

SeHCAT Imaging

Should we be doing dynamics instead of statics?

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I have no financial interests or relationships to disclose with regard to the subject matter of this presentation.

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SeHCAT Imaging – an Evolution

- Imaging time 5 minutes
- Acquired with no collimators
- Exclude Se-75's peak at 136keV

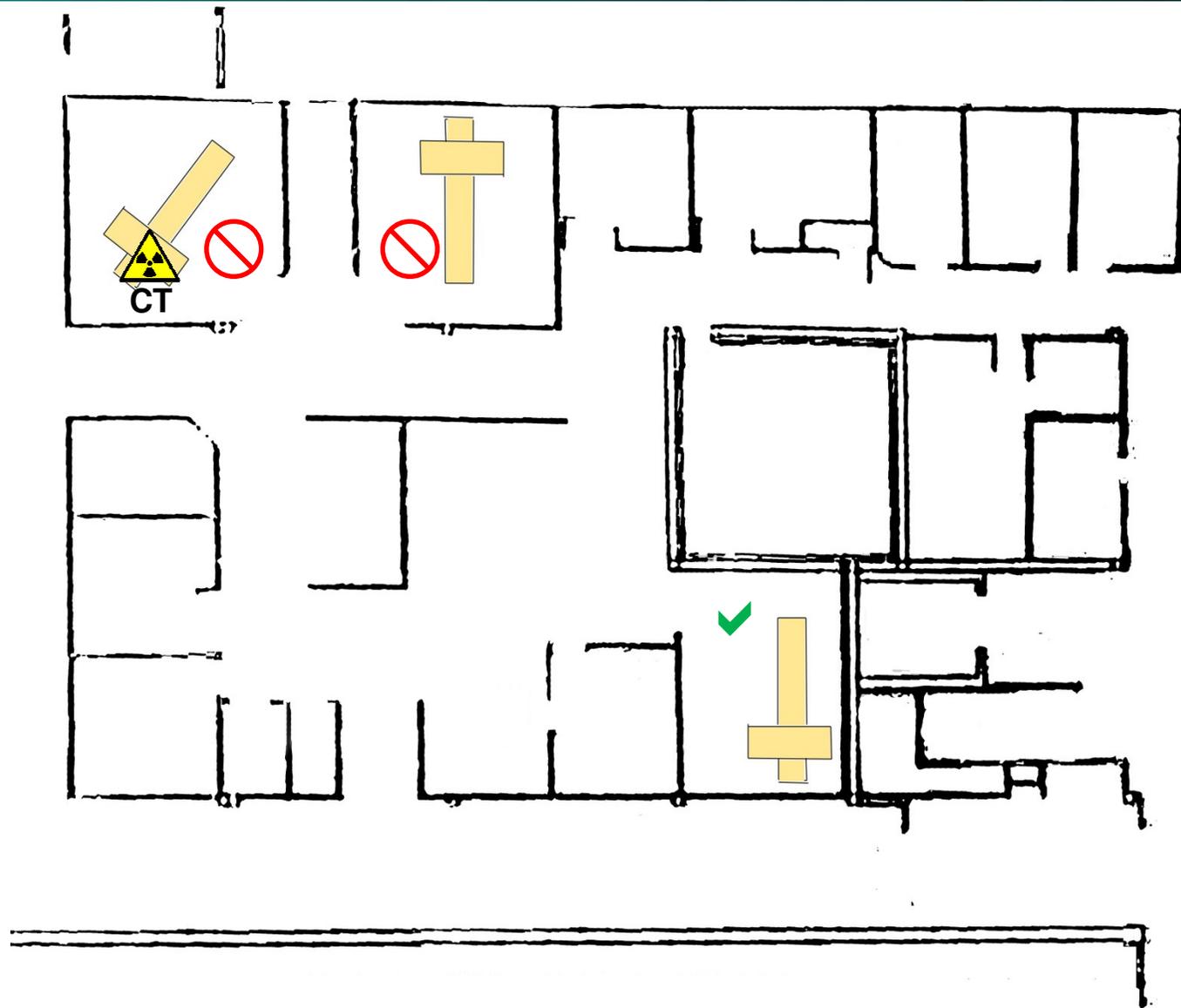
Before 2014 1 x 5 minute static

2014 - 2016 5 x 1 minute statics
allows some QC

2016 - present 60 x 5 second dynamic
more detailed QC



Flow of Radioactivity



Flow of Radioactivity



Moving away from Statics

To get started with dynamic imaging back in 2014, we acquired 5 x 1 minute statics for QC purposes and to facilitate future audit.

