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The Regulation and Quality Improvement Authority

Northern Ireland nuclear medicine equipment survey 2017

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Executive summary

The Regulation and Quality Improvement Authority (RQIA) is the independent body responsible for regulating and inspecting the quality and availability of health and social care (HSC) services in Northern Ireland. RQIA are working with Public Health England (PHE) to develop a different approach to assessing compliance with the Ionising Radiation (Medical Exposure) Regulations (Northern Ireland) 2000 (IR(ME)R)[1].

As part of this programme of work, RQIA commissioned the Medical Exposures Group (MEG) of PHE to design and compile an online survey and spreadsheet to build a picture of the nuclear medicine services and workload available at each site across the region. Responses to the survey were received from eight centres across the region, seven HSC and one independent provider. A completed, or partially completed, spreadsheet was provided from seven centres, six HSC and one independent, giving workload information.

Data from the completed survey demonstrated the range in age of equipment and workload across the region with older equipment having the highest workload at two centres. The last survey to assess the procedures performed across the UK was undertaken in 2004[2]. With the increase in differing technologies, such as PET/CT, and radiopharmaceuticals available, there is a significant shift in the types of imaging procedures now performed compared to the previous survey results. For example, PET/CT now makes up 18% of all imaging with tumour imaging being the most prevalent type, a significant increase from before.

The results from this survey showed what procedures were undertaken at which centres, the details of the administered activities, adherence to National Diagnostic Reference Levels (NDRL's) and the use of image enhancement software. This gives an indication of where protocols may have been optimised, with the ultimate intention of encouraging and sharing safe and effective clinical practice.

The survey results provide a snapshot of clinical practice across the region and can be used to inform future RQIA inspection planning under the new regulations, the Ionising Radiation (Medical Exposure) Regulations (Northern Ireland) 2018[6], which came into force after the completion of this survey.

Introduction

The Regulation and Quality Improvement Authority (RQIA) is the independent body responsible for regulating and inspecting the quality and availability of health and social care (HSC) services in Northern Ireland. RQIA have a well-established proactive inspection programme which over several years has completed inspections of providers from the HSC and independent sectors undertaking medical examinations involving ionising radiation. RQIA are looking to develop a different approach to assessing compliance with the regulations across Northern Ireland. The initial work for this approach required a picture of the current nuclear medicine equipment and services available at each site across the region to inform RQIA's work programme over the coming years in relation to IR(ME)R.

As part of this programme of work RQIA commissioned the Medical Exposures Group (MEG) of Public Health England (PHE) to design and compile and online survey and spreadsheet to build a picture of the nuclear medicine services and workload.

The aim of the survey was to gain a better understanding of current nuclear medicine practice and service delivery of these potentially high dose or high-risk examinations across the region. The survey was intended to guide the focus for future RQIA compliance approaches and provide an indication as to where new equipment and practices have been introduced. The survey would also highlight any ageing equipment due for replacement.

Methodology

The modality specific questions for inclusion in the survey were developed by MEG to address the key questions relating to nuclear medicine. The survey included a total of 27 questions with an additional spreadsheet to collect workload information on the numbers and types of investigations performed at each centre between the 1st April 2016 and the 31st March 2017. Full details of the questions are included in Appendix 1. A letter was sent out from RQIA (Appendix 2) to each radiology service manager requesting their cooperation to complete the survey for each piece of equipment on every hospital site. Access to the survey was available from Friday 31st March 2017 and following an extension (to allow several Trusts to complete the data input) the survey closed on 30th June 2017.

Responses to the survey were received from seven centres across the region, six HSC and one independent provider as can be seen in Table 1. The Royal Victoria Hospital provided two responses, one from each department that used Nuclear Medicine. No response was received from Ulster Hospital, a centre that has previously performed limited nuclear medicine services. A completed or partially completed spreadsheet was provided for seven services, six HSC and one independent, to give workload information.

Table 1. List of hospitals that participated in the survey

Trust	Hospital
Belfast Trust	Royal Victoria
	Royal Victoria (Cardiac)
	Belfast City
	Royal Belfast Hospital for Sick Children
Southern Trust	Craigavon Area
Northern Trust	Antrim Area
Western Trust	Altnagelvin
Independent	Ulster Independent

The data was analysed to review a number of factors to include

- Equipment age and distribution
- Optimisation and use resolution recovery software
- Use of guidelines for delegated authorisation of exposures
- Clinical evaluation
- Use of local DRL's
- Paediatric dosing
- Types of examinations and numbers of scans being performed over a 12-month period.

Results

Number of procedures performed

Workload data was received from 7 of the centres taking part in the survey. Table 2 shows the reported numbers of imaging, non-imaging and therapy procedures. Figure 1 shows that imaging procedures made 94% of the total number of reported procedures, while non-imaging diagnostic and therapy procedures each contribute 3% to the total. This is comparable to UK data collected for the 2003 to 2004 period[2], where imaging accounted for 91% of the total number procedures.

Table 2. Number of procedures performed for 2017

Procedure type		Number of procedures performed
Imaging	Planar	6652
	SPECT	6044
	SPECT-CT	826
	PET-CT	3271
	Total	16793
Non-imaging	Diagnostic	538
	Therapy	574
	Total	1112
Total of all reported procedures		17905

Figure 1 also shows that planar imaging accounts for the majority (37%) of reported procedures, closely followed by SPECT imaging (34%), then PET-CT which makes up 18% of all reported procedures. In comparison with the previous UK data[2], SPECT and PET-CT imaging are much more common. Hart and Wall[2] reported planar imaging accounting for 73% of all reported procedures, while SPECT and PET-CT made up only 15% and 2% respectively. This change follows the increased uptake and popularity of SPECT and PET-CT; at the time of the last survey there were much fewer SPECT or PET-CT systems available in the UK.

