

# 'Smart mA' software and its effect on Image Quality & Dose

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# Introduction

- CT is a high dose diagnostic procedure
- IR(ME)R - DRLs
  - DLP /  $CTDI_w$
  - $CTDI_{vol}$
- Aim
  - Assess the mA modulation software
  - Compare routine protocols within the Trust

# Background

- We have range of scanners with and without mA modulation software
  - GE Lightspeed Ultra – with ‘smart mA’
  - Siemens Emotion Duo
  - Siemens Somatom Plus 4
  - Siemens Sensation 16 – with CAREDOSE
- Scanners on different sites but
  - Radiologists report cross-site
  - Images archived/viewed on PACS cross-site
- Check the ‘mA modulation’ software
- Need to harmonise protocols across the Trust

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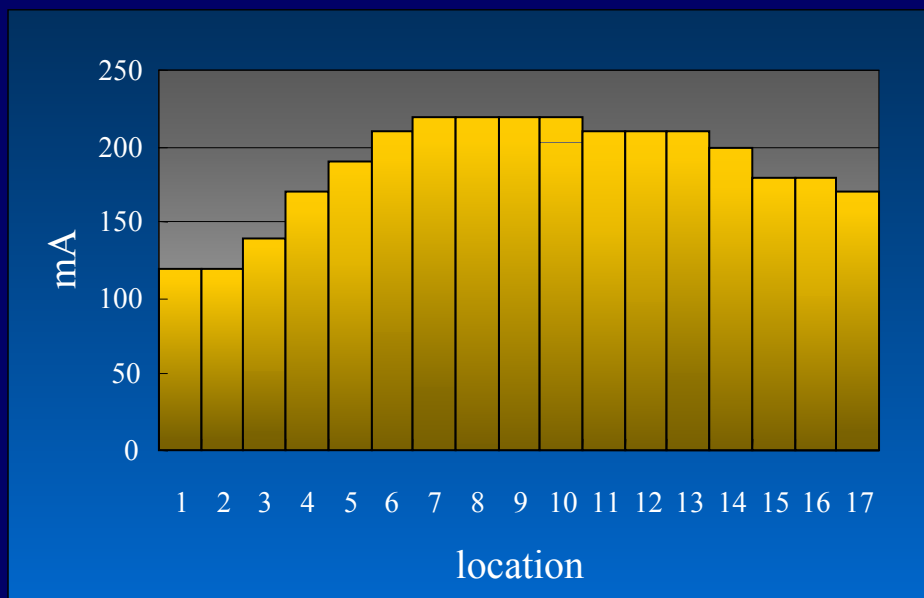
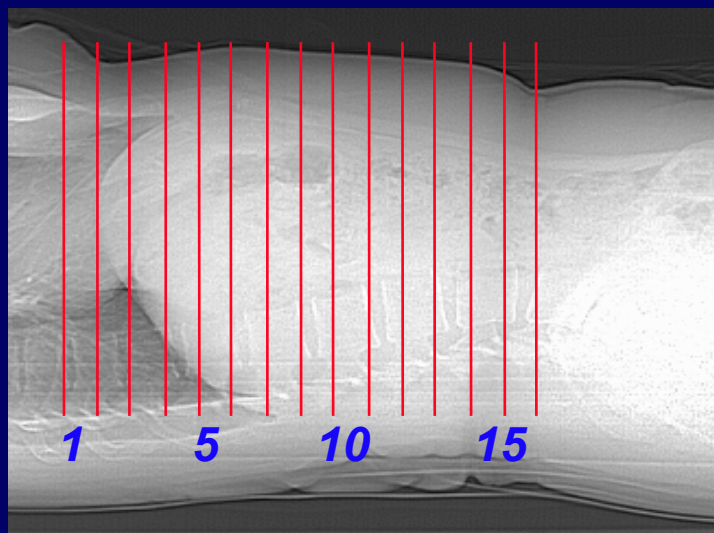
PART: A  
mA modulation

