

BIR Current and Future Prospects

Commissioning of SPECT/CT



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Plan of this talk

- Who am I
 - Nuclear Medicine Physicist
 - Head of Nuclear Medicine Service RFH
 - Kings MSc in Nuclear Medicine Module Lead for Radiation Legislation



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PET/CT a disruptive technology



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Impact of PET

- PET/CT changed the availability of PET in the clinic
- Whether you saw it as CT with a special contrast
- Or a radioisotope scan with great localization
- Its clinical usefulness was very clear to see



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Impact of SPECT/CT

- SPECT/CT has a similar chance to change the landscape
- Greater reach in terms of depts involved
- CT in a Nuclear Medicine Set up poses questions
 - Environment
 - Training
 - Regulatory Compliance



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A brief history

Let us step back with a brief history



GE Hawkeye



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A brief history

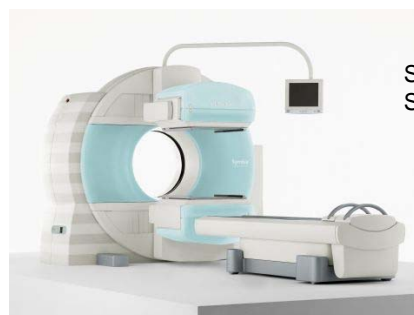


Philips
Precedence



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A brief history



Siemens
Symbia



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A brief history



Philips
Brightview



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A brief history



GE
NM/CT 670



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Long Tail Commissioning

- Procurement
- Planning the environment
- Changing practice
- Keeping Compliant



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Commissioning team

- Clinicians-Physicians, Radiologists
 - ?referrer
- Technologist
 - NM Tech +/- Radiographer
- Physicists
 - MPE NM + DR, RPA
- Hospital Procurement
- Projects department



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Procurement

- OJEU tender
 - All public purchases over a certain value
- Well defined time scales
 - Expression of interest
 - Invitation to tender
 - Evaluation



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Procurement

- Framework purchase
- NHS Supply chain
 - Buy off the self
 - Mini competition
- Turnkey possible as well



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Tender Evaluation

- User Requirement
- Output based specification
- Weighting responses to these
- Specifying mandatory requirements
- Procurement may well have views on scoring system
- Best value vs Cheapest



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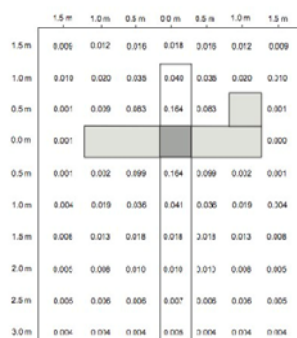
Room design

- Prior Risk assessment
 - What are the risks
 - CT
 - NM patients
- Who we protecting
 - Public
 - Staff
 - What about adjacent radiation workers?
- ⚙️ Dose Constraints



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Isodose



Measurements in $\mu\text{Sv}/\text{h}$ mAs scan

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Room Design

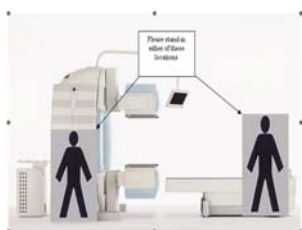
- Control Room essential
- Clarify entry and access
- Warning Lights
- Clear about reason for room designation
- Remember above and below
- Consider UPS system (NM only)



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Local Rules

- Standard NM + CT
- People in room?
 - No
- If you must
 - Lead apron



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Patient dose strategy

- Attenuation Correction
- Localization
- Full Diagnostic
- Contrast Enhanced
- Is localization just a point in 3D space?



