

Assessing SPECT-CT scanners for Lung Cancer Screening

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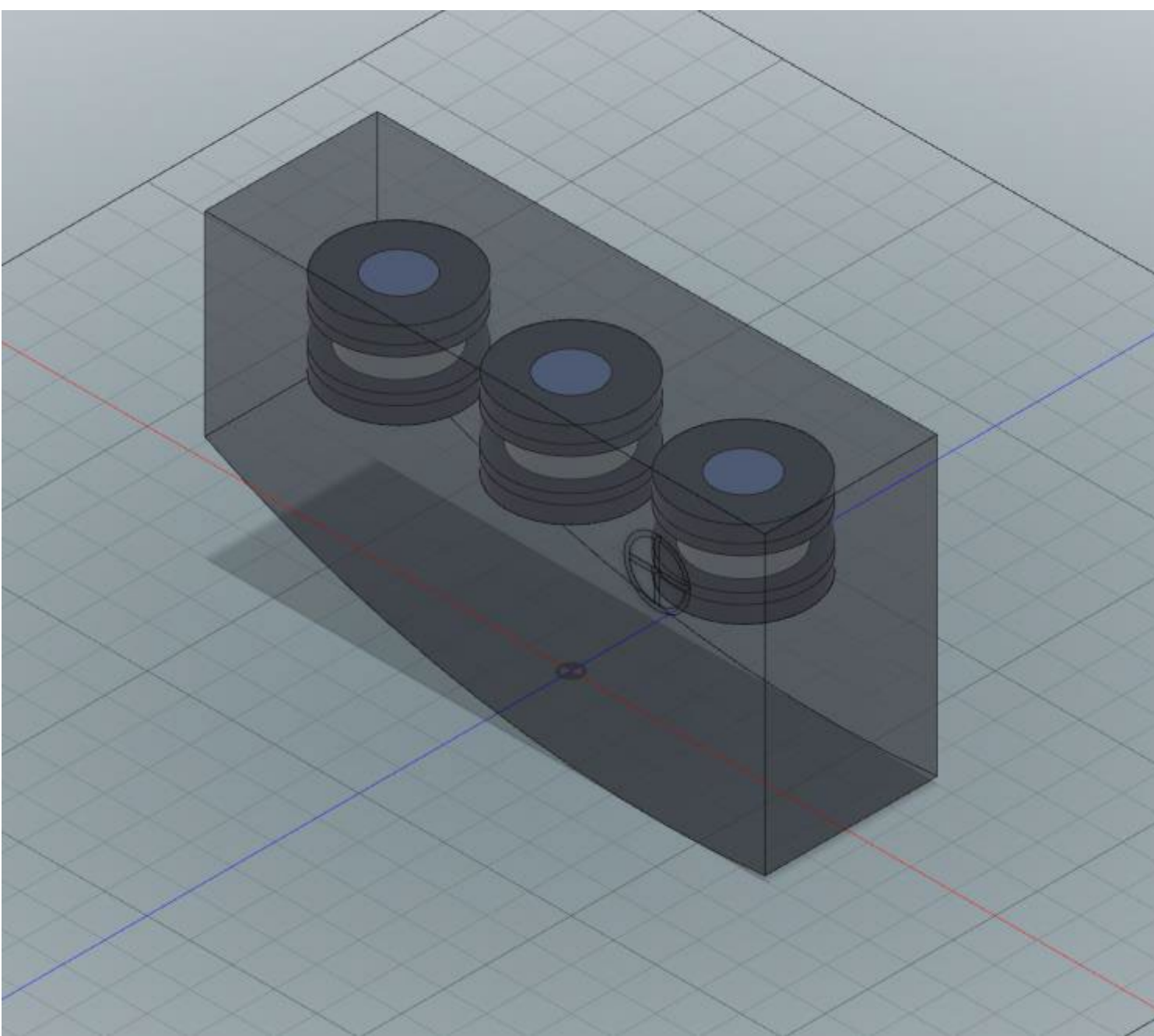
Purpose
Explore the possibility of using 16 slice SPECT-CT scanners for Lung Cancer Screening.

