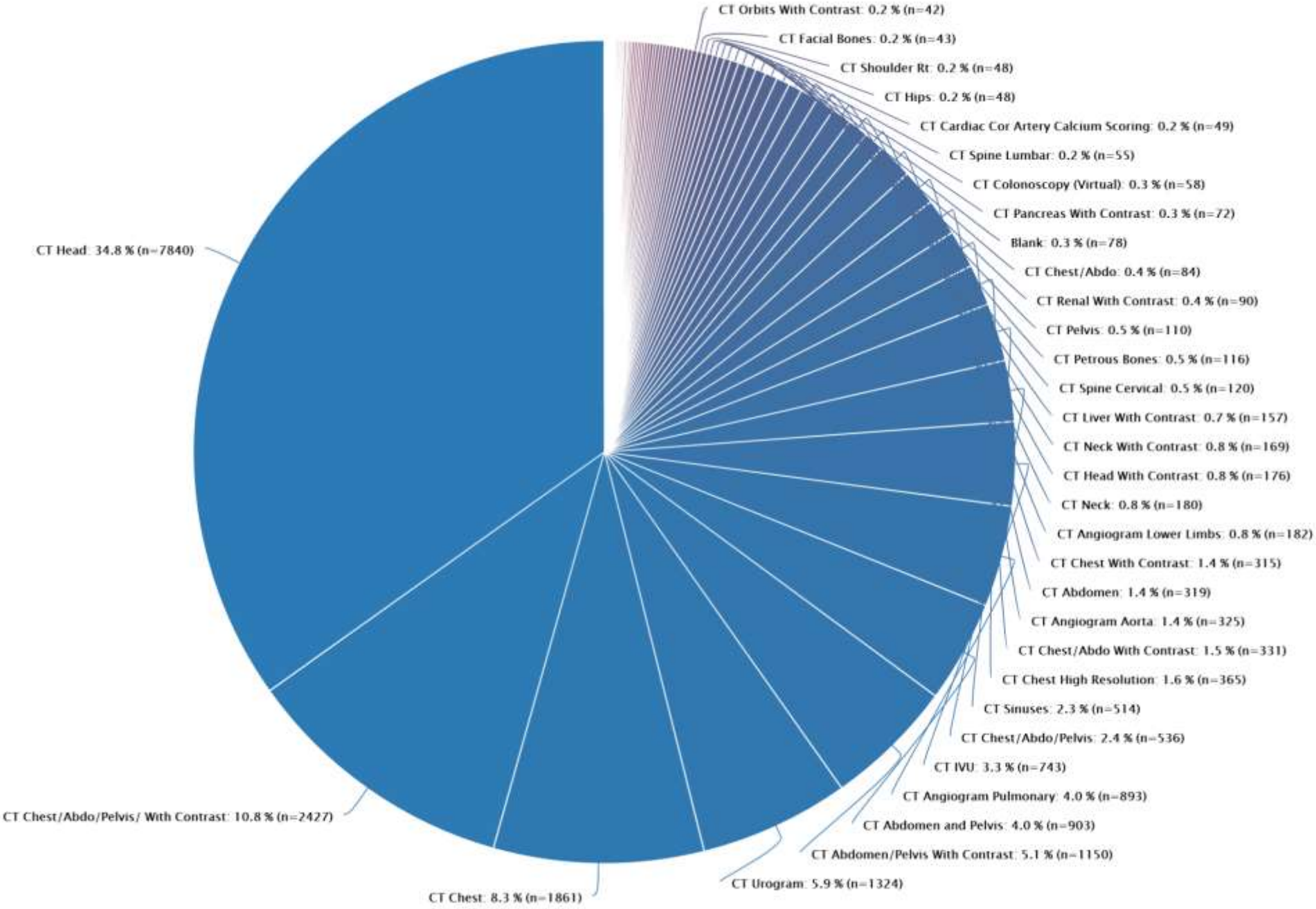
David Platten

Medical Physics Department

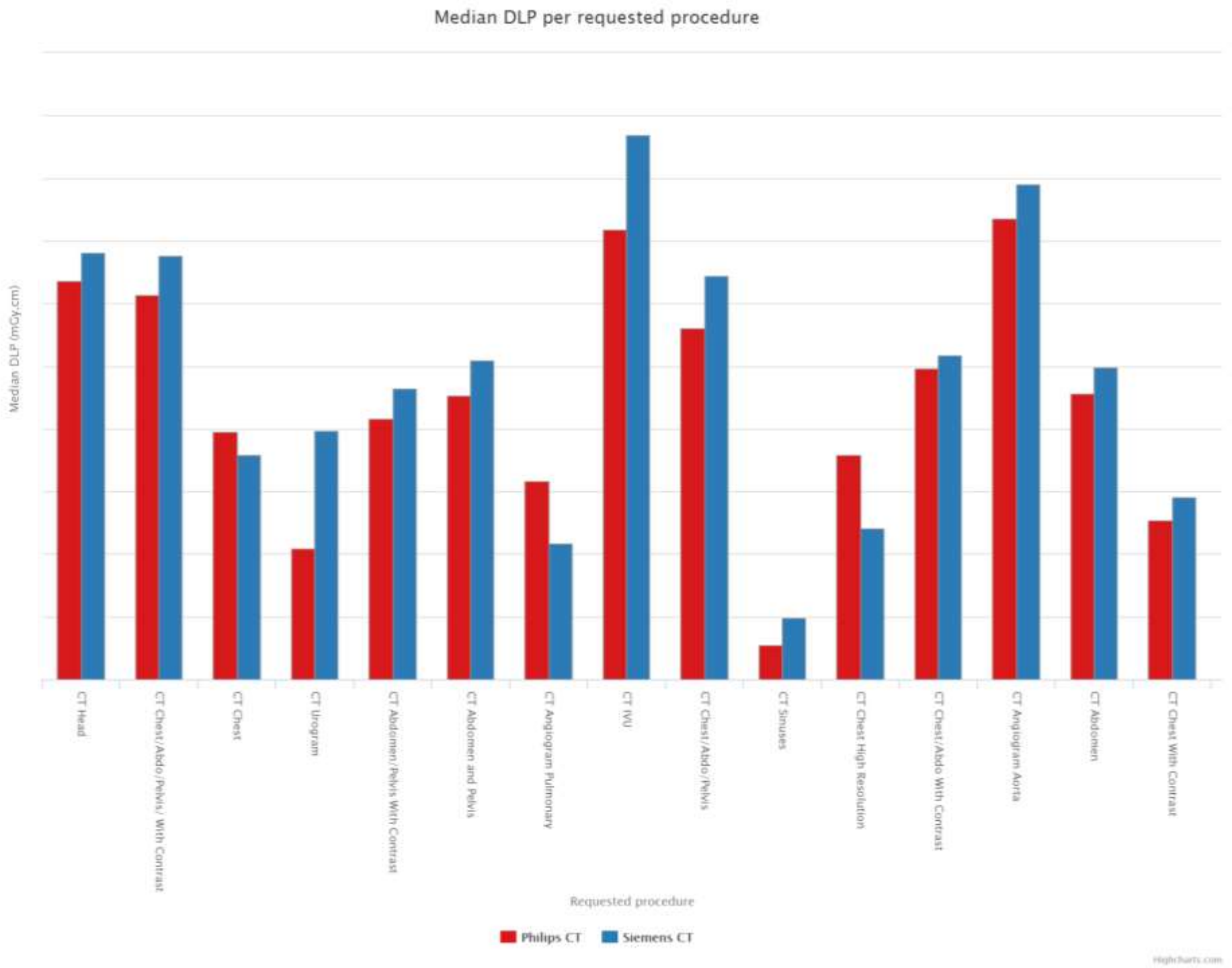
United Lincolnshire Hospitals NHS Trust

DLP per requested procedure

Patients at least 16 years old
1/2/2015 to 31/1/2016
n=24006
n=22500 excluding CT sim


CT Orbits With Contrast: 0.2 % (n=42)
CT Facial Bones: 0.2 % (n=43)
CT Shoulder Rt: 0.2 % (n=48)
CT Hips: 0.2 % (n=48)
CT Cardiac Cor Artery Calcium Scoring: 0.2 % (n=49)
CT Spine Lumbar: 0.2 % (n=55)
CT Colonoscopy (Virtual): 0.3 % (n=58)
CT Pancreas With Contrast: 0.3 % (n=72)
Blank: 0.3 % (n=78)
CT Chest/Abdo: 0.4 % (n=84)
CT Renal With Contrast: 0.4 % (n=90)
CT Pelvis: 0.5 % (n=110)
CT Petrous Bones: 0.5 % (n=116)
CT Spine Cervical: 0.5 % (n=120)
CT Liver With Contrast: 0.7 % (n=157)
CT Neck With Contrast: 0.8 % (n=169)
CT Head With Contrast: 0.8 % (n=176)
CT Neck: 0.8 % (n=180)
CT Angiogram Lower Limbs: 0.8 % (n=182)
CT Chest With Contrast: 1.4 % (n=315)
CT Abdomen: 1.4 % (n=319)
CT Angiogram Aorta: 1.4 % (n=325)
CT Chest/Abdo With Contrast: 1.5 % (n=331)
CT Chest High Resolution: 1.6 % (n=365)
CT Sinuses: 2.3 % (n=514)
CT Chest/Abdo/Pelvis: 2.4 % (n=536)
CT IVU: 3.3 % (n=743)
CT Angiogram Pulmonary: 4.0 % (n=893)
CT Abdomen and Pelvis: 4.0 % (n=903)