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Patient dose strategy

- Who have you got to scan
- Available dose saving techniques
- Iterative reconstruction on CT
- Contrast Enhanced



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Patient dose strategy

- Who have you got to scan
 - technologists
- Use dose care –
 - YES! SPECT Guided
- Iterative reconstruction on CT
 - n/a - look at adaptive filter
- Contrast Enhanced -
 - no, if so will use trained radiographer



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Patient dose strategy

- Attenuation Correction
 - sometimes
- Localization
 - Location plus
- Full Diagnostic
 - MSK
- Technologists strictly confirm to protocol
- Doses based on percentage of Radiology



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Making use of the Team

CT dose calculation

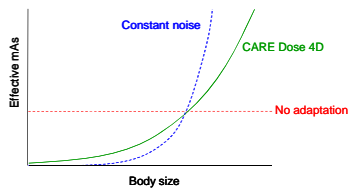
- Available from
<http://www.impactscan.org>
- Used in conjunction with the dose data sets from NRPB SR250 which can be bought from the HPA

Organ	Weight (kg)	Volume (cm³)	Dose (Gy)
Brain	1.5	150	0.01
Brainstem	0.5	50	0.01
Eye	0.5	50	0.01
Ear	0.5	50	0.01
Spinal Cord	0.5	50	0.01
Lung	1.5	150	0.01
Stomach	1.5	150	0.01
Small Intestine	1.5	150	0.01
Large Intestine	1.5	150	0.01
Bladder	1.5	150	0.01
Uterus	1.5	150	0.01
Vagina	1.5	150	0.01
Rectum	1.5	150	0.01
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Importance of dose saving techniques

CARE Dose 4D

- The mA is varied continuously to give high image quality at a reasonable dose.



Dose optimization

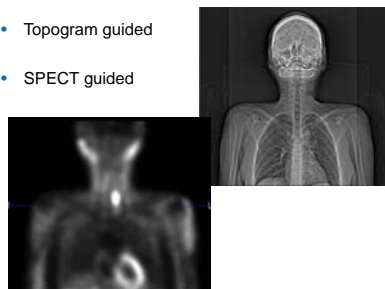


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Importance of Dose saving techniques

Identifying the region to be CT scanned

- Topogram guided
- SPECT guided



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'The technologist issue'

- Some trained abroad and experienced SPECT/CT users
- All staff day of theoretical training
- Competence list to be completed
- Consulted with lead CT radiographer
- Update training and incident feedback
- No ability to vary CT protocols
- 'Pink form'



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Supporting the Technologists

CT protocols

SYMBIA CT PROTOCOLS												
PROTOCOL	BRAIN	PANATHROPE HEAD/NECK	CERVICAL SPINE	SPINE	THORAX	ABDOMEN	PELVIS	KNEES	FEET	HANDS		
PARAMETERS												
TOPOGRAM mAs	20	20	20	20	20	20	20	20	20	20		
TOPOGRAM Length (mm)	448	512	448	512	512	512	512	448	448			
SCAN mAs	140	40	100	60	40	60	60	100	100	100		
kV	130	130	130	130	130	130	130	130	130	130		
Slice (mm)	5 - 16x1.2	5 - 16x1.2	2 - 16x1.2	5 - 16x1.2	5 - 16x1.2	5 - 16x1.2	5 - 16x1.2	5 - 16x1.2	1 - 16x0.6	1 - 16x0.6		
Pitch	0.55	1.2	0.8	1.2	1.2	1.2	1.2	0.6	0.6	0.6		
Rotation Time (sec.)	1.5	0.6	1	0.6	0.6	0.6	0.6	0.6	0.6	0.6		
Reconstruction Kernel	H31 - Soft	B41 - Soft	B31 - Soft	B31 - Soft	B41 - Soft	B41 - Soft	B41 - Soft	B31 - Soft	B41 - Soft	B41 - Soft		
	H50 - Bone	B60 - Bone	B60 - Bone	B60 - Bone	B70 - Lung	B60 - Bone	B60 - Bone	B60 - Bone	B60 - Bone	B60 - Bone		
	H08 - AC	B08 - AC	B08 - AC	B08 - AC	B08 - AC	B08 - AC	B08 - AC	B08 - AC	B08 - AC	B08 - AC		
PROTOCOL												
PARAMETERS												
TOPOGRAM mAs	20	20	-	20								
TOPOGRAM Length (mm)	448	512	-	512								
SCAN mAs	100	100		100								
kV	130	130		130								
Slice (mm)	2 - 16x1.2	1.5 - 16x1.2	1 - 16x1.2	1 - 16x1.2								
Pitch	1	1.2	0.6	0.6								
Rotation Time (sec.)	1	0.6	0.6	0.6								
Reconstruction Kernel	B41 - Soft	B31 - Soft	B31 - Soft	B31 - Soft								
	B60 - Bone	B60 - Bone	B60 - Bone	B60 - Bone								
	B70 - Lung	B08 - AC	B08 - AC	B08 - AC								