Background: We have a shortage of CT technologists that is leading to longer wait lists. Concurrently, we have a surplus of Nuclear Medicine technologists who are looking for more hours to work. Lung Cancer Screening (LCS) patient scans are relatively uncomplicated. The patients are healthy and there is no need for iodine contrast. Are these scanners technically capable?

Methods:

- 8 SPECT-CT scanners from two vendors (five models).
- CTLX1 phantom:

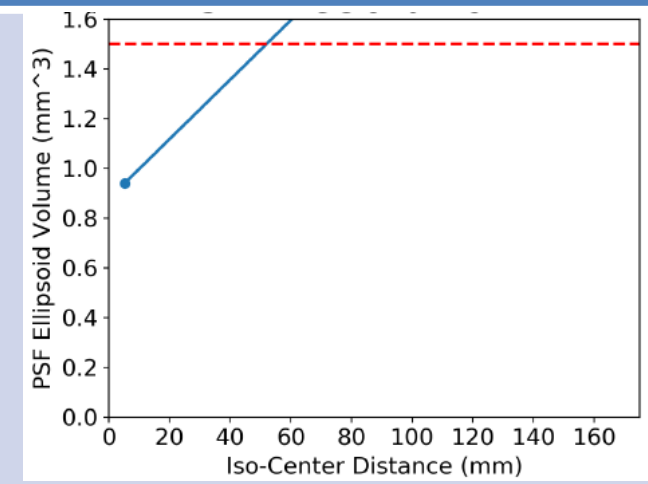
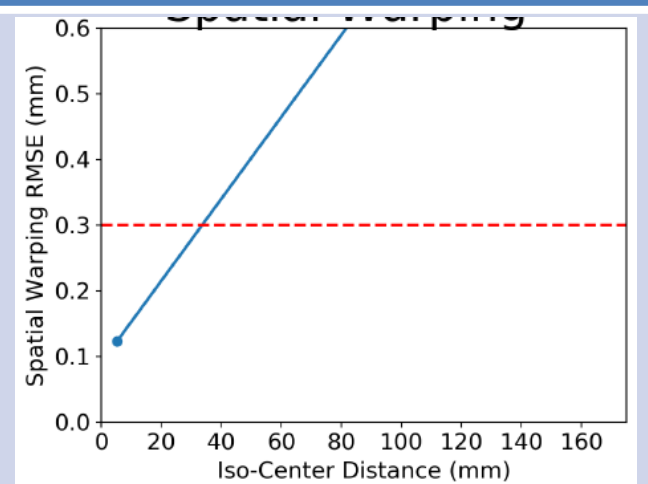
