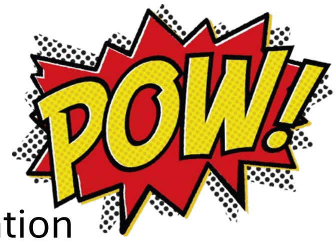
C-TECC Tim Stick's CT Cheat Sheet



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Thanks for attending the 2026 CT Protocol Optimization Workshop at the University of Wisconsin Madison!

Typical Contrast bolus transit times from antecubital vein access to:
Pulmonary artery 7-10 seconds
Ascending aorta 12-15 seconds
Abdominal aorta 15-18 seconds
Hepatic parenchyma 30-40 seconds

Positive material basis map values don't always mean that material is present.

EXERCISE: Anyone can easily assess the operation of your scanner's AEC in MDCT

- Scroll through an axial series (not a reformatted or secondary capture series).
- Note the mA value or the mAs_{eff} for each slice periodically throughout the study.
- The mA value or the mAs_{eff} should be changing for each slice as the scanner's AEC system adapts to changes in patient size over the patient's z-dimension.

For MDCT operated in helical/spiral mode, the mA will vary almost continuously slice to slice along z. For wide coverage MDCT operated in axial/sequential mode, due to the large beam collimation, large numbers of axial images are acquired at once, meaning the same mA is used to acquire many images at the same time. This will cause slabs of slices in the z-dimension to have the same mA or mAs_{eff} corresponding to each axial/sequential table position. The mA usually will (and in most cases should) change as one moves between two different table positions for such wide axial scans.

K factor table. Effective dose = DLP*k

Scan Region	Age	Phantom Diameter (cm)	Huda 2011 [47]	Jessen 1999 [48]	EUR 2004 [49]	Deak 2010 [46]
Head	Adult	16	0.0024	0.0021	0.0023	0.0019
Head and Neck	Adult	16/32	0.0045/0.009			
Neck	Adult	16/32	0.0053/0.0107	0.0048/ n/a	0.0054	0.0051/ n/a
Chest	Adult	32	0.0204	0.014	0.019	0.0145
Abdomen	Adult	32	0.0163	0.012	0.017	0.0153
Pelvis	Adult	32	0.0143	0.016	0.017	0.0129
CAP (Trunk)	Adult	32	0.0186			
Legs	Adult	32			0.0008	
Whole Body	Adult	16/32	0.0077/0.0154			

$$\text{Pitch (no units)} = \frac{\text{couch travel in 1 rotation}}{\text{collimation}}$$

$$\text{Effective mAs} = \text{mA} * \text{rotation time}$$

$$\text{CT noise (SD of HU)} \propto \frac{1}{\sqrt{dose\ (i.e., mA, mAs, CTDIvol)}}$$

Equations Governing the Major Facets of Contrast Delivery

$$Volume_{arbitrary\ strength}(ml) = \frac{Strength_{reference}(mg\ I / ml)}{Strength_{arbitrary}(mg\ I / ml)} Volume_{reference\ strength(ml)}$$

$$Volume(ml) = Duration(s) \times Injection\ flow\ rate(ml/s)$$

$$Total\ iodine\ load\ (mg\ I) = Contrast\ concentration\ (mg\ I\ per\ ml) \times Contrast\ volume\ (ml)$$

$$Scan\ delay = Time\ to\ optimal\ enhancement - \tfrac{1}{2}\ Scan\ duration$$

$$Scan\ speed\ (mm/s) = \frac{Collimation\ (mm) \times Pitch}{Rotation\ time\ (s)}$$

$$Scan\ duration\ (s) = \frac{Scan\ range\ (mm)}{Scan\ speed\ (mm/s)} = \frac{Scan\ range\ (mm) \times Rotation\ time\ (s)}{Collimation\ (mm) \times Pitch}$$

$$\text{Spatial resolution limit due to RFOV } \left(\frac{lp}{mm}\right) = \frac{\#\text{ of pixels in image}}{2 * \text{RFOV}}$$

$$\text{Minimum Voxel size need to support resolution (mm)} = \frac{1}{2 * (\approx 5\text{–}10\%\ MTF\ value\ in \frac{lp}{mm})}$$

$$NoiseSD \propto \frac{1}{\sqrt{CTDI_{vol}}} \text{ and } CTDI_{vol} \propto \left(\frac{kV_X}{kV_{80}}\right)^{\approx 2.5}, \text{therefore } NoiseSD \propto \left(\frac{kV_{80}}{kV_X}\right)^{1.25}$$

