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Productivity of the English National Health Service: 2015/16 Update

Adriana Castelli, Martin Chalkley, Idaira Rodriguez Santana

CHE Research Paper 152

Productivity of the English National Health Service: 2015/16 Update

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No ethical approval was needed as we used secondary data.

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Executive summary

This report updates the Centre for Health Economics' time series of National Health Service (NHS) productivity growth for the period 2014/15 to 2015/16. It also reports trends in output, input and productivity since 2004/05.

NHS productivity growth is measured by comparing growth in the outputs produced by the NHS to growth in the inputs used to produce them. NHS outputs include all the activities undertaken for NHS patients wherever they are treated in England and accounts for changes in the quality of care provided to those patients. NHS inputs include the number of doctors, nurses and support staff providing care, the equipment and clinical supplies used, and the facilities of hospitals and other premises where care is provided.

NHS outputs have increased substantially between 2004/05 and 2015/16, primarily because more patients are receiving treatment. In 2015/16, hospitals treated 4.9 million more patients than in 2004/05 – an increase of 39%. The number of outpatient attendances has also increased by just under 76% since 2004/05, with almost 38 million more contacts in 2015/16 compared to 2004/05.[1]

There have been year-on-year improvements in hospital survival rates, whilst waiting times have been getting longer since 2009/10 (although they remain shorter than they were in 2004/05), taking account of these changes in the quality of care, overall quality-adjusted NHS output increased by just over 55% between 2004/05 and 2015/16, and by 2.62% between 2014/15 and 2015/16.

Increases in NHS outputs have been accompanied by increases in inputs. The number of NHS staff increased by 6.5% between 2004/05 and 2015/16, and expenditure on those staff increased by 48%. Some categories of expenditure have increased more rapidly. For example, between 2004/05 and 2015/16, NHS expenditure on Agency staff has increased by 138%, but this increase has varied considerably over the 11 year period, with periods of increased use of Agency staff followed by periods of restraint. Expenditure on materials and capital increased by 198% and 156% respectively between 2004/05 and 2015/16. Overall expenditure on NHS inputs has increased by 73% since 2004/05, and by 2.59% between 2014/15 and 2015/16.

Over the last eleven years NHS productivity has increased by 13.49%. Productivity growth has been positive since 2009/10, with year-on-year growth averaging 1.17%. We find that productivity amounted to 0.04% between 2014/15 and 2015/16.

Comparing the growth in productivity for the NHS to a measure of productivity for the whole economy (the Gross Value Added per hour worked), NHS productivity kept pace with the economy up to the recession in 2008/09, then between 2008/09 and 2013/14, NHS productivity growth has outpaced that of the economy, but from 2014/15 onwards that has reversed; substantially so in the most recent year.

[1] Outpatient activity data in 2004/05 are not directly comparable to Outpatient activity data in 2015/16. The classification system for Outpatient activity, as captured in the Reference Costs database, underwent a complete overhaul in 2006/07 as documented in Castelli et al. (2008).

Glossary of acronyms

A&E	Accident & Emergency
AD	Admitted
ALB	Arm's Length Body
CCG	Clinical Commissioning Group
CDEL	Capital Departmental Expenditure Limit
CIPS	Continuous Inpatient Spell
CQC	Care Quality Commission
CSU	Commissioning Support Unit
DH	Department of Health
ESR	Electronic Staff Record
EQ5D	EuroQol five dimensions standardized instrument for measuring generic health status
FCE	Finished Consultant Episode
FTE	Full-time Equivalent
H&SC Act	Health & Social Care Act 2012
HES	Hospital Episode Statistics
HRG(4/4+)	Healthcare Resource Group (version 4/4+)
ISHP	Independent Sector Health Care Provider
MH	Mental Health
MSG	Major Staff Group
NAD	Not admitted
NHS	National Health Service
ONS	Office for National Statistics
PCA	Prescription Cost Analysis
PCT	Primary Care Trust
PROMs	Patient Reported Outcome Measures
PSSRU	Personal & Social Services Research Unit
QOF	Quality and Outcomes Framework
RC	Reference Costs
RDEL	Revenue Departmental Expenditure Limit
RDNA	Regular Day and Night Attendance
SHA	Strategic Health Authority
SUS	Secondary Uses Service
TDEL	Total Departmental Expenditure Limit
TFR	Trust Financial Returns

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1. Introduction

This report updates the Centre for Health Economics' time series of National Health Service (NHS) productivity growth, to account for growth between 2014/15 and 2015/16, as well as looking at the 11 year trends starting from 2004/05.[2]

We follow national accounting conventions to measure the change in productivity over time by means of a chained index (Eurostat, 2001). We concentrate on the calculation and comparison of output and inputs between 2014/15 and 2015/16. This latest 'link' is then attached to the chained index that reports productivity changes over the last decade. Technical details about methodology can be found in Appendix A.

In calculating output growth, we construct a Laspeyres index aggregating different types of NHS output, using as weights the previous year's cost for each specific output. We capture changes in quality by taking account of changes in survival following hospital treatment, waiting times, and improvements in blood pressure monitoring in primary care. Improvements in these dimensions contribute to output growth.

Growth in the volume of inputs is calculated primarily using expenditure data. Current spending on labour, capital and material resources are deflated to the previous year's costs in order to generate a measure of changing input use in the paired years. For labour we also use information about the volume and costs of staff recorded in the NHS Electronic Staff Record (ESR). This permits two alternative measures of input growth – one constructed entirely from accounts data (the indirect measure) and one which uses expenditure data for capital and materials and ESR data for labour (the mixed measure of input growth). This allows us to assess how sensitive productivity growth is to how labour input is measured.

The focus of the report is on the data used to calculate output and input growth between 2014/15 and 2015/16. Specific details are provided about any potential data collection and coding artefacts that may compromise a genuine like-for-like comparison across the two years.

The structure of the report is as follows. The output index is described in Section 2, and the elements of the input index are reported in Section 3. Section 4 reports the productivity growth figures. Summary and concluding remarks are provided in Section 5.

[2] For the full productivity series from 1998/99 to 2013/14 see Bojke et al. (2016b).

2. Output

2.1 Measuring output

Our NHS output index is designed to capture all activities provided to NHS patients, whether by NHS or private sector organisations.[3] Table 1 below summarises data sources used to measure activity, quality and costs, and also indicates specific measurement issues that have had to be tackled in constructing the output growth index for 2014/15 – 2015/16. The data and these specific issues are detailed in the remainder of this section. It should be noted that we have two alternative sources of volume of activity for outpatient output: the Hospital Episode Statistics (HES) outpatient dataset, and the Reference Costs database. We compare the outpatient activity in these datasets.

Table 1: Summary of output data sources

Output type	Activity source	Cost source	Quality	Notes for 2014/15 and 2015/16 data
Elective	HES	RC	30-day/in-hospital survival; health outcomes; waiting times	Activity described by HRG4+ In-hospital survival is used for years 2014/15 and 2015/16
Non-elective	HES	RC	30-day /in-hospital survival; health outcomes	Activity described by HRG4+ In-hospital survival is used for years 2014/15 and 2015/16
Outpatient	HES (or RC)	RC	Waiting times	Waiting times come from HES Two sources of activity data
Mental health	HES & RC	RC	30-day/in-hospital survival; health outcomes; waiting times	Activity described by HRG4+ In-hospital survival is used for years 2014/15 and 2015/16
Community care	RC	RC	N/A	
A&E	RC	RC	N/A	
Other (1)	RC	RC	N/A	
Primary care	QResearch (up to 2008/09) General Lifestyle Survey (2008/09-09/10) GP patient survey (from 2009/10)	PSSRU Unit Costs of Health and Social Care	QOF data	Uplift survey responses by population growth; changes in QOF data
Prescribing	Prescription cost analysis system	Prescription cost analysis system	N/A	
Ophthalmic and dental	NHS Digital	NHS Digital	N/A	

Note: (1) Radiotherapy & High Cost Drugs, Diagnostic Tests, Hospital/patient Transport Scheme, Radiology, Rehabilitation, Renal Dialysis, Specialist Services

[3] NHS activity provided by non-NHS providers was included in the output growth series up to 2010/11.

2.2 HES inpatient, day case, mental health and outpatient data

HES is the source of data for both the amount of activity and for the measures of quality for elective and non-elective activity, including mental health care, delivered in hospitals.[4] HES comprises of almost 20.2m records in 2014/15 and 20.6m in 2015/16. We convert HES records, defined as Finished Consultant Episodes (FCEs), into Continuous Inpatient Spells (CIPS) using the official algorithm for calculating CIPS published by NHS Digital (formerly the Health and Social Care Information Centre).[5] We then count the number of CIPS in each Healthcare Resource Group (HRG), which form the basic means of describing different types of hospital output.

The cost of each CIPS is calculated on the basis of the most expensive FCE within the CIPS, with costs for each HRG derived from the Reference Cost data (Bojke et al., 2013). Our previous research suggested that results are not sensitive to the alternatives of calculating the costs of CIPS on the basis of the first episode or the sum of all episodes (Daidone and Street, 2011). Reference Costs are reported for each HRG according to their point of delivery, indicating whether the patient was treated as a non-elective inpatient, elective inpatient or elective day case (Department of Health, 2015). The non-elective Reference Costs are used to determine the cost of patients treated on a non-elective basis, while we use the elective inpatient Reference Costs to determine the cost of all elective patients, including those treated on a day case basis (Bojke et al., 2016a). This ensures that elective inpatient and day case activity is assigned the same cost weight and, hence, is assumed to be of equivalent value, despite the latter being of lower cost. This equal weighting ensures that the output index is not biased downwards if delivery of treatment moves to lower cost forms or settings over time. Having assigned a cost to each CIPS, we then calculate the national average cost per CIPS in each HRG.

Changes to the HRG system pose some difficulties in constructing the output index because costs might not be available for some activities. In such cases we deflate current costs in order to impute prior values (Castelli et al., 2011). However, this is not an issue for this report because no changes in the HRG groupings have occurred between the years 2014/15 and 2015/16.

The vast majority of activity captured in HES is performed by hospital Trusts. As shown in Table 2, 97.3% of all activity was performed in Trusts in 2014/15 and 97.3% in 2015/16. The proportion of activity performed by private providers is gradually increasing: in 2012/13 they provided 2.1% of all activity, increasing to 2.6% in 2014/15 and to 2.7% in 2015/16.

Table 2: Organisational coverage of HES activity, FCEs

Year	NHS Trusts	Private providers	Other[6]	Total
2012/13	18,649,728	406,078	13,754	19,069,560
2013/14	19,061,786	470,454	1,873	19,534,113
2014/15	19,639,539	537,998	3,501	20,181,038
2015/16	20,049,753	557,574	1,204	20,608,531

2.2.1 Elective, day case and non-elective activity

As can be seen from Table 3, elective and day case activity has increased by 53.3% over the 11 years covered in this report, from 6.4m to 9.9m CIPS, while non-elective activity has increased by 23.9%, from 6m to 7.4m CIPS. While elective activity has grown steadily, growth in non-elective activity shows a more erratic pattern, as can be also observed in Figure 1.

[4] As in previous years, we exclude patients categorised to HRGs which are not included in the tariff ("Zero Cost HRGs").
[5] http://www.hesonline.nhs.uk/Ease/servlet/ContentServer?siteID=1937&categoryID=1072.
[6] Primary Care Trusts (2012/13 only) and organisations with the org code starting with 8 or A.

Between 2014/15 and 2015/16 the number of elective CIPS increased by 211,082 (2.2%), while non-elective activity increased by 37,158 (0.5%).

Table 3: Number of CIPS and average cost for electives and non-electives

Year	Elective and day case activity			Non-elective activity	
	# CIPS	Average cost (£)		# CIPS	Average cost (£)
2004/05	6,433,933	1,031		6,009,802	1,210
2005/06	6,864,612	1,041		6,291,117	1,241
2006/07	7,194,697	1,036		6,363,388	1,244
2007/08	7,598,796	1,091		6,593,136	1,237
2008/09	8,148,229	1,147		6,826,035	1,354
2009/10	8,465,757	1,227		6,951,379	1,413
2010/11	8,755,081	1,263		7,109,358	1,460
2011/12	8,946,909	1,287		7,049,528	1,498
2012/13	9,030,530	1,341	1,465*	7,327,228	1,532
2013/14	9,336,918	1,373	1,501*	7,112,856	1,555
2014/15	9,651,505		1,523*	7,414,368	1,569
2015/16	9,862,587		1,590*	7,451,526	1,577

Note: * In previous years we calculated the cost for elective and day case activity as a weighted average between cost of elective and day case activity, but since 2012/13 we switched to using elective costs only.

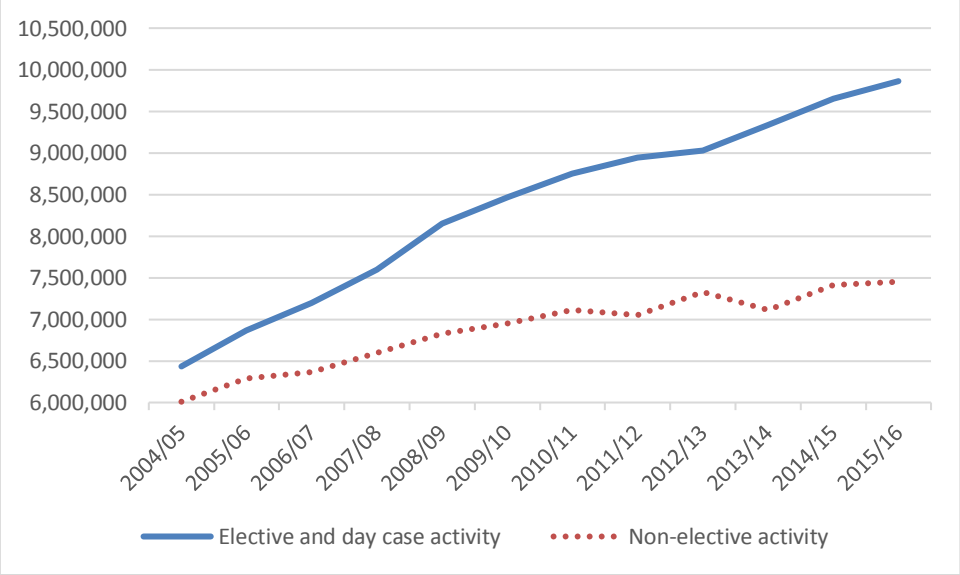


Figure1: Changes in elective and day case and non-elective activity

After cost-weighting this activity, we observe 3.10% growth in activity for electives and day cases and a growth of 3.94% for non-elective activity between 2014/15 and 2015/16. Combining both series, the total cost-weighted activity growth amounts to 3.39%.

2.2.2 Elective, day case and non-elective activity: quality adjustment

Our measure of hospital output captures growth in both the volume of activity and improvements in quality. The quality of hospital activity is measured by survival rate, estimated change in health outcomes following hospital treatment and mean life expectancy. Up to the financial year 2013/14,

we used 30-day post discharge survival rate, but we have since switched to the in-hospital survival measure because ONS date of death data are not released to us in a sufficiently timely fashion.[7] This part of the quality adjustment is designed to capture changes in the expected discounted sum of lifetime Quality Adjusted Life Years (QALYs) conditional on patients surviving treatment.

Our quality adjustment also accounts for changes in inpatient waiting times. Longer waiting times are considered to have adverse health consequences and formulated as a scaling factor multiplying the health effect (Castelli et al., 2007). This adjustment applies only to elective and day case activity, and is measured by 80th percentile waiting times. Information on in-hospital survival rate and waiting times is obtained directly from HES; 30-day survival post-discharge was calculated from the mortality dataset provided by ONS; mean life expectancy is taken from life tables published annually by ONS.[8] Table 4 and Figures 2 and 3 present average values for each of these measures over time.

Table 4: Quality adjustment for elective and day case and for non-elective activity

Year	Elective and day case activity				Non-elective activity		
	30-day survival rate	In-hospital survival rate	Mean life expectancy	80th percentile waiting times	30-day survival rate	In-hospital survival rate	Mean life expectancy
2004/05	99.38%		23.7	104	95.16%		34.1
2005/06	99.47%		23.7	95	95.49%		34.3
2006/07	99.51%		23.6	89	95.65%		34.6
2007/08	99.72%		23.5	74	95.79%		34.7
2008/09	99.74%		23.2	60	95.85%		34.4
2009/10	99.76%		23.4	65	96.07%		34.6
2010/11	99.78%		23.4	76	96.05%		34.8
2011/12	99.45%		23.2	85	96.62%		34.6
2012/13	99.50%	98.76%	23.2	82[a]	96.45%	97.77%	34.1
2013/14[a]	99.44%	99.93%	23.2	81	96.32%	97.27%	34
2014/15	-	99.93%	22.9	79	-	97.18%	33.4
2015/16	-	99.93%	22.9	80	-	97.29%	33.5

[a] Previously reported figures showed the average across HRGs; from 2012/13 the figures show average across patients.

For the majority of hospital treatments, patients are not asked about their health status before or after treatment. However, since April 2009, all providers of NHS-funded care have been required to collect Patient Reported Outcome Measures (PROMs) for all patients undergoing unilateral hip and knee replacement, varicose vein surgery and groin hernia repair. The PROMs survey includes the EQ-5D questionnaire, which allows responses to be scaled from perfect health (=1) to death (=0). Patients report their health status before and either three or six months after surgery.

Table 5 reports the ratio of these before and after responses for patients responding to both questionnaires for each condition since the questionnaire was first introduced. We use changes in the ratios to assess the impact that these four treatments have on patients' health status over time.

[5]For the years 2012/13 and 2013/14 we report both the 30-days post discharge and in-hospital survival data. See Bojke et al (2017) for a sensitivity analysis using both measures

[6] http://www.ons.gov.uk/ons/rel/lifetables/national-life-tables/index.html

Table 5: Ratio of pre to post health status, based on EQ-5D

Year	Groin hernia repair	Hip replacement	Knee replacement	Varicose vein removal
2009/10	0.82	0.32	0.37	0.84
2010/11	0.8	0.36	0.41	0.82
2011/12	0.8	0.4	0.4	0.71
2012/13	0.76	0.36	0.37	0.8
2013/14	0.84	0.37	0.39	0.8
2014/15	0.82	0.37	0.44	0.85
2015/16	0.79	0.36	0.4	0.77

For treatments where no such information is available, we assume that the ratio is 0.8 for elective care and 0.4 for non-elective care.

There is little variation in mean life expectancy for those treated in hospital over the entire period, as shown in Figure 2. A slight negative trend can be observed in recent years: this is mostly likely due to increases in the average age of people admitted to hospital, rather than lower quality of care, given that hospital mortality rates have not declined. Nonetheless, between 2014/15 and 2015/16 the mean life expectancy remained unaltered for electives and showed a slightly improvement for non-elective patients. This, however, masks occasional large variations in life expectancy at HRG level.

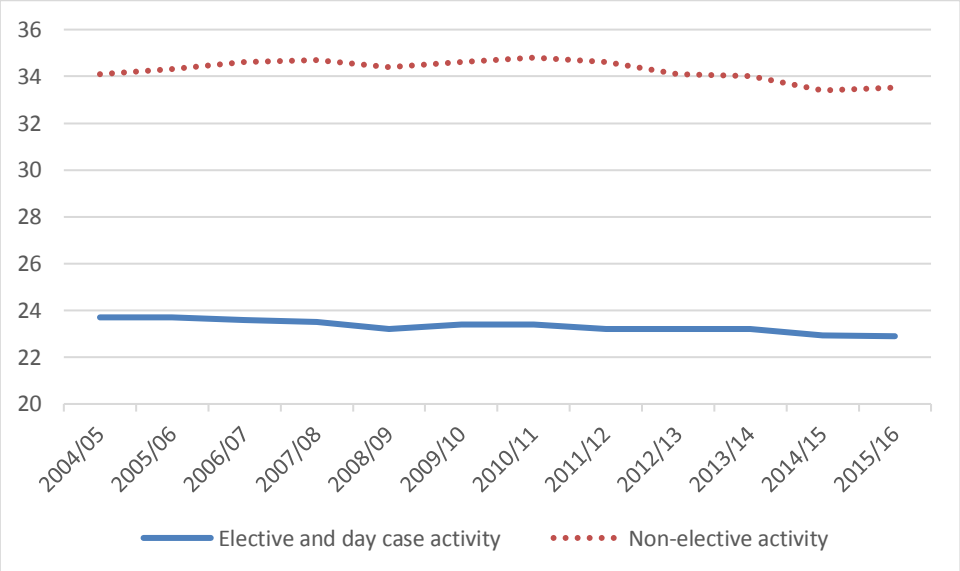


Figure 2: Mean life expectancy

In 2015/16 waiting times increased slightly compared to 2014/15, as shown in Figure 3. In the last four years waiting times are stable, but remain much higher than they were in 2008/09, when they were at an historic low.

