NHS Machines: the utilisation of high-value capital equipment at NHS Trusts

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With the large real-terms budget increases the NHS has become accustomed to no longer possible given the state of the public finances, the NHS desperately needs to become more efficient.

In the 2014 NHS *Five Year Forward View*, NHS England said that in the absence of further funding (flat in real terms) and efficiencies, a £30 billion a year mismatch between resources and patient needs would open up by 2020-21.

In response, NHS Chief Executive Simon Stevens challenged the NHS to find £22 billion of efficiency savings and the government said they would increase NHS funding by £8 billion by 2020-21. However bodies representing NHS organisations such as NHS Providers have already started claiming that the additional £8 billion is not enough and that the £22 billion savings target is "too ambitious".

It is more vital than ever that the NHS makes full use of the resources already at its disposal, particularly as an aging population looks set to put further demands on hospitals, doctors and nurses.

However when it comes to the utilisation of expensive machines, many NHS trusts are not sweating their assets. If NHS Trusts are to achieve genuine efficiency, the management of machines must be improved as part of a greater efficiency drive.

The note looks at the utilisation of five different types of machines in NHS trusts in England:

- **Computerised Tomography (CT) scanners** which provide a detailed view of different tissue types not available with traditional x-rays.
- **Magnetic Resonance Imaging (MRI)** which are a safe means of producing detailed internal scans useful in diagnosis and treatment.
- **Linear accelerators (LINACs)** which play a critical role in cancer care
- **Lithotripters** which use ultrasound shock waves to break up kidney stones.
- **Positron Emission Tomography (PET) scanners** which are useful in effectively diagnosing and treating cancer.

Key findings:

CT scanners:

- There were 306 machines in the survey with **an average value of £443,688.**
- If underused machines were brought up to median usage, an **additional 554,850 scans would have been possible**.
- This is **equivalent to 62 additional machines**.
- At 34 trusts, all machines were used more times than the median.

MRI scanners:

- There were 265 machines in the survey with **an average value of £621,139.**
- If underused machines were brought up to median usage, an **additional 293,137 scans would have been possible**.
- This is **equivalent to 48 additional machines**.
- At 45 trusts, all machines were used more than the median.

LINACs:

- There were 141 machines in the survey with **an average value of £1,028,775.**
- If underused machines were brought up to median usage, an **additional 117,706 fractions would have been possible**.
- This is **equivalent to 16 additional machines**.
- At 3 trusts, all machines were used more than the median.

Lithotripters:

- There were 13 machines in the survey with **average value of £214,982.**
- If underused machines were brought up to median usage, an **additional 1,490 scans would have been possible**.
- This is **equivalent to 3 additional machines**.

PET scanners:

- 13 machines in the survey with **average value of £1,692,799.**
- If underused machines were brought up to median usage, an **additional 1,949 scans would have been possible**.
- This is **equivalent to 2 additional machines**.

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Analysis

Table 1: Under-utilisation of devices by region. Number of uses below median.

Region	CT		MRI		LINAC		Lithotripter		PET	
	Devices	Underuse	Devices	Underuse	Devices	Underuse	Devices	Underuse	Devices	Underuse
East Midlands	22	25,196	16	14,006	9	5,049	1	187	0	0
East of England	43	100,746	37	76,288	34	33,581	1	0	1	0
London	37	75,264	53	67,510	15	15,941	1	0	8	1,113
North East	24	54,144	15	8,188	0	0	1	0	0	0
North West	62	132,881	51	62,236	34	19,888	1	33	3	808
South East	36	57,964	19	14,797	10	8,547	4	703	1	28
South West	30	34,175	26	17,547	11	7,735	1	430	0	0
West Midlands	14	36,767	14	7,546	8	3,483	0	0	0	0
Yorkshire and the Humber	38	37,713	34	25,019	20	23,483	3	137	0	0
Total	**306**	**554,850**	**265**	**293,137**	**141**	**117,706**	**13**	**1,490**	**13**	**1,949**

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Table 2: Under-utilisation of devices by region. Number of hours below median availability.