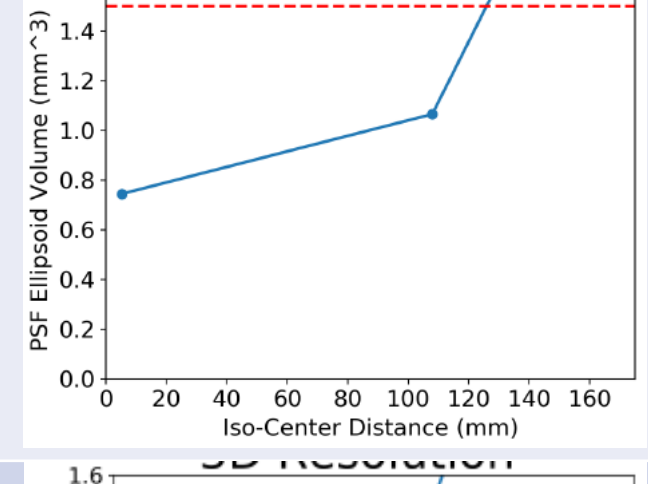
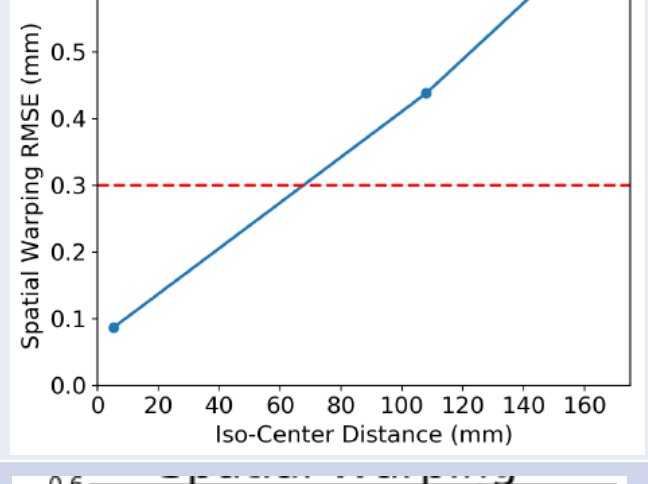
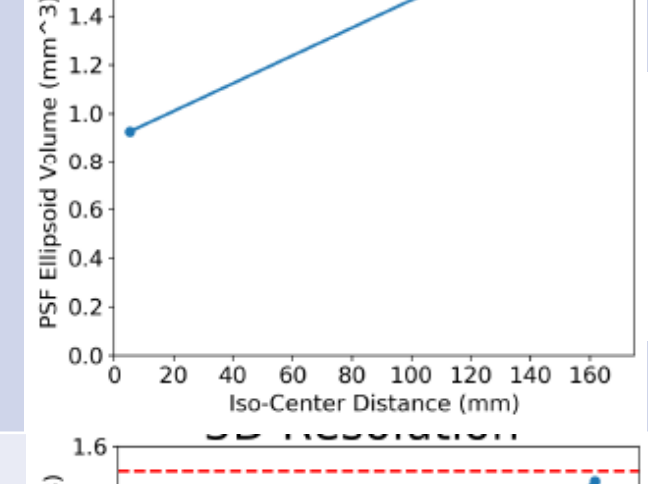
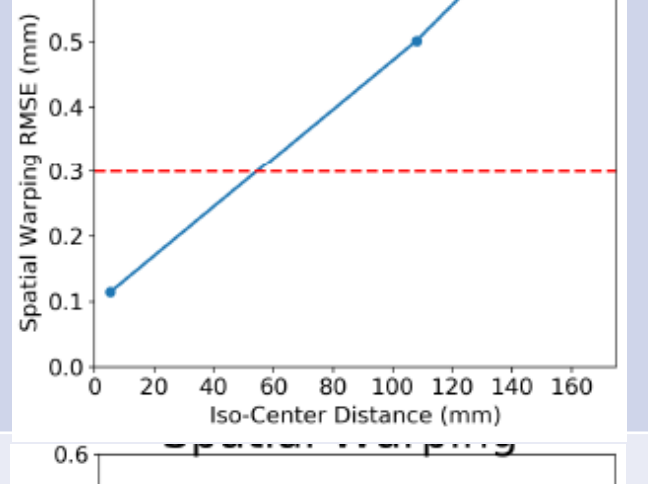
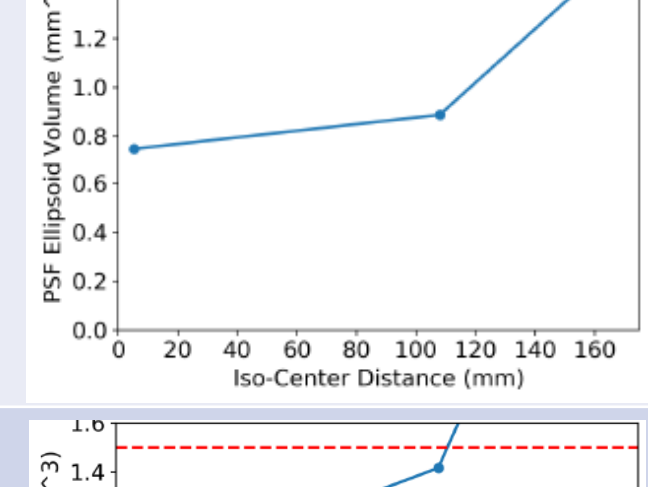
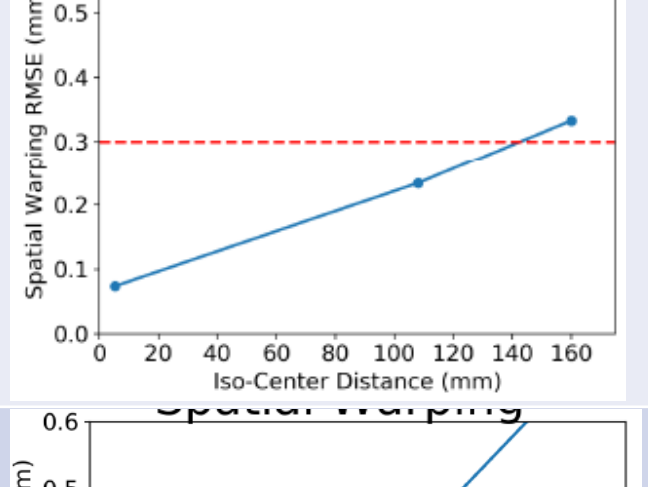
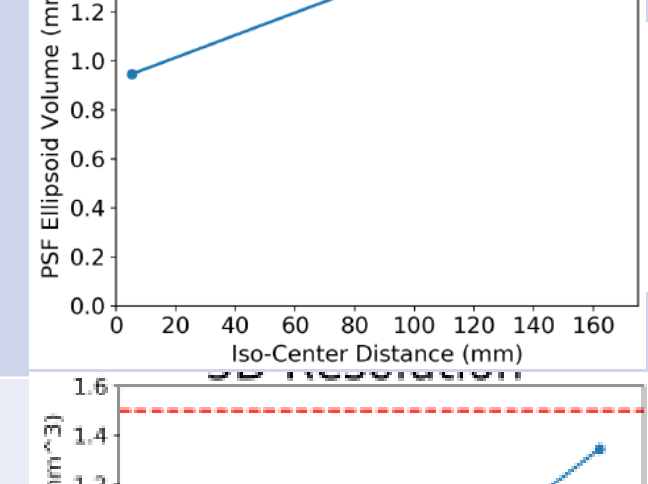