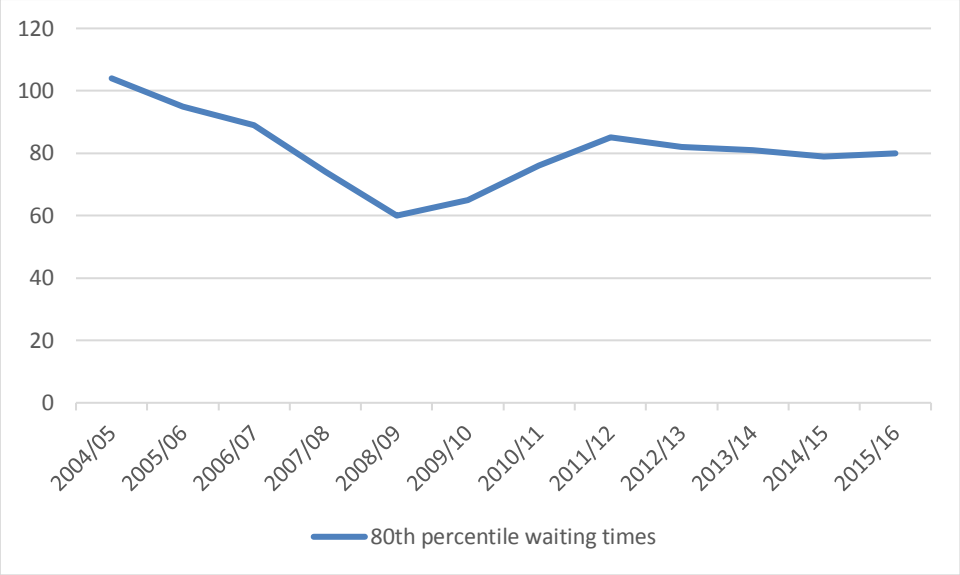


Figure 3: 80th percentile waiting times

We calculate the quality adjustment for each specific HRG, and separately for electives and non-electives. **Once we take quality adjustment into account, the total Laspeyres output growth of elective, day case and non-elective activity is 5.08%.**

We find that the large improvement in the quality adjusted output growth rate for hospital activity is driven by improvements in in-hospital survival rates and life expectancy for non-elective activity. If considering elective and day cases separately from non-electives activity, we find that the quality-adjusted growth rates between 2014/15 and 2015/16 are 3.64% and 7.18% respectively.

2.2.3 Inpatient mental health: quality adjustment

We identify mental health patients as those for whom the HRG falls into the subchapter "WD" (Treatment of Mental Health Patients by Non-Mental Health Service Providers). As seen in Table 6 and Figure 4, there has been year-on-year variation over the last decade in the number of patients with mental health problems treated in an elective/day case setting and a non-elective setting, but numbers have decreased over the last three years.

Table 6: CIPS and average cost for inpatient mental health patients

Year	Elective and day case activity		Non-elective activity	
	# CIPS	Average cost (£)	# CIPS	Average cost (£)
2004/05	45,624	689	123,983	1,012
2005/06	41,439	673	120,203	1,012
2006/07	38,408	656	115,560	1,012
2007/08	33,993	1,141	112,475	1,364
2008/09	25,792	1,133	109,636	1,319
2009/10	28,143	1,195	121,610	1,365
2010/11	30,714	1,297	125,823	1,445
2011/12	31,142	1,318	135,315	1,318
2012/13	31,078	1,358	145,787	1,358
2013/14	25,438	1,368	136,916	1,385
2014/15	24,757	1,384	131,029	1,401
015/16	20,478	1,396	126,899	1,417

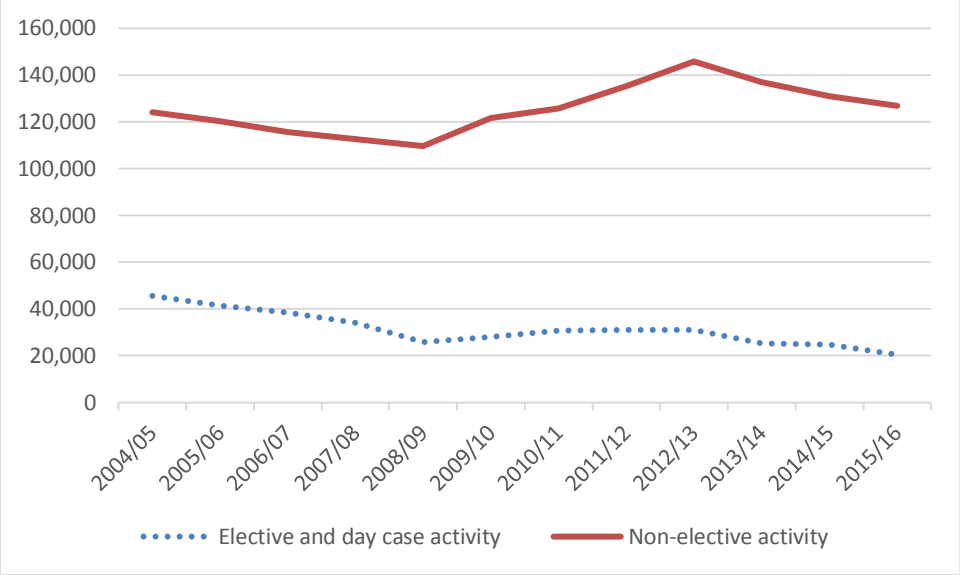


Figure 4: Number of CIPS for elective, day case and non-elective mental health patients over time

After cost-weighting mental health activity, we observe a decline of -5.38% between 2014/15 and 2015/16. We conjecture that the negative growth observed in the last four years relates to the fact that we only account for mental health activity performed in non-mental health hospitals.

2.2.4 Inpatient mental health: quality adjustment

As with other inpatient activity, we also account for changes in the quality of inpatient mental health care. We use the same quality adjusters as for other forms of inpatient activity, namely 30-day/in-hospital survival rates, mean life expectancy and 80th percentile waiting times; these measures are reported in Table 7.

Table 7: Quality adjustments for mental health activity

Year	Elective and day case activity				Non-elective activity		
	30-day survival rate	In-hospital survival rate	Mean life expectancy	80th percentile waiting times	30-day survival rate	In-hospital survival rate	Mean life expectancy
2004/05	97.72%		30.1	40	96.96%		28.7
2005/06	98.01%		30.0	265	97.22%		28.9
2006/07	98.15%		30.6	257	97.38%		29
2007/08	98.64%		29.9	28	97.65%		27.7
2008/09	98.71%		29.0	42	97.56%		27.3
2009/10	98.61%		29.4	28	97.68%		27.7
2010/11	98.85%		30.2	37	97.63%		27.8
2011/12	98.83%		31.1	37	97.78%		27.3
2012/13	98.41%	99.91%	29.6	52[a]	97.61%	97.29%	26.9
2013/14[a]	98.72%	98.95%	30.6	54	97.52%	97.87%	27.4
2014/15[b]	-	99.25%	31.3	51	-	98.66%	27.1
2015/16	-	99.38%	31.6	54	-	98.63%	26.9

[a] Previously reported figures showed the average across HRGs; from 2012/13 the figures show average across patients.
[b] – Previously, the in-hospital survival rates for elective and non-elective patients were estimated to be 99.1% and 98.25% respectively (Bojke et al., 2017).

In the same way as for other HES inpatient activity, we also calculate quality adjustment based on the performance in a specific HRG (separated for electives and non-electives). Some of these quality measures have improved (mortality), others deteriorated (waiting time) but the overall effect of the quality adjustment is positive. **Hence, once we take quality adjustment into account, output growth from 2014/15 to 2015/16 increases from -5.38% to -5.23% for patients admitted to hospital for a mental health condition.**

2.2.5 HES outpatient activity

The volume of outpatient activity can be derived from both the HES Outpatients Dataset and RC data, but we always use RC to determine costs. A like-for-like comparison between the two datasets is not wholly possible because the activity data are recorded somewhat differently in each. Specifically, the HES Outpatient dataset does not allow classification of activity into consultant-led and non-consultant-led activity, which is the common split for non-procedural activity in RC. For a successful match, one would need consultant codes in HES, which are considered sensitive and were not available to us. The HES outpatient activity classification is a combination of treatment speciality and SUS HRG code.

Further differences between HES and RC recorded activity is that HES covers activity conducted by organisation types other than Trusts and HES contains data on appointments which were attended and those which were not. For the purpose of this analysis we include only appointments attended, with these representing approximately 80% of recorded data. Of non-attended appointments, there are roughly equal proportions of cancelations by patients, cancelations by providers, and patients who failed to attend without prior warning.

In order to match consultant-led and non-consultant-led activity definitions from Reference Costs to those in HES, weighted averages are taken to produce averages specific only to currency codes (e.g. WF01A) and service codes. These averages are matched to HES activity. An initial round of matching was based on a complete match of Reference Cost service code and currency code combination with HES treatment speciality and SUS HRG code. This led to over 90% of records being matched to an associated RC code, the remaining unmatched 10% of records is assigned an overall average cost.

Table 8: Volume and average cost over time

Year	All providers (excl. ISHP and 'Other providers')	
	Volume	Average cost (£)
2011/12	88,926,968	114
2012/13	90,850,009	116.98
2013/14	96,690,559	117.18
2014/15	101,382,540	118.26
2015/16	107,092,657	118.37

Table 8 shows the volume of and average cost of attended outpatient activity. **After cost weighting the activity, the Laspeyres growth in outpatient activity amounts to 3.73%.**

2.2.6 HES outpatient activity: quality adjustment

We allow for changes in the quality of outpatient activity by taking account of changes in waiting times, as summarised in Table 9 and Figure 5. The 80th percentile waiting time has increased over the

years and reached a maximum of 63 days in 2015/16. Accounting for this has virtually no impact on the growth index which drops slightly to **3.72%.**

Table 9: Outpatient mean and 80th percentile waiting times (days)

Year	DH	HES	HES
	Mean		80th Percentile
2004/05	52		
2005/06	46		
2006/07	41		
2007/08	24	37	
2008/09	22	34	
2009/10	24	36	
2010/11		37	
2011/12		37	
2012/13		38	55
2013/14		40	57
2014/15		42	61
2015/16		44	63

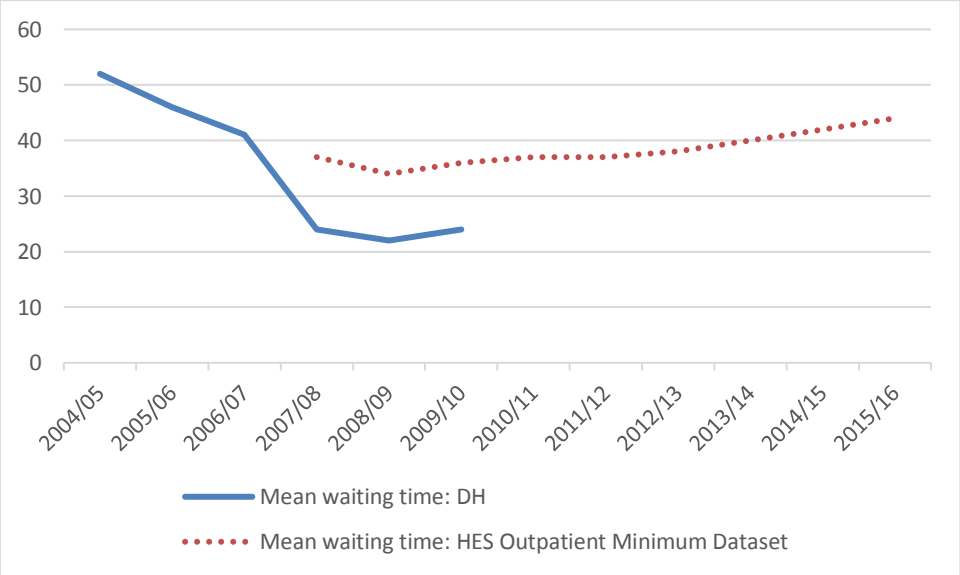


Figure 5: Trends in outpatient waiting times

2.3 Reference Cost data

Reference Cost (RC) returns are used to capture activity performed in most health care settings other than hospitals, outpatient departments and primary care. In particular, RC data cover activity conducted in accident and emergency (A&E) departments, mental health and community care settings, and diagnostic facilities. Activities are reported in various ways: attendances, bed days, contacts and number of tests.

In 2012/13 and 2013/14, the RC returns only covered activity undertaken by hospital Trusts, but since 2014/15 RC returns were also submitted for contracted-out activity, that is, activity delivered by independent sector (non-NHS) providers. Activity provided by non-NHS providers is not included in the overall NHS output growth measure. However, we have conducted a sensitivity analysis of both outputs and inputs provided by non-NHS providers, the results of which are presented in Appendix B.

RC returns also provide information on unit costs for all recorded activities (and about the costs of activity performed in hospitals and outpatient departments, as previously mentioned).

Reference Costs data are checked for both the accuracy of the reported data and the activity coverage.

2.3.1 General RC data validation checks

Since 2011/12, the Department of Health has required mandatory and non-mandatory validations of the Reference Cost data reported by NHS Trusts (Department of Health, 2012). These have reduced the year-on-year volatility in the information contained in the RC returns. NHS Improvement, which has been commissioned to collect and report Reference Cost data since 2014/15, performs the following checks of the quality of Reference Cost returns:

- Mandatory validations included checks that all data (both activity and cost) are reported, unit costs are reported as positive integers to two decimal places, no fields are missing, etc.

- Non-mandatory validations include checking whether unit costs below £5 or over £50,000 are accurate and whether single professional outpatient attendance unit costs were less than multi-professional unit costs.

- Finally, checks on 'year-on-year changes' are carried out. In particular, any change in total cost or activity greater than 25% is flagged and double-checked. The check is carried out by department code and HRG sub-chapter for acute services, or service code for non-acute services (only for outpatient attendances, outpatient procedures and emergency medicine).

Over and above these checks, we have implemented our own validation process (Bojke et al., 2014). This focuses on identifying large increases/decreases in either volume or unit costs of activity for all non-acute services. For 2015/16, we have revised our quality and assurance process, which now consists of four steps.

Firstly, we check whether any NHS activity/HRG codes reported by NHS providers has been affected by a large change in either the total volume (>500,000 units) or the total value (>£25,000,000) of the activity reported in the Reference Cost returns. The check compares volumes of activity, unit costs and total costs of the last two financial years in the national productivity series (step 1). Secondly, we assess whether all identified cases are genuine large changes or possible errors. This step might lead to the identification of a sub-set of HRG / service codes requiring further investigation (step 2).

Thirdly, limited to the HRG/service codes that have been identified as requiring further investigation, we further check whether any of the HRG codes were affected by changes in their labelling/definition/categorisation. This step involves cross-checking the set of HRGs with potential quality issues against the HRG codes listed in the HRG4+ Reference Costs Grouper Roots file (content.digital.nhs.uk/casemix/costing) (step 3). Finally, if this is not the case, then we analyse the

data in greater detail to identify, where possible, the source of the large change in either volume or value of activity (step 4).

The current quality and assurance process compared the Reference Cost data for the financial years 2015/16 and 2014/15. It identified 15 different types of activity/HRG codes, pertaining to six different NHS settings, with a large change in the total value of the activity and three types of activity/HRGs, pertaining to three different NHS settings, with a large change in the total volume of activity reported. Two of the types of activity with a large change in total volumes reported had been already flagged up as having a large change in the total value of activity. So 16 separate cases requiring further scrutiny were identified. Of these, seven codes were considered accurate when investigating trends in both volume and cost, while the nine HRG codes listed in Table 10 were considered suspect. The Table reports also summary statistics for 2014/15 and 2015/16 respectively.

Table 10: HRG codes with a large variation in the total value and/or volume of activity detected and requiring further investigation

NHS setting	Code	2014/15			2015/16			
		Activity	Unit Cost (£)	Total Cost (£)	Activity	Unit Cost (£)	Total Cost (£)	Diff in Total Value (£)
		(a)	(b)	(c)	(d)	(e)	(f)	(f) - (c)
Chemo-Radiotherapy & High Cost Drugs	XD14Z (OP)	21,363	1,253	26,761,705	29,146	3,505	102,158,786	75,397,080
	XD46Z (OP)	238,641	631	150,590,211	314,074	632	198,447,739	47,857,527
Rehabilitation	VC01Z (APC)	89,467	489	43,705,631	2,367	346	819,502	-42,886,129
	VC28Z (APC)	2,316	330	764,008	69,356	469	32,528,444	31,764,436
	VC42Z (APC)	234,757	325	76,242,157	135,963	345	46,967,963	-29,274,195
Renal Dialysis	LD04A (base)	416,863	121	50,408,353	27,132	188	5,087,267	-45,321,087
	LD05A (base)	83	150	12,482	435,913	139	60,750,718	60,738,236
	LD05B (base)	1,115,392	145	162,201,363	963	158	151,837	-162,049,526
	LD06A (base)	345	135	46,548	1,186,905	152	180,491,705	180,445,157

Note: APC: Admitted Patient Care; OP: Outpatient; Base: in England

Table 11 provides a description for each HRG code.

Table 11: HRG code description

HRG code	Description
XD14Z	Respiratory Syncytial Virus Treatment and Hepatitis C Treatment Drugs, Band 1
XD46Z	Subfoveal Choroidal Neovascularisation Drugs, Band 1
VC01Z	Assessment for Rehabilitation, Unidisciplinary
VC28Z	Rehabilitation for Other Psychiatric Disorders
VC42Z	Rehabilitation for Other Disorders
LD04A	Hospital Haemodialysis or Filtration, with Access via Arteriovenous Fistula or Graft, with Blood-Borne Virus, 19 years and over
LD05A	Satellite Haemodialysis or Filtration, with Access via Haemodialysis Catheter, 19 years and over
LD05B	Satellite Haemodialysis or Filtration, with Access via Haemodialysis Catheter, 18 years and under
LD06A	Satellite Haemodialysis or Filtration, with Access via Arteriovenous Fistula or Graft, 19 years and over

For all HRGs identified as requiring further scrutiny, no definition changes or re-categorisations were detected between successive versions of the HRG Reference Costs Grouper root.

Secondly, we look at a possible shift of activity from one setting to the other, i.e. inpatient to outpatient setting. The results of this analysis are reported below. We do this at the NHS setting level first, i.e. for High Cost Drugs overall, and then also for the specific HRGs identified.

Table 12 reports the results for the setting level analysis.

Table 12: High Cost Drugs – overall setting summary statistics

Setting	2014/15			2015/16			
	Activity	Unit Cost (£)	Total Cost (£)	Activity	Unit Cost (£)	Total Cost (£)	Diff in Total Cost (£)
	(a)	(b)	(c)	(d)	(e)	(f)	(f-c)
Admitted Patient Care	791,275	927	733,618,743	818,371	962	787,583,763	53,965,020
Outpatient	1,036,641	887	919,619,415	1,165,712	943	1,099,185,587	179,566,172
Other	154,246	557	85,956,353	131,883	814	107,375,738	21,419,385

The total volume of high cost drugs administered to patients in an inpatient or outpatient setting has increased in 2015/16 compared to 2014/15; an increase of 3.4% and 12.5% respectively for patients treated as an inpatient and those treated as an outpatient. High cost drugs administered to patients seen in 'other' settings have decreased between 2014/15 and 2015/16 by an almost equivalent amount equal to -14.5%.

However, if we focus our attention on the two HRG codes with large changes in total costs (see Table 13), we are not able to detect a clear-cut shift of activity from one type of patient setting to the other. However, what appears as "odd" is the reported Unit costs for HRG XD14Z, which have more than doubled in 2015/16 compared to 2014/15.