Transcribed counts of each static manually from DICOM header info...

Mr. A Patient	1 st min	2 nd min	3 rd min	4 th min	5 th min
Day 0 bg1 ant	4088	4102	4027	4089	4126
Day 0 bg1 post	5183	5205	5254	5205	5245
Day 0 Patient ant	235275	236028	233482	229489	235740
Day 0 Patient post	107300	108544	110028	112313	109310
Day 0 bg2 ant	4018	4199	4133	4012	3978
Day 0 bg2 post	5272	5240	5187	5379	5247
Day 7 bg1 ant	4053	4059	4211	4009	4188
Day 7 bg1 post	5363	5308	5341	5240	5155
Day 7 Patient ant	10196	10039	10245	10124	9922
Day 7 Patient post	9420	9345	9336	9419	9597
Day 7 bg2 ant	4197	4147	4115	4150	4070
Day 7 bg2 post	5164	5348	5178	5149	5227

Dear Radiographers.
Sorry about that.
Best wishes, Physics xXx

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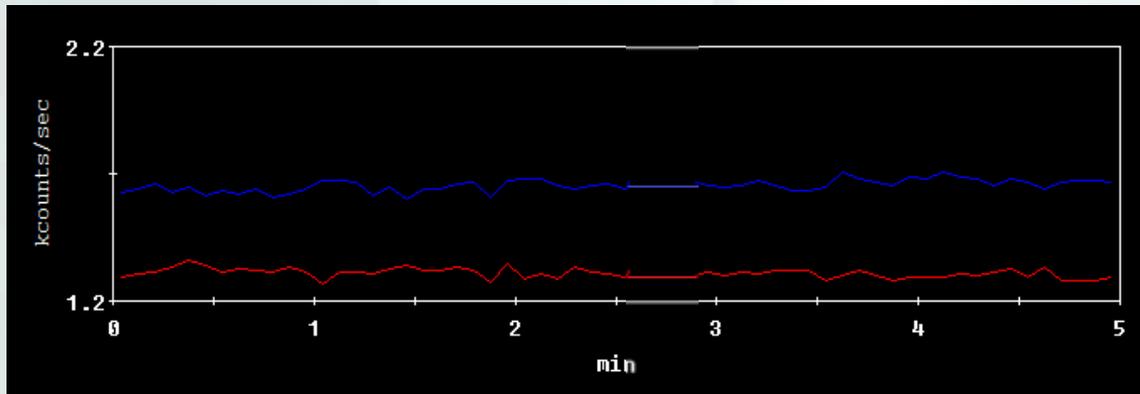
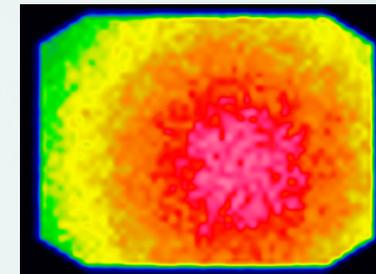
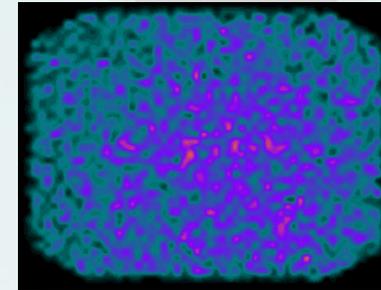


Developing New Analysis Software

Wrote code in Aladdin language on the GE Xeleris

Function of code:

1. Creates Summed Images from the dynamics
2. Rejects any frames with spikes and re-normalises.
3. Decay corrects and calculates SeHCAT result



Day 0 counts: 417128

Day 7 counts: 56179

SeHCAT Retention: 13.47%

% SeHCAT Retention Ranges:

0 - 5 %	Severe Bile Acid Malabsorption
5 - 10 %	Moderate Bile Acid Malabsorption
10 - 15 %	Mild Bile Acid Malabsorption
>15%	Normal