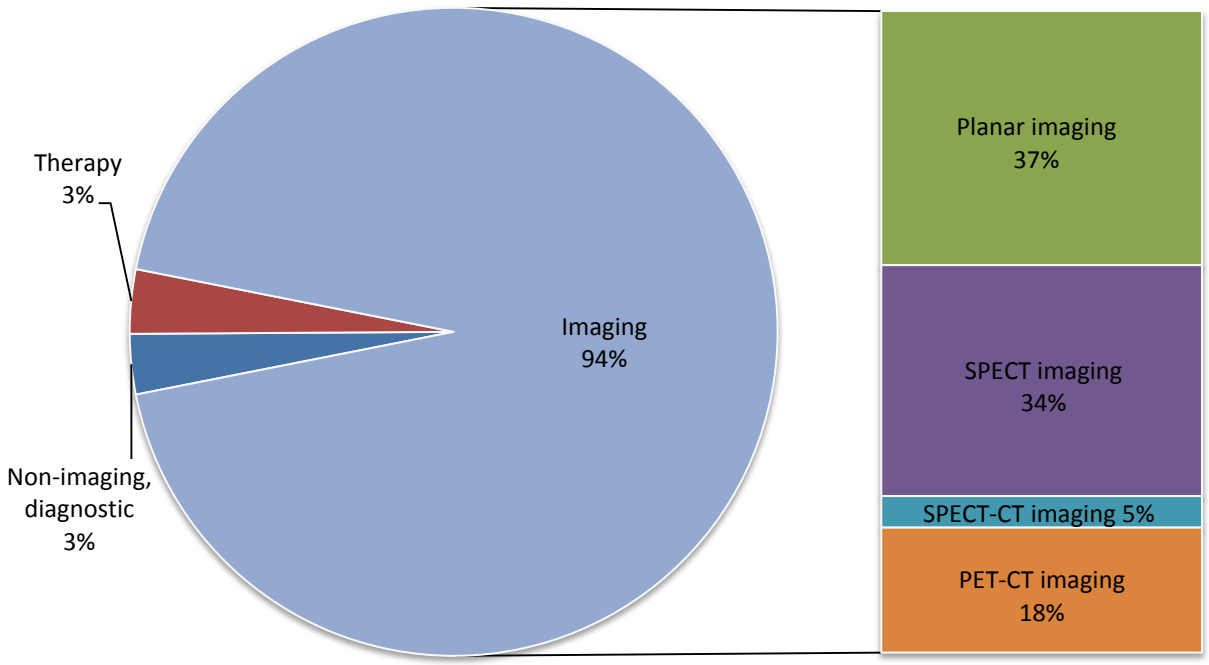

Figure 1. Breakdown of procedures by type

Details of the numbers of centres carrying out each imaging procedure, and the number of procedures performed, are shown in Appendix 3. There were also several procedures included in the survey which had zero returns and were not performed at any centre and these are also listed in Appendix 3.

Procedures per scanner

Responses to the survey included the number of gamma cameras, SPECT-CT cameras and PET-CT scanners held in each department. These results are shown in **Error! Reference source not found.**, showing seven of the eight centres perform imaging and that there is a distribution of nuclear medicine equipment across the region.

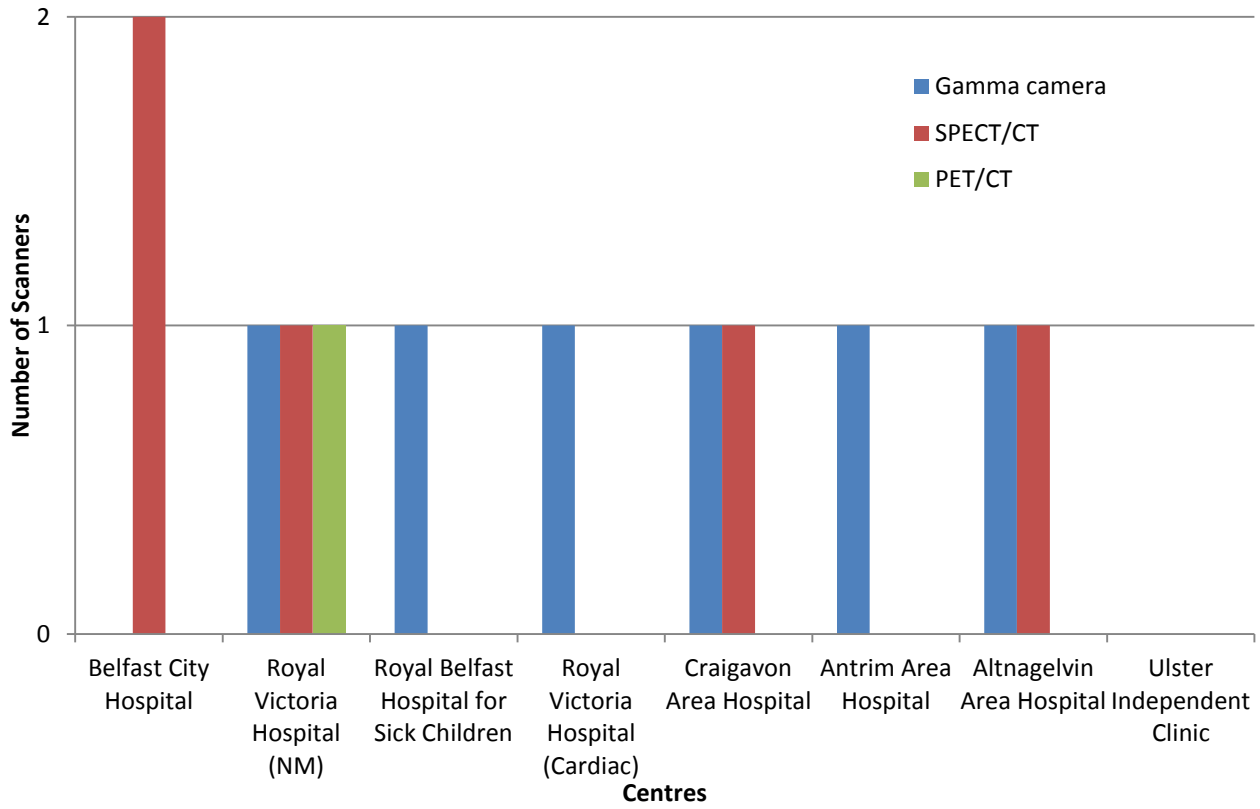

Figure 2. Number of gamma cameras in each department

Age of Scanners

Centres also provided information concerning the ages of imaging equipment this can be seen in Figure 3. This shows a distribution in age, with one centre having equipment less than two years old and four centres having equipment more than ten years old.

The total number of planar and SPECT-CT procedures reported was divided by the total number of gamma and SPECT-CT held for each centre. These values are shown in **Error! Reference source not found.**4. The average number of procedures per camera was reported as 1523 with a range of 456 to 2722. Only one centre carries out PET-CT procedures, with all 3271 procedures carried out on one scanner.

The Royal College of Radiologists (RCR) has stated that a larger single camera department will usually be performing between 1500 and 2400 procedures, this being the upper guidelines for a single gamma camera[3]. At two of the centres, Antrim Area Hospital and Royal Victoria Hospital (Cardiac), the workload is high, over 2400 per camera which is above these guidelines. These two cameras are also among the oldest in the region, with both being over 10 years old.