Table 13: High Cost Drugs – HRG code level analysis summary statistics

		2014/15			2015/16			
HRG code		**Activity**	**Unit Cost (£)**	**Total Cost (£)**	**Activity**	**Unit Cost (£)**	**Total Cost (£)**	**Diff in Total Cost (£)**
		(a)	(b)	(c)	(d)	(e)	(f)	(f-c)
XD14Z	Admitted Patient Care	4,028	1,510	6,083,590	4,338	2,370	10,281,129	4,197,539
	Outpatient	21,363	1,253	26,761,705	29,146	3,505	102,158,786	75,397,080
	Other	2,716	456	1,237,990	1,411	3,679	5,191,060	3,953,070
XD46Z	Admitted Patient Care	98,974	746	73,812,953	104,549	733	76,669,538	2,856,585
	Outpatient	238,641	631	150,590,211	314,074	632	198,447,739	47,857,527
	Other	9,271	530	4,910,742	9,826	992	9,750,057	4,839,316

We followed the same review steps for the NHS setting 'Rehabilitation'. Table 14, 15, and 16 report the overall setting and HRG codes summary statistics respectively.

In the event that large scale changes are detected, we look at each activity in isolation to determine the most appropriate solution. These may be to leave as is, replace an unexpected high cost value with the minimum cost across the two years, or omit the category from the output index.

Table 14: Rehabilitation – overall setting summary statistics

Rehabilitation Type		2014/15			2015/16			
	Setting	Activity	Unit cost (£)	Total cost (£)	Activity	Unit cost (£)	Total cost (£)	Diff in Total Cost (£)
		(a)	(b)	(c)	(d)	(e)	(f)	(f) - (c)
Complex Specialised Rehabilitation Services (CSRS) - Level 1	Admitted Patient Care	790,555	375	296,065,440	771,690	395	304,980,049	8,914,610
	Outpatient	58,640	253	14,832,046	60,798	216	13,139,338	-1,692,708
	Other	139,537	236	32,903,871	83,504	162	13,560,347	-19,343,524
Specialist Rehabilitation Services (SRS)- Level 2	Admitted Patient Care	541,696	360	194,826,776	447,236	375	167,553,710	-27,273,066
	Outpatient	5,248	237	1,241,991	3,853	179	689,064	-552,927
	Other	120,474	166	19,996,059	107,693	157	16,877,473	-3,118,586
Non-specialist Rehabilitation (NSRS) Services	Admitted Patient Care	1,178,669	304	358,140,679	1,339,022	323	432,786,252	74,645,574
	Outpatient	21,256	112	2,372,015	18,077	88	1,598,513	-773,501
	Other	152,814	223	34,034,179	153,844	253	38,960,295	4,926,116

Table 15: Rehabilitation – overall setting summary statistics

Rehabilitation Type		2014/15			2015/16			
	Setting	Activity	Unit cost (£)	Total cost (£)	Activity	Unit cost (£)	Total cost (£)	Diff in Total Cost (£)
		(a)	(b)	(c)	(d)	(e)	(f)	(f) - (c)
Complex Specialised Rehabilitation Services (CSRS) - Level 1	Admitted Patient Care	790,555	375	296,065,440	771,690	395	304,980,049	8,914,610
	Outpatient	58,640	253	14,832,046	60,798	216	13,139,338	-1,692,708
	Other	139,537	236	32,903,871	83,504	162	13,560,347	-19,343,524
Specialist Rehabilitation Services (SRS)- Level 2	Admitted Patient Care	541,696	360	194,826,776	447,236	375	167,553,710	-27,273,066
	Outpatient	5,248	237	1,241,991	3,853	179	689,064	-552,927
	Other	120,474	166	19,996,059	107,693	157	16,877,473	-3,118,586
Non-specialist Rehabilitation (NSRS) Services	Admitted Patient Care	1,178,669	304	358,140,679	1,339,022	323	432,786,252	74,645,574
	Outpatient	21,256	112	2,372,015	18,077	88	1,598,513	-773,501
	Other	152,814	223	34,034,179	153,844	253	38,960,295	4,926,116

No significant shifts of activity from one setting to the next are detected. For the CSRS Level 1 type of Rehabilitation activity, both 'Admitted Patient Care' and 'Other' activity registered a decrease in the volume of activity reported. For 'Other' activity, this decrease was quite substantial at -40.2%.

For SRS Level 2 Rehabilitation type, activity in all settings decreased from -26.6% to -10.6%.

Finally, for NSRS Rehabilitation type activity, a decrease of activity was only registered for the 'Outpatient' setting, whilst both the 'Admitted Patient Care' and the 'Other' settings registered an increase in activity of 13.6% and 0.7% respectively.

Considering only the HRG and Rehabilitation types are affected by large changes in either total value or volume of activity, we do not find in general that a shift of activity from one setting to another to be the cause of the large changes recorded. As already apparent from our initial quality check, these seem to be due to large changes in volumes of activity (either positive or negative) reported by hospital Trusts for the settings affected.

Table 16: Rehabilitation – HRG code level analysis summary statistics

Rehabilitation Type	HRG code/ Setting		2014/15			2015/16			
			Activity	Unit Cost (£)	Total Cost (£)	Activity	Unit Cost (£)	Total Cost (£)	Diff in Total Cost (£)
			(a)	(b)	(c)	(d)	(e)	(f)	(f) – (c)
CSRS	**VC01Z**	Admitted Patient Care	89,467	489	43,705,631	2,367	346	819,502	-42,886,129
		Outpatient	10,414	353	3,676,454	10,284	201	2,065,323	-1,611,131
NSRS	**VC28Z**	Admitted Patient Care	2,316	330	764,008	69,356	469	32,528,444	31,764,436
SRS	**VC42Z**	Admitted Patient Care	234,757	325	76,242,157	135,963	345	46,967,963	-29,274,195
		Other	17,619	208	3,670,089	33,879	99	3,344,018	-326,071

Finally, for the Renal Dialysis HRG codes identified as problematic, we found the same issues as the one identified and reported in Bojke et al. (2017) for the 2014/15 update of the NHS output, input and productivity figures.

We believe that a coding error occurred for HRGs LD05B and LD06A, as the figures for both Volume of Activity and Number of Data submissions (i.e. submissions by Trusts) in 2014/15 and 2015/16 appear to be switched around. In addition, the figures for Volume of Activity and Number of Data submission for HRG LD04A in 2014/15 are very similar to those for HRG LD05A in 2015/16, as reported in Table 17.

Table 17: Coding issues for Renal Dialysis HRGs

Year	HRG	Description	Volume of activity	Average cost (£)	No Data submissions
2013/14	LD04A	Hospital haemodialysis or filtration, with access via arteriovenous fistula or graft, with blood-borne virus, 19 years and over	20,269	176	47
	LD05A	Satellite haemodialysis or filtration, with access via haemodialysis catheter, 19 years and over	416,706	133	42
	LD05B	Satellite haemodialysis or filtration, with access via haemodialysis catheter, 18 years and under	275	115	6
	LD06A	Satellite haemodialysis or filtration, with access via arteriovenous fistula or graft, 19 years and over	1,092,718	153	42
2014/15	LD04A	Hospital haemodialysis or filtration, with access via arteriovenous fistula or graft, with blood-borne virus, 19 years and over	416,863	121	42
	LD05A	Satellite haemodialysis or filtration, with access via haemodialysis catheter, 19 years and over	83	150	4
	LD05B	Satellite haemodialysis or filtration, with access via haemodialysis catheter, 18 years and under	1,115,392	145	42
	LD06A	Satellite haemodialysis or filtration, with access via arteriovenous fistula or graft, 19 years and over	345	135	7
2015/16	LD04A	Hospital haemodialysis or filtration, with access via arteriovenous fistula or graft, with blood-borne virus, 19 years and over	27,132	188	41
	LD05A	Satellite haemodialysis or filtration, with access via haemodialysis catheter, 19 years and over	435,913	139	43
	LD05B	Satellite haemodialysis or filtration, with access via haemodialysis catheter, 18 years and under	963	158	6
	LD06A	Satellite haemodialysis or filtration, with access via arteriovenous fistula or graft, 19 years and over	1,186,905	152	44

After correcting these apparent mistakes, we have decided to keep in our measure of output growth the HRGs LD04A,LD05B and LD06A for the financial year 2014/15 and the HRGs LD05A, LD05B and LD06A for the financial year 2015/16. We have dropped only one HRG in each financial year: LD05A in 2014/15 and LD04A in 2015/16. The total volume of activity that has been excluded is 83 for HRG LD05A in 2014/15 and 27,132 for HRG LD04A in 2015/16. See Table 18 for mapping of HRGs.

Table 18: Mapping of Renal Dialysis HRGs

HRG – 2013/14		HRG-2014/15		HRG-2015/16
LD05A	→	LD04A	→	**LD05A**
LD06A	→	LD05B	→	**LD06A**
LD05B	→	LD06A	→	**LD05B**

Table 19 summarises the RC data according to broad service settings over the past two years. This shows that the number of categories is quite stable between 2014/15 and 2015/16 across the different settings.

Table 19: Reference cost settings

Setting	2014/15			2015/16		
	Nr Cat.	Activity	Cost (£)	Nr Cat.	Activity	Cost (£)
A&E and Ambulance Services	89	36,551,479	4,201,423,614	92	37,792,911	4,454,964,482
Chemo/Radiotherapy & High Cost Drugs	344	7,567,487	3,351,048,218	340	6,283,287	3,697,193,821
Community Care	180	85,733,534	5,052,768,659	184	86,767,072	5,171,028,803
Diagnostic Tests	82	363,656,649	994,023,634	81	367,378,910	984,870,571
Community Mental Health	130	259,036,112	6,489,414,327	125	253,275,018	6,309,945,016
Outpatient	9,465	83,856,229	9,815,241,661	9,616	85,394,479	10,221,877,406
Radiology	258	9,866,952	944,288,512	267	10,755,438	1,048,586,605
Rehabilitation	121	3,008,889	954,413,054	99	2,985,717	990,145,041
Renal Dialysis	39	4,070,447	533,927,599	37	4,157,008	556,027,298
Specialist Services	145	4,967,499	3,252,277,420	143	5,162,337	3,402,452,724
Other	1,119	3,407,664	287,913,867	1,130	3,990,126	319,906,305

Note: A Table summarising the RC data according to broad service settings for the years 2012/13 and 2013/14 can be found in Appendix C.

2.3.2 RC outpatient activity

Outpatient activity as measured in the RC database has tended to be classified into three major groups: consultant led activity; non-consultant led activity and procedures. Consultant and non-consultant led activity represent broadly the same set of outpatient specific HRG-style codes (currency codes beginning with WF) and outpatient procedure codes represent procedure related HRGs which may appear in other hospital settings. On average, consultant led activity for Trusts represents about 68% of overall outpatient cost-weighted activity. Outpatient procedures have increased considerably in volume representing just 3% of overall outpatient activity in 2007/08 and about 14% in 2015/16.

Table 20: Outpatient activity and cost

Year	Outpatient			
	All providers		Trusts only	
	Volume of activity	Average cost (£)	Volume of activity	Average cost (£)
2007/08	**69,679,600**	**94**	**61,508,362**	**98**
2008/09	**74,421,017**	**98**	**65,804,814**	**103**
2009/10	80,093,906	101	71,115,142	105
2010/11	81,301,615	105	73,621,984	107
2011/12	-	-	75,826,947	108
2012/13	-	-	77,222,725	111
2013/14	-	-	81,699,802	114
2014/15	-	-	83,856,229	117
2015/16	-	-	85,394,479	120

The Laspeyres output growth measure for outpatient activity as captured by the Reference Costs data was 2.7% from 2014/15 to 2015/16, which compares to 3.73% when using the HES outpatient data.

The difference between HES and RC measures of growth is about 1%, with RC data reporting lower growth than the HES outpatient data. Although both datasets have some quality issues, our preferred method uses HES, as it is a patient-level dataset as opposed to the more aggregated RC. This allows us to perform more thorough quality checks and better assure a like-for-like comparison over time.

2.3.3 A&E and ambulance services

Table 21 reports summary statistics for A&E services provided in Emergency Departments and Other A&E services according to whether patients were subsequently admitted to hospital (AD) or not admitted (NAD).

Emergency departments offer a consultant-led 24 hour service with full resuscitation facilities and designated accommodation for the reception of A&E patients.[9] Between 2014/15 and 2015/16 there was an increase (of about 2.3%) in the total number of emergency department attendances, with an increase of 1.26% in the number of people being subsequently admitted to hospital.

The category 'Other A&E services' captures activities carried out in any of the following departments: 'Consultant led mono specialty accident and emergency services (e.g. ophthalmology, dental) with designated accommodation for the reception of patients', 'Other type of A&E/minor injury activity with designated accommodation for the reception of accident and emergency patients' and 'NHS Walk-in-Centres'. 'Other A&E services' increased overall by 5.8% between 2014/15 and 2015/16, with an increase by just over 6% of patients being subsequently admitted to hospital.

Overall, the total volume of A&E activity increased by 3.1% between 2014/15 and 2015/16. However, the number of patients subsequently being admitted to hospital as emergency cases, from

[9]http://content.digital.nhs.uk/media/19424/AE-DD-Final-Doc/pdf/DD-AE-V7.pdf

either an A&E Department of other types of A&E departments decreased by just under 5% between 2014/15 and 2015/16. This might be an indication that A&E departments of all types have been dealing with increased demand from patients with ambulatory care conditions, which should have been attended to in a primary care setting.

Table 21: A&E activity and average cost

Year	Emergency departments				Other A&E services			
	AD		NAD		AD		NAD	
	Volume of activity	Average cost (£)	Volume of activity	Average cost (£)	Volume of activity	Average cost (£)	Volume of activity	Average cost (£)
2006/07	3,464,869	107	10,327,147	83	281,135	50	3,900,718	36
2007/08	3,326,719	121	9,058,765	89	531,498	70	3,769,765	43
2008/09	3,566,642	118	9,708,958	99	1,000,986	49	4,184,796	49
2009/10	4,047,176	134	10,075,701	103	1,090,650	49	3,628,469	50
2010/11	4,004,868	141	9,881,747	108	1,145,125	62	3,800,261	55
2011/12	4,040,760	157	10,405,762	108	616,812	83	3,253,452	52
2012/13	4,345,100	160	10,292,933	115	362,656	90	3,426,231	59
2013/14	4,218,480	177	10,189,225	127	494,549	80	3,639,355	59
2014/15	4,050,701	206	10,636,666	133	446,779	65	3,972,875	61
2015/16	4,101,720	219	10,921,696	140	473,723	69	4,202,986	60

Legend: AD – leading to admitted patient care; NAD – Not leading to admitted patient care

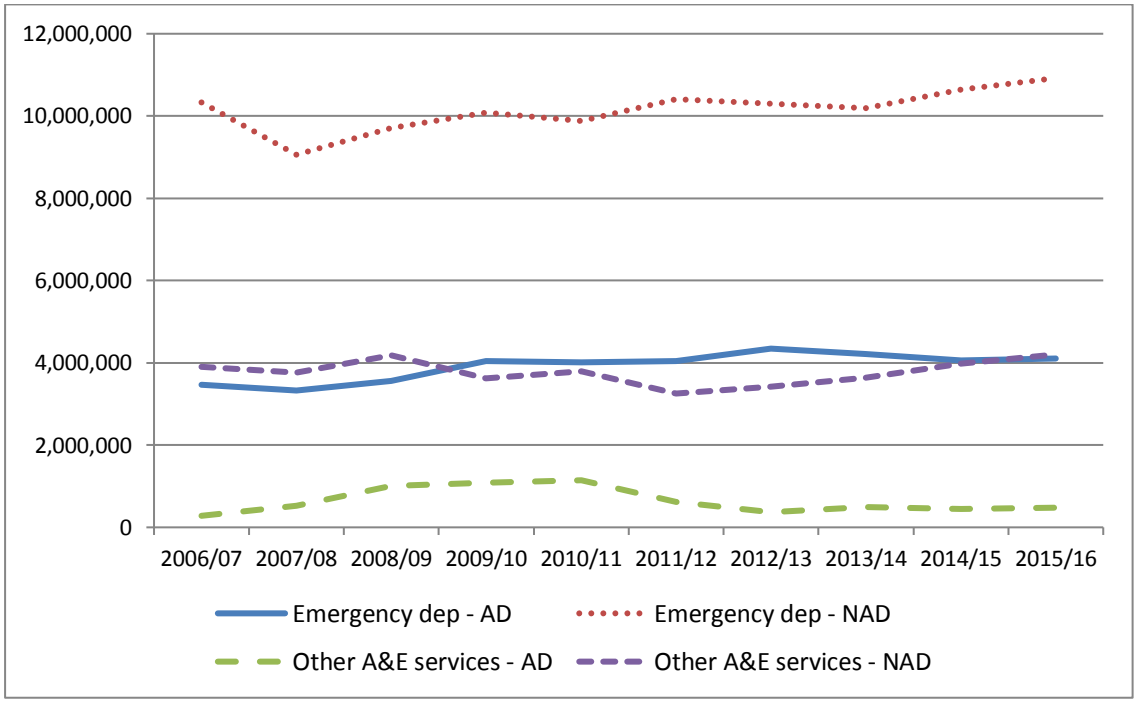


Figure 6: Trend of A&E activity across settings

Ambulance services are reported in Table 22 for the four years since this activity was first recorded in the Reference Cost database. Activity is measured in terms of calls received for the category 'Calls'; patients for the category 'Hear and treat or refer'; incidents for the categories 'See and treat or refer' and categories 'See and treat and convey'. Overall activity by ambulance services increased between 2014/15 and 2015/16 (3.72%), with the category 'Hear' alone increasing by 36.08%, and the category 'See and treat and convey' increasing by just 1.17%.

Table 22: Ambulance services

Year	Ambulance services							
	Calls		Hear and treat or refer		See and treat or refer		See and treat and convey	
	Volume of activity	Average cost (£)	Volume of activity	Average cost (£)	Volume of activity	Average cost (£)	Volume of activity	Average cost (£)
2011/12	8,530,563	8	338,022	44	1,862,892	173	4,895,376	230
2012/13	9,120,422	7	423,821	47	1,997,327	174	4,984,296	230
2013/14	8,926,215	7	400,005	44	2,113,757	180	5,069,806	231
2014/15	9,491,159	7	575,168	35	2,270,229	180	5,107,902	233
2015/16	9,794,437	7	782,665	34	2,347,808	181	5,167,876	236

The Laspeyres output growth measure for the setting 'A&E services', which includes ambulance services, increased by 3.3% between 2014/15 and 2015/16.

2.3.4 Chemotherapy, Radiotherapy & High Cost Drugs

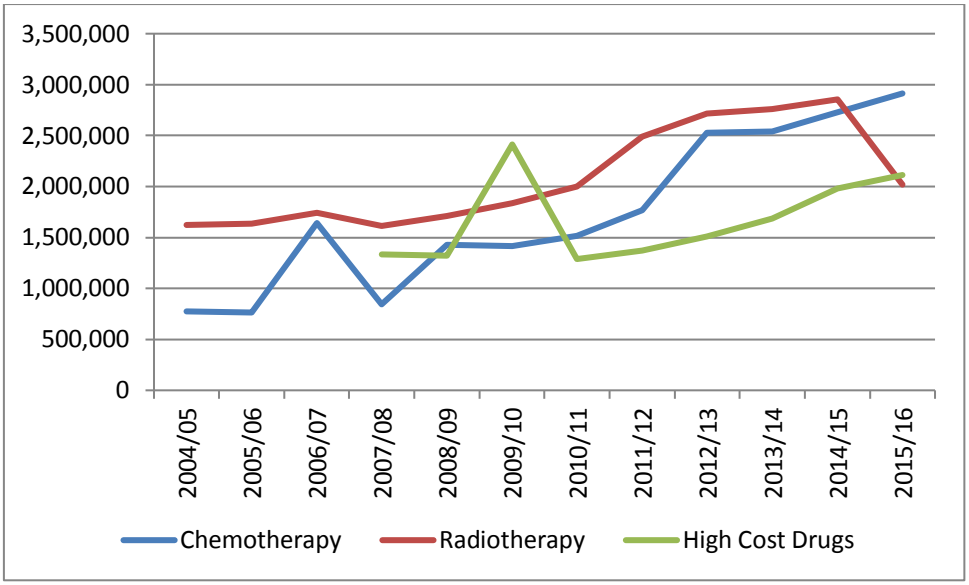
The categories used to describe Chemotherapy, Radiotherapy, and High Cost Drugs have been subject to substantial revision over time, making it difficult to infer much from the simple counts of activity reported below in Table 23 and Figure 7. Since 2013/14 categorisation has been fairly stable for all three types of activity. High Cost Drugs had one new category added in 2015/16, whilst Chemotherapy and Radiotherapy had no categorisation changes. The total volume of Chemotherapy activity increased by 6.7%, that of High Cost Drugs by 6.8%, whilst Radiotherapy registered a decrease in the total volume of activity of 29.3%.