CT Abdomen/Pelvis With Contrast: 5.1 % (n=1150)
CT Urogram: 5.9 % (n=1324)
CT Chest: 8.3 % (n=1861)
CT Chest/Abdo/Pelvis/ With Contrast: 10.8 % (n=2427)
CT Head: 34.8 % (n=7840)

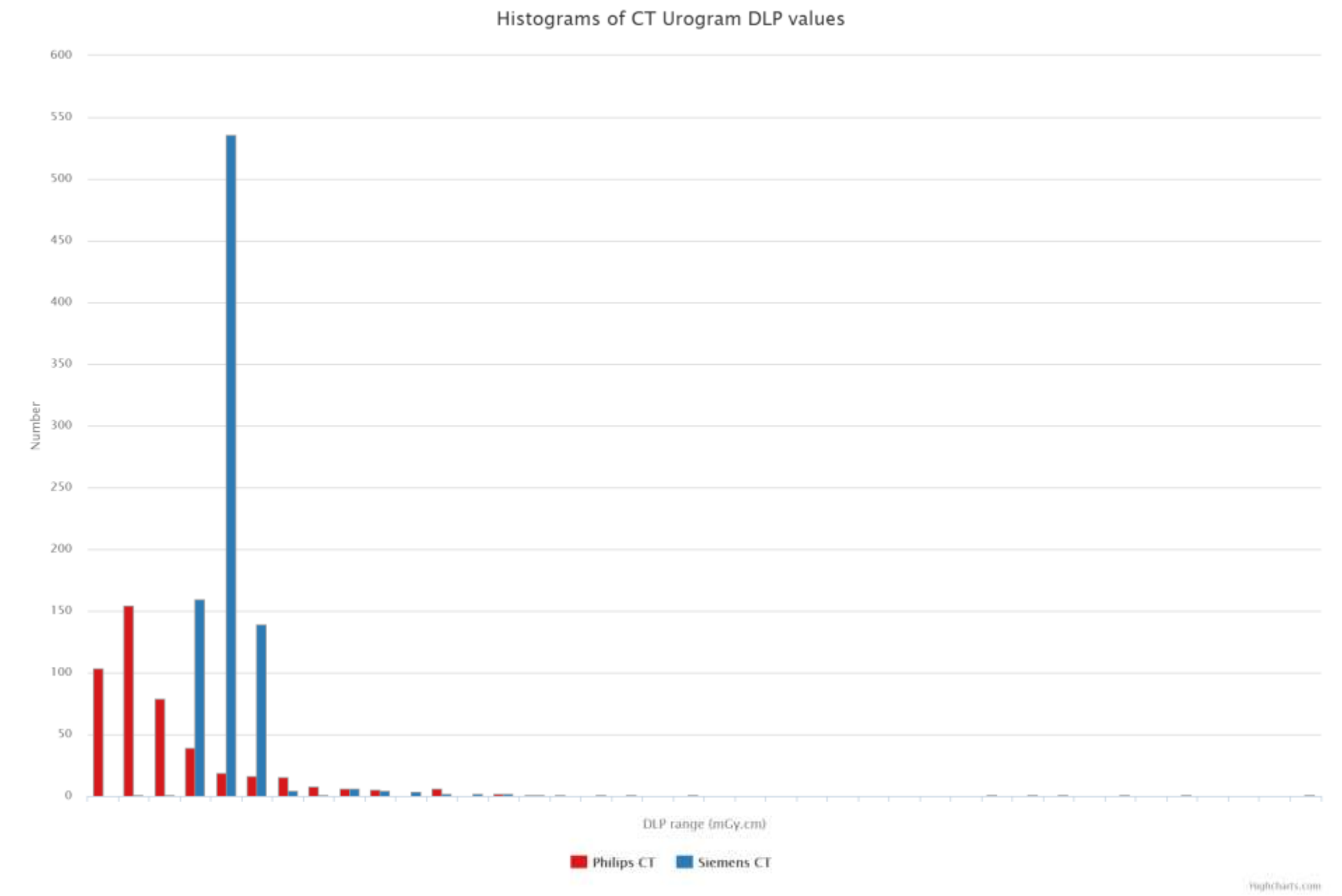
Median DLP per requested procedure
Median DLP (mGy.cm)
CT Head
CT Chest
CT Abdomen/Pelvis With Contrast
CT Angiogram Pulmonary
CT Chest/Abdo/Pelvis
CT Chest High Resolution
CT Angiogram Aorta
CT Chest With Contrast
CT Neck
CT Neck With Contrast
CT Spine Cervical
CT Pelvis
CT Chest/Abdo
CT Pancreas With Contrast
CT Spine Lumbar
CT Hips
CT Facial Bones
CT Guided Biopsy
CT Liver Triple Phase
CT Neck/Thorax/Abdo/Pelvis With Contrast
CT Wrist Lt
CT Wrist Rt
CT Head With/Without Contrast
CT Knee Rt
CT Angiogram Aortic Arch and Carotids
CT Spine Thoracic
CT Angiogram Intracranial
CT Elbow Lt
CT Mandible
CT Foot Lt
CT IAM With Contrast
CT Ankle Lt
CT Lower Leg Rt
CT Elbow Rt
CT Hand Rt
CT Calcaneum Lt
CT Shoulders
CT Guided Biopsy Pelvis
CT Hip Rt
CT Lower Leg Lt
CT Sinuses With Contrast
Head Brain (Adult)
CT Abdomen and Biopsy
CT Arthrogram Shoulder Rt
CT Mastoids
CT Neck/Thorax/Abdomen
CT Pelvis and Drainage
CT Upper Leg (Thigh) with Contrast Rt
Pelvis BonyHips (Adult)
Thorax Chest_Liver (Adult)
Requested procedure
Philips CT
Siemens CT
HighCharts.com