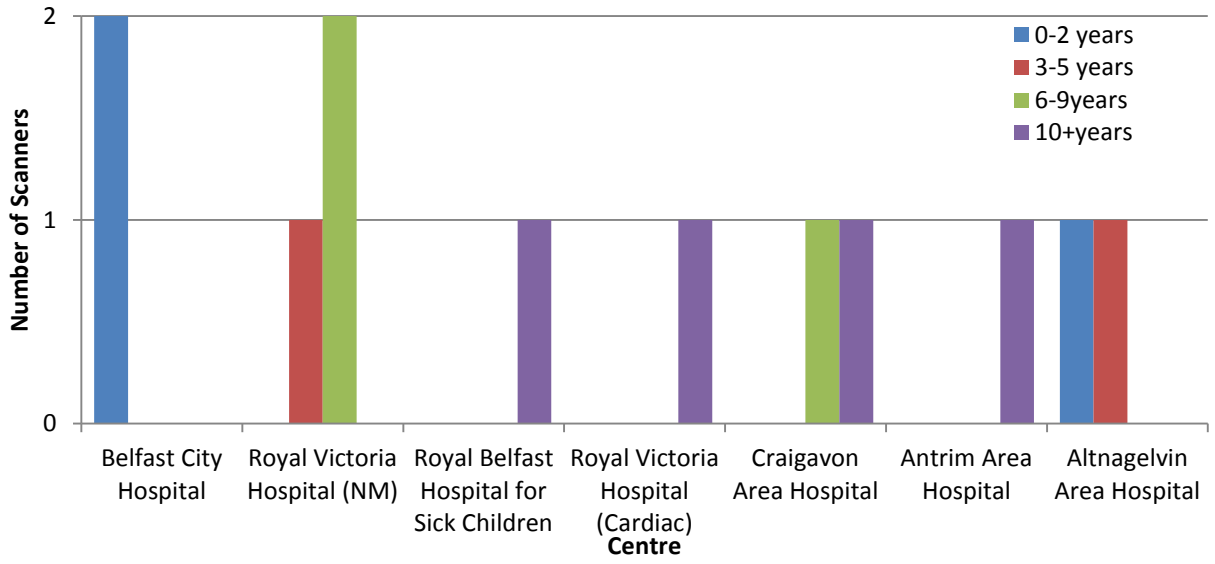

Figure 3. Age of scanners

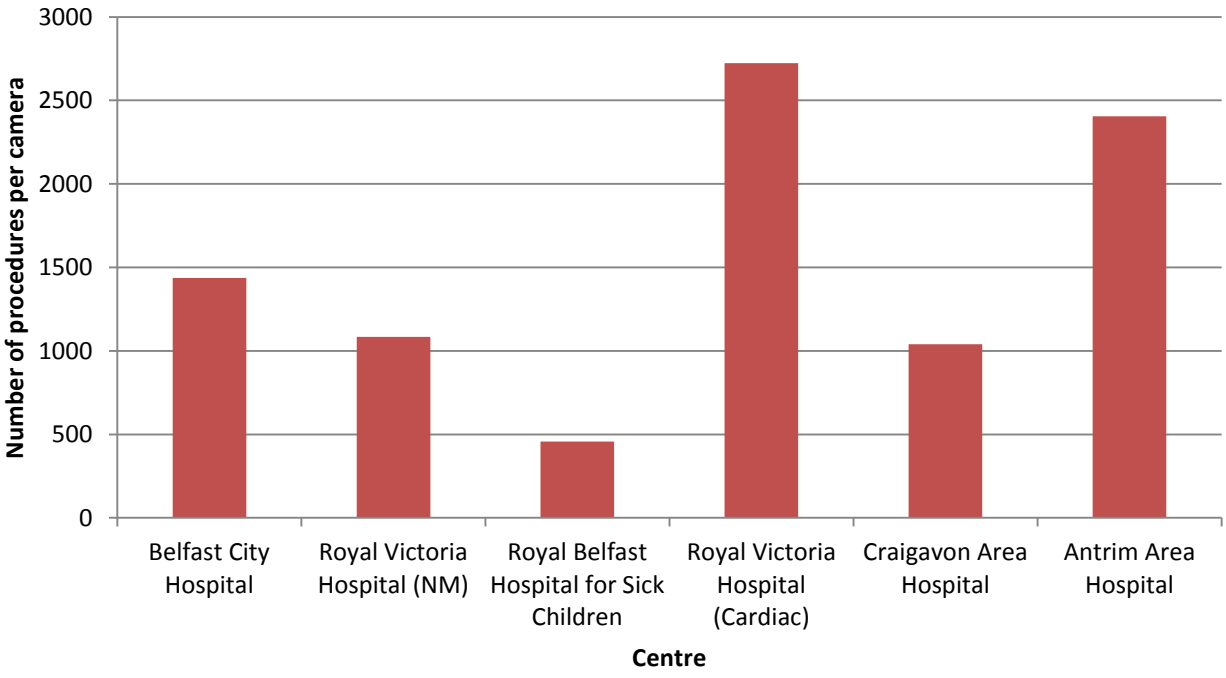

Figure 4. Number of planar and SPECT-CT images performed per gamma camera.

Procedures reported for each organ or system

The number of reported imaging procedures for each organ or system, broken down by imaging modality (planar imaging, SPECT, SPECT-CT and PET-CT) can be seen in Table 3. Imaging of tumours, the cardiac system and bones accounts for 70% of all reported imaging procedures, with tumour imaging being the most common. For tumour imaging this can largely be attributed to the increased use of PET-CT for this indication. There is an increase in the cardiac imaging and tumour imaging compared to the previous survey[2] where these made up 17% and less than 4% of all imaging respectively. Lung imaging now only represents 8% of the imaging workload,

a significant decrease from previous data where it made up over 25% of the imaging workload. This decrease in nuclear medicine imaging probably reflects the increased role of CT pulmonary angiography (CTPA) for investigation of pulmonary embolism.

Table 3. Number of imaging procedures reported for each organ or system

Organ/system	Planar	SPECT	SPECT-CT	PET-CT	Total	Total %
Tumour	887	227	227	2981	4322	26%
Cardiac	27	3736	140	0	3903	23%
Bone	2974	267	266	0	3507	21%
Genitourinary	1687	0	0	0	1687	10%
Lung	515	870	14	0	1399	8%
Brain	0	702	0	218	920	5%
Endocrine	349	228	166	0	743	4%
Gastrointestinal	111	0	0	0	111	1%
Infection/inflammation	12	6	6	72	96	1%
Hepatobiliary	48	8	7	0	63	<1%
Lymph	42	0	0	0	42	<1%
Total	6652	6044	826	3271	16793	100%

The numbers of reported procedures are broken down by organ or system in Table 4 for non-imaging diagnostic procedures and Table 5 for therapy procedures. All Sentinel node (breast) probe studies were undertaken at Ulster Independent Clinic. Almost all therapy procedures are targeted at tumours (55%) or thyroid conditions (42%).