The Laspeyres output growth measure for Chemotherapy, Radiotherapy & High Cost Drugs was 4.7% between 2014/15 and 2015/16.

Table 23: Chemotherapy, Radiotherapy, High Cost Drugs

Year	Chemotherapy		Radiotherapy		High Cost Drugs	
	Volume of activity	Average cost (£)	Volume of activity	Average cost (£)	Volume of activity	Average cost (£)
2004/05	777,312	363	1,622,278	113	-	-
2005/06	763,806	432	1,634,156	126	-	-
2006/07	1,642,444	280	1,743,490	123	26,277,491	17
2007/08	846,425	406	1,613,135	559	1,332,996	305
2008/09	1,428,561	448	1,710,525	157	1,322,354	473
2009/10	1,414,872	505	1,835,695	163	2,412,988	384
2010/11	1,515,845	515	2,001,798	161	1,288,460	818
2011/12	1,769,727	505	2,492,431	137	1,372,131	902
2012/13	2,525,935	387	2,717,024	127	1,511,644	878
2013/14	2,540,353	431	2,760,237	134	1,687,711	859
2014/15	2,729,954	449	2,855,371	135	1,982,162	877
2015/16	2,913,719	454	2,018,956	188	2,115,966	942

Note: In 2006/07, High Cost Drugs were recorded as number of procurements, after which recording was by number of patients.



In 2006/07, High Cost Drugs were categorised and costed differently to subsequent years, hence this data point has not been included in the Figure.

Figure 7: Laspeyres output growth for Chemotherapy, Radiotherapy and High Cost Drugs over time

2.3.5 Community care

Table 24 reports total volumes of Community Care activity from 2004/05 to 2015/16. While the provision of community care has decreased since 2009/10, this is primarily due to Primary Care Trusts (and Personal Medical Services pilots) no longer reporting this activity after 2010/11. Community care activity increased by 1.21% in 2015/16.

Table 24: Community care activity

Year	Community care	
	Volume of activity (a)	Average cost (£)
2004/05	75,673,792	39
2005/06	85,092,838	38
2006/07	83,895,139	40
2007/08	85,470,688	42
2008/09	88,513,663	45
2009/10	92,412,727	46
2010/11	90,724,524	47
2011/12	78,315,576	50
2012/13	79,709,044	52
2013/14	85,975,592	57
2014/15	85,733,534	59
2015/16	86,767,072	60

Note: In 2011/12, PCTs and PMS ceased to report activity about community care. Total volume of activity from 2011/12 is, therefore, not comparable with previous years.

The Laspeyres output growth index for Community Care activity between 2014/15 and 20105/16 is 0.6%.

2.3.6 Diagnostic tests, pathology and radiology

A substantial re-categorisation occurred for Nuclear Medicine (included in the Radiology setting), which in 2013/14 comprised only 7 categories, but has since increased its granularity, bringing the total number of categories to 137 in 2014/15 and to 145 categories in 2015/16.

Table 25: Directly accessed diagnostic and pathology services and radiology

Year	Directly accessed diagnostic services		Directly accessed pathology services		Radiology	
	Volume of activity	Average cost (£)	Volume of activity	Average cost (£)	Volume of activity	Average cost (£)
2004/05	369,988	44	180,676,234	3	5,152,720	31
2005/06	465,622	44	221,966,384	2	5,784,605	33
2006/07	735,569	137	236,269,050	2	23,918,500	59
2007/08	776,368	41	257,249,379	2	7,614,437	103
2008/09	804,607	46	278,917,852	2	7,852,498	102
2009/10	1,063,744	43	300,010,031	2	8,347,404	104
2010/11	1,458,025	39	320,418,662	2	8,491,834	97
2011/12	5,640,762	34	333,108,317	2	8,758,136	93
2012/13	6,339,016	30	335,941,593	2	9,381,616	92
2013/14	6,553,727	31	361,952,265	2	9,709,456	93
2014/15	7,128,172	32	356,528,477	2	9,440,280	88
2015/16	7,467,097	31	359,911,813	2	10,755,438	97

Note: In 2004/05 and 2005/06, radiology was recorded as number of tests; in 2006/7 it comprised number of tests and interventions; from 2007/08 it was number of patients.

The total volume of Directly Accessed Diagnostics services, Directly Accessed Pathology services and Radiology all increased between 2014/15 and 2015/16, respectively by 4.75%, 0.9% and 13.9%. **The Laspeyres output growth for each broad type of test was 5.8%, -3% and 9.3% respectively, leading to an overall growth for these combined activities of 4%.**

2.3.7 Community mental health

Table 26 summarises overall counts of Community Mental Health activity since 2004/05. Activity in this setting underwent a major revision in 2011/12 with the creation of mental health clusters but has since appeared to settle into a consistent measurement scheme.

Table 26: Community mental health

Year	Community mental health		
	Volume of activity	Volume of activity (a)	Average cost (£)
2004/05	16,389,891		164
2005/06	17,738,894		170
2006/07	19,259,205		167
2007/08	21,751,043		153
2008/09	22,674,811		157
2009/10	23,440,616		161
2010/11	24,341,950		159
2011/12		224,329,080	28
2012/13		260,266,214	24
2013/14		259,659,214	25
2014/15		262,460,243	25
2015/16		253,275,018	26

Note: Due to the reclassification of activity in Community Mental Health, data from 2011/12 are not directly comparable with data reported in previous years. Hence, Community mental health activity was excluded from the calculations of both the Community Mental Health and the overall NHS output growth indices for the pair of years 2010/11 to 2011/12.

In 2015/16, the Reference Costs data added to its collection activity and cost information for Improving Access to Psychological Therapy (IAPT) activity for adults by clusters. In previous years, this activity, although not of comparable nature, was captured by contact and delivered by the Mental Health Specialist teams. As a consequence, we had to exclude the newly reported IAPT activity and that reported under MH specialist teams respectively for the years 2015/16 and 2014/15. We therefore report two separate tables summarising Community Mental Health activity: one for the years from 2011/12 to 2014/15, and one for the last two financial years, 2014/15 and 2015/16. Furthermore, 'Other Mental Health' activity underwent a re-labelling of broad category exercise back in 2014/15, which has continued in 2015/16. Thus, in Table 27 the categories reported under 'Other Mental Health' activity are different from those reported in Table 28.

Table 27: Care clusters and other mental health activity, 2011/12 – 2014/15

Community mental health	2011/12		2012/13		2013/14		2014/15	
	Volume of activity	Average cost (£)	Volume of activity	Average cost (£)	Volume of activity	Average cost (£)	Volume of activity	Average cost (£)
Care Clusters								
Mental Health – Care Clusters – Admitted Patient Care	5,900,173	334	5,548,751	348	8,822,616	222	5,389,210	365
Mental Health - Care Clusters - Non-Admitted Patient Care	208,657,970	11	244,072,900	9	239,045,781	9	245,102,673	9
Mental Health – Care Clusters – Initial Assessment	418,356	251	816,112	264	746,982	281	755,151	293
Total volume 'Mental Health Care Clusters'	**214,976,499**	**20**	**250,437,763**	**17**	**248,615,379**	**17**	**251,247,034**	**17**
Other Mental Health								
Secure Units	1,537,140	523	1,526,840	532	1,543,448	516	1,565,824	522
Day Care Facilities: Regular Attendances	28,782	294	34,969	294	41,555	305	30,482	318
Outpatient Attendances*	1,343,458	156	615,632	217	721,849	182	1,019,875	184
Community Contacts	3,309,410	135	2,970,529	161	2,642,912	188	3,285,139	173
Specialist Teams	3,133,791	140	4,680,481	120	6,094,071	117	5,311,889	118
Total volume Other Mental Health	**9,352,581**	**204**	**9,828,451**	**203**	**11,043,835**	**195**	**11,213,209**	**197**
Total volume of Community MH activity	**224,329,080**	**28**	**260,266,214**	**24**	**259,659,214**	**25**	**262,460,243**	**25**

Note: * Excludes Admitted Patient care, which is included in Hospital Mental Health

Table 28: Care clusters and other mental health activity, 2014/15 – 2015/16

Community mental health	2014/15		2015/16	
	Volume of activity	Average cost (£)	Volume of activity	Average cost (£)
Care Clusters				
Mental Health – Care Clusters – Admitted Patient Care	5,389,210	365	5,269,507	388
Mental Health - Care Clusters - Non-Admitted Patient Care	245,102,673	9	239,684,860	9
Mental Health – Care Clusters – Initial Assessment	755,151	293	773,308	306
Total volume 'Mental Health Care Clusters'	**251,247,034**	**17**	**245,727,675**	**18**
Other Mental Health *				
Children and Adolescent Mental Health Services	2,010,635	247	1,993,978	255
Drug and Alcohol Services	2,019,664	100	1,519,640	105
Mental Health Specialist Teams	1,887,758	162	2,111,275	165
Secure Mental Health Services	1,565,824	522	1,570,096	524
Specialist Mental Health Services	305,197	225	352,354	219
Total volume Other Mental Health	**7,789,078**	**243**	**7,547,343**	**254**
Total volume of Community MH activity	**259,036,112**	**25**	**253,275,018**	**26**

Note: * Excludes Admitted Patient care, which is included in Hospital Mental Health

In terms of raw activity, Community Mental Health decreased by 2.2% from 2014/15 to 2015/16, which is reflected by a decrease in its **cost-weighted output growth measure of about -0.6%.** As the decrease in the cost-weighted output growth measure is only small, we can infer that the decrease in the volume of Mental Health activity has predominantly occurred in less costly activity.

2.3.8 Rehabilitation and renal dialysis

The volume of rehabilitation and renal dialysis activity over time is reported in Table 29.

Table 29: Rehabilitation and renal dialysis

Year	Rehabilitation		Renal dialysis	
	Volume of activity	Average cost (£)	Volume of activity	Average cost (£)
2004/05	4,095,087	178	8,232,432	52
2005/06	4,509,489	185	6,819,136	64
2006/07	3,028,598	241	4,200,298	104
2007/08	2,732,048	259	3,980,793	114
2008/09	3,277,757	265	4,091,245	120
2009/10	3,277,430	279	4,050,658	129
2010/11	3,314,085	285	4,088,817	129
2011/12	2,897,721	278	4,166,150	129
2012/13	2,715,650	301	4,135,914	128
2013/14	3,002,512	298	4,069,460	131
2014/15	3,008,889	317	4,070,447	131
2015/16	2,985,717	332	4,157,008	134

The total volume of Rehabilitation services decreased by -0.8% between 2014/15 and 2015/16, whilst the total volume of Renal Dialysis increased by just over 2.1% over the same time period. **The Laspeyres output growth for Rehabilitation and Renal Dialysis services were, respectively, -0.7% and 1.75% between 2014/15 and 2015/16.**

2.3.9 Specialist services

The volume and cost of various types of specialist services are reported in Table 30.

Table 30: Specialist services

Year	Adult critical care		Specialist palliative care		Cystic fibrosis		Cancer multi-disciplinary team meetings	
	Volume of activity	Average cost (£)	Volume of activity	Average cost (£)	Volume of activity	Average cost (£)	Volume of activity	Average cost (£)
2004/05	2,184,333	828	-	-	16,317	1,919	-	-
2005/06	2,197,135	895	-	-	13,704	2,316	-	-
2006/07	2,468,777	840	93,880	269	13,944	2,290	-	-
2007/08	2,165,060	931	208,410	219	15,383	2,349	-	-
2008/09	2,354,447	967	262,305	216	20,756	2,116	-	-
2009/10	2,439,661	1,003	359,121	192	20,323	2,468	-	-
2010/11	2,470,065	1,011	512,972	162	19,942	2,631	-	-
2011/12	2,570,571	998	550,417	166	9,852	8,476	837,418	114
2012/13	2,669,343	984	600,848	169	9,735	8,709	1,079,297	106
2013/14	2,708,897	992	701,439	158	9,990	10,213	1,279,567	101
2014/15	2,746,664	1,044	775,488	157	10,767	9,810	1,434,580	111
2015/16	2,777,403	1,081	855,702	146	11,845	9,100	1,517,387	111

The total volume of Adult Critical Care services increased by 1.1%, that of Specialist Palliative care by 10.3%, that of Cystic Fibrosis by 10% and that of Cancer Multi-Disciplinary Team Meetings activity by 5.8% between 2014/15 and 2015/16.

Taken together, the Laspeyres output growth measure for Specialist Services increased by 0.61% between 2014/15 and 2015/16.

2.3.10 Other Reference Cost activities

Other types of activity reported in the Reference Costs are summarised in Table 31. The way of classifying these activities has changed somewhat over time; rarely are the series recorded in a consistent fashion across all years. Recording of some types of activity is occasionally discontinued, or subsumed under other broad categories.

Table 31: Regular admissions, ward attenders and day care

Year	Regular day and night admissions		Audiological services		Day care facilities		Hospital at home/Early discharge schemes	
	Volume of activity	Average cost (£)	Volume of activity	Average cost (£)	Volume of activity	Average cost (£)	Volume of activity	Average cost (£)
2004/05	122,447	248	1,902,390	41	735,070	124	434,698	73
2005/06	177,131	245	1,692,721	40	649,963	131	593,586	60
2006/07	179,927	271	2,905,175	50	439,932	135	470,737	74
2007/08	164,651	324	3,447,049	51	384,048	137	405,271	73
2008/09	198,573	341	3,716,333	51	345,371	159	522,047	68
2009/10	152,079	393	3,807,539	52	319,706	156	495,961	81
2010/11	176,169	431	3,927,780	51	321,386	148	364,352	91
2011/12	176,877	428	4,033,290	50	275,819	140	323,213	113
2012/13	210,984	371	4,030,693	52	237,040	157	285,754	108
2013/14	204,831	400	3,483,549	55	239,032	146	-	-
2014/15	223,302	355	2,918,029	60	266,333	131	-	-
2015/16	224,523	389	3,523,847	57	241,756	131	-	-

There has been no change in coding for Regular Day and Night Admissions (RDNA), Audiological Services and Day Care Facilities. The total volume of RDNA activity increased by 0.5%, whilst the total volume of Audiological services increased by 20.8% between 2014/15 and 2015/16. The total volume of Day Care Facilities decreased by -9.2% between 2014/15 and 2015/16. Hospital at Home services are now captured under Community Intermediate Care activities in the community care setting.

The Cost-weighted output growth measure for 'Other NHS activity' increased by 4.3% between 2014/15 and 2015/16.

2.3.11 Total Reference Cost growth

Including outpatient data, the activities recorded in the Reference Cost returns grew by 1.88% from 2014/15 to 2015/16. Excluding Outpatient activity, Reference Cost activity grew by 1.57% between 2014/15 and 2015/16.

2.4 Dentistry and ophthalmology

Information about dentistry is derived from the NHS Digital website[10] with dental activity differentiated into dental bands, as shown in Table 32.

[10] http://content.digital.nhs.uk/catalogue/PUB18129

Table 32: Dental services

Year	Dentistry										
	Band 1		Band 2		Band 3		Urgent		Other		Total
	Volume activity	Av cost (£)	Volume activity	Av cost (£)	Volume activity	Av cost (£)	Volume activity	Av cost (£)	Volume activity	Av cost (£)	
2004/05*											2,241,095,331
2005/06*											2,433,471,413
2006/07	19,012,890	16	10,687,669	42	1,529,129	189	2,881,205	16	939,871	16	1,096,089,020
2007/08	19,275,334	17	10,991,870	46	1,684,537	198	3,133,209	17	901,975	17	1,219,391,145
2008/09	19,803,371	17	11,489,585	46	1,859,524	198	3,343,459	17	930,279	17	1,289,383,127
2009/10	20,346,012	17	11,699,635	46	2,086,179	198	3,509,055	17	948,634	17	1,355,827,865
2010/11	20,718,874	17	11,804,774	46	2,187,483	198	3,615,027	17	918,371	17	1,388,081,816
2011/12	20,886,648	17	11,862,329	46	2,217,060	198	3,685,411	17	919,217	17	1,400,506,136
2012/13	21,016,444	18	11,750,849	48	2,239,287	209	3,712,031	18	603,054	18	1,475,353,493
2013/14	21,685,314	18	11,801,493	49	2,232,243	214	3,852,470	18	190,216	18	1,519,077,159
2014/15	22,028,232	19	11,446,920	51	2,177,960	219	3,780,401	19	178,531	19	1,535,805,234
2015/16	22,437,889	19	11,251,942	51	2,129,467	223	3,693,752	19	169,831	19	1,545,498,706

Note: Total value of dentistry activity for years 2004/05 and 2005/06 is not directly comparable to following years, as it comes from a different data source (DH).

As shown in Figure 8, output for all dental services, except for those in Band 1, has continued to decrease in 2015/16**. Overall, the Laspeyres growth rate for dental activity decreased by -0.95% between 2014/15 and 2015/16.**

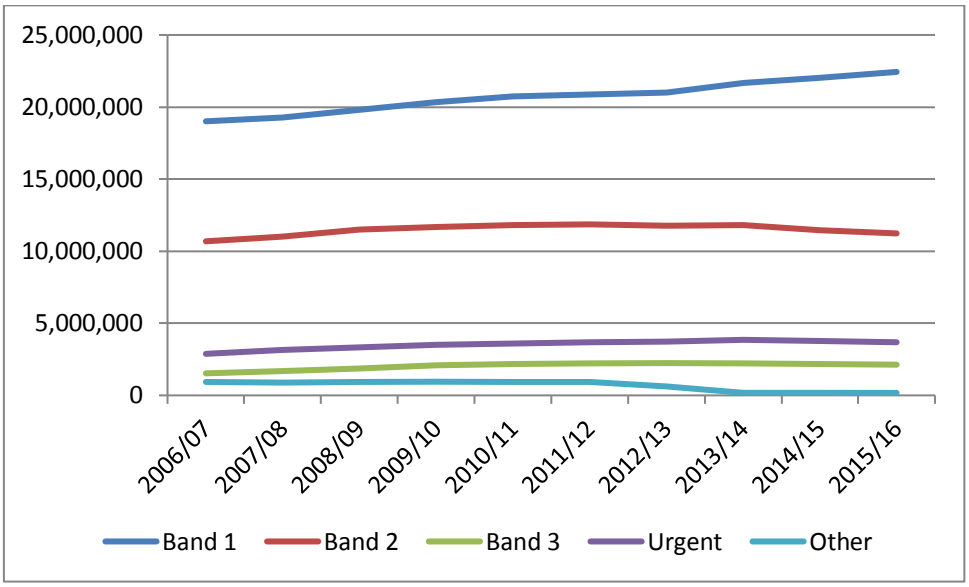


Figure 8: Number of courses of treatments (CoT) over time

Data about the volume of activity for ophthalmology is published by NHS Digital on a bi-annual basis.[11] Table 33 presents the volume of activity and cost for ophthalmic services over time. In 2015/16, we have been able to update the source of cost data for ophthalmological services, using those provided by the Association of Optometrists. The new cost data are reported in the last column of Table 33.

Table 33: Volume and average cost in ophthalmology

Year	Ophthalmology		
	Volume of activity	Average cost (£)	Average cost (£) - New source
2004/05	10,148,978	33	
2005/06	10,354,682	35	
2006/07	10,484,922	36	19
2007/08	11,047,890	28	19
2008/09	11,278,474	28	20
2009/10	11,811,651	28	20
2010/11	11,938,529	28	21
2011/12	12,305,727	28	21
2012/13	12,339,253	28	21
2013/14	12,787,430	28	21
2014/15	12,764,485	28	21
2015/16	12,979,762	28	21

[11] http://content.digital.nhs.uk/article/2021/Website-Search?productid=21325&q=a+guide+to+NHS+eye+care&sort=Relevance&size=10&page=1&area=both#top

Ophthalmic activity increased between the financial years 2014/15 and 2015/16, with cost-weighted output growth equal to 1.7%.

Overall, cost-weighted output growth in both series combined (Dental services and Ophthalmology) decreased by -0.46% between 2014/15 and 2015/16.

2.5 Primary care activity

The data we have used to measure the volume of primary care consultations have changed over time, as summarised below.