# GE Lightspeed Ultra

- Examination protocols – modified std GE protocols
- Reporting / archiving : softcopy / PACS
- One month's data: 60-90 exams per protocol
- Comparison of  $CTDI_{vol}$  and DLP pre and post 'Smart mA' software

# mA modulation

- GE smart mA
  - Looks at attenuation along a scout view, and varies the mA in each slice accordingly – planned before scanning
  - Define the amount of acceptable noise per image



Courtesy: GE Medical Systems

# smart mA

The image shows a control interface for mA. At the top, it is titled "mA Control". Below the title, there are three main sections. The first section is for "Auto mA", which includes three buttons: "IQ 4.05", "Normal 4.50", and "LowDose 4.95". The "Normal 4.50" button is highlighted in red. Above these buttons is the text "Default Noise Index". To the right of the buttons is a "Relative Dose" control with a vertical slider set to "0.00". Further right is a "Noise Index" input field containing the value "4.50". The second section is for "mA Range", with "Min" set to "40" and "Max" set to "160". The third section is for "Manual mA", with a single input field containing the value "160". At the bottom of the interface are two buttons: "OK" and "Cancel".

- Normal is the Default Noise Index
- IQ is a 10% lower Noise Index
- LowDose is a 10% higher Noise Index

# Std Protocols pre 'smart mA'

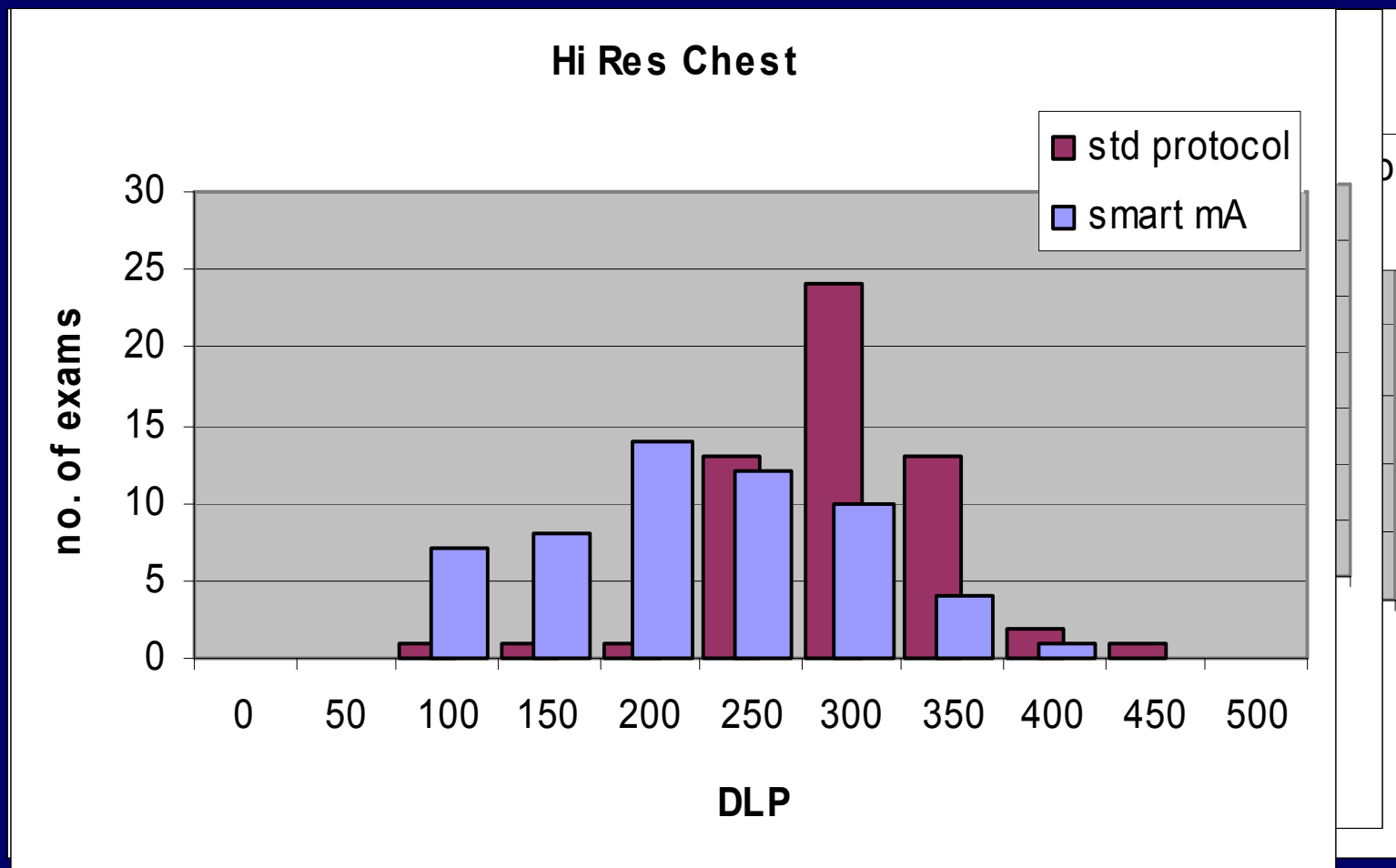
Examination Protocol (GE Lightspeed Ultra)		kV	mA	Time (s)	Collim. (mm)	Feed/rot (mm)	CTDI <sub>vol</sub> (mGy)
Routine Brain (axial)	P. Fossa	140	190	2.0	4x2.5	10	76.8
	Cerebrum	120	150	2.0	2x7.5	15	55.4
Routine Chest (helical)		120	250	0.8	8x2.5	27	17.3
High Resolution Chest (axial)		120	400	0.5 (cine)	1.25	10	10.3
Abdomen (helical)		120	300	0.8	8x2.5	27	16.6
Chest / Abdo / Pelvis (helical)	Chest	120	250	0.8	8x2.5	27	17.3
	Abdo/Pelvis	120	300	0.8	8x2.5	27	16.6