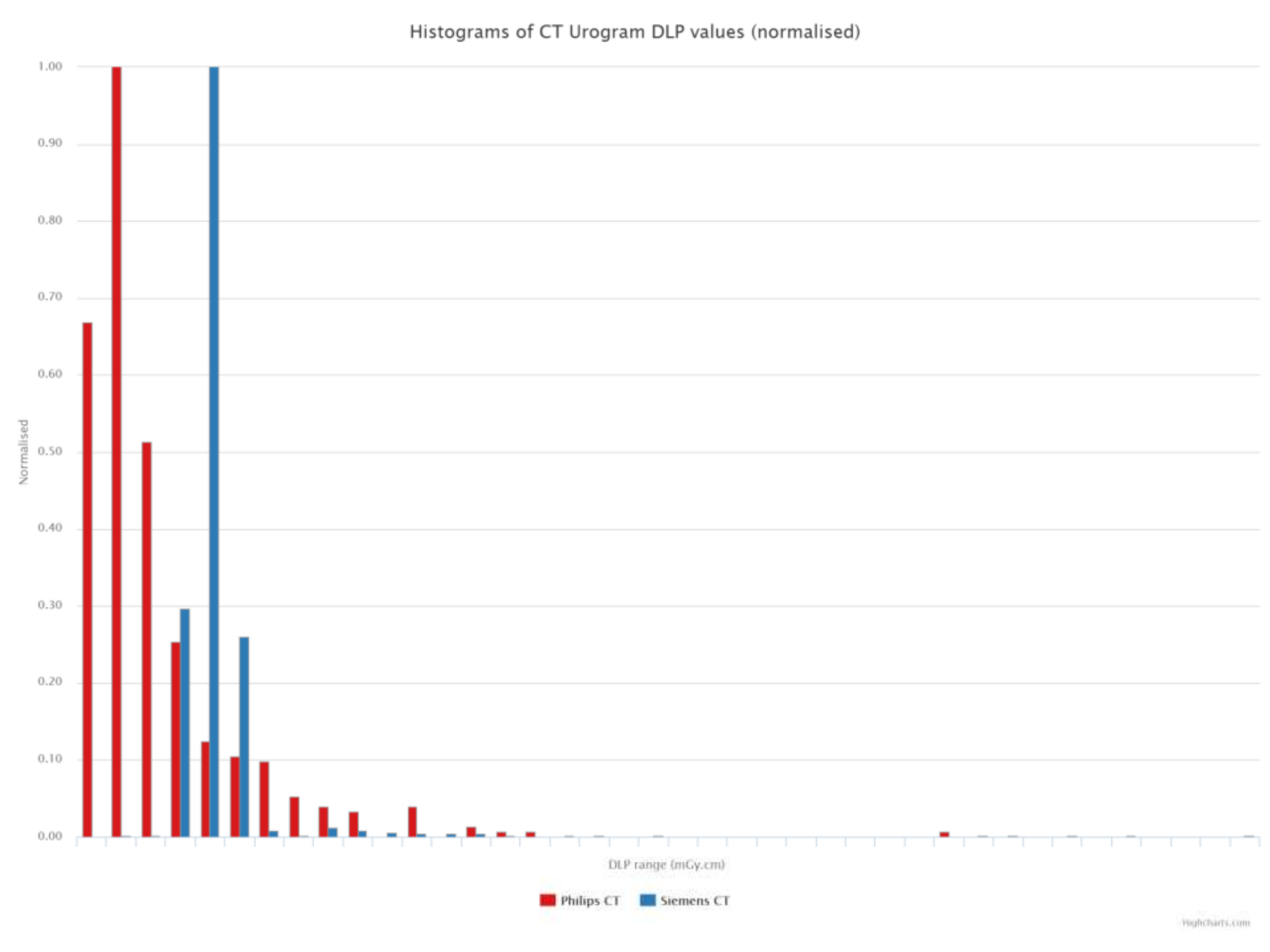

Median DLP per requested procedure
Median DLP (mGy.cm)
CT Head
CT Chest/Abdo/Pelvis/ With Contrast
CT Chest
CT Urogram
CT Abdomen/Pelvis With Contrast
CT Abdomen and Pelvis
CT Angiogram Pulmonary
CT IVU
CT Chest/Abdo/Pelvis
CT Sinuses
CT Chest High Resolution
CT Chest/Abdo With Contrast
CT Angiogram Aorta
CT Abdomen
CT Chest With Contrast
Requested procedure
Philips CT
Siemens CT
Highcharts.com