Table 4. Number of non- imaging procedures reported for each organ or system

Organ/system	Number of procedures	
Absorption	306	57%
Genito-urinary	175	33%
Sentinel node (breast) probe studies	38	7%
Haematology	19	4%
TOTAL	538	100.0%

Table 5. Number of therapy procedures reported for each organ or system

Organ/system	Number of procedures	
Tumour	314	55%
Thyroid	240	42%
Polycythaemia	11	2%
Arthritic conditions	9	2%
TOTAL	574	100.0%

Procedures reported for each radioisotope

A breakdown of the reported procedures by radioisotope can be seen in **Error! Reference source not found.**. The majority (67%) of procedures use Tc-99m; this is mostly used for imaging procedures. F-18 for PET-CT imaging accounts for 18% of all reported procedures. I-123 is used in imaging procedures and makes up 6% of all reported procedures. The remaining 9% of procedures use a variety of radioisotopes, with each radioisotope accounting for no more than 2% of the total number of reported procedures.

Comparing this breakdown with the UK in the last survey shows that Tc-99m is still the most frequently used radioisotope, although it's use has dropped from 80% of all procedures in the 2003/2004 data[2]. Previously the use of F-18 was reported at just 1.5% compared to 18% in this survey. This shows the uptake of PET-CT since the previous report. The use of I-123 has also increased between the two surveys, from 0.7% to 6%, while the use of Kr -81m has declined from 6% to 1%, and Cr-51 has declined from 4% to 1%.

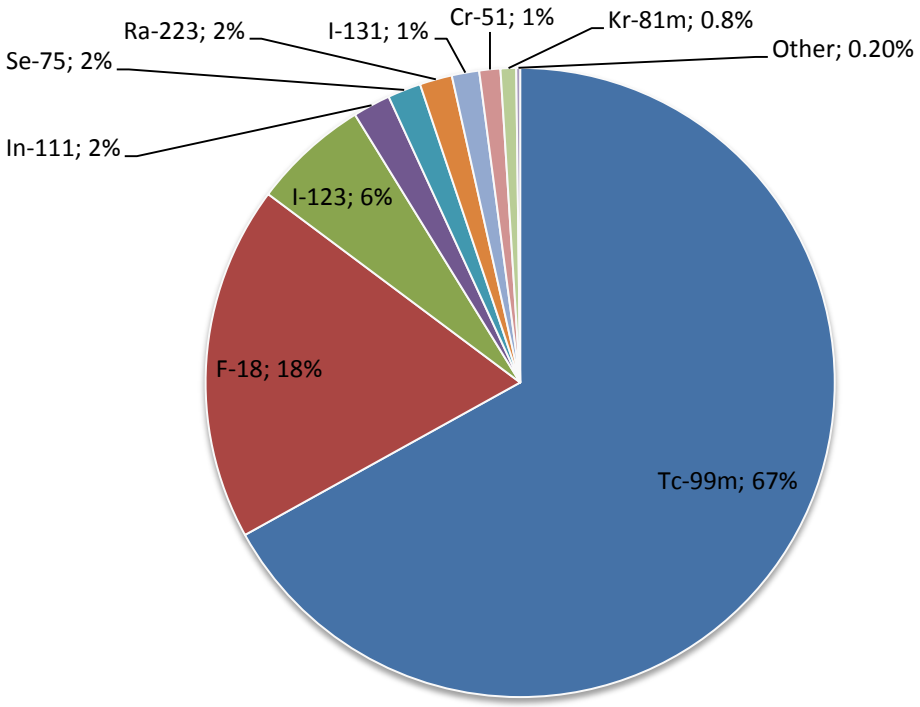

Figure 5. Breakdown of all procedures by isotope used.

Reported administered activities used

Not all responses to the survey included details of administered activities for every procedure. Where details of the administered activity for a procedure has been provided these were compared to the activities specified in the ARSAC Notes for Guidance[4] as the National Diagnostic Reference Level (NDRL).

For planar and SPECT imaging procedures, administered activities were given for 43 procedures. In all but one case, the average activity listed was below the NDRL where available. For the use of Tc-99m –MAG 3 for renal imaging at Antrim Area Hospital, a higher administered activity than the NDRL was reported.

Where SPECT-CT was used, details of the dose from the CT were provided for 12 procedures. As CT acquired as part of nuclear medicine study may be acquired for different functions (attenuation correction, localisation or diagnostic purposes), multiple values for each procedure were reported for some systems. It is not always possible to make a direct comparison of the values due to their differing functions, however these were compared to the NDRL's for SPECT-CT where these were available[5]. In 13 cases the NDRL was not available, in 10 cases the maximum reported dose was below or equal to the NDRL and in two cases the NDRL was exceeded. The two cases were listed as for attenuation correction for the use of myocardial perfusion imaging at Craigavon Area Hospital.

Information on four PET-CT procedures was provided. Weight based administered activities were used for whole body imaging and all administered activities reported were below the NDRL.

Paediatrics

Of the eight centres which provided survey data, four centres routinely perform administrations in paediatric patients. These are, Antrim Area Hospital, Altnagelvin Area Hospital, Craigavon Area Hospital and Royal Belfast Hospital for Sick Children. All centres used the ARSAC factors to scale the adult administered activity.

Justification of Administrations

At the time of this survey justification of administrations under IRMER[1] must be undertaken by a certificated practitioner. All eight of the centres that provided data used delegated authorisation guidelines to allow entitled operators to authorise exposures. At each centre there were different staff groups of operators who were entitled to authorise exposures against guidelines as can be seen in Figure 6.