Table 34: CHE primary care evidence sources

Year	Activity Source	Cost source
2004/05-2008/09	QResearch	PSSRU cost estimates
2008/09-2009/10	General Lifestyle Survey	
2009/10 -current	GP Patient Survey	

As with other types of healthcare output, primary care consultations are divided into a subset of activity, here based on location (surgery, home, phone) and type of contact (GP, practice nurse, other). Up until 2008/09, we use data from QResearch (QR) as the basis for measuring primary care output (Fenty et al., 2006).

From 2008/09, CHE's source of primary care data switched to survey-based measures. This was initially the General Lifestyle Survey (GLS), but from 2010/2011 onwards, the GP Patient Survey (GPPS). In the GP Patient Survey, patients are asked when they last had any contact with their GP or nurse within the last three months. The responses are then extrapolated to reflect a number of contacts over the course of a year. Further, as the GP Patient Survey does not ask the interviewees to state the type of contact they had or the location, as described above, we assume the distribution of contacts as observed in the 2008/09 QResearch for all subsequent years.

We refer to Bojke et al. (2017) for the methods to estimate consultation rates and the adjustment made to reflect population growth. Figure 9 shows the population shares for 2008/09 and 2015/16, as well as the average number of consultations. It can be noted that there has been a shift in the age of population, which is now older. This would imply an increase in the number of consultations, as older people tend to have more consultations in a year; however, we find that the percentage of people interviewed who stated that they had seen either a GP or a nurse in the preceding three months is actually decreasing (see Table 35). One potential reason might be the increasing difficulty in booking an appointment, with the percentage of patients reporting easy access to GP surgery on the phone dropping from 77.9% in 2012 to 69.9% in 2016.[12]

[12] GP Patient Survey National Results and Trends (https://gp-patient.co.uk/SurveysAndReports)

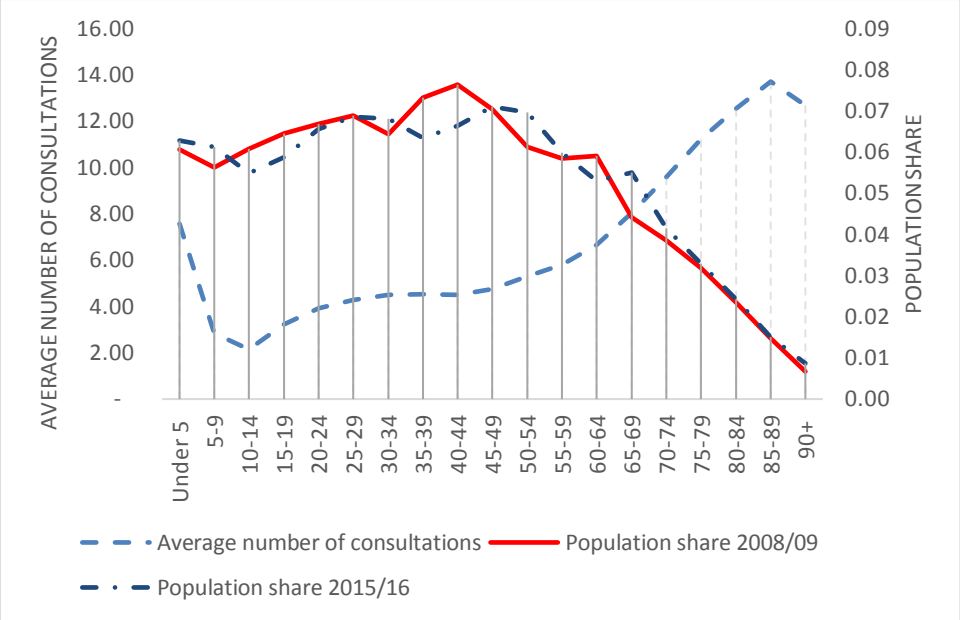


Figure 9: Population characteristics

The numbers of primary care consultations reported in Table 35 are those that were used to construct the year-on-year growth in primary care output as published in our successive NHS productivity reports. The figures do not constitute a consistent historic series and should not be interpreted or used as such. For the historic series, please see Appendix D.

Table 35: CHE GPPS based measure of volume of consultations[13]

Year	Patients who report having seen a GP in previous 3 months	Patients who report having seen a nurse in previous 3 months	Number of consultations	Population adjusted number of consultations	Quality and population adjusted number of consultations
QR					
2004/05				265,600	274,122
2005/06				283,100	293,733
2006/07				293,000	305,517
2007/08				292,500	305,291
2008/09				300,400	313,815
GLS					
2009/10	53.55%		300,400	300,400	313,988
GPPS					
2010/11	52.37%		293,517		303,355
2011/12	54.00%		303,820		317,893
Population Adjustment*					
2011/12	54.00%		303,764	319,661	334,468
2012/13	54.83%		308,433	327,301	342,667
2013/14	54.28%		305,328	328,199	343,942
Age & Gender Adjustment					
2013/14**	54.28%	35.91%	301,253	318,249	333,484
2014/15	53.28%	35.86%	298,024	318,519	333,842
2015/16	51.47%	34.81%	288,092	311,103	325,950

Notes: *The population-adjustments are based on estimates for England only, and since 2013/14 these have also been adjusted for age and gender.

** Up to 2013/14, the number of consultations was based on those reporting they'd seen a GP within the previous 3 months. From 2013/14 onwards, the number also includes those who'd seen a primary care nurse. As a baseline, this calculation also takes the number of consultations reported by QResearch for the 2008/09 financial rather than calendar year (303,900,000) (http://content.digital.nhs.uk/pubs/gpcons95-09).

The total number of consultations is broken down into types of consultations by using the relative shares as measured by QResearch in 2008/09. Cost information for different types of consultation is derived from the PSSRU Unit Costs of Health and Social Care publication, as shown in Table 36.

[13] The 2013/14 and 2014/15 figures for 'Population adjusted number of consultations' and ''Quality and population adjusted number of consultations' differ from those reported in Bojke et al. (2017). These were amended following the identification of an error in the age-gender population adjustment formula. The correction has an effect on the output growth measure for primary care between 2013/14 and 2014/15 (the amended growth rate is reported in Table 38) and also on the NHS productivity figure (mixed method) which goes up to 0.56% from 0.53%.

Table 36: PSSRU unit costs for consultation types (£)

Year	GP Home Visit	GP Telephone	GP Surgery	GP Other	Practice Nurse	Other Consultations
2004/05	69	30	24	24	10	15
2005/06	69	27	24	24	10	15
2006/07	55	21	34	34	9	14
2007/08	58	22	36	36	11	15
2008/09	117	21	35	35	11	14
2009/10	120	22	36	36	12	17
2010/11	121	22	36	36	13	25
2011/12	110	26	43	43	14	25
2012/13	114	27	45	45	13	25
2013/14	114	28	46	46	14	25
2014/15	114	27	44	44	14	25
2015/16	114	15[a]	36[b]	36	11	N/A

Notes: a: Estimates extracted from a telephone triage GP-lead cost estimates.
b: Duration of GP consultation contact has been reduced from 11.7 to 9.22 minutes.

Changes in the quality of primary care activity, limited to Coronary Heart Disease, Stroke and Hypertension are accounted for using the Quality & Outcomes Framework (QOF) achievement indicators.[14] (Derbyshire et al., 2007)

The numbers for prevalence are obtained from Annex 1 of the QOF report.[15] Data about success rates are obtained from the Clinical results tables, available in the same report. These data are summarised in Table 37. The QOF achievements for 2015/16 are slightly smaller than those reported in 2014/15; thus, we expect the quality-adjusted primary care output growth measure to reflect this.

Table 37: Quality adjustment for primary care (%)

Year	Prevalence			QOF achievement		
	CHD	Stroke	Hypertension	CHD	Stroke	Hypertension
2005/06	3.57	1.66	11.48	84.44	81.22	71.05
2006/07	3.54	1.61	12.49	88.86	86.92	77.62
2007/08	3.5	1.63	12.79	89.41	87.51	78.35
2008/09	3.47	1.66	13.13	89.68	87.88	78.56
2009/10	3.44	1.68	13.35	89.77	88.12	78.72
2010/11	3.4	1.71	13.52	90.16	88.57	79.3
2011/12	3.38	1.74	13.63	90.14	88.61	79.65
2012/13	3.4	1.7	13.68	90.57	89.26	80.79
2013/14	3.29	1.72	13.73	91.27	89.84	83.09
2014/15	3.25	1.73	13.79	91.98	88.17	83.61
2015/16	3.20	1.74	13.81	91.89	87.63	82.90

[14] These are QOF CHD002 for Coronary Heart Disease, STIA003 for Stroke and HYP006 for Hypertension.
[15] http://content.digital.nhs.uk/catalogue/PUB18887

The Laspeyres growth rates for primary care are reported in Table 38.

Table 38: Laspeyres growth rates for primary care

Years	Unadjusted growth rate	Population adjusted growth rate	Population and quality adjusted growth rate
2004/05 - 2005/06		6.59%	7.15%
2005/06 - 2006/07		3.50%	4.01%
2006/07 - 2007/08		-0.17%	-0.07%
2007/08 - 2008/09		2.70%	2.79%
2008/09 - 2009/10		0.00%	0.06%
2009/10 - 2010/11	-2.61%	-1.11%	-0.99%
2010/11 - 2011/12	3.83%	4.66%	4.70%
2011/12 - 2012/13	1.54%	2.39%	2.45%
2012/13 - 2013/14	-1.01%	0.27%	0.37%
2013/14 - 2014/15	-1.07%	0.08%	0.11%
2014/15 - 2015/16	-3.33%	-2.33%	-2.36%

The survey data suggest that the number of primary care consultations decreased by -3.33% between 2014/15 and 2015/16. Scaled up to account for population growth, the growth in primary care activity amounts to -2.33%. Finally, after taking account of the quality of consultations over these two years, the growth in primary care consultations amounts to -2.36%. The quality adjustment further reduces the growth rate and the result is due both to the higher prevalence of stroke and hypertension and the lower achievement of the three QOF indicators in 2015/16 with respect to the same indicators in 2014/15.

2.6 Community prescribing

Data about community prescribing are derived from the Prescription Cost Analysis (PCA) system, supplied by the Prescription Pricing Authority via the NHS Digital Prescription Drugs Team. The data are based on a full analysis of all prescriptions dispensed in the community, summarised into different categories defined according to chemical composition. The data include information about the Drug code (PropGenLinkCode), Net Ingredient Cost (NIC), Quantity of Drug Dispensed, and Number of Prescription Items. The data are complete and prices are available for all items across the years.

Table 39 reports summary statistics about community prescribing. Drugs are categorised according to their chemical composition, with the number of category changing over time. A peak number of categories was reported in 2004/05 (8,779 categories), falling to a low in 2013/14 (7,809 categories)

before picking up again. Variations in the number of categories are usually due to zero counts in some years, rather than definitional changes.

The 2015/16 data contain information on 8,021 distinct community prescribed drug items representing over a billion prescriptions with a total value/cost of approximately £9.3 billion, which is almost £346m more than in 2014/15. There are 704 new drug items totalling £14.6m that appear in 2015/16 but not 2014/15. There are 609 drug items which appeared in 2014/15 but not in 2015/16, with a lagged total spend of £1.6m. There are no data items which appear obviously incorrect and we therefore take the data at face value.

Table 39: Community prescribing, summary data

Year	Unique drug codes observed	Total Prescribing	Total Spend	Activity weighted average prescription unit cost (£)
2004/05	8,779	691,948,868	£8,094,174,944	11.7
2005/06	8,535	733,010,929	£8,013,483,226	10.93
2006/07	8,218	762,631,738	£8,250,323,893	10.82
2007/08	8,769	803,297,137	£8,303,500,918	10.34
2008/09	8,276	852,482,281	£8,376,264,432	9.83
2009/10	8,072	897,727,347	£8,621,421,130	9.6
2010/11	7,860	936,743,859	£8,880,735,344	9.48
2011/12	7,856	973,381,568	£8,777,964,802	9.02
2012/13	7,699	1,001,825,994	£8,397,492,181	8.38
2013/14	7,353	1,031,703,347	£8,540,423,964	8.28
2013/14*	7,809	1,039,535,998	£8,703,169,718	8.37
2014/15	7,926	1,071,065,672	£8,942,734,216	8.35
2015/16	8,021	1,087,838,465	£9,288,424,660	8.54

Note: *In February 2017, NHS Digital released a new set of prescribing data to include previously omitted drug codes. The 2012/13-2013/14 growth figures for prescribing are based on the earlier data, whilst the 2013/14-2014/15 growth figures are based on the new data.

From the data we observe changes in average cost of prescription and in unit (i.e. item) cost over recent years (Table 39). Output and price indices for community prescribing are reported in Table 40. Prices have fallen year-on-year over the whole period, the drop is minimal between 2014/15 and 2015/16, being equal to -0.07%, the smallest decrease in all years reported**.**

Table 40: Community prescribing: price and volume growth

Years	Paasche Price Ratio	Laspeyres Volume Ratio
2004/05 - 2005/06	0.9014	1.0984
2005/06 - 2006/07	0.9659	1.0659
2006/07 - 2007/08	0.9376	1.0735
2007/08 - 2008/09	0.9485	1.0636
2008/09 - 2009/10	0.9626	1.0693
2009/10 - 2010/11	0.9833	1.0476
2010/11 - 2011/12	0.9564	1.0335
2011/12 - 2012/13	0.9284	1.0356
2012/13 - 2013/14	0.9855	1.032
2013/14 - 2014/15*	0.9869	1.0411
2014/15 - 2015/16	0.9993	1.0394

Note: * In February 2017, NHS Digital released a new set of prescribing data to include previously omitted drug codes. The 2012/13-2013/14 growth figures for prescribing are based on the earlier data; whilst the 2013/14-2014/15 growth figures are based on the new data.

The Laspeyres growth in the volume of prescriptions has increased annually, the most recent year-on-year increase amounting to 3.94%.

Taking the base year as 2004/05, trends in the volume and prices of pharmaceuticals are shown in figure 10.

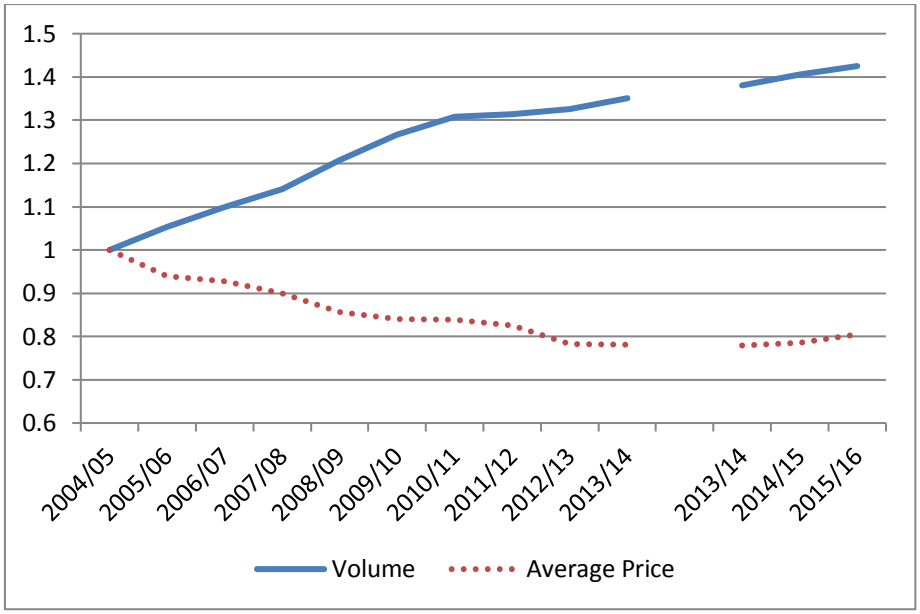


Figure 10: Price and volume changes for community prescribed pharmaceuticals

Note: * In February 2017, NHS Digital released a new set of prescribing data to include previously omitted drug codes. The 2012/13-2013/14 growth figures for prescribing are based on the earlier data, whilst the 2013/14-2014/15 growth figures are based on the new data.

2.7 Output growth

Output growth is measured by combining activities of different types into a single index, using costs to reflect their values**. As shown in Table 41, this generates our cost-weighted output growth index, which increased by 2.16% between 2014/15 and 2015/16**.

We then re-scale each type of cost-weighted output according to changes in survival, health improvements, waiting times, and blood pressure monitoring. **This generates our quality-adjusted index, which increased by 2.62% between 2014/15 and 2015/16.** This is (0.46%) higher than the cost-weighted index, with improvements registered in some of the quality measures (survival rates, life expectancy and PROMS) and deteriorations in others (waiting times and QOF achievement in primary care).

Table 41: Output growth

Years	All NHS	
	Cost-weighted growth	Quality adjusted CW growth
2004/05 – 2005/06	6.53%	7.11%
2005/06 – 2006/07	5.88%	6.50%
2006/07 – 2007/08	3.41%	3.66%
2007/08 – 2008/09	5.34%	5.73%
2008/09 – 2009/10	3.44%	4.11%
2009/10 – 2010/11	3.61%	4.57%
2010/11 – 2011/12	2.38%	3.15%
2011/12 – 2012/13	2.58%	2.34%
2012/13 – 2013/14	2.37%	2.64%
2013/14 – 2014/15	2.53%	2.49%
2014/15 – 2015/16	2.16%	2.63%

2.7.1 Contribution by settings

Not all settings contribute equally to the output index. Figure 11 shows the share of overall spend for each of the settings as well as contribution to growth, calculated as a share of overall spend multiplied by the output growth of the setting. More detailed information on contribution of each setting can be also found in Table 42.

By far the largest contributor to the output index is HES inpatient activity, with a share of over 30% of both total spend and overall output growth. Other sizeable contributors are Outpatient activity, Primary care, Community prescribing and Community mental health. All other settings contribute less than 6% to total spend or output.

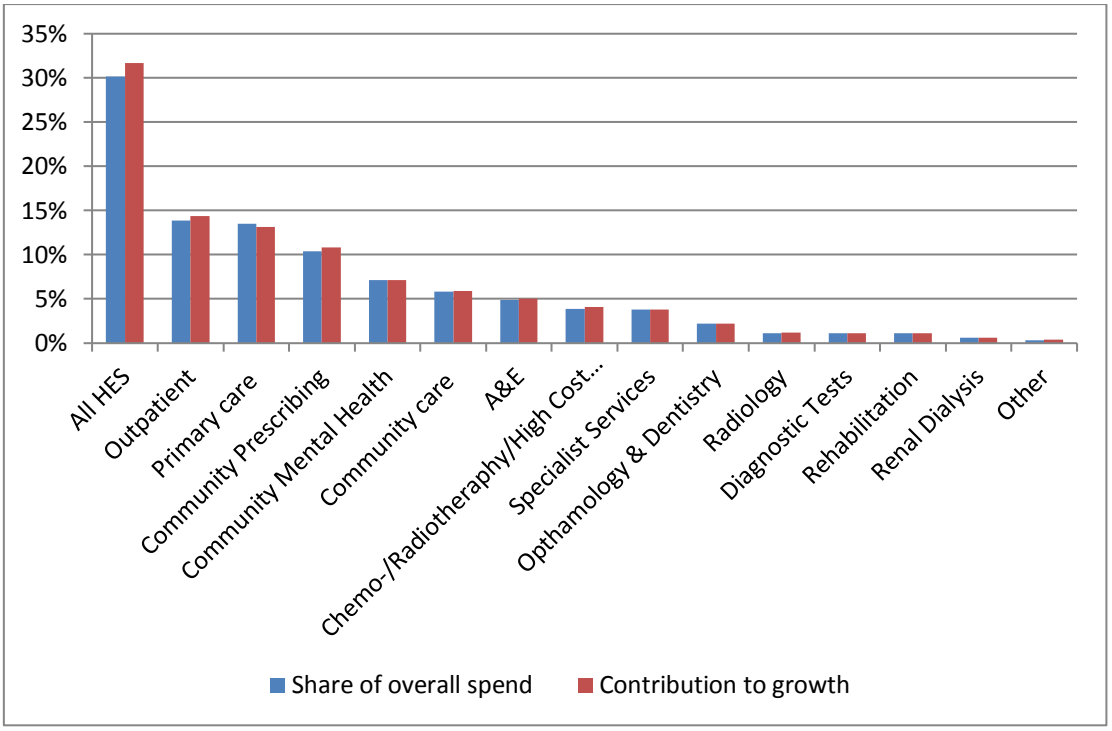


Figure 11: Contribution by setting, 2015/16

Table 42: Contribution of setting to growth, 2015/16

Setting	Growth	Setting specific growth index	Value of Activity (14/15 prices)	Share of overall spend	Contribution to growth**
All HES*	5.08%	105.08%	25,997,195,906	30.35%	31.89%
Outpatient*	3.72%	103.72%	11,964,876,407	13.97%	14.49%
Primary Care*	-2.36%	97.64%	11,120,240,712	12.98%	12.68%
Community Prescribing	3.94%	103.94%	8,942,734,216	10.44%	10.85%
Community Mental Health	-0.64%	99.36%	6,167,556,467	7.20%	7.15%
Community Care	0.64%	100.64%	5,052,768,659	5.90%	5.94%
A&E	3.33%	103.33%	4,201,423,614	4.90%	5.07%
Chemo-/Radiotherapy/High Cost Drugs	4.73%	104.73%	3,350,582,978	3.91%	4.10%
Specialist Services	0.61%	100.61%	3,247,414,340	3.79%	3.81%
Ophthalmology & Dentistry	-0.46%	99.54%	1,886,828,572	2.20%	2.19%
Radiology	9.34%	109.34%	944,215,000	1.10%	1.21%
Diagnostic Tests	-1.04%	98.96%	994,023,634	1.16%	1.15%
Rehabilitation	-0.71%	99.29%	946,566,661	1.11%	1.10%
Renal Dialysis	1.75%	101.75%	533,927,599	0.62%	0.63%
Other	4.27%	104.27%	307,103,637	0.36%	0.37%
Total value of NHS Output			**85,657,458,401**		
Overall NHS Output growth					**2.63%**

*All HES, Primary Care and Outpatient activity are quality adjusted.