CT Urograms

Median DLP from one system higher than the other

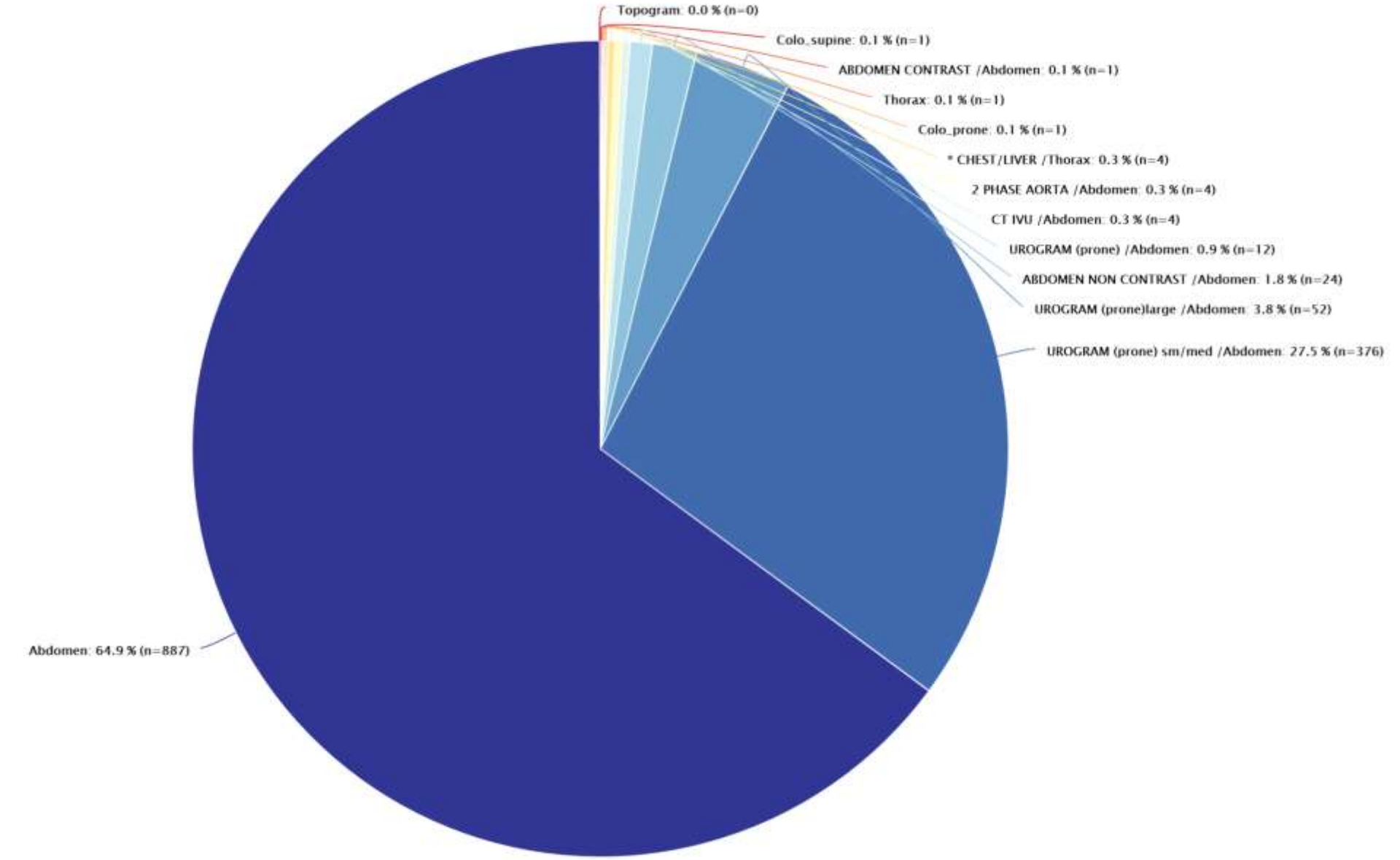
Look at the histograms

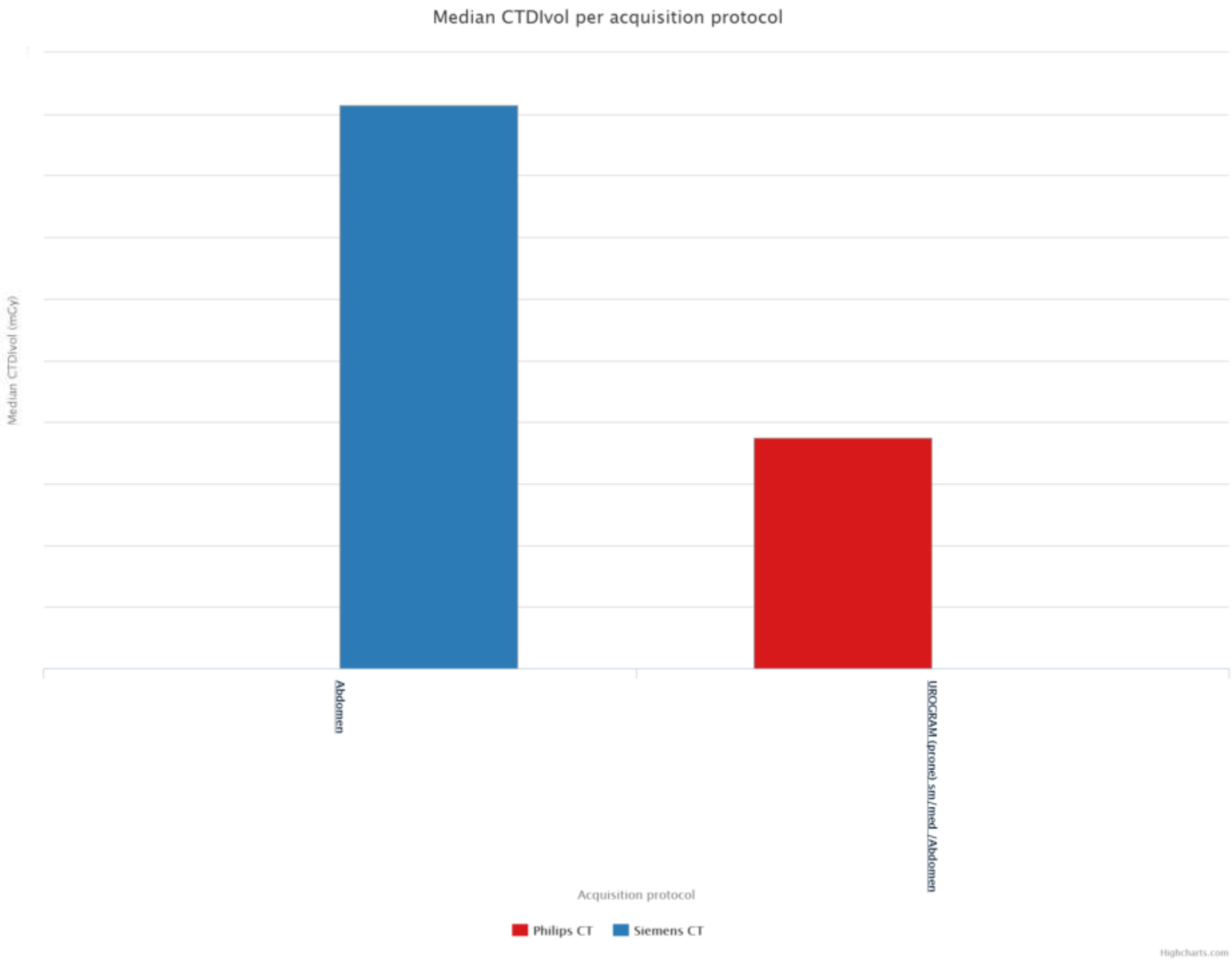

Histograms of CT Urogram DLP values
600
550
500
450
400
350
300
250
200
150
100
50
0
Number