Typical WW/WL default settings

	Anatomy being Scanned	WW/WL (HU/HU)
CT Localizer Radiography	All	500/50
Abdominal	Soft Tissue	450/50
	CTA	800/150
Chest	Lung Fields	1500/–700
	Soft Tissue (i.e., mediastinum)	450/50
Neuro	Bone (i.e., temporal and spine)	2500/350
	CTA	450/50
	Thin brain grey/white	180/25
	Neck soft tissue	300/35
	Orbits soft tissue	300/0
	Routine brain	80/25
MSK	Bone	2500/350
	Soft tissue	450/50

How many scans you can take before hitting fetal doses of 50 or 100 mGy

Scan Region	$CTDI_{vol}$ (mGy) Required to Give Uterus Dose of 50–100 mGy	Median Dose for This Scan Type	Number of Scans Needed to Exceed 50/100 mGy Threshold	Scan Range Limits
Abdominal and thoracic Imaging				
Abdomen Pelvis	36/72	12	3/6	Top of diaphragm to pubic symphysis
Pelvis	36/72	13	3/5.5	Top of iliac crests to pubic symphysis
Chest	>100	11	>100	Lung apices to lung bases
Neuro Imaging				
Brain	>100	49	>100	
Neck	>100	15	>100	
Thoracic Spine	>100	23	>100	Top of C7 to the bottom of L1
Lumbar Spine	38/76	25	1.5/3	Top of T12 to the bottom of S2

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Optimizing protocols isn't always a science project. If radiologists complain on image quality, try different slice thickness, kernels, denoising options, vendor bells and whistles, and do a review session. 20 mins of radiologist time is worth weeks of "physics".
AAPM TG-233 approaches should not be your first, second, or third go to.

Low Resolution?

Radiologist has difficulty distinguishing anatomy?

Does "**through-plane resolution**" need to ↑? Do vessels in superior/inferior ends appear blurry?

Consider ↓ slice thickness

Does "**in-plane resolution**" need to ↑?

- E.g., Does trabecular detail look blurry?

Try sharper kernel (e.g., increase Siemens kernel #, GE soft→ standard →detail→bone→ultra)

Do not mix high resolution kernels with large focal spots and/or large RFOV and/or 512 matrix sizes

Acquisition Technique

Ensure correct patient centering during scout phase. Within 10 cm of isocenter for best results.

Use low pitch / small collimation whenever possible for all MSK/T-bones/spine scans.

Reformat Resolution

Blurry

Check source recons

- Reformats should be generated from images that are half or less the target slice thickness.

Blocky

If images are 'stairstep' blocky, use "Z" feature on GE.

All vendors, rule of thumb → slice interval is less than half of target slice thickness

Noise too high?

Last Option: ↑ Dose

Increase AEC quality target (Siemens: increase eff mAs or IQ level, GE: decrease NI, Canon decrease SD)

Make sure protocol is "slow" enough to deliver the higher dose w/o tube max out issues

Patient size

Large

Make protocol slower, or make an additional "large" patient slower protocol to allow more output

Small

Adjust AEC size control to lessen dose decrease with size smaller than reference patient (i.e., on Siemens and "auto prescription" GE)

"Simple AEC" scanner? Make separate smaller patient protocol with higher AEC quality target.

Dose can't be raised?

→Increase denoising strength
→Increase slice thickness
→Use a lower resolution "softer" kernel
→Turn off edge enhancing options or kernels

M.D. Pairs appropriate?

If the **M.D. pair is similar** image noise will be very high. Consider the following examples:

1. An Iodine–Calcium image will appear significantly noisier than an Iodine–Water basis pair, even though both reconstructions are decomposed onto iodine.
2. Water–Fat reconstructions are much noisier than Water–HAP, following the same principle.
3. For cardiac Ca, same for Ca (Iodine) will be nosier than Ca(Water)

Does recon have low keV?

Low keVs are usually meant to enhance ICM+ studies. Not useful to have on for non-con spectral scans. (minus gall stones and small renal calculi) Check WW/WL→ Too tight of WW can make IQ look worse