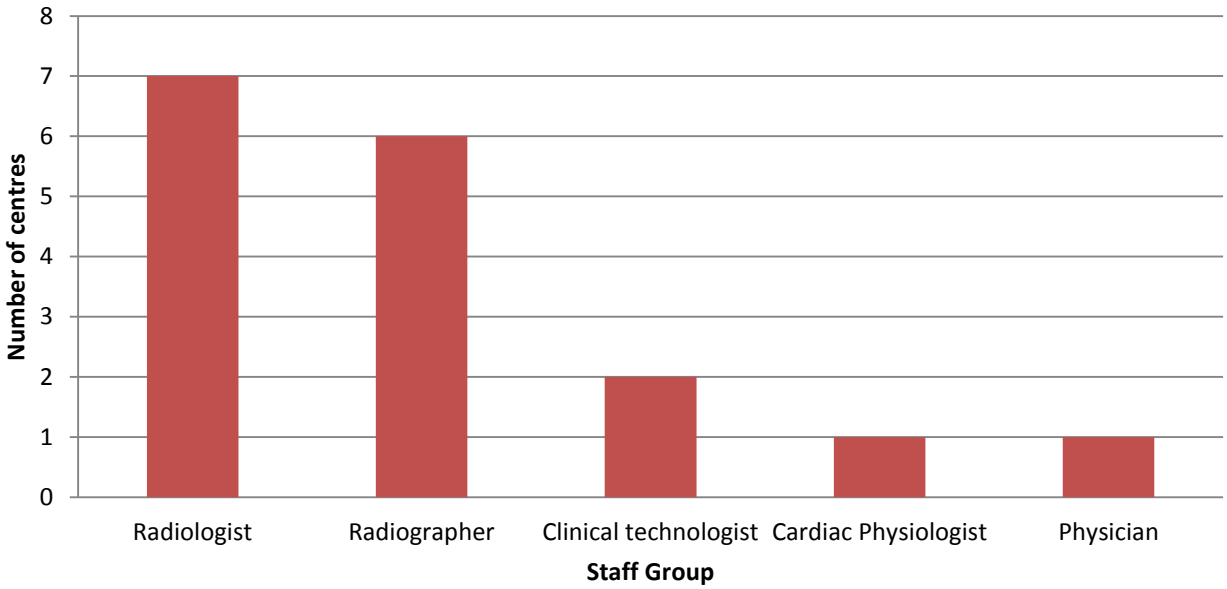

Figure 6. Staff Entitled to use Authorisation Guidelines

Data was provided on the categories of the procedures that guidelines were used for at each centre. All centres had guidelines that were used for either all types of procedures performed or for a significant number across the scope of the service to include, planar imaging, SPECT-CT, PET-CT and non-imaging. The survey responses did not have the detail to conclude which staff groups were entitled to authorise which type of procedures.

Optimisation

Resolution recovery software is now being used in nuclear medicine; sites were asked whether they had this software available and whether it was used routinely. Both Belfast City Hospital and Craigavon Area Hospital state that they had system specific resolution recovery software available in nuclear medicine. This is only routinely being used for SPECT Myocardial Perfusion Imaging at Craigavon Area Hospital to improve image quality for the same imaging parameters.

Clinical Evaluation

All centres provided a response on the clinical evaluation of the procedures performed detailed in Figure 7. Across the region, local radiologists perform the majority of clinical evaluation. Cardiac specialists are used at the Royal Victoria Hospital (Cardiac) and the Craigavon Area Hospital uses an external provider. A wider range of staff groups are performing the clinical evaluation for non-imaging tests.

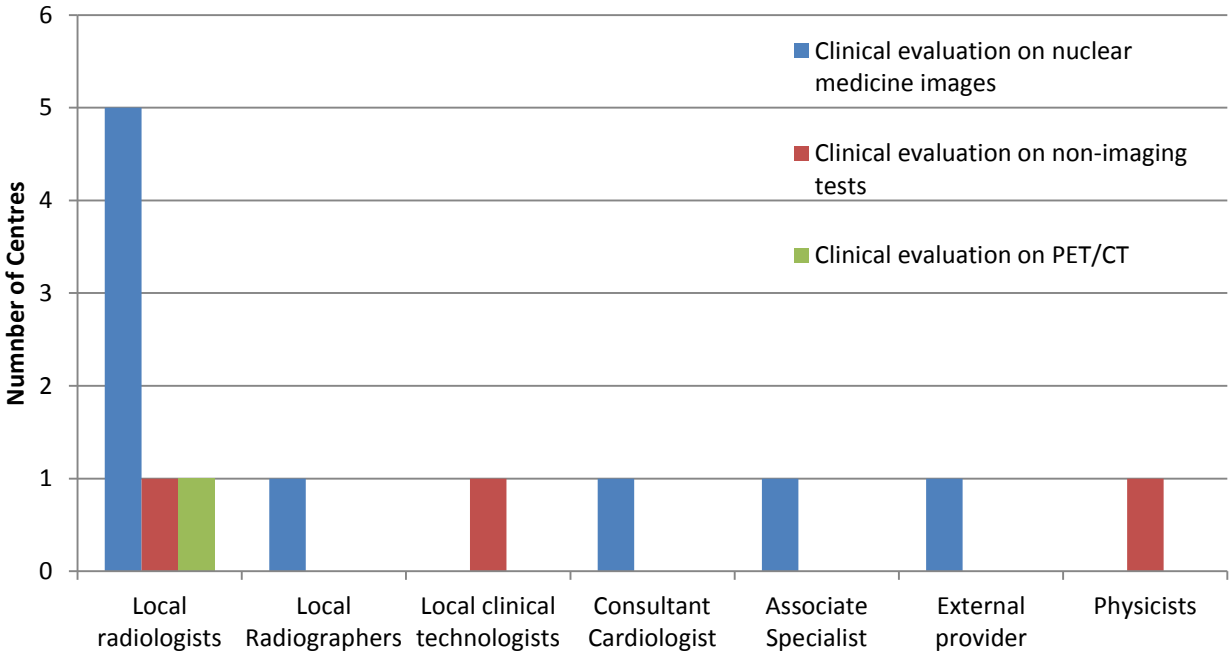

Figure 7. Staff performing clinical evaluation

Conclusion

The responses to the survey and the workload spreadsheet provide a snapshot of the nuclear medicine services across the region. There is a wide variation in practice across the region with two of the eight centres providing a far more limited scope service and one centre providing a comprehensive service to include therapy and PET-CT.

There is a range of equipment across the region with multiple centres having equipment older than 10 years. The European Society of Radiology made a statement regarding the renewal of radiological equipment[6], citing lifespans of equipment and supporting the renewal of any piece of equipment older than 10 years. For the majority of nuclear medicine equipment, a lifespan of 8 to 12 years was quoted with shorter lifespans expected for equipment under high workload. Older equipment has the potential for increased operating costs and may have a higher incidence of unreliability. This survey has highlighted that there are centres with a high single camera workload and that there is a significant variation in the age of equipment at different centres. At two of these centres, the cameras are over 10 years old and it would be expected that the renewal of this equipment is planned.

The last survey to assess the procedures performed across the UK was undertaken in 2004[2]. With the increase in PET-CT and SPECT-CT and range of radiopharmaceuticals available there is a significant shift in the types of imaging procedures now performed compared to the previous survey results. There has been an increased uptake in the use of PET-CT imaging with it now making up 18% of all imaging, albeit all at a single centre in this region. Throughout this and pervious survey results, Tc-99m still remains as the most commonly used radiopharmaceutical making up most of the imaging and some non-imaging procedures. Bone imaging still makes up a significant portion of the imaging workload reported with significant increases in tumour imaging and a move away from nuclear medicine demonstrated for lung imaging.