Region	CT		MRI		LINAC		Lithotripter		PET	
	Devices	Underuse	Devices	Underuse	Devices	Underuse	Devices	Underuse	Devices	Underuse
East Midlands	26	249	19	86	9	131	1	62	0	0
East of England	45	358	40	39	35	783	2	116	1	2
London	59	727	69	418	24	435	1	29	8	154
North East	22	298	15	38	0	0	1	28	0	0
North West	65	717	50	261	35	140	2	30	3	100
South East	45	561	27	216	8	180	9	348	1	20
South West	29	342	25	213	5	128	0	0	0	0
West Midlands	23	394	23	113	8	103	0	0	1	23
Yorkshire and the Humber	42	593	37	214	20	395	3	138	0	0
Total	**356**	**4,238**	**305**	**1,596**	**144**	**2,294**	**19**	**751**	**14**	**298**

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CT scanners

A Computerised Tomography (CT) scanner uses cross-sectional x-ray examination to show the body in layers. CT scanning provides a detailed view of different tissue types that are not available with traditional x-rays. They are most commonly used for diagnostics, particularly checking for tumours and diagnosing conditions in internal organs. They are also important in radiotherapy planning for cancer treatment though, as they can identify normal and abnormal tissue

Summary

Category	Finding
Numbers of machines in survey	306
Average value	£443,688
Total annual uses	2,976,410
Median annual uses per machine	9,008
Number of additional uses possible if under-utilised machines brought up to median	554,850
Number of machines underuse represents	62

Trust with most underused CT scanners, number of uses below median

Trust	Number of devices	Number of scans below median
Cambridge University Hospitals NHS Foundation Trust	10	39,327
The Christie NHS Foundation Trust	7	38,644
Colchester Hospital University NHS Foundation Trust	6	26,404
Barnet and Chase Farm Hospitals NHS Trust (Royal Free London NHS Foundation Trust)	7	24,526
Northumbria Healthcare NHS Foundation Trust	6	19,197
University Hospitals Of Leicester NHS Trust	8	17,936
East Sussex Healthcare NHS Trust	4	16,794
Lancashire Teaching Hospitals NHS Foundation Trust	6	16,667
The Clatterbridge Cancer Centre NHS Foundation Trust	3	16,269
University Hospital Southampton NHS Foundation Trust	2	14,280

Trusts with least available CT scanners, number of hours below full availability per week

Trust	Number of devices	Hours short of full availability
The Christie NHS Foundation Trust	7	218.0
York Teaching Hospital NHS Foundation Trust	5	202.5
Barts Health NHS Trust	7	185.8
Sheffield Teaching Hospitals NHS Foundation Trust	6	185.0
Worcestershire Acute Hospitals NHS Trust	5	184.5
Colchester Hospital University NHS Foundation Trust	6	182.0
University Hospital Of North Staffordshire NHS Trust	6	180.0
Royal Berkshire NHS Foundation Trust	4	176.0
Cambridge University Hospitals NHS Foundation Trust	10	160.0
United Lincolnshire Hospitals NHS Trust	5	157.5

Trusts with all CT scanners above median use

Trust	Number of devices	Number of uses above median
East Kent Hospitals University NHS Foundation Trust	4	35,416
Ashford and St Peter's Hospitals NHS Foundation Trust	3	29,370
Basildon and Thurrock University Hospitals NHS Foundation Trust	2	25,955
Sherwood Forest Hospitals NHS Foundation Trust	3	25,412
Taunton and Somerset NHS Foundation Trust	2	20,613
Doncaster and Bassetlaw Hospitals NHS Foundation Trust	2	16,822
Milton Keynes Hospital NHS Foundation Trust	2	14,914
Royal National Hospital For Rheumatic Diseases NHS Foundation Trust (Royal United Hospital Bath NHS Foundation Trust)	2	13,197
The Princess Alexandra Hospital NHS Trust	1	12,992
Mid Yorkshire Hospitals NHS Trust	4	12,360
Calderdale and Huddersfield NHS Foundation Trust	3	11,220
Kettering General Hospital NHS Foundation Trust	2	10,984
Bradford Teaching Hospitals NHS Foundation Trust	3	10,925
Great Western Hospitals NHS Foundation Trust	2	10,745
Western Sussex Hospitals NHS Trust	4	10,628
Homerton University Hospital NHS Foundation Trust	1	9,873
Epsom and St Helier University Hospitals NHS Trust	2	9,665
North Cumbria University Hospitals NHS Trust	2	8,417
Stockport NHS Foundation Trust	2	8,355
Harrogate and District NHS Foundation Trust	1	7,993
Mid Cheshire Hospitals NHS Foundation Trust	2	7,688
Northampton General Hospital NHS Trust	2	6,821
Barnsley Hospital NHS Foundation Trust	2	4,137
The Hillingdon Hospitals NHS Foundation Trust	1	4,030
East Cheshire NHS Trust	1	3,431
Geroge Eliot Hospital Trust	1	2,992
Weston Area Health NHS Trust	1	2,690
West Suffolk NHS Foundation Trust	2	2,347
Royal Surrey County NHS Foundation Trust	2	2,269
St George's Healthcare NHS Trust	1	1,644
South Tyneside NHS Foundation Trust	1	1,302
Poole Hospital NHS Foundation Trust	2	1,114
Northern Devon Healthcare NHS Trust	1	992
Tameside Hospital NHS Foundation Trust	2	36