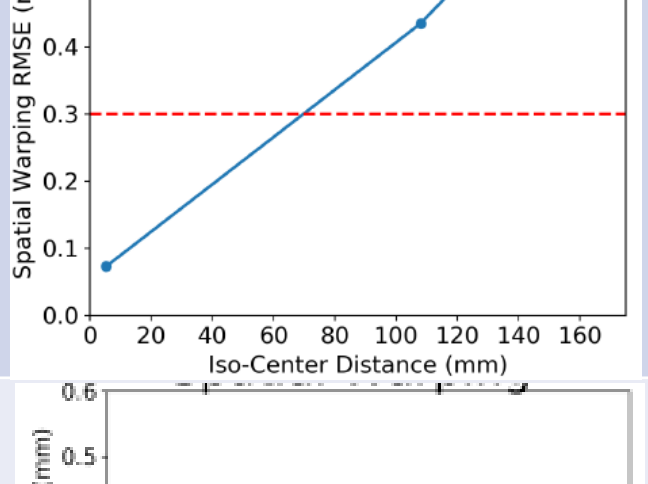
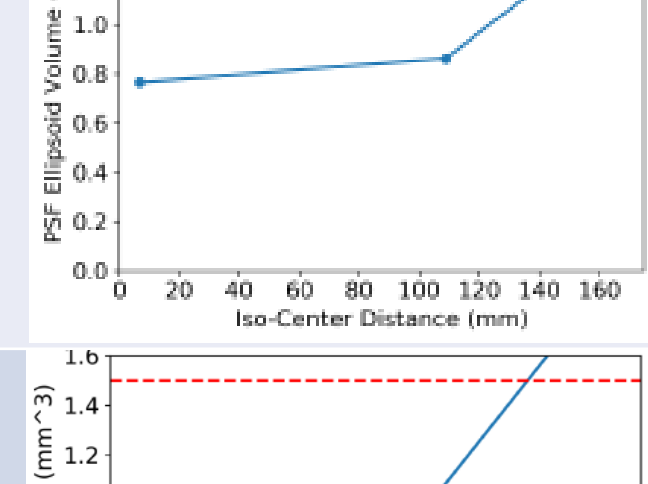
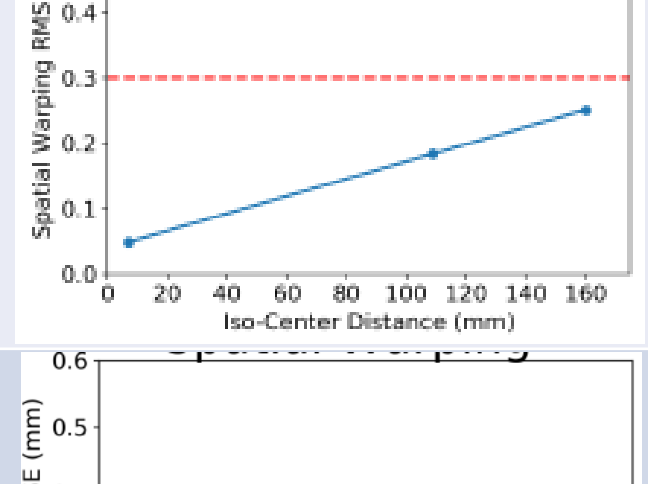
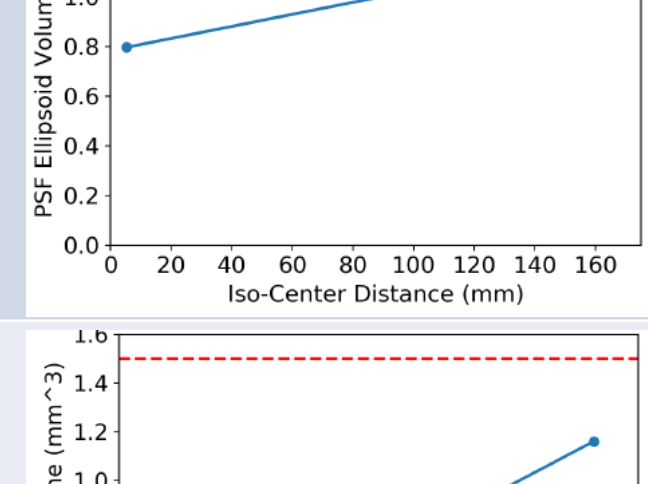
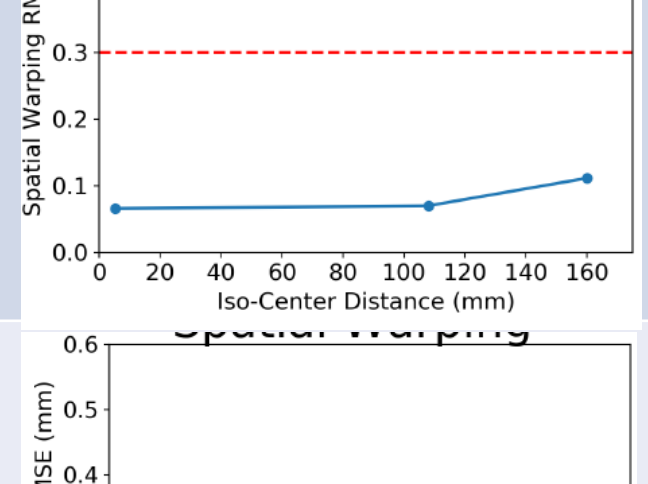
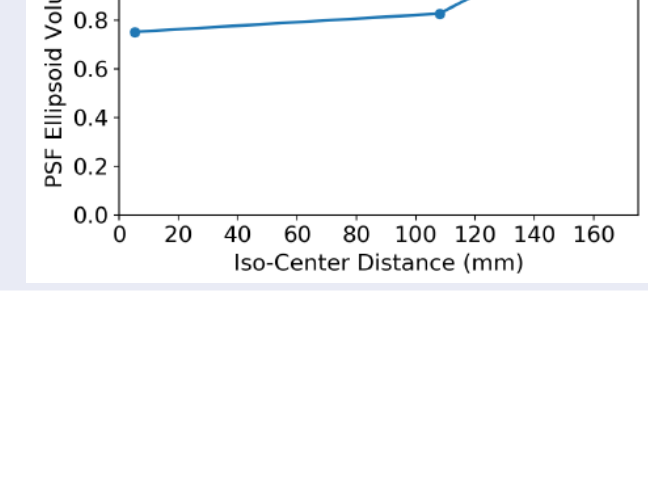
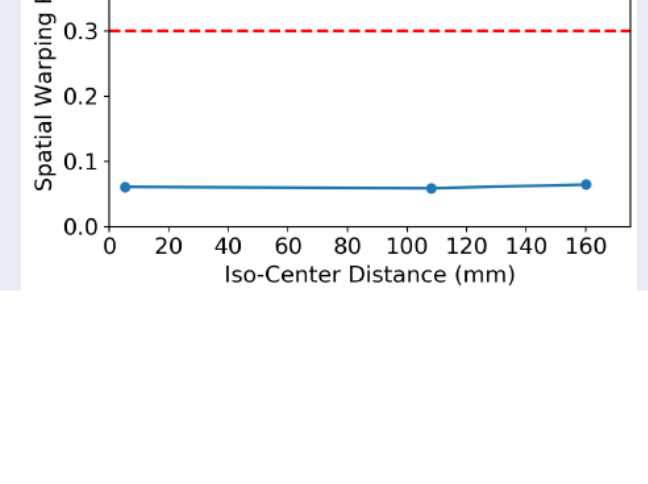