Details of the activities administered were provided for some centres and procedures. This showed good compliance with the NDRL's for all but one procedure. Where PET-CT was used, a weight-based activity was also used in accordance with current guidance[4]. Limited information on CT DRL's was provided for SPECT-CT and PET-CT imaging. Due to difficulties in rationalising the purpose of CT as part of hybrid nuclear medicine imaging, it is not always possible to directly compare the values provided to NDRL's. Where CT DRL's were reported the majority were within the NDRL. At Craigavon Area Hospital, the NDRL was exceeded for myocardial imaging. IPEM recommends that if mean doses are found to exceed reference doses then an immediate investigation should take place locally to establish the cause and to take corrective action, unless the abnormally high doses could be clinically justified. Based on the information provided it is not possible to determine if this instance of exceeding the NDRL was appropriate for the subset of patients that were being imaged. All centres that performed

paediatric imaging were compliant with the ARSAC guidelines for the scaling of administered activity.

Resolution recovery software can be used to optimise exposures. At two of the seven centres where imaging is performed resolution recovery software was available. This was only routinely being used at one centre to improve image quality. This is an area where there may be future developments.

The use of delegated authorisation guidelines is widespread across the region with guidelines being used to authorise a range of procedures at all centres. A wide range of healthcare professionals were entitled as operators for this task to include radiologists, radiographers, clinical technologists and cardiac specialists. At most centres there were radiologists and radiographers working under guidelines to authorise exposures. Clinical evaluation of imaging tests is largely performed by local radiologists across the region. At one centre radiographers also perform clinical evaluation. Technologists and physicists are involved in the evaluation of non-imaging tests. Most centres use local staff to undertake clinical evaluation however Craigavon Area Hospital uses an external provider.

The aim of the survey was to establish a better understanding of nuclear medicine practice across Northern Ireland. Through the analysis of eight responses, MEG has been able to provide information on the service delivery across the region. The survey also provides information on ageing equipment, equipment with high workload and levels of optimisation performed. The survey results can be used to inform future RQIA inspection planning under the Ionising Radiation (Medical Exposure) (Northern Ireland) Regulations 2018[6], which came into force after the completion of this survey.

References

1. The Ionising Radiation (Medical Exposure) Regulations (Northern Ireland) 2000 (SR 2000 No. 194). Belfast: HMSO
2. HPA RPD 003: a survey of nuclear medicine in the UK in 2003-2004; Hart and Wall, 2005
3. The radiologist and nuclear medicine: https://www.rcr.ac.uk/system/files/publication/field_publication_files/BFCR%2812%296_nuclear.pdf
4. ARSAC Notes for Guidance on the Clinical Use of Radioactive Substances.
5. https://www.gov.uk/government/publications/diagnostic-radiology-national-diagnostic-reference-levels-ndrls/ndrl#national-drls-for-computed-tomography-ct
6. Renewal of radiological equipment. Statement from European Society of Radiology. Insights Imaging 2014; 5: 543–546
7. The Ionising Radiation (Medical Exposure) Regulations (Northern Ireland) 2018 (SR 2018 No. 17). Belfast: HMSO

Appendix 1 – Survey Questionnaire

Regulatory and Quality Improvement Authority Nuclear Medicine service and equipment survey

Introduction

As part of its responsibility for monitoring, inspecting and enforcement of the Ionising Radiation (Medical Exposures) Regulations (IR(ME)R) the Regulatory and Quality Improvement Authority (RQIA) is requesting your cooperation in undertaking a short survey of nuclear medicine equipment and services across the region.

You will be aware of RQIA's well established proactive inspection programme which, over a number of years, has completed inspections of providers undertaking medical examinations involving ionising radiation. These snapshots of clinical practice and of the framework employers are required to provide to assure patient safety have raised awareness, understanding and indeed improved compliance with the regulations.

Over the next few months RQIA will be developing a different approach to assessing compliance across Northern Ireland. The first step is to build a picture of the equipment and current services available across each site. The data collected will be used to inform RQIA's work programme over the coming years in relation to IR(ME)R.

The survey should be completed and submitted on or before 12th May 2017. If you have any questions, please contact Public Health England in the first instance at MedicalExposures@phe.gov.uk.

Contact information

Details of survey participant:*

Name

Role

Email

Who is responsible for your nuclear medicine service?*

Name

Role

Email

NHS Trust/Region:

- Belfast
- Northern
- South Eastern
- Southern
- Western
- Independent provider/non-NHS

Hospital name:

--None--

Please state provider:*

Equipment Profile

Please indicate the number of the following types of equipment you have in your department:*

Gamma camera
SPECT/CT gamma camera
PET/CT scanner

Gamma counter
Beta counter
Gamma probes
Radionuclide calibrators

Please indicate the age(s) of the gamma camera(s) (with or without SPECT/CT) in your department:*

- [ ] 0-2 years
- [ ] 3-5 years
- [ ] 6-9 years
- [ ] 10+ years

Please indicate the age(s) of the PET/CT scanner(s) in your department:*

Not applicable – no PET/CT equipment
0-2 years
3-5 years
6-9 years
10+ years

Paediatrics

Do you routinely carry out paediatric procedures?*

Which guidance do you use to calculate administered activity for paediatric patients?*

ARSAC
EANM

Authorisation

Do healthcare professionals use authorisation guidelines for any procedures?*

Which staff groups are entitled to use authorisation guidelines?*

Radiologist
Radiographer
Clinical scientist
Physician
Clinical technologist

Do the authorisation guidelines include the following types of imaging?*

Bone
Brain
Cardiac
Endocrine
Gastrointestinal
Genitourinary
Haematology
Hepatobiliary
Infection/inflammation
Lacrimal
Lung
Lymph
NM tumour
Non-imaging
PET/CT bone
PET/CT brain
PET/CT infection/inflammation
PET/CT tumour

Optimisation

Do you have resolution recovery software (RRS) available in your department?*

Is the RRS:

Generic (i.e. will run on any gamma camera)
System specific
Both

Do you routinely use RRS?*

Do you use RRS on planar images?*

On which types of planar images do you use RRS?*

Bone
Renal

Lung
MUGA/RNV
Other

For planar imaging, do you use RRS to:*

Improve image quality for standard acquisition parameters
Reduce acquisition time whilst maintaining image quality
Reduce administered activity whilst maintaining image quality
Change the collimator required

Do you use RRS on SPECT images?*

On which types of SPECT images do you use RRS?*

MPI
Bone
Oncology
Parathyroid
MUGA/RNV

For SPECT imaging, do you use RRS to:*

Improve image quality for standard acquisition parameters
Reduce number of projections whilst maintaining image quality
Reduce time per projection whilst maintaining image quality
Reduce administered activity whilst maintaining image quality
Change the collimator required

Clinical evaluation

Who performs clinical evaluation (written report) on nuclear medicine images in your department?*

- ☐ Local Trust/hospital radiologists
- ☐ Local Trust/hospital physicians
- ☐ Local Trust/hospital radiographers
- ☐ Local Trust/hospital clinical technologists
- ☐ External provider

Who performs clinical evaluation (written report) on non-imaging tests in your department?*

Not applicable - non-imaging tests are not carried out at this site
Local Trust/hospital radiologists
Local Trust/hospital physicians
Local Trust/hospital radiographers
Local Trust/hospital clinical technologists
External provider

Who performs clinical evaluation (written report) on PET/CT images in your department?*

Not applicable - non-imaging PET/CT imaging is not carried out at this site
Local Trust/hospital radiologists
Local Trust/hospital physicians
External provider

Additional information

Please provide any further information below that you feel would be helpful in relation your Nuclear Medicine service:

Would you be happy to be contacted about your survey responses?*

Appendix 2 -Letter to Radiology Service Managers

Dear …….