# Std Protocols with 'smart mA'

- Maximum mA was set to the std protocol mA
- Noise Index mode was set to 'Image Quality'

Examination Protocol (GE Lightspeed Ultra)		Mean mA	Noise Index	Mean CTDI <sub>vol</sub> (mGy)
Routine Brain (axial)	P. Fossa	190	2.16	76.8
	Cerebrum	130	2.16	44.3
Routine Chest (helical)		120	14.27	7.5
High Resolution Chest (axial)		190	19.3	4.1
Abdomen (helical)		190	14.27	9.5
Chest / Abdo / Pelvis (helical)	Chest	120	14.27	7.5
	Abdo/Pelvis	240	14.27	13.3

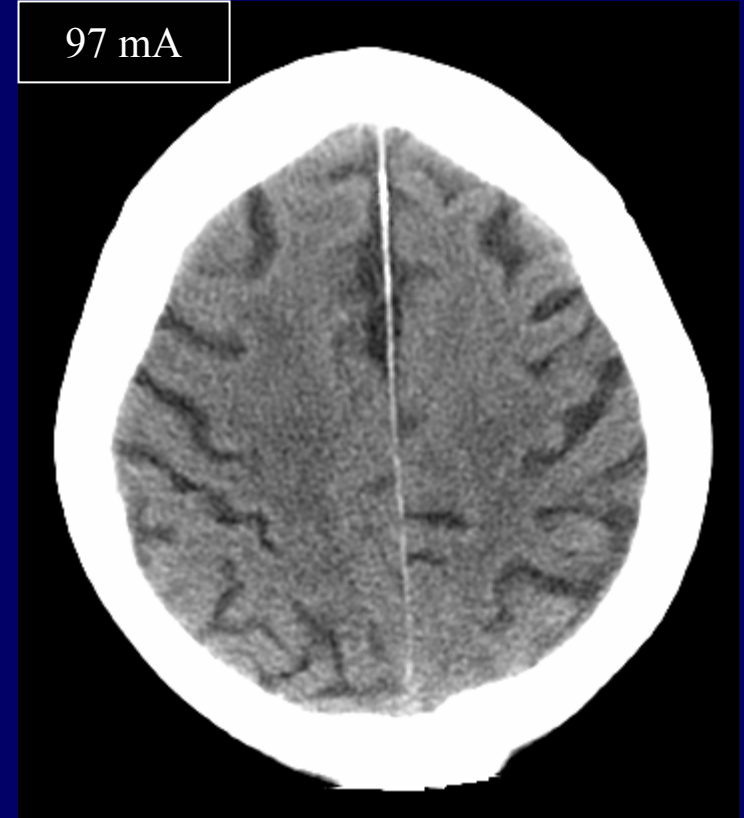
# Std Protocols pre/post 'smart mA'