*Luton and Dunstable Hospital NHS Foundation Trust's response stated two scanners operating for 80 hours per week were used 114,186 times. This implies more than one scan every five minutes. Cancer Research state that a CT scan takes between 10 and 15 minutes.[1] This response has therefore been excluded from the table.

[1] http://www.cancerresearchuk.org/about-cancer/cancers-in-general/tests/ct-scan

MRI scanners

Magnetic Resonance Imaging (MRI) uses a strong magnetic field and radio waves to produce detailed pictures of the inside of a patient's body. It is one of the safest imaging techniques available and is particularly useful in showing soft tissue structures such as those found in cancer tumours or brain damage, as well as diagnosing other serious disorders such as epilepsy

Summary

Category	Finding
Numbers of machines in survey	265
Average value	£621,139
Total annual uses	1,700,103
Median annual uses per machine	6,122
Number of additional uses possible if under-utilised machines brought up to median	293,137
Number of machines underuse represents	48

Trust with most underused MRI scanners, number of uses below median

Trust	Number of devices	Number below median
Cambridge University Hospitals NHS Foundation Trust	16	72,037
Great Ormond Street Hospital for Children NHS Foundation Trust	5	23,977
The Royal Marsden NHS Foundation Trust	5	12,918
University Hospitals Of Morecambe Bay NHS Foundation Trust	4	12,779
University Hospitals Of Leicester NHS Trust	7	12,232
Leeds Teaching Hospitals NHS Trust	9	12,141
The Walton Centre NHS Foundation Trust	5	11,622
Lancashire Teaching Hospitals NHS Foundation Trust	4	10,860
Sheffield Children's NHS Foundation Trust	2	8,863
Barnet and Chase Farm Hospitals NHS Trust (Royal Free London NHS Foundation Trust)	5	8,096

Trusts with least available MRI scanners, number of hours below full availability per week

Trust	Number of devices	Hours short of full availability
The Royal Marsden NHS Foundation Trust	5	187
Hull and East Yorkshire Hospitals NHS Trust	4	136
North Bristol NHS Trust	5	133
Royal Berkshire NHS Foundation Trust	3	132
Kettering General Hospital NHS Foundation Trust	3	128
Great Ormond Street Hospital for Children NHS Foundation Trust	5	124
Birmingham Children's Hospital NHS Foundation Trust	3	116
Poole Hospital NHS Foundation Trust	3	102
Imperial College Healthcare NHS Trust	9	98
King's College Hospital NHS Foundation Trust	6	97