** The contribution of each setting to growth in 2015/16 is expressed as a percentage of the total output in 2014/15. Where numbers in this column are lower than numbers in the preceding column, this represents negative growth in output for that sector.

3. Inputs

Inputs into the health care system consist of:

- Labour, such as doctors, nurses, technicians and managers;
- Materials and supplies, such as drugs and disposable items;
- Capital, such as buildings and equipment with an asset life of more than a year.

We construct a comprehensive index of input growth, using the workforce data and organisational accounts submitted by NHS organisations together with other forms of expenditure data. These data are used to quantify the amount of all inputs used in the production of health care provided to NHS patients.

For capital and materials we have only expenditure data, but labour data comes from two sources: expenditure data as well as staff numbers from the Electronic Staff Record (ESR). We explore the growth consequences of using these alternative data sources for labour input. We report estimates for two different formulations of the input index. Our mixed index uses information about labour inputs recorded in the ESR and expenditure for everything else; our indirect method uses expenditure data for all types of input.

3.1 Direct labour

Since 2007/08 we use the ESR data to calculate growth in labour inputs.[16] These data are obtained from the NHS iView database[17] which draws data directly from the ESR, and combined Payroll and Human Resources system for the NHS. The data contain numbers of full time equivalent (FTEs) staff and earnings for over 580 different occupational groups for all staff employed by NHS organisations.[18] Where 5 or less staff members are employed in a particular staff group, the organisation randomly reports either 5 or 0. For this reason, the reported total number of staff constructed using the ESR source data differs from the aggregated figures published by NHS Digital.[19]

The ESR data collection method was updated in March 2016, and resulted in a list of several developments that affect the way staff are counted and classified and which have been introduced to improve the quality of the data available. The complete list of developments is available on the NHS Digital website.[20] The new methodology introduces a break in the chain and makes the figures from 2015/16 no longer comparable to previous financial years. We have, however, obtained from NHS Digital ESR data for the financial year 2014/15 that are comparable to those reported for 2015/16. Thus, in the following tables, we present two columns of data for the year 2014/15: the first column reports data from the pre-update of the ESR data collection method (as reported in our previous research paper, Bojke et al. (2017)) and the second 2014/15 column which reports data using NHS Digital newest methodology.

Data on staff earnings come from a separate dataset, also provided by NHS Digital, which includes all earnings data submitted by NHS organisations for staff paid directly by the NHS. This dataset

[16] Up to 2006/07, we used data from the Workforce Census to count the number of staff working in the NHS.
[17] http://content.digital.nhs.uk/iview
[18] We drop ESR returns made by private providers, NHS Arm's-length bodies, Special Health Authorities and other NHS bodies that report to the ESR but do not fall in the included categories (e.g. Sussex Health Informatics Service (YDD81))
[19] http://content.digital.nhs.uk/workforce.
[20] http://content.digital.nhs.uk/hchs

contains average earnings by occupational group.[21] In our calculation, we sum basic and non-basic pay to get total earnings for each particular staff group. As non-basic pay is not reported by FTEs, but only by headcount, we multiply that number first by an FTE/headcount ratio to get the equivalent FTE number (as advised by NHS Digital).

Gradually more and more Clinical Commissioning Groups (CCGs) have been reporting ESR data, although for the financial year 2015/16 11 CCGs out of 212 are still not doing so (Table 43).

Table 43: Number of reporting entities by organisation type

Organisation type	2010/11	2011/12	2012/13	2013/14	2014/15	2014/15[a]	2015/16
CCGs	n/a	n/a	9	152	202	202	201
CSUs	0	0	0	24	25	22	11
NHS England	0	0	1	1	1	1	1
Non-geographical staff	0	1	1	1	1	1	1
PCTs	147	142	132	40	26	10	0
SHA	10	10	10	2	0	4	0
NHS Trusts	248	260	260	251	249	249	249

Note: CCGs: Clinical Commissioning Groups; CSUs: Commissioning Support Units; Non-Geographic Central Staff, code AHO; PCTs: Primary Care Trusts; SHA: Strategic Health Authorities; n/a not applicable.
[a]:This column corresponds to NHS staff numbers for the financial year 2014/15 updated to the new methodology implemented by NHS Digital in March 2016.

Table 44 shows expenditure by organisational type as determined by the summed product of staff group FTEs and average earnings. It also illustrates the impact that the NHS re-organisation has had on the apparent distribution of labour expenditure over time, especially with the shift of staff from PCTs to Trusts. This appears to be now completed, as the labour expenditure of PCTs for the financial year 2015/16 is zero.

Table 44: Expenditure on labour in current prices (£m)

Organisation type	2010/11 (£)	2011/12 (£)	2012/13 (£)	2013/14 (£)	2014/15 (£)	2014/15 (£)[a]	2015/16 (£)
CCGs	0	0	7	434	535	530	618
CSUs	0	0	0	318	306	333	261
NHS England	0	0	1	221	205	202	171
Non-geographical staff	0	157	143	76	71	16	8
PCTs	5,822	3,742	1,329	89	1	0.15	0
SHA	133	114	110	0.4	0	0.32	0
NHS Trusts	28,809	31,761	33,753	34,510	35,820	35,131	36,319

[a]:This column corresponds to NHS staff numbers for the financial year 2014/15 updated to the new methodology implemented by NHS Digital in March 2016.

The number of NHS staff, measured as Full Time Equivalents (FTEs), is reported in Table 45.

[21] In the past we had information on total earnings per month, without separation in basic/non-basic.

Table 45: NHS staff numbers

	2004/5	2005/6	2006/7	2007/8	2008/9	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2014/15(c)	2015/16
GPs (a)	31,021	32,855	33,384	33,730	34,043	36,085	35,243	35,319	35,871	36,294	n/a	n/a	n/a
GP Practice staff	69,140	72,006	72,990	75,085	73,292	72,153	73,306						
GP Practice staff – new method							82,802	84,609	85,546	87,114	n/a	n/a	n/a
Medical staff (b)	78,462	82,568	85,975	84,811	90,460	93,393	95,531	99,331	100,878	100,797	104,189	102,764	104,009
Ambulance staff				21,149	23,084	24,489	25,056	24,908	24,566	24,757	25,381	25,028	26,008
Administration and estates staff				237,264	243,018	262,479	263,723	250,539	242,980	239,359	245,504	208,961	213,880
Health care assistants and other support staff				101,114	106,406	112,710	114,786	116,643	116,018	119,138	123,870	121,564	126,549
Nursing, midwifery and health visiting staff and learners				366,520	372,132	379,841	380,114	377,948	363,781	366,246	372,060	359,221	359,826
Scientific, therapeutic and technical staff and healthcare scientists				141,754	150,056	159,538	165,454	168,750	164,312	165,683	173,536	165,188	167,438
Unknown and Non-funded staff				4,327	3,595	3,462	3,351	3,055	2,652	2,423	0	3,544	3,757
Professionally qualified clinical staff	412,013	425,044	425,983										
Support to clinical staff	271,347	278,994	273,202										
NHS infrastructure support staff	178,530	186,510	178,230										

Notes: [a] Data for GPs and GP practice staff are not available from ESR; Workforce Census data are used instead; there were also changes in counting of GP Practice staff, therefore data from 2010/11 onwards are not comparable to previous years. NHS Digital stopped reporting the GP figures in 2014/15. [b] FTE data up to 2006/07 are taken from the Workforce Census data. FTE data from 2007/08 onwards are taken from organisational returns of Electronic Staff Records. When there are 5 or less people employed in an occupational group, organisations report either 5 or 0; these totals therefore will differ from those derived from national level data. [c] This column corresponds to NHS staff numbers for the financial year 2014/15 updated to the new methodology implemented by NHS Digital in March 2016.

Table 46: Growth in direct labour

Years	Nominal expenditure growth		Laspeyres volume growth	
	All*	Trusts	All*	Trusts
2007/08 – 2008/09	7.61%	7.21%	4.14%	3.77%
2008/09 – 2009/10	7.03%	6.55%	4.54%	4.15%
2009/10 – 2010/11	2.62%	3.70%	1.42%	2.95%
2010/11 – 2011/12	2.91%	10.25%	0.10%	7.26%
2011/12 – 2012/13	-1.21%	6.27%	-1.97%	5.50%
2012/13 – 2013/14	0.87%	2.24%	0.38%	1.71%
2013/14 – 2014/15	3.67%	3.80%	2.80%	2.92%
2014/15 – 2015/16**	3.17%	3.38%	1.32%	1.47%

Notes: *All organisations reporting to ESR except independent providers; arms-length bodies and special health authorities;
** Nominal expenditure and Laspeyres growth figures for 2014/15 – 2015/16 are not directly comparable to previous years due to the implementation of the new methodology.

Table 46 shows the growth in nominal expenditure and the Laspeyres input growth over time by all organisations submitting ESR data (i.e. Trusts plus PCTs, CCGs, CSUs, NHS England, SHAs and the non-geographical category) and hospital Trusts only.

At 1.32%, the growth rate for labour between 2014/15 and 2015/16 is positive, but smaller than that observed between 2013/14 and 2014/15. The positive growth observed for the last three pair of years may be a consequence of the several efforts made by Trusts to adopt higher staffing ratios following the reports published in 2012/13 (Berwick, 2013, Francis, 2013, Keogh, 2013).

3.2 Expenditure data

The source of expenditure data has changed over time and by type of organisation, as summarised in Table 47. Data for Foundation Trusts are derived from the Consolidated NHS Financial Trust Accounts, the format of which has remained unchanged over the past decade. These accounts are less detailed than Trust Financial Returns (TFRs) reported by NHS Trusts, PCTs and SHAs up to and including 2011/12. The TFRs were discontinued in 2011/12 because of the reorganisation of the NHS. Aggregated information is now obtained from the DH Annual Report and Accounts.[22]

For NHS Trusts, TFRs were replaced with Financial Monitoring and Accounts, although both reporting systems were used in 2011/12. The Financial Monitoring and Accounts are much less detailed than the TFRs, reporting information for very broad input categories, making it no longer possible to report time series for specific input types. For instance, it is not possible to identify expenditure by NHS Trusts on agency staff from this information.[23] Instead, we rely on data provided directly by the Department of Health to identify expenditure on agency staff.[24]

[22] https://www.gov.uk/government/publications/department-of-health-annual-report-and-accounts-2015-to-2016
[23] http://www.parliament.uk/business/publications/written-questions-answers-statements/written-question/Commons/2014-10-22/211600/
[24] For both 2014/15 and 2015/16 the total number of FTEs for agency staff used by Foundation Trusts (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/544144/Consolidated_NHS_FT_accounts_2015-16_corrected.pdf) is available; however, since it is only an aggregate number, we cannot use it in the direct calculation of labour input growth.

Table 47: Source of financial information

Years	Foundation Trusts	NHS Trusts	PCT/SHAs	NHS England/CSUs/CCGs
2004/05 - 2011/12		Trust Financial Returns	PCT/SHA Financial Returns	N/A
2011/12 - 2012/13	Consolidated NHS Financial Trusts Accounts	Financial Monitoring and Accounts	DH Annual Reports and Accounts	DH Annual Reports and Accounts
2012/13 - current			N/A	

The use of more aggregated data, apart from the loss of detail, has two further implications for the construction of the input index:

1. We have to apply deflators for each aggregated input category, rather than input specific deflators. This does not permit us to fully understand the contributions of changes in volume and price changes of the different inputs used.[25]

2. The annual accounts do not identify all items of capital. This makes it practically impossible to account for utilisation of different types of capital in each period, based on assumptions about their asset life and depreciation (Street and Ward, 2009), and thus to ascertain how much has been spent on capital in each period, and more importantly how much of the capital acquired has been utilised.

The financial reporting lines designated as materials and capital items in the most recent financial data are listed separately in Table 48 for NHS Foundation Trusts and NHS Trusts and CCGs/NHS England Group.

[25] We apply the Hospital and Community Health Services (HCHS) prices deflator for materials and capital and the pay and prices deflator for primary care expenditure. For labour and prescribing expenditure, we construct our own deflators using ESR and Prescription Cost Analysis data respectively. See Table E1 in Appendix E for the list of deflators.

Table 48: Materials and capital items

Organisation	Materials	Capital
Foundation Trusts and NHS Trusts *Source: Financial Monitoring & Accounts, Consolidated NHS Financial Trusts Accounts*	Services from Other NHS Trusts Services from PCTs Services from Other NHS Bodies Services from Foundation Trusts Purchase of Healthcare from Non-NHS Bodies Supplies & Services - Clinical Supplies & Services - General Consultancy Services Transport Audit fees Other Auditors Remuneration Clinical Negligence Research & Development (excluding staff costs) Education & Training Establishment Other	Premises Impairments & Reversals of Receivables Inventories write downs Depreciation Amortisation Impairments & Reversals of Property, Plant & Equipment Impairments & Reversals of Intangible Assets Impairments & Reversals of Financial Assets Impairments & Reversals for Non-Current Assets held for sale Impairments & Reversals for Investment Properties
CCGs/NHS England Group *Source: DH Annual Report & Accounts*	Consultancy Services Transport Clinical Negligence Costs Establishment Education, Training & Conferences Supplies & Services - Clinical Supplies & Services - General Inventories consumed Research & Development Expenditure Other	Premises Impairment of Receivables Rentals under operating leases Depreciation Amortisation Impairments & reversals Interest Charges

3.2.1 Input use derived from expenditure data

Table 49 presents expenditure data reported by PCTs, CCGs and NHS England Group. PCTs officially ceased to exist in 2013/14; their activity was partly taken over by CCGs, as well as by CSUs and NHS England, together forming the NHS England Group.

Between 2014/15 and 2015/16 we observe a large increase in the expenditure associated with Materials, and more specifically with the item '*Supplies & Services – General'*, which experienced a growth equal to 86.21%.

Table 49: Current expenditure by PCTs and NHS England Group, (£000)

Organisation	Year	Labour	Materials	Capital
PCTs	2007/08	6,701,228	2,617,114	1,174,841
	2008/09	7,478,953	2,526,610	1,247,997
	2009/10	8,230,341	2,623,459	1,703,974
	2010/11	7,175,399	2,638,638	1,171,813
	2011/12	2,328,314	2,052,029	892,604
	2011/12*	2,358,373	860,860	1,721,795
	2012/13*	1,938,770	885,265	1,814,809
NHS England Group	2013/14*	1,529,067	1,420,027	696,400
	2014/15*	1,726,006	1,457,798	536,383
	2015/16*	1,741,655	1,960,006	502,897

* Data up to 2010/11 are taken from Financial Returns and from 2011/12 onwards from DH Annual Report and Accounts. Material and capital items are identified differently in each source.

Table 50 shows the expenditure for labour, materials and capital for hospital Trusts. **In current terms, labour expenditure increased by 2.87% between 2014/15 and 2015/16. We also observe a large increase in spend on materials of 9.68%, whilst capital spend decreased by -1.4% between 2014/15 and 2015/16.**

Table 50: Current expenditure by hospital Trusts (£000)

Year	Labour	Materials	Capital
2007/08	30,884,556	10,140,836	6,452,630
2008/09	33,435,219	11,322,441	6,340,019
2009/10	35,983,781	12,115,273	6,529,977
2010/11	38,222,951	12,961,217	6,839,898
2011/12	42,647,889	14,941,588	7,278,435
2011/12*	42,701,684	17,477,370	12,097,485
2012/13*	43,797,935	19,681,855	12,377,259
2013/14*	45,360,562	21,108,612	13,217,703
2014/15*	46,847,155	21,983,076	12,747,384
2015/16*	48,193,902	24,110,377	12,569,351

* For NHS Trusts, data up to 2011/12 are derived from Financial Returns; for 2011/12 and following years data are derived from Financial Monitoring and Accounts. Material and capital items are identified differently in each source.

The use of agency staff is subject to considerable year-on-year variation, as shown in Figure 12. The increase of 10.7% between 2014/15 and 2015/16 will contribute to increased overall input growth.

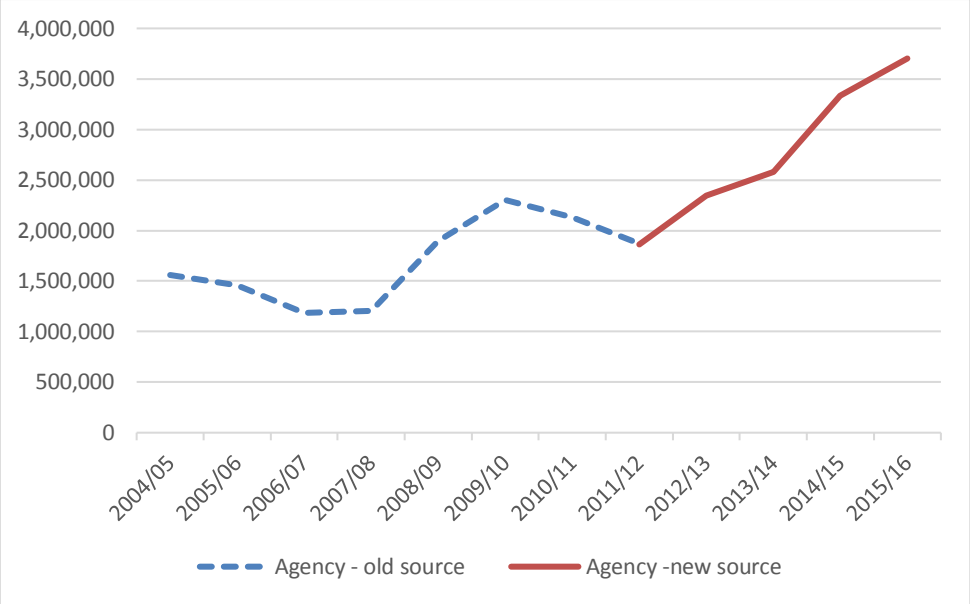


Figure 12: Trends in use of agency staff

Table 51 presents current expenditures for the whole NHS. From 2013/14 onwards, we do not include spend for DH administration. This is due to the restructuring of the NHS and changes to the DH responsibilities. Table 52 shows the share of expenditure by setting for the years 2014/15 and 2015/16.