# EU Diagnostic Reference Levels in CT

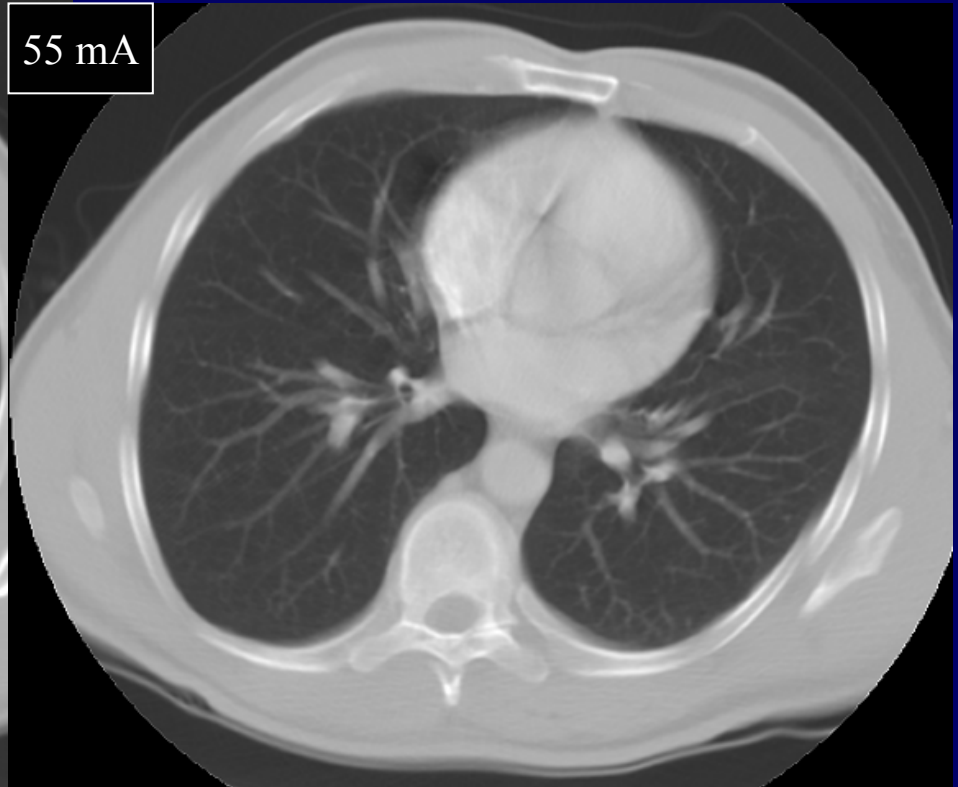
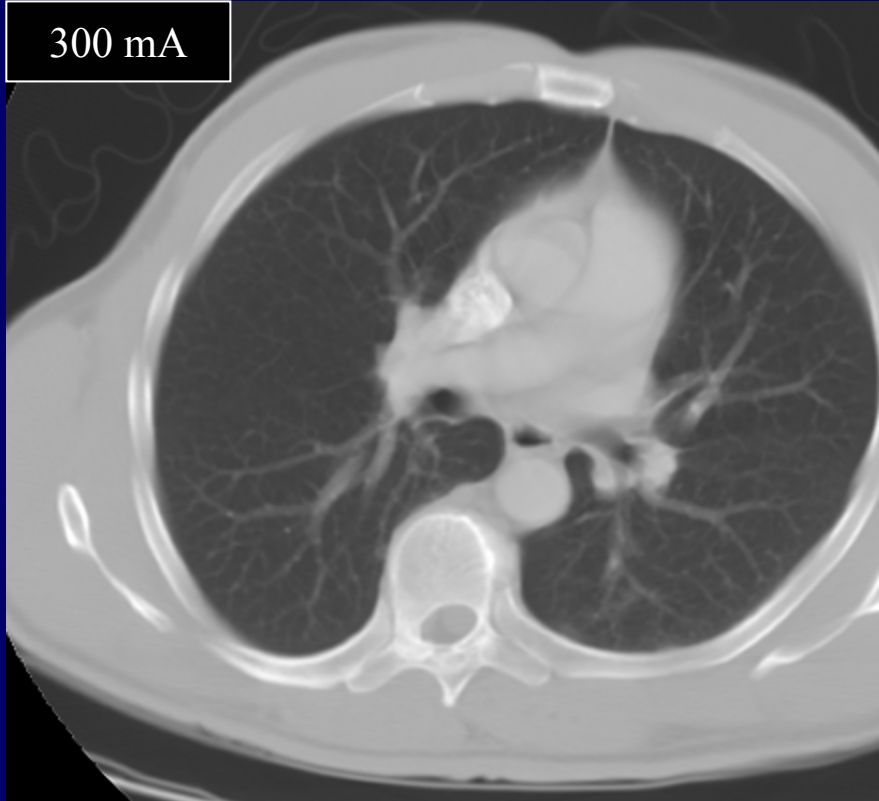
<b>Examination Protocol</b>	<b>Pre 'smart mA'</b>	<b>With 'smart mA'</b>	<b>EU DRL (mGy)</b>
Routine Brain	76.8/55.4	76.8/44.3	60
Routine Chest	17.3	7.5	30
High Resolution Chest	10.3	4.1	35
Routine Abdomen	16.6	9.5	35
Routine Pelvis	16.6	9.5	35