Trusts with all MRI scanners above median use

Trust	Number of devices	Number of uses above median
East Kent Hospitals University NHS Foundation Trust	5	32,724
Royal Devon and Exeter NHS Foundation Trust	2	19,250
Northern Lincolnshire and Goole Hospitals NHS Foundation Trust	2	16,649
East and North Hertfordshire NHS Trust	3	16,330
Sheffield Teaching Hospitals NHS Foundation Trust	4	15,070
Mid Cheshire Hospitals NHS Foundation Trust	3	13,200
Barking, Havering and Redbridge University Hospitals NHS Trust	4	10,912
Lewisham and Greenwich NHS Trust	2	9,666
Royal National Hospital For Rheumatic Diseases NHS Foundation Trust (Royal United Hospital Bath NHS Foundation Trust)	2	8,462
Walsall Healthcare NHS Trust	1	8,168
Bradford Teaching Hospitals NHS Foundation Trust	2	8,023
Great Western Hospitals NHS Foundation Trust	2	7,310
Dartford and Gravesham NHS Trust	1	7,174
Stockport NHS Foundation Trust	1	6,672
Mid Yorkshire Hospitals NHS Trust	3	6,583
Basildon and Thurrock University Hospitals NHS Foundation Trust	2	6,110
The Hillingdon Hospitals NHS Foundation Trust	1	4,829
St Helens and Knowsley Hospitals NHS Trust	2	4,544
Tameside Hospital NHS Foundation Trust	1	4,188
Doncaster and Bassetlaw Hospitals NHS Foundation Trust	2	3,813
Western Sussex Hospitals NHS Trust	2	3,805
Bolton NHS Foundation Trust	1	3,749
The Royal Orthopaedic Hospital NHS Foundation Trust	1	3,743
Sherwood Forest Hospitals NHS Foundation Trust	1	3,729
Southend University Hospital NHS Foundation Trust	2	3,177
Airedale NHS Foundation Trust	1	3,126
Epsom and St Helier University Hospitals NHS Trust	2	3,090
East Cheshire NHS Trust	1	2,721
Calderdale and Huddersfield NHS Foundation Trust	2	2,717
Gateshead Health NHS Foundation Trust	1	2,474
Robert Jones and Agnes Hunt Orthopaedic and District Hospital NHS Trust	2	2,317
Northampton General Hospital NHS Trust	1	2,208
Homerton University Hospital NHS Foundation Trust	2	2,089
Chesterfield Royal Hospital NHS Foundation Trust	1	1,878
The Princess Alexandra Hospital NHS Trust	1	1,678
The Rotherham NHS Foundation Trust	1	1,478
Salisbury NHS Foundation Trust	1	1,140
West Suffolk NHS Foundation Trust	2	895
Pennine Acute Hospitals NHS Trust	3	824
Ipswich Hospital NHS Trust	2	683
Royal Surrey County NHS Foundation Trust	1	413
South Tees Hospitals NHS Foundation Trust	2	410
Mid Essex Hospital Services NHS Trust	1	400
South Tyneside NHS Foundation Trust	1	117

Barnsley Hospital NHS Foundation Trust	1	82

*Luton and Dunstable Hospital NHS Foundation Trust's response implied just under 8 scans per hour. The NHS states that an MRI scan takes between 15 and 90 minutes.[2] This response has therefore been excluded from the table.

Linear Accelerators

Linear accelerators (Linacs) use ionised radiation to destroy cancer cells through fractionated treatment which allows high doses of radiation to be given over a number of days to reduce unwanted effects on normal tissue.

Summary

Category	Finding
Numbers of machines in survey	141
Average value	1,028,775
Total annual uses	1,123,177
Median annual uses per machine	7,349
Number of additional uses possible if under-utilised machines brought up to median	117,706
Number of machines underuse represents	16

Trust with most underused linacs, number of uses below median

Trust	Number of devices	Number below median
Leeds Teaching Hospitals NHS Trust	12	19,924
East and North Hertfordshire NHS Trust	10	19,427
The Royal Marsden NHS Foundation Trust	12	14,903
The Christie NHS Foundation Trust	14	9,174
University Hospital Southampton NHS Foundation Trust	6	8,318
Gloucestershire Hospitals NHS Foundation Trust	6	7,735
The Clatterbridge Cancer Centre NHS Foundation Trust	12	7,506
Southend University Hospital NHS Foundation Trust	4	7,395
United Lincolnshire Hospitals NHS Trust	5	5,049
Cambridge University Hospitals NHS Foundation Trust	7	3,851

[2] http://www.nhs.uk/Conditions/MRI-scan/Pages/How-is-it-performed.aspx

Trusts with least available linacs, number of hours below full availability per week