DLP range (mGy.cm)
Philips CT
Siemens CT
Highcharts.com

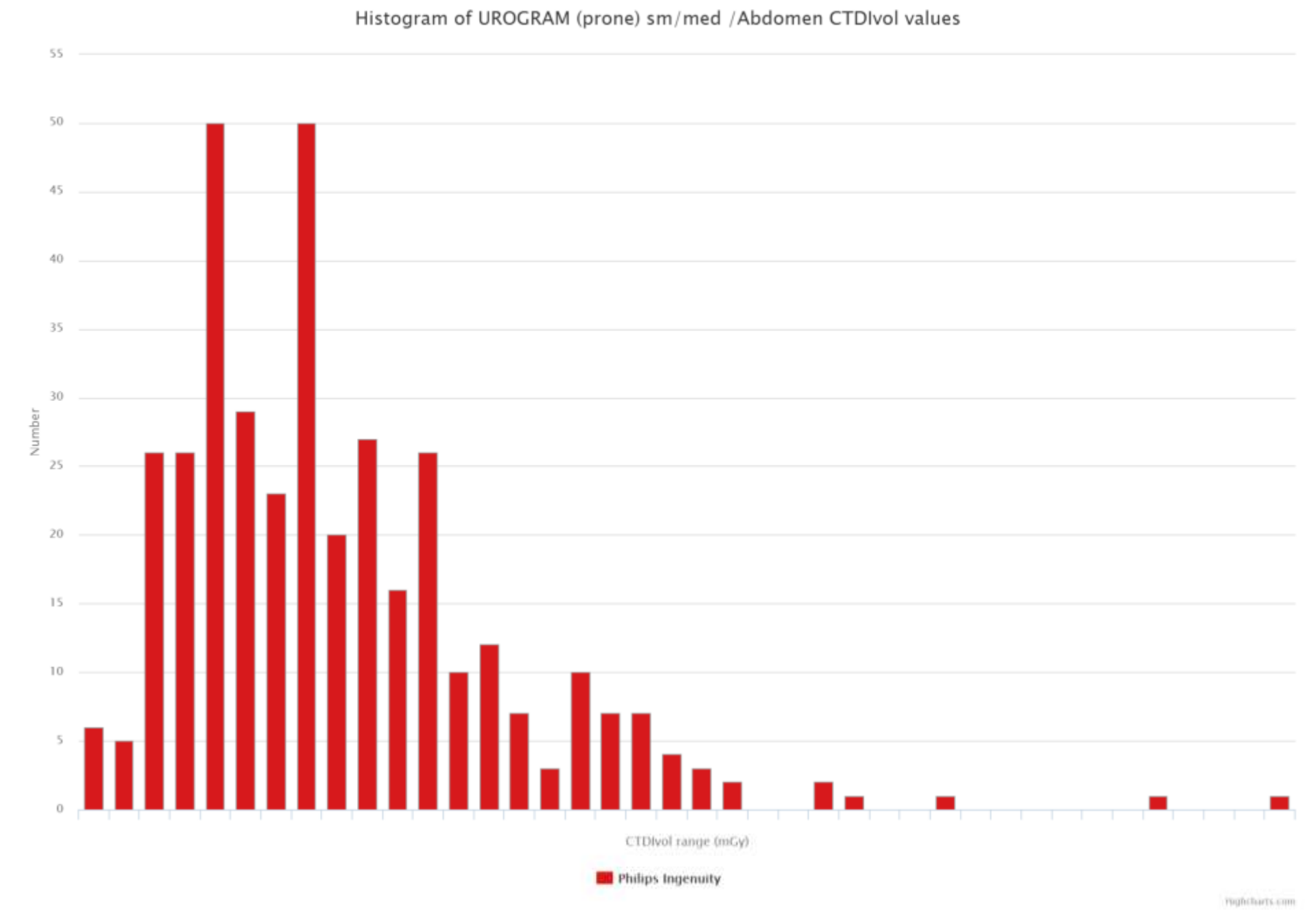

Histograms of CT Urogram DLP values (normalised)
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
Normalised
DLP range (mGy.cm)
Philips CT
Siemens CT
Highcharts.com