# Image Quality pre & post 'smart mA'



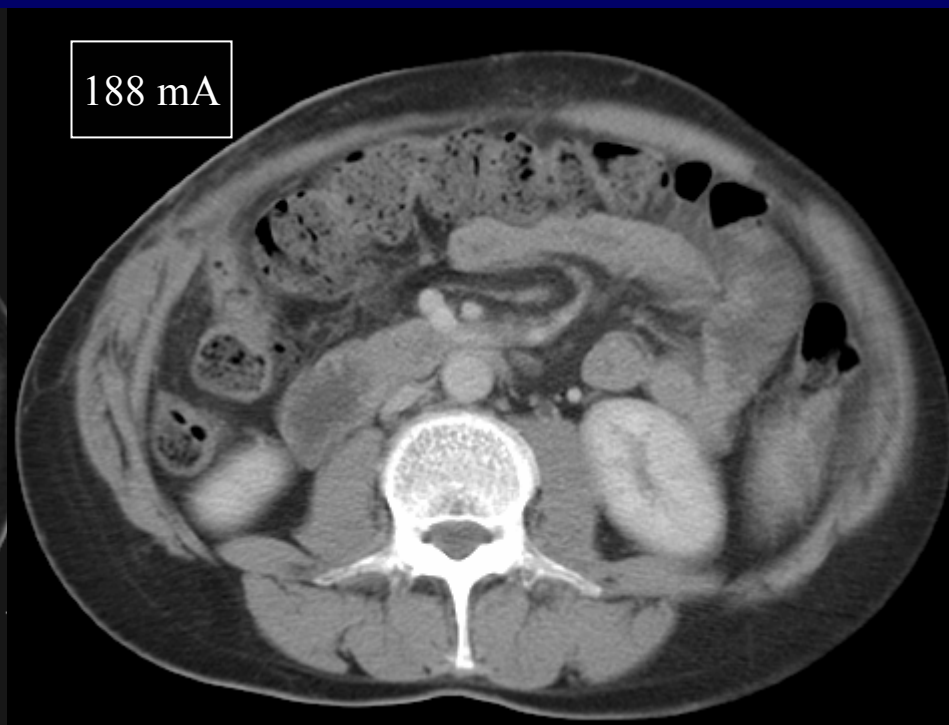
- Routine Brain

# Image Quality pre & post 'smart mA'



- Routine Chest

# Image Quality pre & post 'smart mA'



- Routine Abdomen

# Conclusions - part A

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- mA modulation provides constant IQ
  - through the same patient
  - from one patient to another
- average DLP is reduced
  - well within European DRLs
- It works!

