AUDIT OF PHYSICS SERVICES TO THE NHSBSP IN 2007

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1. INTRODUCTION

1.1. Purpose

The purpose of this audit is to monitor the provision of physics services to the NHSBSP. The audit checks whether physics services are complying with the standards defined in the *Quality Assurance Guidelines for Medical Physics Services*,[1] and also checks for organisational changes in service provision.

1.2. Method

This report has been produced by the National Coordinating Centre for the Physics of Mammography (NCCPM) on behalf of the NHSBSP Quality Assurance (QA) Coordinating Group for Physics, and is an update of a previous audit conducted in 2003. The audit was carried out by sending a questionnaire to each of the physics services working for the NHSBSP in October 2007, and answers were returned to NCCPM. The audit returns are maintained on a database at NCCPM for future reference. Each of the physics services is identified by a physics service code on the graphs and tables in this report. Each service has been informed of its own code, and regional QA physicists are aware of the codes in their region. It is currently planned to repeat this audit procedure every 2–3 years.

1.3. Layout

For convenience the subject headings in the *Quality Assurance Guidelines*[1] are used in Chapter 2 to summarise the broad conclusions. The responses to the questionnaire under the various headings are detailed in tables and figures in Chapters 3 to 10.

2. SUMMARY OF CONCLUSIONS

Overview

All of the 533 mammography systems used by the NHSBSP are routinely monitored by one of 32 physics services.

Organisation

Wales, Scotland and Northern Ireland each have a single physics service covering all the programmes in their regions. In England all regions except one are covered by more than one service. A consortium of physics services provides the service for most of London.

All services participate in NHSBSP national physics reviews.

Qualifications

All services are supervised by a registered clinical scientist (as required in the QA guidelines).

Training

In every service at least some of the staff have received basic training in general diagnostic radiological physics and radiation protection. Some who have not are identified as administrative staff or are ultrasound physicists, who perform only ultrasound measurements.

Of the 166 staff involved in these services, 122 have attended the Institute of Physics and Engineering in Medicine (IPEM) Basic Mammography Training Course and 104 have attended an update course.

Experience

The requirement in the QA guidelines for the minimum number of QA tests conducted by staff (ie for six units per year or two units per year with extensive experience of general radiological work, for staff who work unsupervised) was met by all the services. Overall, 125 staff met this requirement.

All services participate in a review of quality assurance data on at least six systems at least once a year.

In the last two years buddy visits have been made by at least one member of staff from approximately half of the services.

Level of service

All except two of the services operate under a written service agreement.

All the services conduct acceptance testing and routine monitoring of the x-ray set following the procedures in *Commissioning and Routine Testing of Mammographic X-ray Systems,*[2] with a few minor exceptions. Most services now test ultrasound systems, and those who do not named a different service which carried out the testing.

All services check that image quality and dose (to the standard breast) comply with NHSBSP guidelines.

All the services periodically measure doses to samples of screened women.

About 30–50% of services test processors and viewing boxes, while a much smaller proportion test films, screens and cassettes. Not all services test digital or analogue stereo systems, which reflects the fact that some have only analogue or only digital systems in their areas.

Frequency

The interval between routine tests was six months for all services, which meets the national guidelines.

Test equipment for digital mammography

Most services had or could borrow a CDMAM, and most had a suitable light-meter and some image analysis software.

3. REGIONAL ORGANISATION

East Midlands is covered by one service, but all the other English regions are covered by more than one physics service, as shown in Table 1. In London a consortium of services covers five centres, and there are two other separate services. Five physics departments provide services to more than one region. Wales, Scotland and Northern Ireland are each covered by single physics services.

At the time of the audit every NHSBSP programme was attended by an appointed physics service.

The number of x-ray systems (analogue and digital) monitored by each of the physics services is shown in Figure 1a. Figures 1b and 1c show the numbers of digital radiography (DR) and computed radiography (CR) systems monitored.