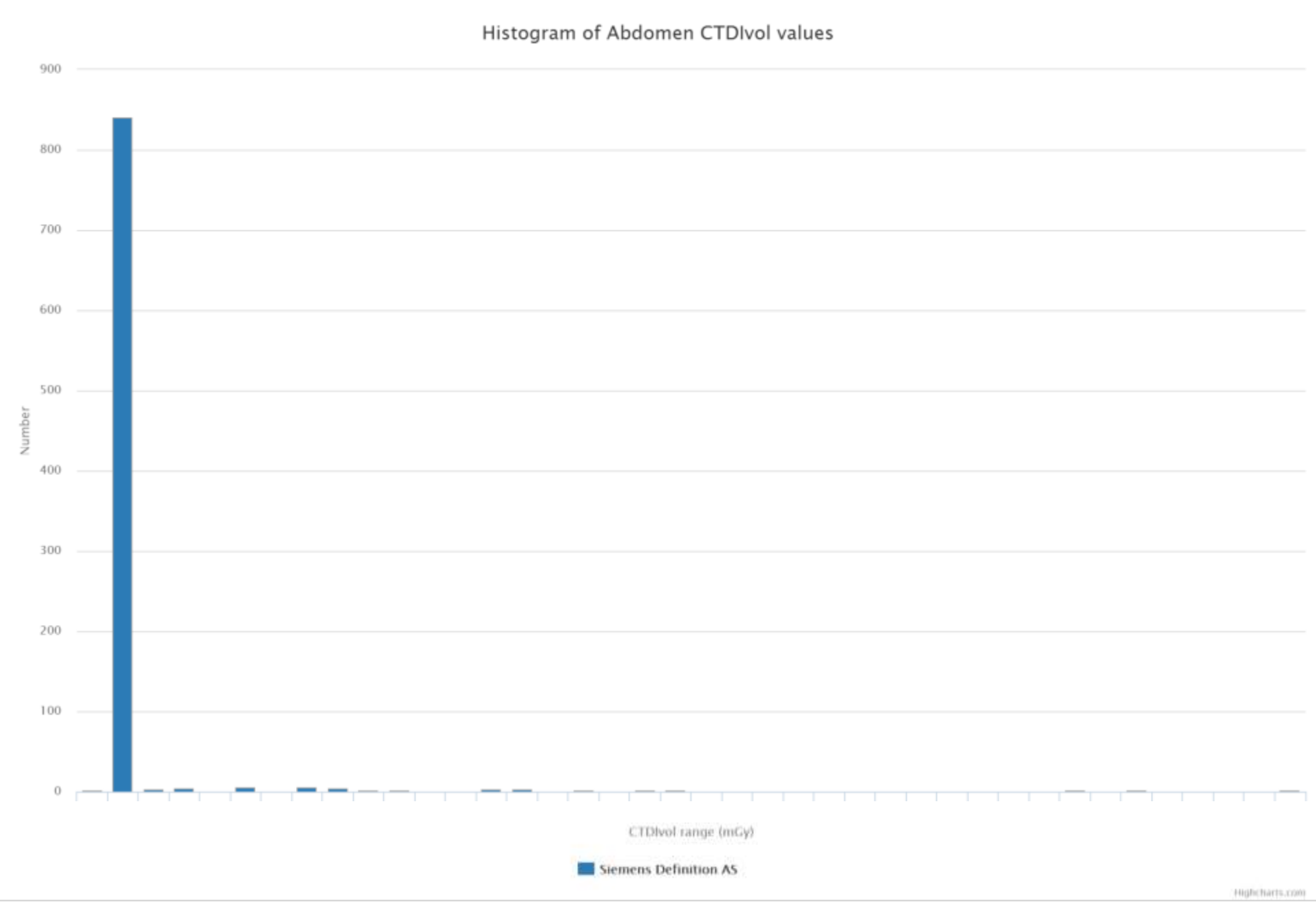
CT Urograms

What acquisition protocols are being used?


Topogram: 0.0 % (n=0)
Colo_supine: 0.1 % (n=1)
ABDOMEN CONTRAST /Abdomen: 0.1 % (n=1)
Thorax: 0.1 % (n=1)
Colo_prone: 0.1 % (n=1)
* CHEST/LIVER /Thorax: 0.3 % (n=4)
2 PHASE AORTA /Abdomen: 0.3 % (n=4)
CT IVU /Abdomen: 0.3 % (n=4)
UROGRAM (prone) /Abdomen: 0.9 % (n=12)
ABDOMEN NON CONTRAST /Abdomen: 1.8 % (n=24)
UROGRAM (prone)large /Abdomen: 3.8 % (n=52)
UROGRAM (prone) sm/med /Abdomen: 27.5 % (n=376)
Abdomen: 64.9 % (n=887)


Median CTDIvol per acquisition protocol
Median CTDIvol (mGy)
Abdomen
UROGRAM (prone) sm/med /Abdomen
Acquisition protocol
Philips CT
Siemens CT
Highcharts.com