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PART: B

Harmonisation of Std Protocols

# Siemens Emotion Duo

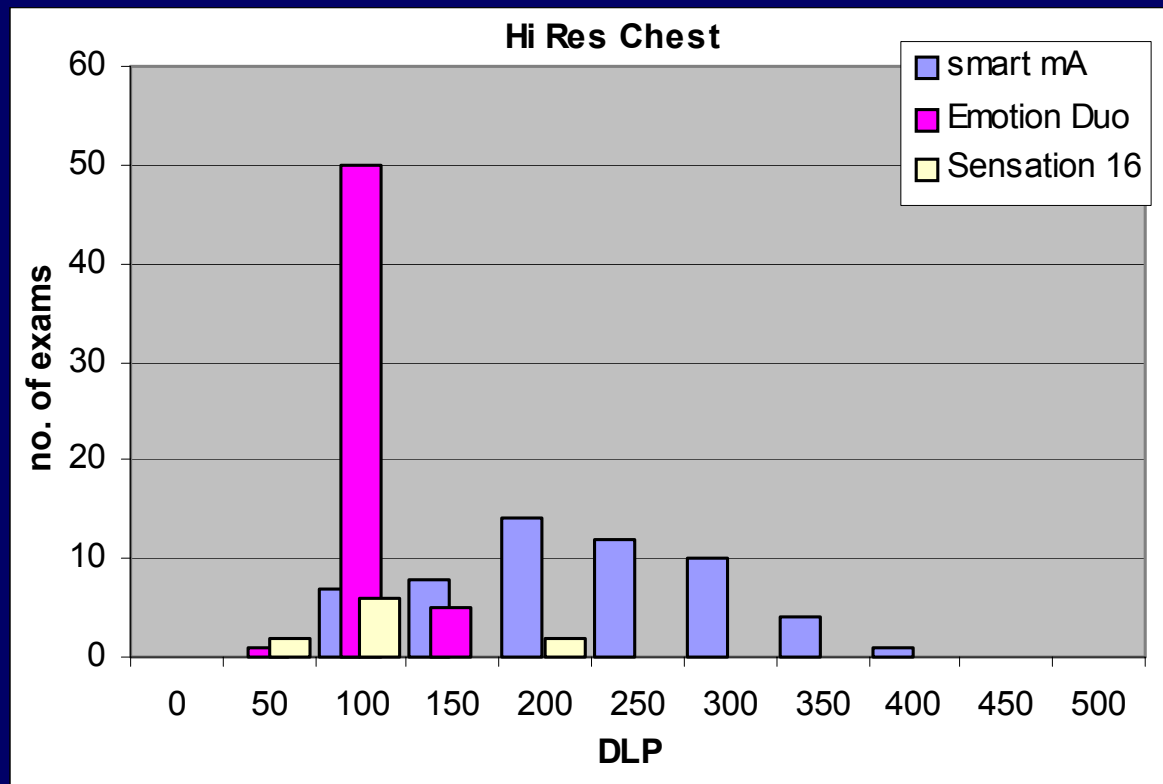
Examination Protocol (Siemens Emotion Duo)		kV	mA	Time (s)	Collim. (mm)	Feed/rot (mm)	CTDI <sub>vol</sub> (mGy)
Routine Brain (axial)	P. Fossa	130	173	1.5	2x1	4	29.6
	Cerebrum	130	173	1.5	2x4	8	59.2
Routine Chest (helical)		130	75	0.8	2x4	12	4.3
High Resolution Chest (axial)		130	100	1.0	2x1	10	2.2
Abdomen (helical)		130	113	0.8	2x4	12	6.5
Chest / Abdo / Pelvis (helical)	Chest	130	75	0.8	2x4	12	4.3
	Abdo/Pelvis	130	113	0.8	2x4	12	6.5