As part of our responsibility for monitoring, inspecting and enforcement of the Ionising Radiation (Medical Exposures) Regulations [IR(ME)R], the Regulatory and Quality Improvement Authority (RQIA) is requesting your cooperation in undertaking short surveys of CT scanning and nuclear medicine equipment and services across the region.

You will be aware of our well established proactive inspection programme which over a number of years has completed inspections of providers undertaking medical examinations involving ionising radiation. These snapshots of clinical practice and of the framework employers are required to provide to assure patient safety, have raised awareness, understanding and indeed improved compliance with the regulations.

Over the next few months we will be developing a different approach to assessing compliance across Northern Ireland. The first step is to build a picture of the current CT and nuclear medicine equipment and services available across each site. With the support of Public Health England, we have compiled two modality specific (CT and nuclear medicine) online surveys, accessed via the links below. A separate spreadsheet is also attached for completion of nuclear medicine workload data (to be returned separately to MedicalExposures@phe.gov.uk).

The data collected will be used to inform our work programme over the coming years in relation to IR(ME)R.

We ask for your help in ensuring the links to the appropriate surveys (CT and /or nuclear medicine) are sent to the most suitable members of your team for completion.

An individual survey will need to be completed for every CT scanner (excluding hybrid NM CT systems or radiotherapy planning CT scanners) on each hospital site. There is not an option to pause/save the data once you have started the online survey, so your teams may find it helpful to gather data for the following areas, prior to commencing:

- Total patient throughput on each piece of equipment (e.g. each CT scanner or gamma camera) from 1st April 2016 - 31st March 2017
- Manufacturer, model, number of slices and year of installation (not required for hybrid NM CT systems or radiotherapy planning CT scanners)
- Dose optimisation packages available on each CT scanner (not required for hybrid NM CT systems or radiotherapy planning CT scanners) for example automatic tube current modulation, iterative reconstruction, dose alert/notification, dose monitoring/tracking

We would ask that your teams submit their completed survey(s) by Friday 12th May 2017.

Please feel free to contact and involve your medical physics team for support with any queries arising from the survey questions.

I thank you in anticipation of your co-operation with this piece of work.

Hall Graham

Head of Programme Reviews/Primary Care Advisor

The Regulation and Quality Improvement Authority

9th Floor, Riverside Tower

5 Lanyon Place

Belfast

BT1 3

Appendix 3 - Workload information

Imaging procedures reported: planar imaging

Organ/system	Procedure	Radio-Isotope	Chemical form	No of centres	Total no of procedures
Bone	Bone	^{99m}Tc	Phosphates and phosphonates	4	2,974
Genitourinary	Renal imaging	^{99m}Tc	DMSA(III)	4	1,140
Genitourinary	Renal imaging/renography	^{99m}Tc	MAG3	5	504
Tumour	Sentinel node (breast) imaging or probe	^{99m}Tc	Colloid	2	373
Lung	Lung perfusion imaging	^{99m}Tc	MAA	2	290
Endocrine	Parathyroid imaging	^{99m}Tc	Sestamibi	3	287
Tumour	Breast imaging	^{99m}Tc	Sestamibi	1	203
Lung	Lung ventilation imaging	^{81m}Kr	Gas	1	143
Tumour	Somatostatin receptor imaging	^{111}In	Pentetreotide	3	122
Gastrointestinal	Gastric emptying	^{99m}Tc	Non-absorbable compounds or pertechnetate	2	87
Tumour	Thyroid metastases imaging (after ablation)	^{131}I	Iodide	2	73
Lung	Lung ventilation imaging	^{99m}Tc	DTPA	1	68
Tumour	Neuroectodermal tumour imaging	^{123}I	MIBG	2	44
Lymph	Lymphoedema	^{99m}Tc	Colloid	3	42
Genitourinary	Micturating cystogram	^{99m}Tc	MAG3	1	42
Hepatobiliary	Functional biliary system imaging	^{99m}Tc	Iminodiacetate	3	40
Endocrine	Thyroid imaging	^{123}I	Iodide	2	39
Tumour	Thyroid metastases imaging (after ablation)	^{123}I	Iodide	2	36
Tumour	Vulva sentinel node (melanoma) imaging and probe	^{99m}Tc	Colloid	1	24
Endocrine	Thyroid imaging	^{99m}Tc	pertechnetate	2	23
Gastrointestinal	Meckel's scan	^{99m}Tc	pertechnetate	5	22
Cardiac	Sympathetic innervation imaging of the heart	^{123}I	MIBG	2	21

Lung	Lung shunt imaging	^{99m}Tc	MAA	2	14
Infection/inflammation	Infection/inflammation imaging	^{99m}Tc	Exametazime labelled leucocytes	2	12
Tumour	Thyroid metastases imaging (after ablation)	^{131}I	Iodide	1	12
Hepatobiliary	Liver and Spleen imaging	^{99m}Tc	Colloid	2	8
Cardiac	MUGA	^{99m}Tc	Normal erythrocytes	1	6
Gastrointestinal	GI bleeding	^{99m}Tc	Normal erythrocytes/ pertechnetate	1	2
Genitourinary	Micturating cystogram	^{99m}Tc	pertechnetate	1	1

Imaging procedures reported: SPECT imaging

Organ/system	Procedure	Radio-isotope	Chemical form	No of centres	Total no of procedures
Cardiac	Myocardial perfusion imaging	99mTc	Sestamibi	2	2,730
Cardiac	Myocardial perfusion imaging	99mTc	Tetrofosmin	2	1,006
Brain	Datscan	123I	Ioflupane	4	653
Lung	Lung ventilation imaging	99mTc	Technegas	2	496
Lung	Lung perfusion imaging	99mTc	MAA	2	360
Bone	Bone	99mTc	Phosphates and phosphonates	4	267
Endocrine	Parathyroid imaging	99mTc	Sestamibi	4	228
Tumour	Somatostatin receptor imaging	111In	Pentetreotide	3	112
Brain	Cerebral blood flow imaging	99mTc	Exametazime	2	49
Tumour	Neuroectodermal tumour imaging	123I	MIBG	2	44
Tumour	Thyroid metastases imaging (after ablation)	131I	Iodide	2	42
Tumour	Thyroid metastases imaging (after ablation)	123I	Iodide	1	17
Lung	Lung shunt imaging	99mTc	MAA	2	14
Tumour	Vulva sentinel node (melanoma) imaging and probe	99mTc	Colloid	1	12
Hepatobiliary	Liver and Spleen imaging	99mTc	Colloid	2	8
Infection/inflammation	Infection/inflammation imaging	99mTc	Exametazime	1	?