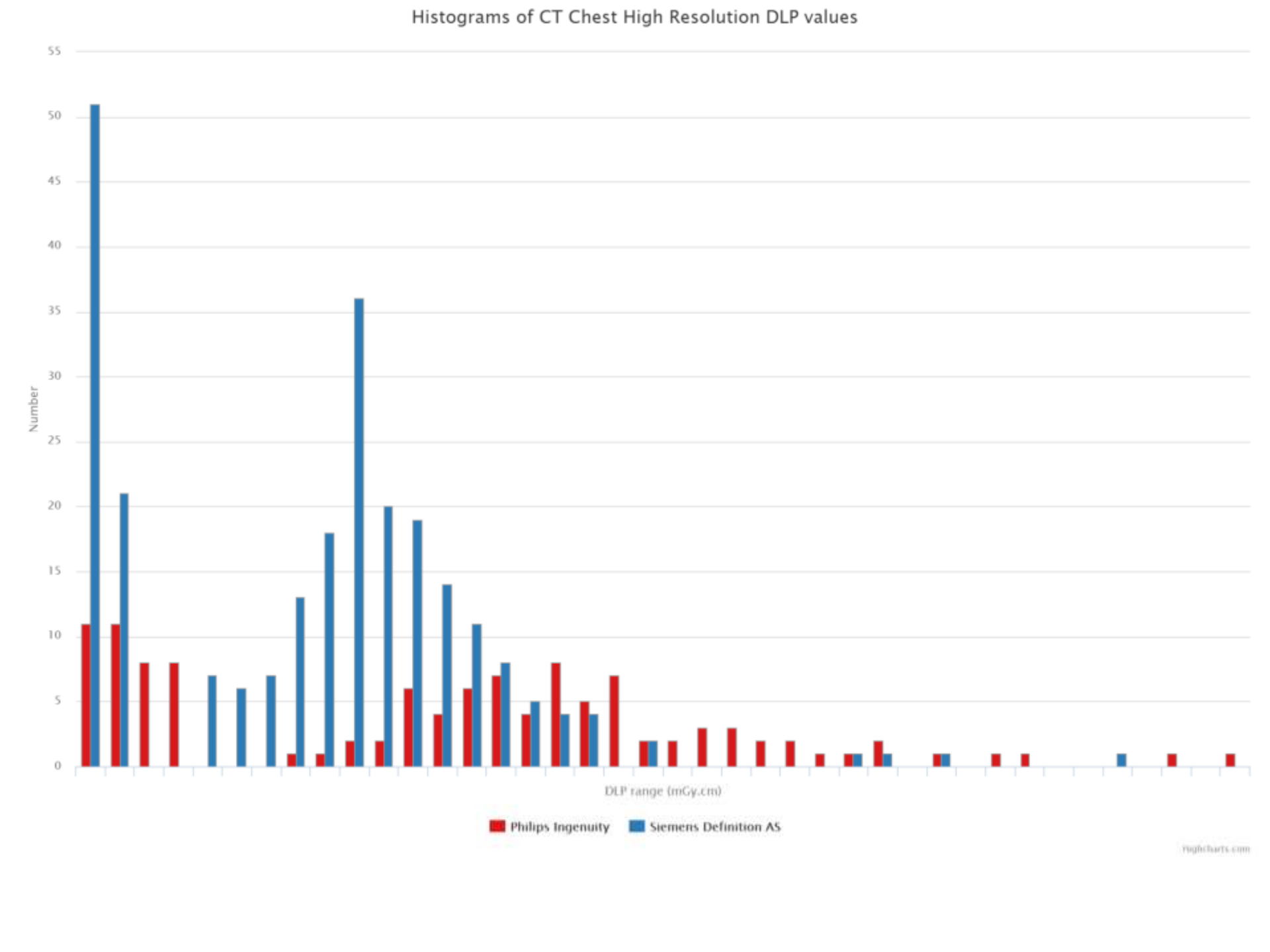

Histogram of UROGRAM (prone) sm/med /Abdomen CTDIvol values
55
50
45
40
35
30
25
20
15
10
5
0
Number
CTDIvol range (mGy)
Philips Ingenuity
highcharts.com

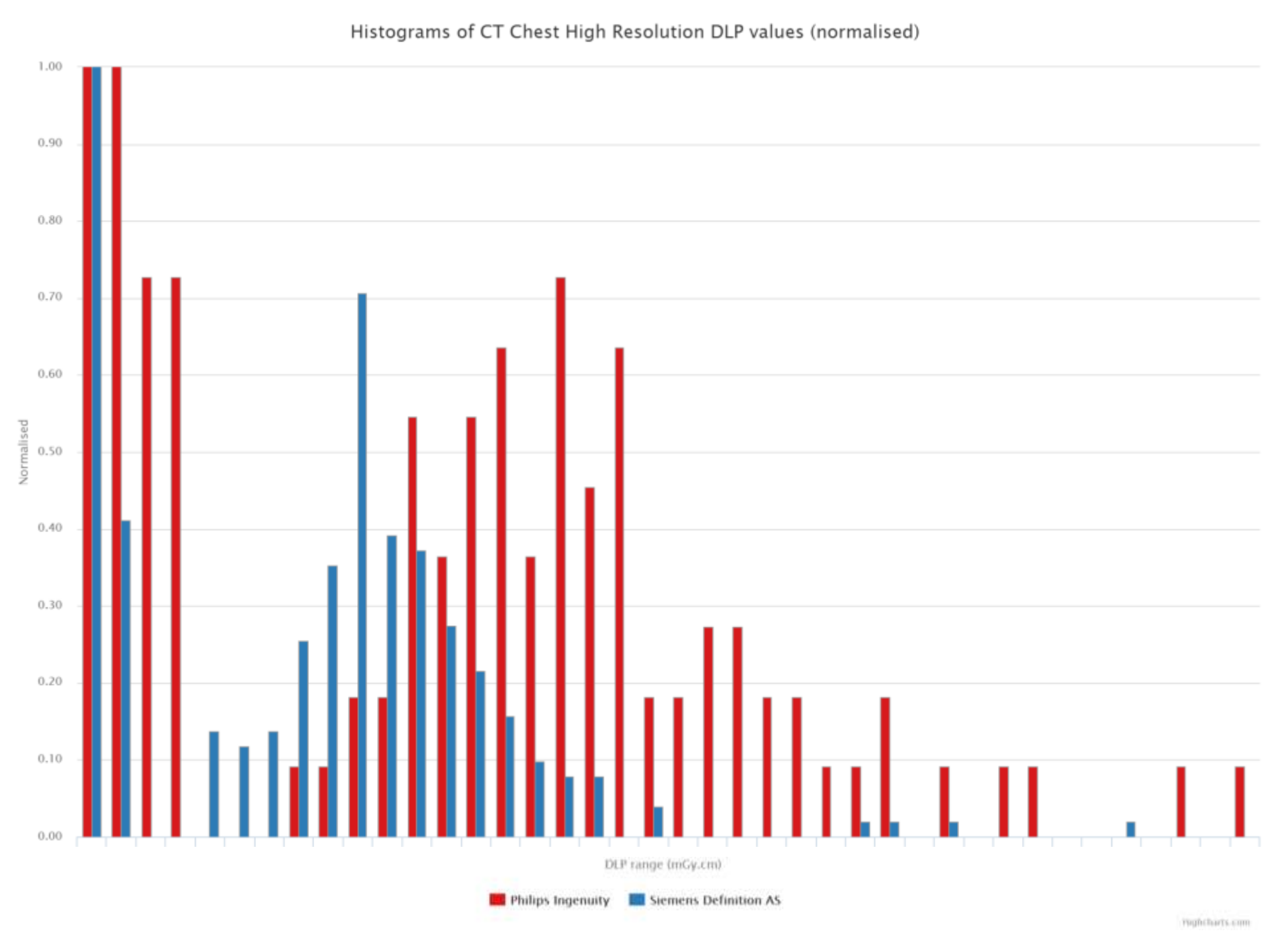

Histogram of Abdomen CTDIvol values
900
800
700
600
500
400
300
200
100
0
Number
CTDIvol range (mGy)
Siemens Definition AS
Highcharts.com