# High Resolution Chest Protocol

<b>High Resolution Chest</b>	<b>kV</b>	<b>mA</b>	<b>Time (s)</b>	<b>Collimation (mm)</b>	<b>Feed/rot (mm)</b>	<b>CTDI<sub>vol</sub> (mGy)</b>
GE Lightspeed (smart mA)	120	190	0.5	1.25	10	4.1
Siemens Emotion Duo	130	100	1.0	2x1	10	2.2
Siemens S-16	120	158	0.75	1.0	10	2.1
Siemens S-16 (CAREDOSE)	120	110	0.75	1.0	10	1.4

# High Resolution Chest Protocol

- Geometry
- kV
- Collimation
- mA modulation
- $CTDI_{vol}$  x2-3
- Image quality?
  - Noise
  - Radiologists

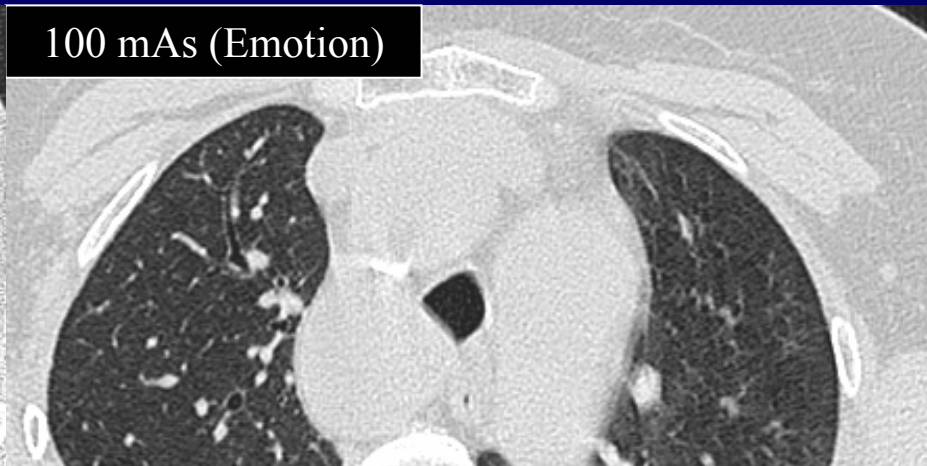


# Image Quality for HR Chest

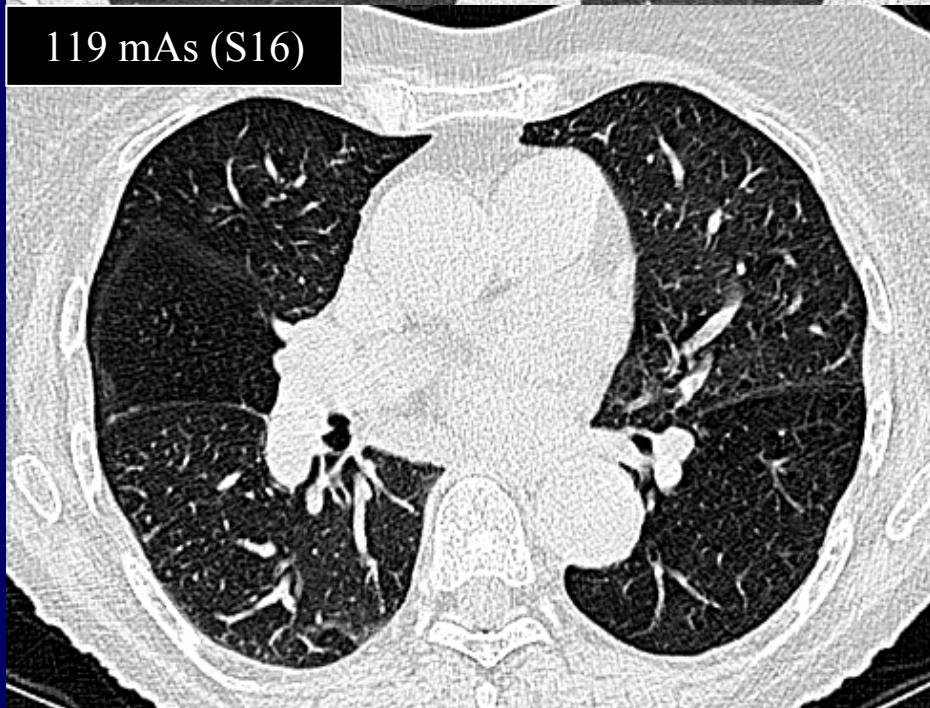
125 mAs (GE)