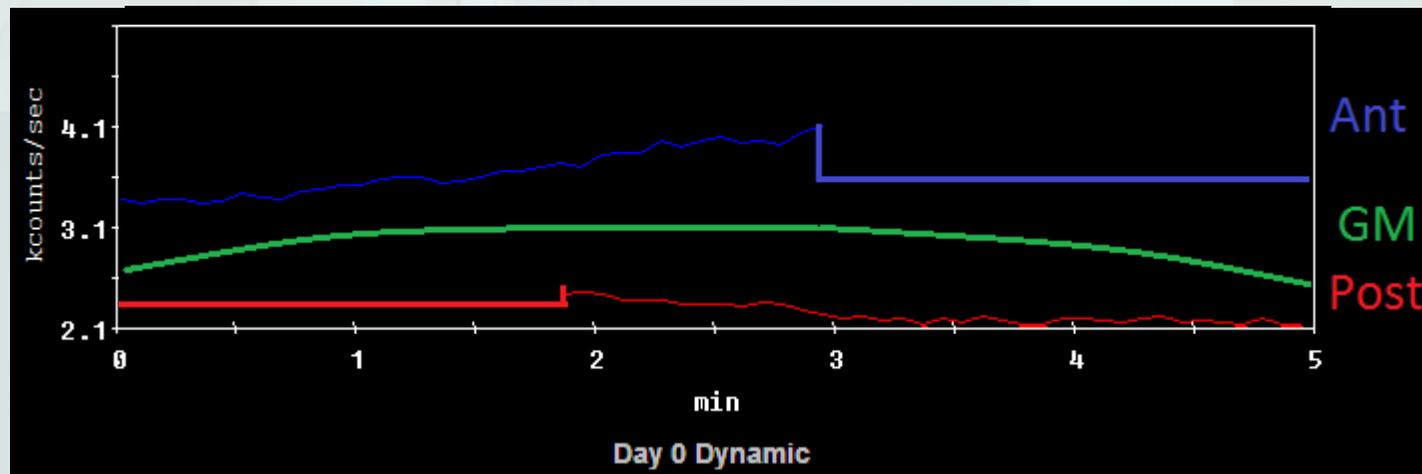
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Note: Rejecting Spikes in Counts

We used to reject ANT or POST dynamic frames (or 1 minute statics) if they were significantly above mean, which works ok for simple spikes, however:



In 20 of 100 patients audited, the activity in the patient was moving in the ant-post direction at 3hrs

Geometric Mean was found to be robust in these cases

Removing frames based on ANT or POST alone tends to over-correct in error.

You should look at the geometric mean of each time point when selecting frames to discard.