- 3 cylindrical cylinders at 0, 100, 200 mm from isocentre
- Assess RSNA-QIBA small lung nodule profiles [1] to ensure quantitative measurements taken across vendors/models, and over time, are consistent. Of interest:
 - 3D resolution aspect ratio (≤ 2.0)
 - spatial warping root means squared error ($\leq 0.33\text{mm}$)
- Provincial LCS program requirements [2]:
 - ≥ 16 slice
 - 1-1.25 mm contiguous slices
 - scan time $< 12\text{s}$ to ensure a viable patient breath hold.
 - Helical pitch and reconstruction kernel options were exhaustively explored

Results – overall:

Make	Model	Slices	Scan duration (s)	Passes phantom testing?	Fastest tube rotation time	Max collimation at LCS slice width (mm)
A	a1	16	9.6	no	0.5	20
A	a1	16	9.6	no	0.5	20
A	a1	16	9.6	no	0.5	20
A	a2	16	13	n/a	0.8	9.6
B	b1	16	17.5	n/a	0.6	9.6
B	b1	16	17.5	n/a	0.6	9.6
B	b2	<16	n/a	n/a	n/a	n/a
B	b3	2	17.5	na/	0.6	n/a

Results – Vendor A, Model a1

Pitch	Table speed	Est scan time	3D resolution	Spatial Warping
1.75:1	35.0 mm/rot	5.2s		
1.75:1	17.5 mm/rot	11s		
1.375:1	27.5 mm/rot	6.6s		
1.375:1	13.75 mm/rot	13s		
0.938:1	18.75 mm/rot	9.7s		
0.938:1	9.37 mm/rot	19s		
0.562:1	11.25 mm/rot	16s		
0.562:1	5.62 mm/rot	32s		

Conclusions

- None of the SPECT-CT scanners in this study were technically capable of LCS. One vendor failed to achieve the required scan time.
- 64 slice models from Vendor A all pass.
- Previously, it was found that 16-slice versions of stand-alone Vendor A CT scanners suffered the same limitations found here. [3]

[1] QIBA Profile: Small Lung Nodule Volume Assessment and Monitoring in Low Dose CT screening. 2023 (qmic.org) [2] BC Cancer Agency. LDCT Technical Acquisition Procedure 2025 [3] Henschke CI et al. Tumor volume measurement error using computed tomography imaging in a phase II clinical trial in lung cancer. Journal of Medical Imaging 3: 035505 (2016)