Table 1 Physics services per region

NHS region	Number of physics services in 2007
East Midlands	1
East of England	3
London	3
North East, Yorkshire and Humber	5
North West	3
Northern Ireland	1
Scotland	1
South Central	3
South East Coast	2
South West	9
Wales	1
West Midlands	3

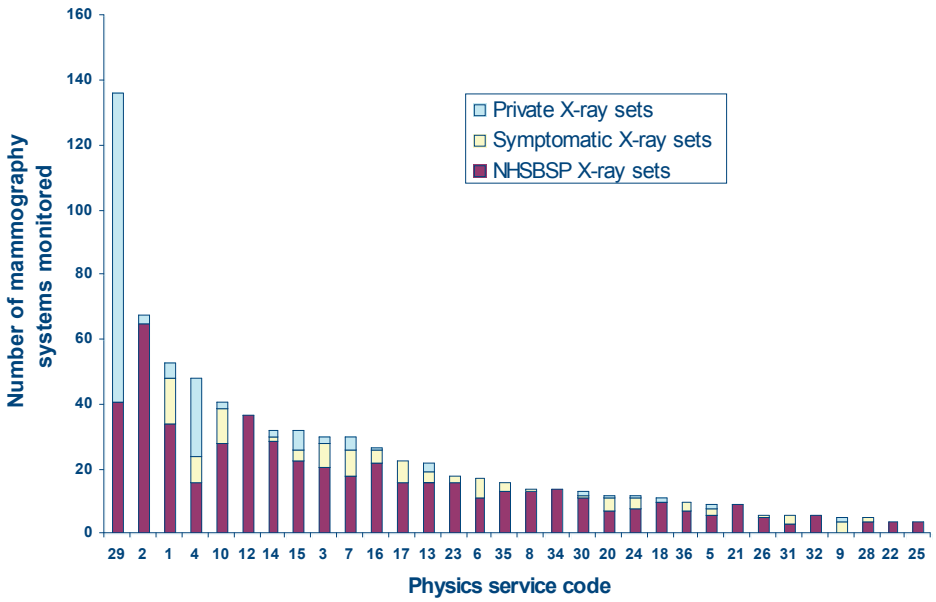

Figure 1a The number of mammography systems monitored by each physics service.

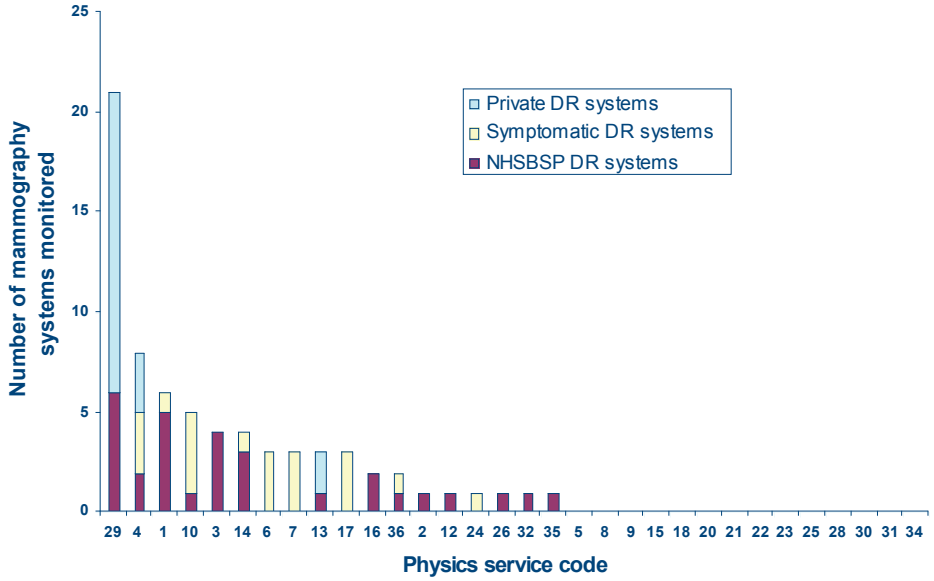

Figure 1b The number of digital radiography systems monitored by each physics service.