Trust	Number of devices	Hours short of full availability
Leeds Teaching Hospitals NHS Trust	12	378
East and North Hertfordshire NHS Trust	9	306
Sheffield Teaching Hospitals NHS Foundation Trust	8	297
The Royal Marsden NHS Foundation Trust	12	294
Cambridge University Hospitals NHS Foundation Trust	8	267
Barts Health NHS Trust	5	214
The Christie NHS Foundation Trust	15	210
Lancashire Teaching Hospitals NHS Foundation Trust	7	208
Norfolk and Norwich University Hospitals NHS Foundation Trust	5	180
Royal Berkshire NHS Foundation Trust	4	176

Trusts with all machines above median use

Trust	Number of devices	Number of uses above median
Ipswich Hospital NHS Trust	4	25,741
Royal Devon and Exeter NHS Foundation Trust	3	4,954
Royal National Hospital For Rheumatic Diseases NHS Foundation Trust (Royal United Hospital Bath NHS Foundation Trust)	2	2,792

*Derby Hospitals NHS Foundation Trust's response implied just under 4 uses per minute. The American Cancer Society states that a LINAC session takes between 15 and 30 minutes.[3] This response has therefore been excluded from the table.

[3] http://www.cancer.org/treatment/treatmentsandsideeffects/treatmenttypes/radiation/understandingradiationtherapyaguideforpatientsandfamilies/understanding-radiation-therapy-external-radiation-therapy

Lithotripters

Lithotripters use shock waves formed by ultrasound to break kidney stones into small particles that will pass painlessly through the body. Kidney stones are often painful and can lead to infection or blood in the urine. Without removal, they have the potential to damage kidneys. Lithotripters remove the need for surgery and anaesthetic, and therefore the need for hospital stays and long recovery times.

Summary

Category	Finding
Numbers of machines in survey	13
Average value	214,982
Total annual uses	5,067
Median annual uses per machine	431
Number of additional uses possible if under-utilised machines brought up to median	1,490
Number of machines underuse represents	3

Trust with most underused lithotripters, number of uses below median

Trust	Number of devices	Number below median
Northern Devon Healthcare NHS Trust	1	430
Ashford and St Peter's Hospitals NHS Foundation Trust	2	359
Dartford and Gravesham NHS Trust	1	344
Derby Hospitals NHS Foundation Trust	1	187
Sheffield Teaching Hospitals NHS Foundation Trust	1	137

Trusts with least available lithotripters, number of hours below full availability per week

Trust	Number of devices	Hours short of full availability
East Kent Hospitals University NHS Foundation Trust	5	240
Ashford and St Peter's Hospitals NHS Foundation Trust	2	136
East and North Hertfordshire NHS Trust	1	82
Derby Hospitals NHS Foundation Trust	1	76
Sheffield Teaching Hospitals NHS Foundation Trust	1	67
Cambridge University Hospitals NHS Foundation Trust	1	62
Leeds Teaching Hospitals NHS Trust	1	60
Brighton and Sussex University Hospitals NHS Trust	1	54
Mid Yorkshire Hospitals NHS Trust	1	53
Royal Berkshire NHS Foundation Trust	1	44

Positron Emission Tomography

PET scanning is a rapidly changing field, with evidence of the benefits of such scans only recently becoming sufficiently well established to warrant UK-wide facilities. The scanner uses short term radionuclides to highlight biochemical or functional change rather than just structural. The system therefore has a range of uses with cancer patients, providing improved diagnosis and planning for care and treatment, particularly in combination with a CT scan

Summary

Category	Finding
Numbers of machines in survey	13
Average value	£1,692,799
Total annual uses	19,904
Median annual uses per machine	1,228
Number of additional scans possible if under-utilised machines brought up to median	1,949
Number of machines underuse represents	2

Trust with most underused PETs, number of uses below median

Trust	Number of devices	Number below median
The Royal Marsden NHS Foundation Trust	5	1,113
The Clatterbridge Cancer Centre NHS Foundation Trust	1	808
Royal Surrey County NHS Foundation Trust	1	28

Trusts with least available PETs, number of hours below full availability per week