CT Tech documents/SYMBIA

Last review: 21/09/2011



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Compliance

- Not just for technologist
- Justification criteria
- Authorization protocol
- In scan authorization
- Communication and recording of this



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Understanding Our Scan doses

Local Diagnostic Reference Levels and Dose Investigation Levels for Symbia CT Protocols

CT Protocol	DLP (mGycm)		Effective Dose (mSv)	
	Local Diagnostic Reference Level (LDRL)	Dose Investigation Level (DIL)	Local Diagnostic Reference Level (LDRL)	Dose Investigation Level (DIL)
Abdomen	200	395	3.0	5.9
Head	80	150	0.3	0.6
Knees	400	600	0.2	0.3
Neck/Thorax I131	170	240	2.8	4.0
Parathyroid	170	240	1.9	2.7
Pelvis	160	285	3.0	5.3
Thorax	180	290	3.0	4.9
T/L Spine	270	390	4.0	5.9



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'Pink form'

Symbia SPECT WORKSHEET

Patient Name: _____ Hospital No: _____

Patient requires a SPECT: YES ☐ NO ☐ Perform additional review: ☐

If yes, SPECT to be performed: ☐

Indications: ☐ Metastatic for PR and T1/2 (good PR) ☐

Scan: ☐ Head ☐ Neck ☐ Thorax ☐ Abdomen ☐ Pelvis ☐

Camera gain: ☐ 0.0 ☐ 0.1 ☐ 0.2 ☐ 0.3 ☐ 0.4 ☐ 0.5 ☐ 0.6 ☐ 0.7 ☐ 0.8 ☐ 0.9 ☐ 1.0

SPINE WITH DEXGADOLIC CT: ☐ (Heterogeneous patients only) ☐

Operator Signature: _____ Date: _____

Signature of Justifying Consultant: _____ Date: _____



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Ensuring Compliance

CT dose information

Ward:								
Physician:								
Operator:								
Total mAs 795		Total DLP 105						
	Scan	kV	mAs / ref.		CTDIvol	DLP	TI	cSL
Patient Position H-SP								
	Topogram	1	130				5.9	0.6
	Topogram	2	130				5.9	0.6
	ThorRoutine	3	130	27 / 40	3.09	105	0.6	1.2



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Dose Recording in future

- IHE
 - Integrating the Healthcare Enterprise
- Radiation Exposure monitoring profiles
- Accurate information to database
- Auditable
 - RFH input into Excel



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Dose recording

- Required by IRMER
- Allows audit
- Diagnostic Reference Levels (DRL)
- Diagnostic Incident level (DIL)



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Audit

- Audit required by IRMER
- Idea of reviewing images to see if dose can be reduced
 - May be difficult in NM with patient numbers
 - We have done this on particular scans
- Phantom scanning



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Acceptance testing, commissioning and QC

- Standard nuclear medicine and CT tests plus SPECT/CT image registration



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Miscellaneous

- Handover forms
- Particular important on CT
 - How do you check all protocols not changed?
 - Remote login?
- Inform HSE that you are going to have a SPECT/CT
- Policy on Unexpected findings



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Summary

- All key regulations involved
- Technology chosen will effect how you comply
- Dept Workflows impacted
- Iterative process will take time
- Training, audit and review crucial



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