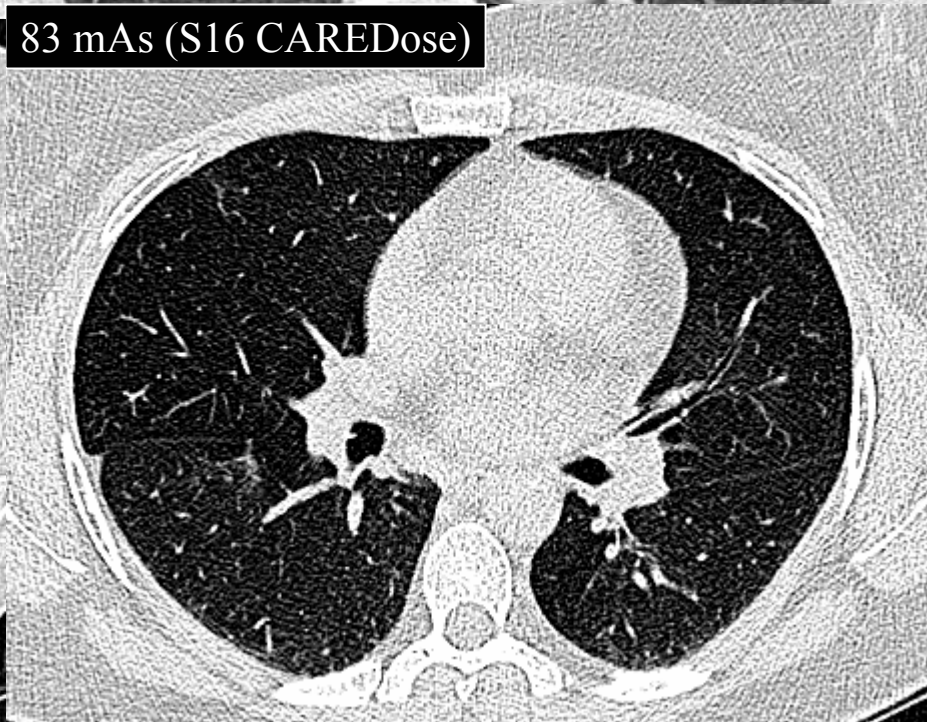
100 mAs (Emotion)



119 mAs (S16)



83 mAs (S16 CAREDOSE)



# Conclusions - part B

- Blind review of data sets by radiologists showed
  - GE (mean mAs=125,  $CTDI_{vol}=4.1$ ): very good IQ
  - S-16 (mAs=119,  $CTDI_{vol}=2.1$ ): good IQ
  - Emotion Duo (mAs=100,  $CTDI_{vol}=2.2$ ): acceptable IQ
  - S-16 with CAREDose (mean mAs=83,  $CTDI_{vol}=1.4$ ): loss of fine details / not acceptable
- So, in order to harmonise the HR Chest protocol
  - GE: reduce the mean mAs by using 'Normal' noise index
  - Emotion: keep the same mAs but reduce time to 0.8 s
  - S-16 with CAREDose: increase the mean mAs to 120

# Next Steps

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- Harmonise remaining Routine Scan Protocols!
  - Identify what structures must be visualised
  - Set IQ criteria
  - Compare  $CTDI_{vol}$  of old & new protocols

Thank you!