Trust	Number of devices	Hours short of full availability
The Royal Marsden NHS Foundation Trust	5	170
North Cumbria University Hospitals NHS Trust	1	72
Barnet and Chase Farm Hospitals NHS Trust (Royal Free London NHS Foundation Trust)	1	44
The Clatterbridge Cancer Centre NHS Foundation Trust	1	42
University Hospital Of North Staffordshire NHS Trust	1	37
King's College Hospital NHS Foundation Trust	1	34
Royal Surrey County NHS Foundation Trust	1	34
The Christie NHS Foundation Trust	1	28
Imperial College Healthcare NHS Trust	1	18
Cambridge University Hospitals NHS Foundation Trust	1	16

What can be done to make better use of machines?

With pressure on funding, the NHS needs to reverse the trend of falling productivity. In 2010-11 and 2011-12 productivity increased only to fall in the following three years as costs rose faster than activity.[4]

This follows a decade in which the NHS budget doubled in real terms. In 2010 Amyas Morse, the head of the National Audit Office said that:

> *"Over the last ten years, there has been significant real growth in the resources going into the NHS, most of it funding higher staff pay and increases in headcount. The evidence shows that productivity in the same period has gone down, particularly in hospitals."*

The failure to fully utilise high value equipment is a component of this. There are challenges in increasing the usage of expensive NHS machines, such as shortages of qualified staff, but there are a number of ways Trusts across the NHS could use their machines more intensively in order to increase capacity. Part of this could be small administrative changes that might secure better value.

For example, the machines could be used for more hours per week. We live in a 24 hour society where people in many professions are required to work at the weekends. The government has gone some way to recognising this with its changes to contracts for trainee doctors and consultants, removing the former's ability to opt out of elective weekend working.

Many businesses achieve better value by making more intensive use of expensive capital equipment. Airlines, for example, go to great lengths to ensure that their planes spend as little time on the ground as possible and carry as many passengers per flight as possible. Diluting fixed costs in this way is the only way of getting better value from such expensive resources. Unfortunately, there are presently few incentives for trusts to get better use out of machines in their care. If Trusts had to compete to secure patients it is unlikely that they would leave such valuable resources underutilised.

It may be the case that there is a shortage of staff trained to operate the machines covered in the report. Indeed in April 2015, NHS employers added consultants in clinical radiology to its shortage occupation list, an official list of occupations where there are not currently enough resident UK workers to fill vacancies.[5] These are longer term problems that require attention but it does not excuse underuse of high value equipment. Trusts should not purchase equipment if they do not have the staff available to operate it efficiently.

Changes to the NHS National Tariff Payment System should be considered. If a trust has a machine lying idle they should have the option of cutting prices. This would lead to a more efficient allocation of financial resources and reduce waiting lists.

There are a range of resources available to the NHS that Trusts need to get maximum value from, including staff and drugs. Effective utilisation of machines is relatively easy to monitor, and therefore manage, which means that they are a good test of the effectiveness of the NHS in delivering value for money. This report's findings confirm that there is serious work to be done improving productivity, which might yield considerable results.

[4] http://www.health.org.uk/chart-productivity-nhs
[5] http://www.nhsemployers.org/news/2015/04/shortage-occupation-list-updated-april-2015

Sources and methodology

- Freedom of Information requests were sent to every NHS trust in England asking for:
    - The make and model of each machine
    - Its value
    - Annual maintenance costs
    - Weekly operating hours
    - Number of uses
- Insufficient data on maintenance costs was provided to use in the report.
- Some trust provided data for financial years while others provided data for calendar years.
- Full availability is considered to be 12 hours per day, seven days a week.
- If trusts responded that the scanner was available “24/7”, this was considered to be full usage.
- Some trusts provided hours in which the machine was available for appointments but added that the machine was “on call” or “available for emergencies” 24 hours a day, seven days a week. In such cases only the hours in which it was available for appointments were considered.
- If the response did not contain data on the operating hours or the number of uses, it was excluded from any totals or averages.
- Usage figures for devices that were installed part way through the year were annualised for the purpose of calculating averages. Where no specific date was provided for the installation of a device part way through the year, it was assumed the device was installed for six months.