			labelled leucocytes		

Imaging procedures reported: SPECT-CT imaging

Organ/system	Procedure	Radio-isotope	Chemical form	No of centres	Total no of procedures
Bone	Bone	99mTc	Phosphates and phosphonates	3	266
Endocrine	Parathyroid imaging	99mTc	Sestamibi	3	166
Cardiac	Myocardial perfusion imaging	99mTc	Tetrofosmin	1	132
Tumour	Somatostatin receptor imaging	111In	Pentetreotide	3	112
Tumour	Neuroectodermal tumour imaging	123I	MIBG	2	44
Tumour	Thyroid metastases imaging (after ablation)	131I	Iodide	2	42
Tumour	Thyroid metastases imaging (after ablation)	123I	Iodide	1	17
Lung	Lung shunt imaging	99mTc	MAA	2	14
Tumour	Vulva sentinel node (melanoma) imaging and probe	99mTc	Colloid	1	12
Cardiac	Myocardial perfusion imaging	99mTc	Sestamibi	1	8
Hepatobiliary	Liver and Spleen imaging	99mTc	Colloid	1	7
Infection/inflammation	Infection/inflammation imaging	99mTc	Exametazime labelled leucocytes	1	6

Imaging procedures reported: PET-CT

Organ/system	Procedure	Radio-isotope	Chemical form	No of centres	Total no of procedures
Tumour	Whole body tumour imaging	18F	FDG	1	2980
Brain	Differential diagnosis of dementia	18F	FDG	1	218
Infection/inflammation	Infection/inflammation imaging	18F	FDG	1	72
Tumour	Brain tumour imaging	18F	FDG	1	1

Non-imaging diagnostic procedures reported

Organ/system	Procedure	Radio-isotope	Chemical form	No of centres	Total no of procedures
Absorption	Bile salt absorption	75Se	SeHCAT	1	306
Genito-unrinary	GFR	51Cr	EDTA	2	175
Tumour	Sentinel node (breast) probe studies	99mTc	Colloid	1	38
Haematology	Red cell volume	51Cr	Normal erythrocytes	1	19

Therapy procedures reported

Organ/system	Procedure	Radio-isotope	Chemical form	No of centres	Total no of procedures
Tumour	Bone metastases	223Ra	Dichloride	1	298
Thyroid	Thyrotoxicosis (including non-toxic goitre)	131I	iodide	2	172
Thyroid	Carcinoma of the thyroid	131I	iodide	2	68
Tumour	Hepatic malignancy	90Y	microspheres	2	15
Polycythaemia	Polycythaemia	32P	Phosphate	1	11
Arthritic conditions	Arthritic conditions	90Y	colloid	1	9
Tumour	Bone metastases	153Sm	EDTMP	1	1

Procedures with zero returns on the questionnaires

Organ/system	Procedure	Radio-isotope	Chemical form
Imaging procedures			
Bone	Bone Marrow	99mTc	Colloid
Brain	Brain imaging	99mTc	ECD
Cardiac	First pass blood flow imaging	99mTc	pertechnetate
Gastrointestinal	Salivary gland imaging	99mTc	pertechnetate
Gastrointestinal	GI bleeding	99mTc	Colloid

Gastrointestinal	GI bleeding	99mTc	Normal erythrocytes
Gastrointestinal	Oesophageal transit and reflux	99mTc	Colloid
Gastrointestinal	Oesophageal transit and reflux	99mTc	Non-absorbable compounds
Gastrointestinal	GI transit	111In	DTPA
Gastrointestinal	GI transit	111In	Non-absorbable compounds
Genitourinary	Renal imaging/renography	99mTc	DTPA
Genitourinary	First pass blood flow imaging	99mTc	MAG3
Lacrimal	Lacrimal drainage	99mTc	Colloid
Endocrine	Parathyroid imaging	201Tl	Thallous chloride
Infection/inflammation	Infection/inflammation imaging	67Ga	citrate
Infection/inflammation	Infection/inflammation imaging	99mTc	Sulesomab
Infection/inflammation	Infection/inflammation imaging	111In	Leucocytes
Haematology	Spleen imaging	99mTc	Denatured erythrocytes
Tumour	Tumour imaging	99mTc	DMSA(V)
Tumour	Tumour imaging	99mTc	Sestamibi
Tumour	Sentinel node (melanoma) imaging and probe	99mTc	Colloid
Tumour	Somatostatin receptor imaging	99mTc	Tektrotyd
Tumour	RT planning imaging	18F	FDG
Tumour	Prostate cancer imaging	18F	Choline
Tumour	Hepatocellular cancer imaging	18F	Choline
Tumour	Somatostatin receptor imaging	68Ga	Dotatate / Dotanoc/ Dotatoc
Tumour	Prostate cancer imaging	68Ga	PSMA
Brain	Focal epilepsy	18F	FDG
Brain	cerebral amyloid assessment	18F	Florbetapir
Brain	cerebral amyloid assessment	18F	Florbetaben
Brain	cerebral amyloid assessment	18F	Flutemetamol
Bone	Bone imaging	18F	Fluoride
Non-imaging diagnostic procedures			
Haematology	Plasma volume	125I	Human albumin
Endocrine	Thyroid uptake	99mTc	Pertechnetate
Endocrine	Thyroid uptake	123I	iodide
Endocrine	Thyroid uptake	131I	iodide
Gastrointestinal	Breath tests	14C	Glycocholic acid

Gastrointestinal	H pylori detection	14C	Urea
Gastrointestinal	GI blood loss	51Cr	Normal erythrocytes
Genito-unrinary	GFR	99mTc	DTPA
Therapy procedures			
Tumour	Malignant disease	131I	MIBG
Tumour	Neuroendocrine tumours	177Lu	Dotatate / Dotanoc/ Dotatoc
Tumour	Neuroendocrine tumours	90Y	Dotatate / Dotanoc/ Dotatoc
Tumour	Bone metastases	89Sr	chloride
Tumour	Bone metastases	186Re	HEDP
Arthritic conditions	Arthritic conditions	169Er	colloid
Arthritic conditions	Arthritic conditions	186Re	colloid