UK PERSPECTIVES ON RADIATION PROTECTION 2010

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UK Questions posed:

- Infrastructure: National Health Service and radiology departments 5 mins
- Radiation protection: success and challenges
- Case scenario

UK Infrastructure NHS and radiology

- Majority patients NHS funded small and growing private practice. Uncommon for paediatric practice
- Usually radiologists run imaging centres but some US/ MRI sports medicine/cardiac centres in private sector clinician led
- Radiology practised by Radiologists trained by RCR standardised training (FRCR exam)
- Established Subspeciality of Paed Radiology
- UK 6-12 month paeds rad training (variable across EU) 3months -2 yrs
- EU (joint ESR /ESPR funded 3 month ESOR fellowships) Designated centres competitive applications across EC - 3 per annum

UK National Imaging & Radio-Diagnostic Activity

	2007 - 2008	2006 - 2007	2005 - 2006
Total	34,706,697	33,550,610	32,487,693
CT	3,044,516	2,728,119	2,481,571
MRI	1,488,059	1,257,972	1,118,487
Obstetric US	2,419,010	2,253,996	2,216,035
Non-Obstetric US	4,716,541	4,461,490	4,253,361
Radio-isotopes	673,413	588,638	623,532
Radio-graphs	21,028,109	21,011,234	20,585,678
Fluoro-scopy	1,337,049	1,249,161	1,209,029

GOSH Radiology Total Examinations

	2006	2007	2008	2009
CT	2,571	2,365	2,410	2,501
	(5.4%)	(5%)	(4.9%)	(4.7%)
Fluoroscopy	1,786	1,887	1,923	1,854
MRI	4,441	4,676	5,187	5,197
Ultrasound	9,272	9,361	10,110	11,973
Radio-Isotope	1,889	1,710	1,320	1,252
Dexa	1,805	1,707	1,177	1,237
IR & cardiac cath	2,938	2,995	3,271	3,464
General/Mob/Theatre	22,731	22,956	24,066	25,766
Department Total	47,433	47,657	49,464	53,244

Breakdown GOS CT data

	2006	2007	2008	2009
Chest	650	594	635	710
Cardiac	139	145	177	142
Body	141	150	108	110
Extremity	91	88	81	87
Neuro	1470	1278	1253	1377
Spine	80	98	89	66
PM	0	12	67	9
Total	2571	2365	2410	2501
	5.4%	5.0%	4.9%	4.7%

UK radiation protection

- Strong established history of robust Infrastructure via National Radiation Protection Board (NRPB)

UK/EU perspective : bodies

1 National Patient Dose Database (NPDD)
1992 plain films

PREDICT (Patient Radiation Exposure and Dose In CT)

Coordinated by National Radiation Protection Board (NRPB)

2 UK CT DOSE SURVEY 2002 (NRPB IMPACT and CTUG)

3 CT users group UK

UK/EU perspective : bodies

1 National Patient Dose Database (NPDD)
1992 plain films

PREDICT (Patient Radiation Exposure and Dose In CT) NRPB

National Patient Dose Database (NPDD)1992

- National protocol for patient dose measurements in diagnostic radiology
- Patient dose measurements made by hospital x-ray departments throughout UK according to national protocol sent to HPA Radiation Protection Division for national collation and analysis. Database reviewed every five years, (latest review being for 2001-2005 and published in HPA-RPD-029).
- *Dr David Hart*
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Radiation Protection Division
Chilton, Didcot, Oxon, OX11 0RQ

National Patient Dose Database (NPDD) plain films

- Data required for new technology, computed radiography (photostimulable phosphor plates) flat panel digital detectors, conventional screen/film and image intensifier systems.
- of particular interest in order of priority…….

National Patient Dose Database (NPDD) plain films

- Common radiographs on children.
- Examinations with major contribution to collective dose.
- common high-dose procedures. (>10,000 per year in the UK, effective dose >4 mSv)
- Rare but very high dose procedures (effective dose >10 mSv)
- Examples of above examinations, in order of priority.
- Paediatric radiographs
  Chest, abdomen, pelvis, and skull

National Patient Dose Database (NPDD) plain films

- Adult examinations

  PTCA (specify number of artery dilations and stents)
  Peripheral arteriography
  Hip radiography
  Angioplasty (specify anatomical location)
  Vascular stenting (specify anatomical location)
  Renal arteriography
  ERCP (separate diagnostic and interventional)
  Embolisation (specify anatomical location)
  Radiofrequency cardiac catheter ablation
  Kidney stenting
  Mesenteric angiography
  TIPS