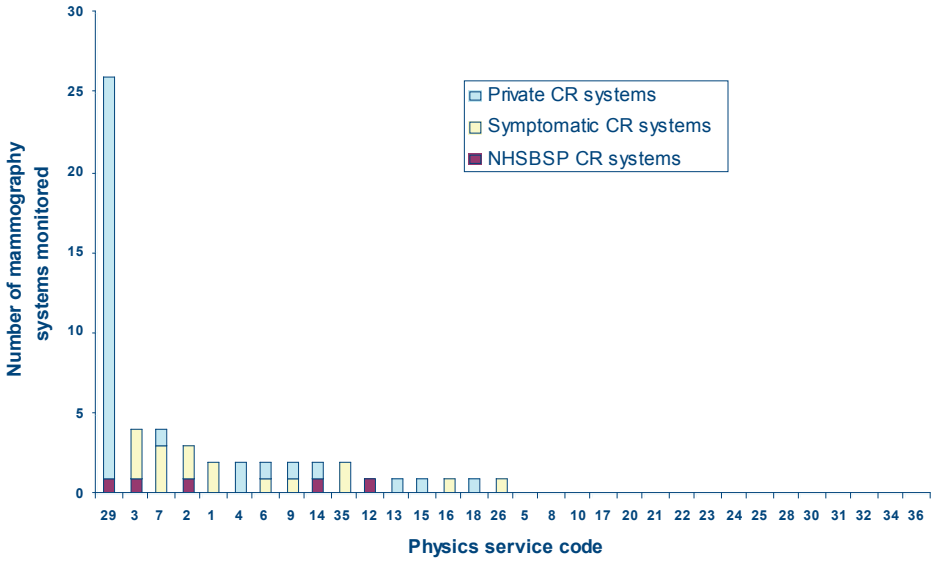

Figure 1c The number of computed radiography systems monitored by each physics service.

One of the main methods by which quality assurance is organised at the regional level is by multidisciplinary quality assurance visits. It is NHSBSP policy in England that a clinical scientist should participate in these visits, and this was the case for all English regions, as shown in Table 2. Other arrangements apply in Scotland, Wales and Northern Ireland.

Except where a single service covers the whole region, there are committees for regional coordination, and most of these meet twice yearly (one meets quarterly).

Table 2 Participation of physicists in multidisciplinary quality assurance (QA) visits to screening centres

NHS region	Do physics services participate in multidisciplinary QA visits?
East Midlands	Yes
East of England	Yes
London	Yes
North East, Yorkshire and Humber	Yes
North West	Yes
Northern Ireland	No
Scotland	Yes
South Central	Yes
South East Coast	Yes
South West	Yes
Wales	No
West Midlands	Yes

4. SERVICE AGREEMENTS

Twenty-eight of the 32 services have a written service agreement for the provision of routine physics quality assurance. For the 54 separate agreements for which a positive response was made, 29 are for one year, 15 are for three years, and the remainder for two or four years or not recorded.

Sixteen services fulfil a regional or subregional coordinating role and 14 of them have a written agreement for this role. The exceptions are Wales and Northern Ireland, for which regional operation is a defined part of the service provision, so that separate written agreements would be inappropriate.

5. EQUIPMENT

The total numbers of each type of equipment monitored by the physics services in the NHSBSP are shown in Table 3a. The sets listed as 'assessment x-ray sets' may also be used part-time for screening, whereas the 'mobile' and 'static' x-ray screening systems are generally used only for screening. Numbers of DR and CR systems in the NHSBSP monitored by physics services are shown separately in Table 3b.