Table 51: Total NHS current expenditure (£000)

Year	NHS Staff	Agency	Material	Capital	Prescribing	Primary Care	DH Admin	TOTAL
2004/05	31,334,252	1,557,282	8,757,990	5,115,514	8,094,175	9,569,836	278,000	64,707,050
2005/06	33,926,746	1,459,936	10,271,344	5,839,664	8,013,483	11,162,141	262,000	70,935,314
2006/07	35,177,509	1,185,244	11,378,727	6,568,363	8,250,324	11,209,422	229,000	73,998,589
2007/08	36,561,167	1,207,654	13,036,200	7,784,592	8,303,501	11,697,639	226,000	78,816,753
2008/09	39,264,185	1,895,423	13,991,803	7,426,031	8,376,264	12,074,672	242,958	83,271,336
2009/10	42,104,673	2,302,578	14,911,074	7,635,390	8,621,421	12,683,418	241,608	88,500,162
2010/11	43,513,839	2,127,889	16,077,609	8,025,361	8,880,735	12,962,081	212,245	91,799,759
2011/12	43,360,622	1,872,598	17,221,673	8,265,079	8,777,965	13,250,874	453,000	93,201,811
2011/12*	43,457,477	1,862,385	19,154,991	13,892,358	8,777,965	13,250,874	453,000	100,849,049
2012/13*	43,654,591	2,345,552	21,442,537	14,273,017	8,397,492	13,419,803	457,000	103,989,992
2013/14*	44,310,698	2,578,931	22,528,639	13,914,103	8,540,424	13,294,670	n/a	105,167,465
2013/14**					8,703,170			105,330,221
2014/15**	45,239,355	3,333,806	23,440,874	13,283,767	8,942,734	13,460,552	n/a	107,701,088
2015/16**	46,233,148	3,702,409	26,070,383	13,072,248	9,288,425	13,759,292	n/a	112,125,905

*For NHS Trusts, data from prior to 2011/12 from Financial Returns and from 2011/12 onwards data from Financial Monitoring and Accounts. Agency costs, material and capital items are identified differently in each source.
** In February 2017, NHS Digital released a new set of prescribing data to include previously omitted drug codes. The 2013/14 and 2014/15 expenditure figure for prescribing are based on the new data.

Table 52 Share of expenditure by setting (in £M)

	2014/15		2015/16	
	Current expenditure	Share	Current expenditure	Share
NHS Staff	45,239	42.0%	46,233	41.2%
Agency Staff	3,334	3.1%	3,702	3.3%
Materials	23,441	21.8%	26,070	23.3%
Capital	13,284	12.3%	13,072	11.7%
Primary care	13,460	12.5%	13,759	12.3%
Prescribing	8,943	8.3%	9,288	8.3%
Total	107,701		112,124	

3.3 Input growth

Our measures of input growth are reported in Table 53, differentiated according to the use of the mixed or indirect index. **For 2014/15 – 2015/16 the mixed index suggests a growth rate of 2.59%, whilst the indirect index suggests that an input growth rate of 2.82%.** This implies that growth in labour inputs between 2014/15 and 2015/16 is greater if using expenditure data rather than ESR data.

Table 53: Input growth

Years	All NHS	
	Mixed	Indirect
2004/05 – 2005/06	7.19%	7.10%
2005/06 – 2006/07	1.92%	1.36%
2006/07 – 2007/08	3.88%	3.70%
2007/08 – 2008/09	4.23%	4.24%
2008/09 – 2009/10	5.43%	5.83%
2009/10 – 2010/11	1.33%	0.80%
2010/11 – 2011/12	1.00%	0.75%
2011/12 – 2012/13	1.98%	2.63%
2012/12 – 2013/14	0.43%	0.55%
2013/14 – 2014/15	1.94%	1.52%
2014/15 – 2015/16	2.59%	2.82%

4. Productivity growth

Year-on-year productivity growth figures over the pair of years from 2004/05 – 2015/16 are provided in Table 54. These figures are constructed by comparing the quality-adjusted output growth rate, as reported in the final column of Table 41, with the estimates of mixed and indirect input growth, as reported in Table 53. **Productivity growth between 2014/15and 2015/16 is estimated to have been -0.19% based on the mixed method, and 0.04 % based on the indirect method.**

Table 54: Quality-adjusted productivity growth year-on-year

Years	All NHS	
	Mixed	**Indirect**
2004/05 – 2005/06	-0.07%	0.01%
2005/06 – 2006/07	4.50%	5.07%
2006/07 – 2007/08	-0.21%	-0.04%
2007/08 – 2008/09	1.44%	1.43%
2008/09 – 2009/10	-1.25%	-1.63%
2009/10 – 2010/11	3.21%	3.74%
2010/11 – 2011/12	2.13%	2.38%
2011/12 – 2012/13	0.36%	-0.28%
2012/13 – 2013/14	2.20%	2.07%
2013/14 – 2014/15	0.53%	0.95%
2014/15 – 2015/16	0.04%	-0.19%

As can be observed in figure 13, both input and output year-on-year growth rates have increased between 2014/15 and 2015/16, which will result in a close to zero productivity growth.

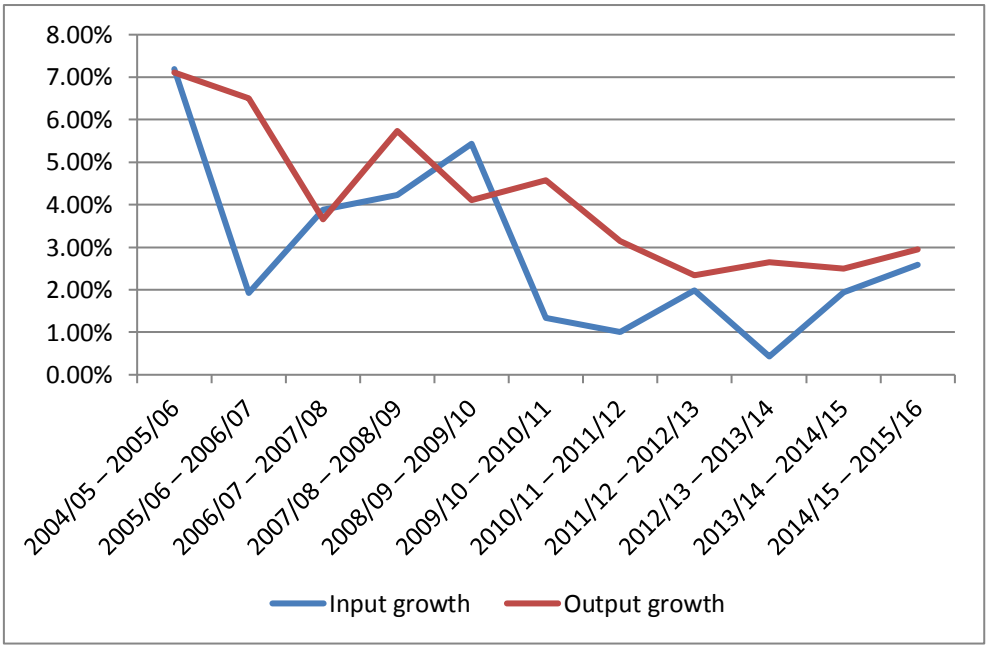


Figure 13: Input and Output growth

Finally, Figure 14 shows the trend in the NHS Output, Input and Productivity indices from the start of the most recent time series. NHS Outputs and Inputs have both increased since 2004/05, with NHS Outputs increasing by over 5% over the whole period, and NHS inputs only just under 4%.

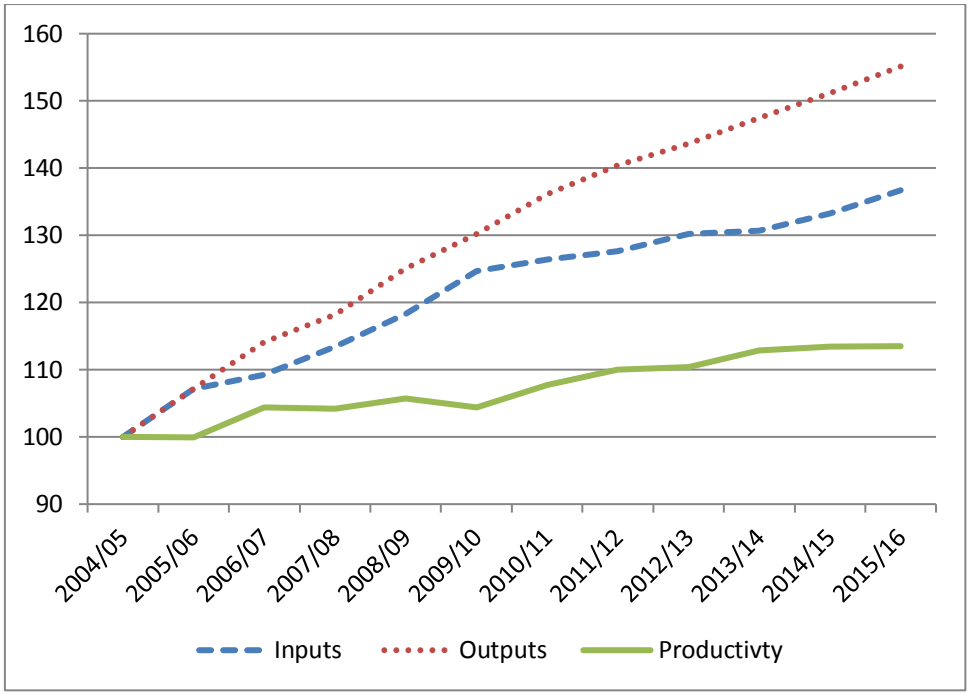


Figure 14: Trends in input, output and productivity indices

The increasing productivity growth that we observe in the NHS over time is not observed in the rest of the economy. Productivity is measured somewhat differently according to the nature of the data available for each sector of the economy, but the measures are otherwise equivalent. The main measure produced by the Office of National Statistics is called Gross Value Added per hour worked,[26] which is used to measure the contribution to the economy of each sector in the United Kingdom.[27]

The rate of NHS productivity growth since 2004/05 compares favourably with that achieved by the economy as a whole. This is shown in the graph below, with NHS productivity growth index outpacing the economy as a whole through the entire period. The recession in 2008/09 is reflected by the notable dip in the two series. Since then, NHS productivity has increased year-on-year, whereas whole economy productivity has been falling or been stable over the same time period, except for the last three financial years, where the productivity for the whole economy has grown at a faster rate than that for the NHS. From 2004/05 total productivity growth was 13.49% for the NHS, compared to only 6.04% in the whole economy.

[26] http://www.ons.gov.uk/ons/guide-method/method-quality/specific/economy/national-accounts/gva/relationship-gva-and-gdp/gross-value-added-and-gross-domestic-product.html

[27] http://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/labourproductivity/datasets/labourproductivitytables110andr1

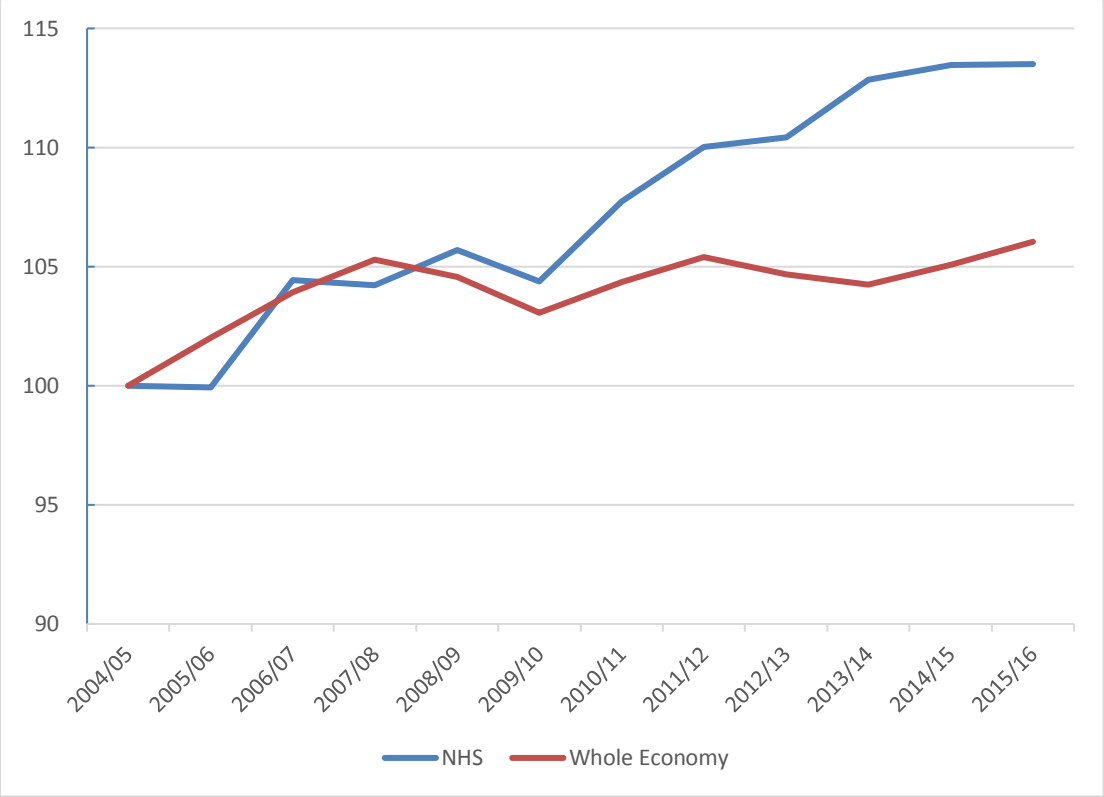


Figure 15: Comparison of productivity indices: NHS vs Whole Economy

5. Conclusions

Total NHS productivity growth between 2014/15 and 2015/16 amounted to 0.04%, according to our preferred mixed method and to -0.19% according to the indirect method.

Quality-adjusted output growth between 2014/15 and 2015/16 amounted to 2.63% for the NHS as a whole, which is slightly higher than last year (2.49%), but lower than the average over the whole period (4.08 %). We observe positive growth across all settings, with the exception of Primary Care, Community Mental Health, Ophthalmology, Diagnostic Tests and Rehabilitation. Growth was substantial in both inpatient and outpatient settings, amounting to 5.08% and 3.72% respectively. We also observe high growth in the A&E attendances (3.33%) as well as across most of RC categories.

Quality of care is captured only for hospital inpatient activity by measuring changes in survival following hospital admission, health status, life expectancy and waiting times, and for primary care activity by changes in blood pressure monitoring of patients with either a Coronary Heart Disease, Stroke or Hypertension. There were improvements in most of the quality measures for hospital inpatient activity other than waiting times. The quality of primary care has deteriorated between 2014/15 and 2015/16, with higher prevalence for Stroke and Hypertension amongst the patient population and lower QOF achievements for stroke, hypertension and chronic heart disease. Overall, however, the net effect is an improvement in quality between 2014/15 and 2015/16, which increases the output index by 0.47% over the simple cost-weighted output index.

Our indirect measure of input growth is 2.82% between 2014/15 and 2015/16 and our mixed measure (using the direct measure of labour) is 2.59%. Our usual base case measure uses the mixed method, as it is appropriate to use direct measures of input whenever possible.

In addition to our usual whole-NHS measurement, we include a measurement for Trusts. The full results are reported in Appendix F. Between 2014/15 and 2015/16 NHS Trusts had output growth of 3.38% and mixed input growth of 2.40%; hence productivity growth of Trusts is 0.96% between these two years.

In order to meet the challenge of reduced real increases in resources, the NHS has been set the target of increasing productivity by 2-3% a year (NHS England, 2014). Our previous reports have shown that this target is ambitious because the average increase since 2004/05 has been 1.17%. This latest report indicates that the NHS had zero productivity growth over the last year. To catch up with the 2-3% target, it implies having to find unprecedented productivity gains.

Establishing the reasons for the stagnation in NHS productivity is beyond the remit of this report. However, our findings suggest that the target growth in productivity of 2-3% may soon unattainable. There may thus need to be a reassessment of what the realistic funding needs of the NHS are, going forward.

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Appendix A

A.1 Technical details

In calculating productivity growth for the health care system, it is necessary to combine the multitude of outputs and inputs into single measures for both outputs and inputs. This requires the construction of an output growth index (X) and an input growth index (Z), with total factor productivity growth ΔTFP calculated by comparing growth in outputs with growth in inputs such that:

$$\Delta TFP = [X/Z] - 1 \quad \text{(A1)}$$

In order to estimate total factor productivity, it is necessary to correctly define and measure the output and input indices.

Output growth

Quantification of health care output is a challenge because patients have varied health care requirements and receive very different packages of care. To address this, it is necessary to classify patients into reasonably homogenous output groupings, such as Healthcare Resource Groups (HRGs) or Reference Cost (RC) categories. Furthermore, in order to aggregate these diverse outputs into a single index, some means of assessing their relative value is required. Usually prices are used to assess value, but prices are not available for the vast majority of NHS services for which people do not have to pay at point of use. In common with the treatment of other non-market sectors of the economy in the national accounts, costs are used to indicate the value of health services. Costs reflect producer rather than consumer valuations of outputs, but have the advantage of being readily available.

As costs are not believed to truly reflect consumers' valuations, Atkinson suggests supplementing costs with information about the quality of non-market goods and services (Atkinson, 2010). One way of doing this is by adding a scalar to the output index that captures changes over time in different dimensions of quality (Castelli et al., 2007). Thus, following Castelli et al. (2007), the output growth index (in its Laspeyres form) can be calculated across two time periods as:

$$X^{cq}_{(0,t)} = \frac{\sum_{j=1}^{J} x_{jt} c_{j0} \left[\frac{v_{j0} q_{jt}}{q_{j0}}\right]}{\sum_{j=1}^{J} x_{j0} c_{j0}} \quad \text{(A2)}$$

We define x_j as the number of patients who have output type *j*, where *j*=1…*J;* c_{jo} indicates the cost of output *j*; q_j represents a unit of quality for output *j*, and v_j is the value of this unit of quality; and *t* indicates time with 0 indicating the first period of the time series. Our measures of quality include inpatient and outpatient waiting times, health improvements (limited to four conditions), survival rates following hospitalisation, and blood pressure management in primary care.

Input growth

Turning to the input growth index (Z), inputs into the health care system consist of labour, material goods and capital. Growth in the use of these factors of production can be calculated directly or indirectly (OECD, 2001). A direct measure of input growth can be calculated when data on the volume and price of inputs are available. In its Laspeyres form, the input growth index can be calculated as:

$$Z^{D}_{(0,t)} = \frac{\sum_{n=1}^{N} z_{nt} \omega_{n0}}{\sum_{n=1}^{N} z_{n0} \omega_{n0}} \quad \text{(A3)}$$

Where z_{nt} is the volume of input of type *n* at time *t* and ω_{nt} is the price of input type *n* at time *t*.

However, data about the volume of inputs are rarely available. It is, therefore, common practice to calculate input growth using expenditure data. Changes in expenditure are driven by both changes in the volume of resource use and in prices. Hence to isolate the volume effect, it is necessary to wash out price changes by converting 'current' monetary values into 'constant' expenditure using a deflator π_{nt}. This deflator reflects the underlying trend in prices for the input in question, such that $\omega_{nt+1} = \pi_{nt}\omega_{nt}$.

If expenditure data and deflators are available, the input growth index can be specified as:

$$Z^{Ind}_{(0,t)} = \frac{\sum_{n=1}^{N} \pi_{nt} E_{nt}}{\sum_{n=1}^{N} E_{n0}} = \frac{\sum_{n=1}^{N} z_{nt}\pi_{nt}\omega_{nt}}{\sum_{n=1}^{N} z_{n0}\omega_{n0}} = \frac{\sum_{n=1}^{N} z_{nt}\omega_{n0}}{\sum_{n=1}^{N} z_{n0}\omega_{n0}} = Z^{D}_{(0,t)} \quad \text{(A4)}$$

As shown, this is equivalent to using volume data, provided that deflators correctly capture the trend in prices for each input in question.

Productivity growth

The above equations show output or input growth over two periods from a base (0) to a current period (*t*). Usually, there is interest in assessing productivity growth over longer periods of time. We do this by means of a chained index that involves updating weights in every period, thereby making it possible to account for ongoing changes in the composition of the outputs and inputs being measured (Diewert et al., 2010).