Findings from 100 Patients Dynamic Images



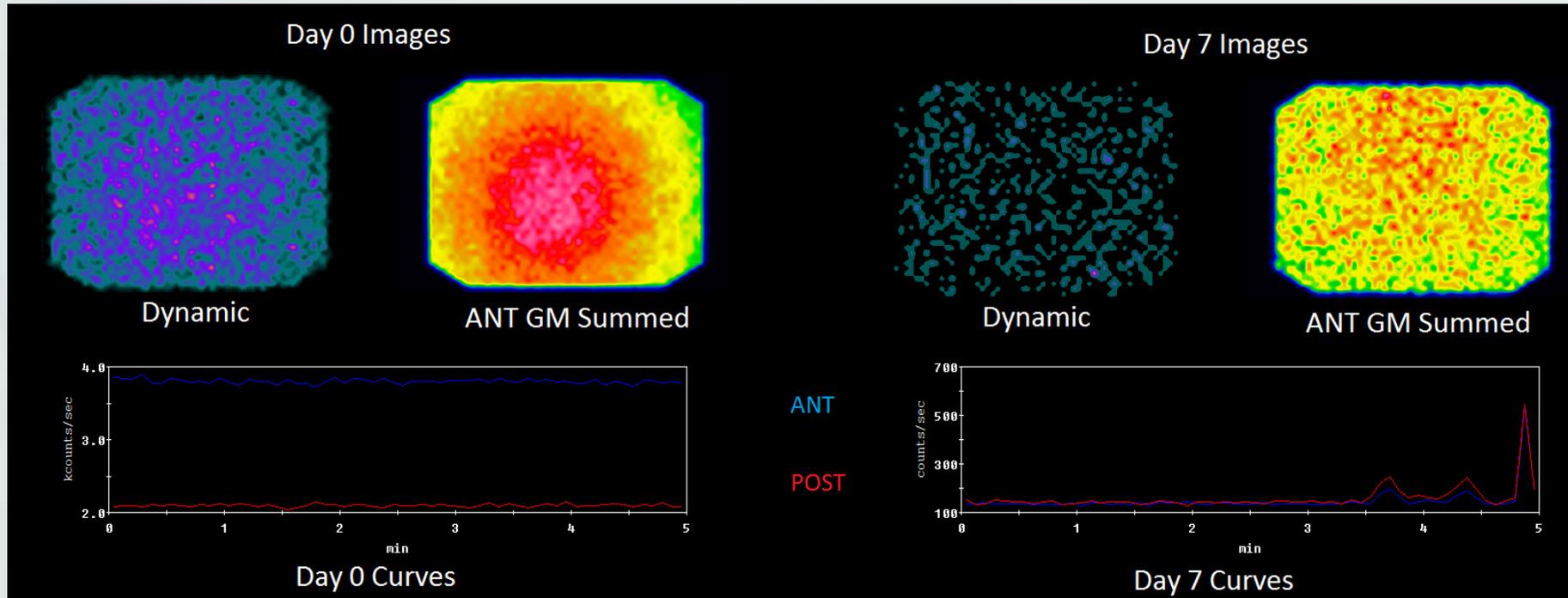
Lift

Vending
Machines

Findings from 100 Patients Dynamic Images

Imaging using the 265keV window.

Spikes seen in **7 of 100 day 7** patient images
(but none of the 3 hour images)



What's the Impact?

If we had acquired 5 minute statics:

Day 7 Counts = 22,391

SeHCAT Result = 3.34%

Correcting for the spikes:

Day 7 Counts = 18,494

SeHCAT Result = 2.76%

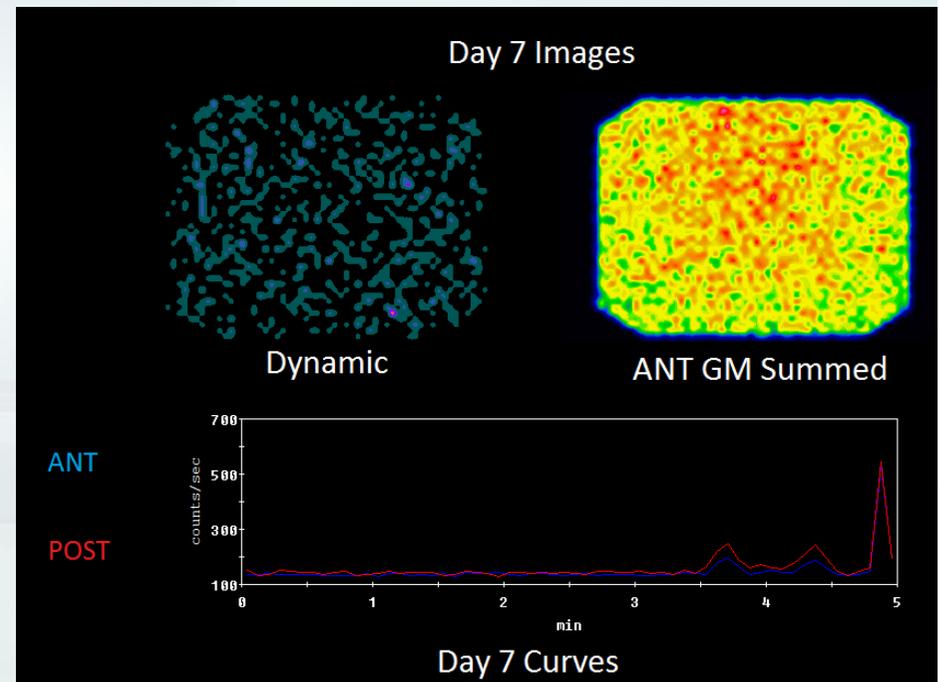
No significant change to result

The spikes contributed ~4,000 counts

Which is about 0.5% of a typical day 0 count

And hence a 0.5% additive error

If this happened on a different patient with a true result of 14%, this would make it 14.5%