CT Urograms

AEC has been switched on for the Siemens system

CT Chest High Resolution


Histograms of CT Chest High Resolution DLP values
55
50
45
40
35
30
25
20
15
10
5
0
Number
DLP range (mGy.cm)
Philips Ingenuity
Siemens Definition AS
Highcharts.com


Histograms of CT Chest High Resolution DLP values (normalised)
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
Normalised
DLP range (mGy.cm)
Philips Ingenuity
Siemens Definition AS
Highcharts.com

CT Chest High Resolution

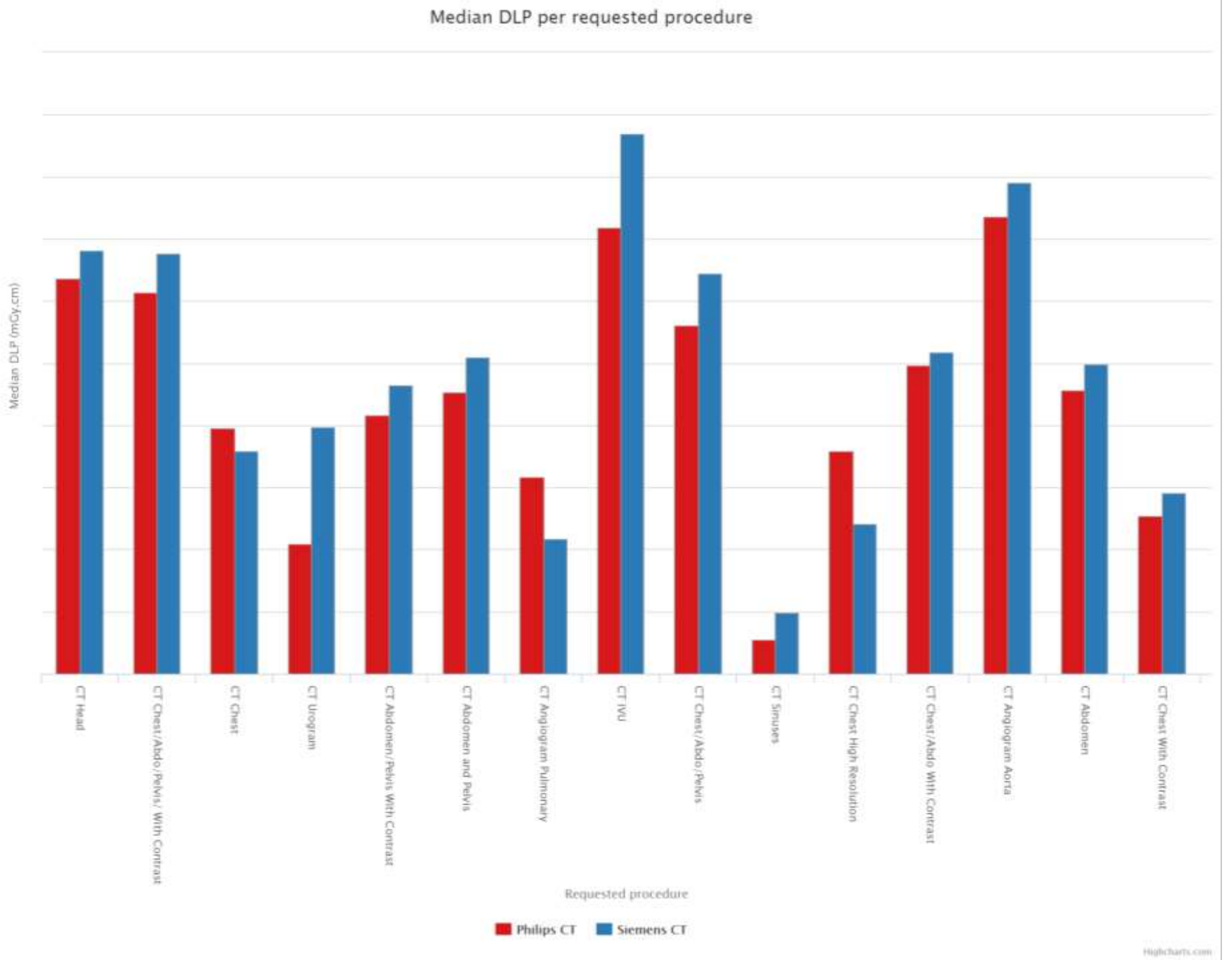
A mixture of axial and helical scans

Helical AEC settings to be reviewed for the Philips scanner

OpenREM vs. CRIS

CRIS dose data

- DLP data for total examination
  - No breakdown per acquisition protocol
  - No scan parameter data available
- DLP values manually entered by radiographer
  - Transcription errors
- CT scanner sometimes incorrect
  - All patients entered as scanner 1 by reception; checked and updated by radiographer post-scan
- Takes time to analyse


Median DLP per requested procedure
Median DLP (mGy.cm)
CT Head
CT Chest/Abdo./Pelvis/ With Contrast
CT Chest
CT Urogram
CT Abdomen/Pelvis With Contrast
CT Abdomen and Pelvis
CT Angiogram Pulmonary
CT IVU
CT Chest/Abdo./Pelvis
CT Sinuses
CT Chest High Resolution
CT Chest/Abdo With Contrast
CT Angiogram Aorta
CT Abdomen
CT Chest With Contrast
Requested procedure
Philips CT
Siemens CT
HighCharts.com

Philips CT (CRIS)
Siemens CT (CRIS)
Median DLP (mGy.cm)
CT Head
CT Chest/Abdo/Pelvis/ With Contrast
CT Thorax
CT Urogram
CT Abdomen/Pelvis With Contrast
CT Abdomen and pelvis
CT Angiogram pulmonary
CT IVU
CT Thorax abdomen and pelvis
CT Sinuses
CT Chest high resolution
CT Chest/Abdo With Contrast
CT Angiogram aorta
CT Abdomen
CT Chest with contrast
Exam name

Summary

- Easy to compare mean or median dose values between systems using a variety of methods
  - Requested procedure; study description; acquisition protocols
- More information that previous audit method (examining RIS data)
- More reliable data than previous audit method (no manual data entry)
- Doesn't solve all problems
  - Different acquisition and study names; assuming that requested procedures did what was requested
- Tabulated and graphical dose data can be exported
- Relatively easy to install (docs.openrem.org) with little or no capital outlay