Table 3a Total numbers of equipment in the NHSBSP monitored by physics services

	Number monitored by physics services				
Type of equipment	**1996**	**1998**	**2000/2001**	**2003**	**2007**
Mobile screening x-ray systems	110	116	141	187	207
Static screening x-ray systems	38.5	62	62	123	78
Assessment x-ray systems	134	139	168	145	235
Prone biopsy unit			9	10	13
Total of all x-ray systems	287.5	317	380	465	533
Processors	183	188	163	206	224
Ultrasound	112	114	123	160	164
Stereo accessory (film)	116	118	89	62	32
Stereo accessory (digital)			41	80	105
Specimen cabinet	39	43	51	54	66
Roller viewers		84	104	122	210

Table 3b Total numbers of DR and CR systems in the NHSBSP monitored by physics services

Type of equipment	**Number monitored in 2007**
Mobile screening DR systems	8
Static screening DR systems	3
Assessment DR systems	16
CR systems	5

6. LEVEL OF SERVICE

6.1. Services provided

All the services conducted routine surveys according to IPEM Report 89.[2] Almost all services monitor image quality and dose to the standard breast. However there are variations in some additional procedures and these are shown in Table 4. Note that numbers for previous years are numbers of services, but the 2007 survey recorded answers in terms of numbers of service agreements.

Table 4 Level of service

	Yes 1996 (of 31 services)	Yes 1998 (of 35 services)	Yes 2000/1 (of 34 services)	Yes 2003 (of 31 services)	Yes 2007 (of 60 agreements)
Advice on equipment selection	23	28	21	21	54
Advice on the use of equipment			33	30	57
RPA cover			29	24	44
Acceptance testing on x-ray sets	31	33	34	31	60
Acceptance testing on DR systems					18
Acceptance testing on analogue stereo attachments		13	24	26	28
Acceptance testing on digital stereo attachments				29	47
Acceptance testing on processors	9	11	13	13	34
Acceptance testing on screens	9	11	9	4	6
Acceptance testing on film	5	6	7	4	3
Acceptance testing on viewbox	11	11	12	11	24
Acceptance testing on cassettes	5	6	8	4	11
Acceptance testing on ultrasound					46
Acceptance testing on CR systems (NHSBSP)					4*
Acceptance testing on monitors (for digital)					23
Routine testing on x-ray sets			34	31	60
Routine testing on DR systems					18
Routine testing on analogue stereo attachments	16	21	22	22	10
Routine testing on digital stereo attachments				30	47
Routine testing on processors			17	19	37
Routine testing on screens			5	1	5
Routine testing on film			4	1	2
Routine testing on viewbox			13	10	34
Routine testing on cassettes			5	4	7
Routine testing on ultrasound	24	28	24	27	53
Routine testing on CR systems					4*
Routine testing on monitors (for digital)					19
Image quality tested for compliance with NHSBSP standards	31	35	34	31	60
Mean glandular dose to standard breast measured	31	35	34	31	60
Participates in drafting QA manual	28	35	30	25	49
Conducts patient dose measurement		31	29	30	60

*These answers relate to the five CR systems in the NHSBSP; in addition, there were 12 other positive responses that related to physics services' experience with CR systems in symptomatic and private units.

Twenty-seven out of 32 services now test ultrasound systems, and all the remaining five gave the name of another service provider for ultrasound testing. Some services do not test digital or analogue stereo systems because they have only analogue or only digital systems in their areas. About 30–50% of services test processors and viewing boxes, while much smaller numbers test films, screens and cassettes.

6.2. Test equipment for digital mammography systems

Nineteen of the 32 physics services have a CDMAM test object, and nine could borrow one. The four services which have no access to a CDMAM do not have any digital mammography equipment in the centres to which they provide a service. Twenty-nine physics services have a light-meter that is suitable for monitor testing. Eleven services have no image analysis software. Of those which have, 14 have ImageJ, five have CDMAM analysis software, three have Matlab, and several others are used by one or two services.

6.3. Patient dose surveys

Patient dose surveys are conducted under all the service agreements. The majority of agreements (42 out of 60) include collection of data for 50 women, while seven collect data for 100 to 250 women; for 11 others no data were given. The stated frequencies of patient dose surveys are shown in Table 5.

6.4. Support for radiography service

Some physics services provide extra support for radiographer quality control (QC) and for other aspects relating to screening centres. The results shown in Table 6 relate to the number of service agreements (total 60) covering these aspects.