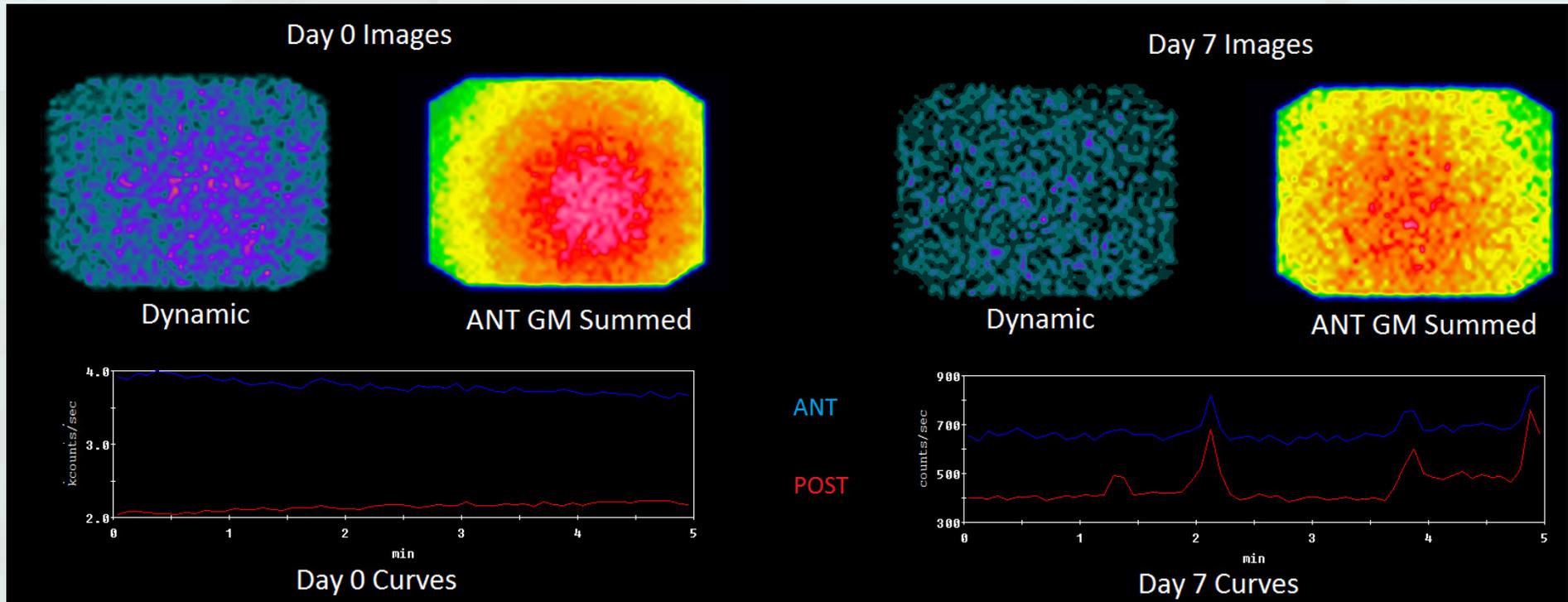


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Most Extreme Case



If we had acquired 5 minute statics:

Day 7 Counts = 144,889

SeHCAT Result = 17.65%

(additive error of 0.9% on of any result)

No significant change to result

Correcting for the spikes:

Day 7 Counts = 137,809

SeHCAT Result = 16.79%

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Acceptable Errors?

- Additive errors of the order of 0.1% to 0.9% were found in 7 patients. This could push a 14.5% result over the 15% mark if you treated these as absolute.

Should we care about 0.5% errors?

Show of hands:

If you gave your patients appointments at 10am for the capsule
+ 1pm for the 3 hour scan,

Would you tell them to come back at 10am or 1pm for their scan on day 7?

A patient with 15% retention at 7 days post admin
would give a result of 14.3% if you scanned them three hours later.

$$15\%^{168/171} = 14.3\%$$

Conclusion

- The spikes in count rate we saw had surprisingly little impact on the clinical results (+0.1% to +0.9%, mean +0.3%)
- If you do dynamic imaging and correct for spikes, then remember you should look at the GM of each frame to identify which frames are spikes
- We will continue to do dynamic imaging because it does catch some minor errors and because we have already set it up.

Should you consider dynamic imaging?

Size of spikes and errors will depend upon your department layout and flow. Dynamic acquisitions for all patients can be time consuming without automatic processing.

*If you include the 134keV Se-75 peak in your window, then **yes**.*

If you only use the 265keV peak, then you should do some kind of assessment or experiment to answer this question, and either then switch to dynamics, or use this as validation that statics are OK at your centre

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