National Patient Dose Database (NPDD) plain films

- NPDD does not include information on CT (has separate national database for CT examinations PREDICT (Patient Radiation Exposure and Dose In CT).
- Intended data in PREDICT will be reviewed at regular intervals in a similar manner to NPDD.
- Data supplied to the HPA in electronic format :

UK/EU perspective : bodies

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PREDICT (Patient Radiation Exposure and Dose In CT) NRPB

2 UK CT DOSE SURVEY 2002

3 CT users group UK

UK CT DOSE SURVEY 2002

- Led by NRPB Paul Shrimpton NRPB Chilton Didcot Oxon UK
- CT USERS GROUP
- IMPACT

UK CT DOSE SURVEY 2002

- SURVEY INSTRUCTIONS
- DATA FORMS survey routine adult and paeds body parts - age and part dependent 1, 5, 10 years
- Survey individual patients
- CTDI measurement
- Data return form
- List of CT scanners in UK

2003 UK review

- Increasing demands due to evolving technology with new clinical applications
- 2003 NHS recorded 2 million CT exams = 9% total x-ray exams (DOH)
- Wide variations in practices between centres
- Recorded effective dose for 0 to 10 year old:

  Chest CT 6.3 – 3.9mSv

  Head CT 2.5 – 1.6mSv
- Radiation dose 10 - 40% lower from 1999 review
- MSCT dose slightly higher then single slice
- $CTDI_{VOL}$ comparable to European review 2001

UK/EU perspective : bodies

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CT users groups UK

- CONSTITUTION
- 1 NAME: 'CT USERS GROUP'
- 2 AIMS: to enable members to discuss new developments, share expertise, discuss problems, advance knowledge, facilitate collaborative projects within the fields of physics applied to X-ray Computed Tomography (CT).

CT users groups UK

- 3 MEMBERSHIP: open to all physicists, technicians, radiographers, radiologists with an active involvement in the Radiology physics CT.
- Applications considered by officers of the group.
- Membership of the group for commercial purposes is not permitted

CT users groups UK

- 4 OFFICERS: chairman, Vice-Chairman, Secretary, Treasurer and Newsletter Editor elected by members.
- 5 MEETINGS: The group shall hold scientific meetings to discuss matters of relevance to members.
- 6 NEWSLETTER: to disseminate information to members.

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UK PERSPECTIVE RADIATION PROTECTION 2010

10 year old abdominal pain

- Surgical consultation
- ?pregnancy issue
- AXR
- US abdo and pelvis
- STOP
- REVIEW and repeat all above without X ray
- REFRACTORY ???MRI

10 year old abdominal pain when CT done

- Surgical consultation and US inconclusive and MRI not available or contraindicated

Radiation Dose - Cardiac CTA 2009

	Gated		Non-gated	
	80kV	100kV	80kV	100kV
Patient nos.	29	50	42	25
Weight kg.	8.9 ±4	35.4 ±17	5.2 ±2.5	21.6 ±20
min - max	2.7 - 14.3	15 - 79	0.7 - 12.4	4.7 - 95
Age years	1.6 ±1.4	11 ±4.3	0.6 ±0.6	5.4 ±4.7
min - max	0.04 - 7	4 - 17.5	0.02 - 2.5	0.2 - 17
Eff Dose	1.3 ±0.5	5.2 ±2.2	0.86 ±0.2	1.7 ±0.5
min - max	0.46 - 2.4	2.6 - 12.2	0.3 - 1.3	1.1 - 2.8

Image Gently Worksheet

Abdomen Baseline:	kVp	mA	Time (sec)	Pitch Abdomen	Pitch Thorax
	120	250	1	1	1
		Abdomen		Thorax	
PA Thickness (cm)	Approx Age	mAs Reduction Factor (RF)	Estimated mAs = BL x RF	mAs Reduction Factor (RF)	Estimated mAs = BL x RF
9	newborn	0.43	108	0.42	105
12	1 yr	0.51	128	0.49	122.5
14	5 yr	0.59	148	0.57	142.5
16	10 yr	0.66	165	0.64	160
19	15 yr	0.76	190	0.73	182.5
22	small adult	0.90	225	0.82	205
25	med adult	1.0	250	0.91	227.5
31	large adult	1.27	318	1.16	290

1. Type in baseline abdomen techniques and mAs in yellow cells

2. Spreadsheet will calculate mAs estimated for pediatric patients of varying sizes

Dose Tutor Kalender et al Phys Med 2008 24 2 71-79

- Retrospective simulation of image data sets generated by:
  - decreasing mAs values to increase image noise
  - altering filters to reduce image resolution
- Mimic images that is equivalent to those that will be obtained at respective settings
- User determines maximum noise level and minimum resolution for diagnostic task
- Supports establishing CT protocols and reference dose concept