Where image quality test films are reviewed, the test objects are mainly TOR-MAX (18), TOR-MAM (15) and TOR-MAS (12); the majority are reviewed monthly or six monthly. Fifteen of the 60 service agreements do not explicitly cover the review of any aspects of radiographer QC, but most of the services involved explained that they review radiographer QC informally, on request, or when there are specific problems.

Table 5 Stated frequency of patient dose surveys

	Number
Annually	8
Every two years	10
Every three years	29
BSP audits and equipment changes	5
Not stated	8

Table 6 Numbers providing support to aspects of radiography service

	Number of agreements	Frequency
Check electricity supply to mobile vans	7	
Support radiographers' QA software	36	
Extra support when film or processors changed	49	
Check processor rep rates, pH, temperature, etc.	3	
Review image quality test films	37	Weekly to annually
Review sensitometry data	36	Monthly to six monthly
Review radiographers' sensitometry	41	
Review radiographers' image quality checks	45	
Review radiographers' stereo checks	21	
Review radiographers' ultrasound checks	18	
Review radiographers' film–screen contact checks	14	
Review radiographers' cassette matching	18	
Review radiographers' light box/illuminator checks	12	
Review radiographers' digital tests, eg contrast to noise ratio	12	
Review radiographers' viewing monitor checks	4	

7. INTERVAL BETWEEN PHYSICS SURVEYS

The *Quality Assurance Guidelines for Medical Physics Services* require a physics survey at intervals of no more than six months. All of the 32 services complied with this requirement.

8. QUALIFICATIONS, EXPERIENCE AND TRAINING

A summary of the replies to questions about qualifications, experience and training is given in Table 7, showing numbers of services out of 32.

All services are supervised by a registered clinical scientist (as required in the QA guidelines).

Out of the 166 staff involved in services to NHSBSP, 122 have attended the IPEM Basic Mammography Training Course and 104 have attended update training. In total, 149 staff have received basic training in general diagnostic radiological physics and radiation protection, and 125 staff perform QA surveys on at least six mammography units (or two mammography units and extensive other work) in a year. Comments indicated that some other types of staff are involved in the work, eg a radiographer, administrative staff, and ultrasound physicists, who perform only ultrasound testing.

In the last two years buddy visits have been made by least one staff member from approximately half of the services, and a similar proportion of visits were received.

Table 7 Qualifications, experience and training

	Yes	No	No answer
Is the work performed or closely supervised by a registered clinical scientist?	32	0	0
Has at least one staff member received basic training in general diagnostic radiological physics and radiation protection?	32	0	0
Has at least one staff member in the service attended the IPEM Basic Mammography Training Course, which takes place every two years?	32	0	0
Has at least one staff member in the service attended the IPEM Mammography Physics Update Training Day, which takes place every two years?	32	0	0
Has at least one staff member in the service attended a centre for practical training?	12	19	1
Has at least one staff member in the service received training in ultrasound measurement?	30	1	1
Does at least one staff member perform QA surveys on at least six mammography units at least once a year, or on 2two mammography sets and have extensive experience of general diagnostic work?	32	0	0
Does the service participate in a review of the data from QA surveys on at least six mammography units at least once a year, and have access to such data when necessary?	32	0	0
Has at least one staff member made a buddy visit in the last two years?	17	14	1
Have any buddy visits been received in the last two years?	15	16	1

9. QUALITY ASSURANCE OF PHYSICS SERVICE

Answers to questions on the quality assurance of the physics services are given in Table 8. All clinical scientists participate in a recognised continuing professional development (CPD) scheme, and for 30 out of 32 services this is the IPEM scheme. Participation in a recognised CPD scheme is a requirement in the QA guidelines for all staff, but only half of the clinical technologists participate. Nine physics services have ISO9001 or 9002 accreditation (and one ISO13485); however, this is not a requirement of the QA guidelines.

Table 8 QA of physics service

	Yes	No
Is there a written procedures manual for the physics service?	30	2
Are records maintained of the survey reports?	32	0
Are records maintained of the instrument calibrations?	32	0
Are training records kept?	30	2
Do clinical scientists participate in a recognised CPD scheme?	32	0
Do clinical technologists participate in a recognised CPD scheme?	15	17
Does the service participate in NHSBSP national physics reviews?	32	0
Does the service have external accreditation?	10	22

10. STAFFING

The total number of staff involved in NHSBSP work is 166. This includes three administrative staff and one medical physics radiographer, and the remaining 162 are registered clinical scientists, pre-registration clinical scientists, and clinical technologists. The whole time equivalents (WTE) for the last three groups are summarised in Table 9. Some services have separately identified time spent fulfilling a regional or sub-regional co-ordinating role, and this amounts to about 7% of the time spent overall on routine work. This is an underestimate of the total, as three of the sixteen services providing regional coordination were unable to provide figures.

For the individual services, WTE per x-ray set ranges from 0.017 to 0.104 (mean 0.051); these figures are summarised in Table 10. Comments from seven services indicated that they felt they were short staffed. The spectrum of comments ranged from 'could do with more staff' to 'staffing level critically low'. For five of these services the WTE per x-ray set was in the lowest two groups of Table 10. Comments indicated that some staff shortages were temporary, due to maternity leave, but others were due to recruitment difficulties.

Table 9 Physics staff involved in routine work for the NHSBSP

	Total whole time equivalent
Routine work	
Registered clinical scientists	17.2
Pre-registration clinical scientists	3.9
Clinical technologists	9.7
Total	*30.7*
Regional coordination	
Total (all staff)	2.1
Grand total	*32.8*

Table 10 Range of whole time equivalents per x-ray set for different services

WTE per x-ray set	**Number of services**
0–0.019	1
0.020–0.039	12
0.040–0.059	7
0.060–0.079	9
≥ 0.080	3

Data on Agenda for Change (AfC) grades of staff were collected, and the totals for each staff group are shown in Figure 2. The totals do not include staff of the Mersey Physics Service, who do not have AfC grades.

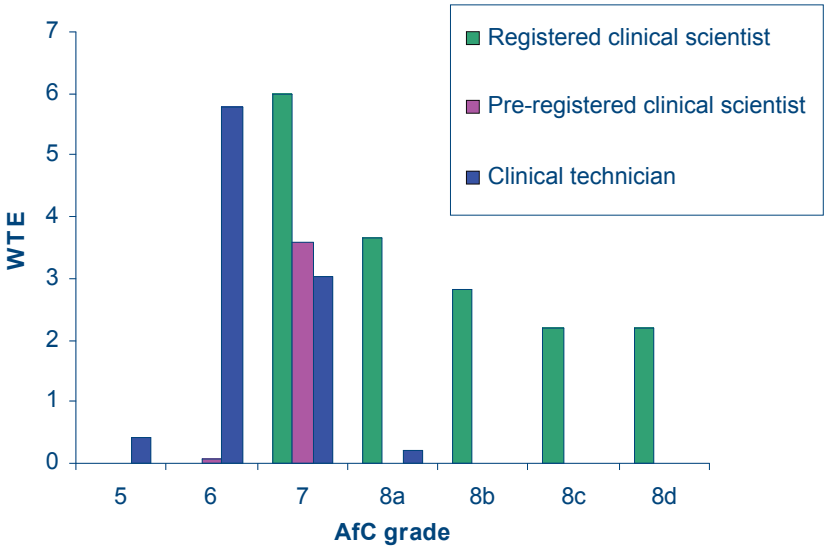

Figure 2 Total whole time equivalents by Agenda for Change grade for each group of staff.

REFERENCES

1. *Quality Assurance Guidelines for Medical Physics Services*. NHS Cancer Screening Programmes, 2005 (NHSBSP Publication No 33, 2nd edn).
2. *The Commissioning and Routine Testing of Mammographic X-ray Systems*. Institute of Physics and Engineering in Medicine, 2005 (IPEM Report 89).