Using the Laspeyres output index as defined in eq. (A2), a chained output index takes the following form:

$$X^{cq}_{(0,T)} = \frac{\sum_{j=1}^{J} x_{jt} c_{j0} \left[\frac{v_{j0} q_{jt}}{q_{j0}}\right]}{\sum_{j=1}^{J} x_{j0} c_{j0}} \times \frac{\sum_{j=1}^{J} x_{jt+1} c_{jt} \left[\frac{v_{jt} q_{jt+1}}{q_{jt}}\right]}{\sum_{j=1}^{J} x_{jt} c_{jt}} \times \cdots \times \frac{\sum_{j=1}^{J} x_{jT} c_{jT-1} \left[\frac{v_{jT} q_{jT}}{q_{jT-1}}\right]}{\sum_{j=1}^{J} x_{jT-1} c_{jT-1}} \quad \text{(A5)}$$

This can be simplified as:

$$X^{c,q}_{(0,T)} = X^{c,q}_{(0,t)} \times X^{c,q}_{(t,t+1)} \times \cdots \times X^{c,q}_{(T-1,T)} \quad \text{(A6)}$$

where each link is represented by eq. (A2) for the relevant two consecutive years. An analogous construction applies to the chained input index.

Appendix B

B.1 Independent sector providers (non-NHS bodies): output, input and sensitivity analysis, 2014/15 – 2015/16

NHS Trusts and NHS Foundation Trusts sub-contract services to the independent sector. They do so for a number of reasons, the most common being the inability to meet capacity requirements (DH, 2016). Reference Costs data for non-NHS providers do not capture, as far as we are aware, services directly sub-contracted by either NHS England and/or by Clinical Commissioning Groups (CCGs).

Up until 2011/12, the Reference Costs data collection included information on the total volume and unit costs of NHS activity contracted out to the independent sector (non-NHS bodies). This series was discontinued until 2014/15 when NHS Improvement and NHS England re-mandated the collection and publication of the costs and the activity of the services sub-contracted out. Unit costs and activity provided by non-NHS bodies continued in 2015/16. The availability of activity and cost data for two consecutive years allows us to calculate the growth in NHS output sub-contracted to and provided by non-NHS bodies. However, since the collection of these data is still new, the DH warns that "it is difficult to be assured that the quality or consistency of the data will be consistent over the two years, making comparisons less meaningful." (Department of Health and Social Care, 2016) Another caveat to keep in mind is that the unit costs associated with services which are contracted out are not "[…] the same as the cost(s) of a provider delivering activity itself with the difference varying on a case by case basis depending on local arrangements."(Department of Health and Social Care, 2016).

With these two caveats in mind, Table B1: Volume and value of activity provided by non-NHS bodies, 2014/15 and 2015/16 shows the total volume and value of activity (both in current and constant terms) sub-contracted to non-NHS bodies in 2014/15 and 2015/16, for all services (see Box B1B1 for the full list of health care settings) provided but excluding inpatient activity. The latter is already covered in the national NHS output series as we derive the information on inpatient activity from the HES database.

Table B1: Volume and value of activity provided by non-NHS bodies, 2014/15 and 2015/16

Year	Volume of activity	Value of activity (current)	Value of activity (constant costs – base year, with correction for high and low cost outliers)
2014/15	3,712,158	74,254,313	73,761,799
2015/16	4,490,166	147,782,944	152,261,233

Box B1: Health care settings for which non-NHS bodies provided activity in 2014/15 and 2015/16

NHS settings
A&E Services
Chemo/Radiotherapy & High Cost Drugs
Community Care
Diagnostic Tests
Community Mental Health
Other
Outpatient
Radiology
Rehabilitation
Renal Dialysis
Specialist Services

In calculating total activity provided and reported in the RC dataset by non-NHS bodies, we follow the same quality checks as we do for the Reference Costs data for NHS Trusts and NHS Foundation Trusts. In particular, our quality assurance procedures check that no activity type has been affected by either a large change in the total volume (>500,000 units) or the total value (>£25,000,000) between two financial years under investigation. Our internal quality checks identified only one activity, Other Specialist Mental Health Services, Admitted Patient (code SPHMSOTHAPC), pertaining to the setting Community Mental Health, for which a large increase in the total value of activity was recorded. This activity was dropped from our analysis in both financial years. Thus, figures in Table 1 do not include the above dropped activity.

To calculate the growth in the total amount of activity sub-contracted to and provided by non-NHS bodies between 2014/15 and 2015/16, we divide the value of activity in constant terms for 2015/16 by the value of activity in constant terms for 2014/15 (see Table B1). Between 2014/15 and 2015/16 this amounts to a growth of over 106%.

Purchases for health care services from non-NHS bodies are already accounted for in the national NHS input series (see Table 49 of this report). Table B2 summarises the value of these purchases by type of NHS Trusts for 2014/15 and 2015/16 respectively.

Table B2 Purchases of health care services from non-NHS bodies (£000), 2014/15 and 2015/16

Year	Total value of purchases of health care services from non-NHS bodies (£000)		
	NHS Trust	NHS Foundation Trusts	Total
2014/15	306,654	475,113	781,767
2015/16	303,148	643,688	946,836

Finally, we conduct a sensitivity analysis including NHS activity provided by non-NHS providers in the overall NHS output measure, and calculate the resulting NHS productivity growth measure. Table B3 reports the NHS output, input and productivity growth rates for the whole NHS, and for the whole NHS including activity contracted out to independent sector providers. Table B4 restricts the analysis to outputs provided by NHS Trusts and non-NHS bodies only.

Table B3: NHS output, input and productivity growth rates, 2014/15 – 2015/16, NHS overall

Year		Output	Input	Productivity
2014/15 – 2015/16		*Indirect*		
	NHS Overall	2.63%	2.82%	-0.19%
	NHS Overall, incl. non-NHS bodies	2.78%		-0.05%
		Mixed		
	NHS Overall	2.63%	2.59%	0.04%
	NHS Overall, incl. non-NHS bodies	2.78%		0.19%

Table B4: NHS output, input and productivity growth rates, 2014/15 – 2015/16, Trusts and non-NHS bodies only

Year		Output	Input	Productivity
2014/15 – 2015/16		*Indirect*		
	Trusts only	3.38%	2.65%	0.71%
	Trusts only and non-NHS bodies	3.50%		0.83%
		Mixed		
	Trusts only	3.38%	2.40%	0.96%
	Trusts only and non-NHS bodies	3.50%		1.08%

We find that including services sub-contracted to non-NHS bodies increases the NHS productivity growth rate by 0.15 percentage points in the mixed method. Restricting the analysis to Trusts only, we find that including services delivered by non-NHS bodies increases the NHS Trusts only productivity growth rate by 0.12 percentage points (mixed method).

Appendix C

C.1 Summary Statistics of Reference Costs data by broad service setting

Table C1: Reference Cost settings, 2012/13 – 2013/14

Setting	2012/13			2013/14		
	Nr Cat.	Activity	Cost (£)	Nr Cat.	Activity	Cost (£)
A&E and Ambulance Services	89	34,952,786	3,692,014,018	90	35,051,392	3,923,106,579
Chemo/Radiotherapy & High Cost Drugs	317	6,754,603	2,652,051,626	323	6,988,301	2,915,174,231
Community Care	149	79,709,044	4,139,765,181	174	85,975,592	4,864,684,367
Diagnostic Tests	64	342,280,609	941,490,357	72	368,505,992	964,981,062
Community Mental Health	117	260,266,214	6,311,927,307	124	259,659,214	6,410,525,825
Outpatient	6,979	77,222,725	8,546,218,360	8,055	81,699,802	9,275,173,143
Radiology	5,047	9,381,616	859,058,674	136	9,709,456	904,796,391
Rehabilitation	119	2,715,650	817,792,033	113	3,002,512	893,588,640
Renal Dialysis	40	4,135,914	528,076,698	40	4,079,238	533,459,915
Specialist Services	86	4,359,263	2,927,444,066	145	4,699,893	3,030,502,560
Other	3,099	4,763,955	354,760,843	937	3,927,412	309,107,379

Appendix D

D.1 Growth in primary care output 2004/05 – 2015/16: an historic series

Introduction

We calculate growth in primary care output in a similar way as for any type of NHS output. This involves constructing a Laspeyres output index for primary care of the form:

$$X^{pc} = \frac{[\sum_{j=1}^{J} x_{jt+1} c_{jt}]q_{jt+1}}{[\sum_{j=1}^{J} x_{jt} c_{jt}]q_{jt}} \quad \text{(D1)}$$

Where x_j captures the national annual volume of primary care activity of type *j* such as GP surgery consultations, practice nurse consultations, GP home visits, c reflects the cost of each activity, q captures the quality of primary care activity, and t indexes time.

The main practical challenge in England is to derive information about the volume of each type of x_j. Ideally there would be a comprehensive and exhaustive dataset, akin to Hospital Episode Statistics (HES) in the case of secondary care, which routinely captures all activity. Although the data are already being captured by individual practice software management systems, there is no accessible single repository of these nationally.

From 2004/05 to 2008/09, we used data from QResearch (QR) as the basis for measuring primary care output (Fenty et al., 2006, Hippisley-Cox and Vinogradova, 2009), this representing a major data source in understanding primary care activity. The key data from QResearch are: the average number of consultations per person-year over time; the distribution of consultation rates across the population by five year age and gender bands; and the distribution of consultations by staff type and by location.

The problem is that QResearch data were last reported for 2008/09. With QResearch data no longer being available, and there being no alternative source of the volume of primary consultations, it has been necessary to estimate the growth in primary care output, taking 2008/09 as the baseline. There are three key elements to this process, which involve taking account of annual changes in the following:

1. Frequency of primary care contacts
2. Size and composition of the population
3. Quality of primary care

We have used different sources of information to do this over successive productivity reports, as data sources have changed or as we have refined our methods. In this note, we apply consistent data (insofar as is possible) and a standard methodology to construct an historical series.

Establishing the baseline

QResearch published figures by calendar year (2008) and financial year (2008/09)(Hippisley-Cox and Vinogradova, 2009).[28] In past productivity reports, we used the calendar year, but here we take the number of consultations reported by QResearch for the 2008/09 financial year (303,900k, rather than 300,400k). This is the baseline used in other estimates of changes in primary care activity, reviewed in Appendix B of our report 146 (Bojke et al., 2017).

[28] http://content.digital.nhs.uk/pubs/gpcons95-09

The QResearch figures are broken down by:

1. type of consultation based on location (surgery, home, phone) and type of contact (GP, practice nurse, other) and
2. five-year age and gender bands, which indicate differences in the propensity to have contact with primary care.

No recent data are available for either breakdown, so both compositional mixes have been assumed unchanged over time.

Changes in the frequency of primary care contacts

From 2008/09, we measured the frequency with which people had contact with primary care from annual national surveys. From 2008/09 we used the General Lifestyle Survey (GLS) and, from 2010/2011 onwards, the GP Patient Survey (GPPS) (Bojke et al., 2013). For the purposes of this historic series, we use the GPPS from 2008/09 to 2014/15.

From 2009/10 we account for the year-on-year change in the percentage of respondents who reported that they had last seen or spoken to a GP in the preceding three months (using the 2008/09 GPPS responses as a baseline). From 2012/13, we additionally take account of the change in the percentage of respondents saying that they had seen or spoken to a practice nurse in the preceding three months (with the 2011/12 responses as a baseline). Information about contacts with practice nurses had not previously been available. Taken from the GPPS, columns 1 and 2 of Table D1 report the percentages response of visiting a GP or nurse in the preceding three months.

We look at the percentage of survey respondents who answered they had seen or spoken to their GP (or practice nurse) in the last three months and compare this to the percentage from the previous year. This indicates how the frequency of primary care contacts has changed from one year to the next. This can be used to uplift the number of consultations in the previous year to the current year. The formulation is as follows:

$$\tilde{x}_{jt} = \frac{p_t}{p_{t-1}} \tilde{x}_{jt-1} \qquad \text{(D2)}$$

Here, $\tilde{x}_{jt}$ is the estimated number of GP or nurse observations of type *j* in year *t* and p_t is the proportion of individuals who have seen a GP or nurse in the last three months in year *t*. The baseline for the number of consultations is 2008/09, this being the last year in which there was a QResearch measure of the number of consultations.

As mentioned, we are forced to assume that the mix of consultation types (*j*) observed by QResearch in 2008/09 has not changed over time.

From this baseline GPPS ratios are applied year-by-year to obtain annual estimates of the number of consultations in each subsequent year. The resulting numbers of contacts are reported in column 3 of Table D1.

Changes in the size and composition of the population

The GPPS (and other such surveys) indicate how frequently a representative sample of the population has contact with primary care. But there will also be changes in the number of primary care contacts as a result of changes in the size and composition of the population. In our productivity calculations we started to take overall population growth into account in calculating primary care output growth from 2011/12 (Bojke et al., 2015), and took account of composition changes from

2013/14 (Bojke et al., 2017). In constructing this historical series we account for changes in the size and composition of the population since 2008/09 in a consistent fashion.

As can be seen in Figure 9, there has been a shift in the age composition of population which is now older. This also implies an increase in the number of consultations, as older people tend to have more consultations in a year. The QResearch data for 2008/09 provided a breakdown of consultation rates by five-year age and gender bands, there being marked differences in the propensity to contact primary care for different population sub-groups. Changes in the size and composition of the population are extrapolated forward from these propensities.

For this historical series we account for changes since 2008/09 in the size and composition of the population, using data published by the Office of National Statistics.[29] This allows us to derive a population-adjusted estimate of the volume of consultations. The formulation is as follows:

$$x_{jt} = \tilde{x}_{jt}\delta_{gt} \quad \text{(D3)}$$

Where δ_{gt} indicates population growth (from a baseline of 2008/09) for each (g=1…G) of the five-year age/gender groups. The resulting numbers of population-adjusted contacts are reported in column 4 of Table D1.

Changes in the quality of primary care

We account for changes in the quality of primary care using data captured as part of the Quality and Outcomes Framework (QOF), under which GPs are rewarded for achieving a range of diverse targets (Derbyshire et al., 2007). If disease management in primary care is improving over time, it suggests this will be reflected in reduced blood pressure for an increasing proportion of patients with Coronary Heart Disease (CHD), Stroke or Hypertension. Hence, primary care consultations are deemed to be 30% more valuable if a blood pressure reading equal or below the target of 150/90 is recorded.

To incorporate these aspects of quality into an output index for primary care, information is required about the prevalence rate for each of these three conditions, the QOF success rate, and the value of a consultation where a successful (below target) blood pressure reading is taken relative to other consultations. So, the cost-weighted volume of primary care consultations is weighted upwards if any feature successful blood pressure management, with the quality adjustment for primary care in any particular year being formulated as:

$$q_{jt} = 1 + [0.3 * (\sum_{m=1}^{3} P_{mt}S_{mt})] \quad \text{(D4)}$$

Where m indexes the three conditions $m = 1 \dots 3$, P_m is the prevalence rate for condition m and S_m is the QOF success rate for condition m.

The numbers for prevalence are obtained from Annex 1 of the QOF report.[30] Data about success rates are obtained from the Clinical results tables, available in the same report. These data are summarised in Table D2.

Output growth in primary care

The Laspeyres growth rates for primary care based on this historical series are reported in Table D3, while the growth rates reported in previous productivity reports are show in Table D4. Table D5

[29] https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections
[30] http://content.digital.nhs.uk/catalogue/PUB18887

reports the difference between the two sets of annual growth rates and provides a comment on the reasons for the differences. These reasons are:

- The use of QResearch data by financial year (FY) rather than calendar year (CY), as was originally used (Castelli et al., 2008).
- The consequent move to using the 2008/09 FY estimate of 303,900k rather than 300,400k as the baseline for future projections.
- The use of the GPPS to determine the frequency of primary care contacts – we had used the GLS for 2008/09 and 2009/10 (Bojke et al., 2012).
- Use of changes in the size and age-gender composition of the population from 2009/10. In our previous productivity reports, we had performed a crude population adjustment from 2011/12 (Bojke et al., 2015), and an age-gender adjustment from 2013/14 (Bojke et al., 2017).
- Inclusion of growth in contacts with practice nurses from 2012/13. Previously these were first introduced from 2013/140 (Bojke et al., 2017).

This series yields an estimate of 325,950k primary care consultations for 2015/16. This is considerably below the estimate for 2015/16 of 384,303k from a series produced by Deloitte (Deloitte, 2014). The Deloitte series should be treated with caution as it appears to be a simple linear trend, constructed by applying a forecast of population growth to the QResearch estimate of 303,900k consultations in 2008/09 (Bojke et al., 2017).

Table D1 Growth in the volume of consultations, historical series

Year	Patients who report having seen a GP in previous 3 months	Patients who report having seen a nurse in previous 3 months	Number of consultations (000s)	Population adjusted number of consultations (000s)	Quality and population adjusted number of consultations (000s)
	(1)	(2)	(3)	(4)	(5)
QR*					
2004/05				264,900	273,735
2005/06				283,200	293,842
2006/07				291,500	303,950
2007/08				291,900	304,670
2008/09				303,900	317,476
GPPS with age & gender population adjustment					
2009/10	55.15%		303,900	303,900	317,647
2010/11	52.37%		288,589	295,013	308,562
2011/12	54.00%		297,550	307,579	321,826
2012/13	54.83%		302,125	315,947	330,779
Allowing for consultations with a practice nurse					
2012/13**	54.83%	35.80%	302,779	316,631	331,495
2013/14	54.28%	35.91%	301,253	318,249	333,484
2014/15	53.38%	35.86%	298,024	318,519	333,842
2015/16	51.47%	34.81%	288,092	311,103	325,950

* Number of consultations from 2004/05 to 2008/09 is taken from: Consultations Report 22 - QRESEARCH financial year consultations 2008/9 (http://www.qresearch.org)
** From 2012/13, the calculation now also includes those who'd seen a primary care nurse.

Table D2: Quality adjustment for primary care (%)

Year	Prevalence			QOF achievement		
	CHD	Stroke	Hypertension	CHD	Stroke	Hypertension
2004/05	3.57	1.63	11.06	78.60	73.13	64.33
2005/06	3.57	1.66	11.48	84.44	81.22	71.05
2006/07	3.54	1.61	12.49	88.86	86.92	77.62
2007/08	3.50	1.63	12.79	89.41	87.55	78.35
2008/09	3.47	1.66	13.13	89.68	87.88	78.56
2009/10	3.44	1.68	13.35	89.77	88.12	78.72
2010/11	3.40	1.71	13.52	90.16	88.58	79.30
2011/12	3.38	1.74	13.63	90.14	88.61	79.65
2012/13	3.40	1.70	13.68	90.57	89.26	80.79
2013/14	3.29	1.72	13.73	91.27	89.84	83.09
2014/15	3.25	1.73	13.79	91.98	88.17	83.61
2015/16	3.20	1.74	13.81	91.89	87.63	82.90

Box D1: Original sources of QOF data (links are not stable)

2003/4-2005/6
http://www.ic.nhs.uk/webfiles/QOF/2006-07/QResearch%202006-70%20QOF/Times%20Series%20Analysis%20for%20Selected%20Clinical%20Indicators%20from%20QOF%202001-2006%20-%20Tables%20%28v1-0%29.xls
2006/7
http://www.ic.nhs.uk/webfiles/QOF/2006-07/National%20QOF%20tables%202006-07%20-%20prevalence.xls
2007/8
http://www.ic.nhs.uk/webfiles/QOF/2007-08/NewFilesGS/National%20QOF%20tables%202007-08%20-%20prevalence.xls
2008/09
http://www.ic.nhs.uk/webfiles/QOF/2008-09/QOF%20Achievement%20and%20Prevalence%20Bulletin%202008-09.pdf
2010/11
http://www.ic.nhs.uk/statistics-and-data-collections/supporting-information/audits-and-performance/the-quality-and-outcomes-framework/qof-2010-11/qof-2010-11-data-tables/qof-prevalence-data-tables-2010-11
2011/12
http://content.digital.nhs.uk/catalogue/PUB08135
2012/13
http://content.digital.nhs.uk/catalogue/PUB12262
2013/14
http://content.digital.nhs.uk/catalogue/PUB15751
2014/15
http://content.digital.nhs.uk/catalogue/PUB18887
2015/16
https://digital.nhs.uk/catalogue/PUB22266

Table D3: Laspeyres growth rates for primary care – historic series

Years	Unadjusted Growth rate	Population adjusted growth rate	Population and quality-adjusted growth rate
2004/05-2005/06		6.91%	7.35%
2005/06-2006/07		2.93%	3.44%
2006/07-2007/08		0.14%	0.24%
2007/08-2008/09		4.11%	4.20%
2008/09-2009/10		0.00%	0.05%
2009/10 - 2010/11	-5.04%	-2.92%	-2.86%
2010/11 - 2011/12	3.11%	4.26%	4.30%
2011/12 - 2012/13	1.54%	2.72%	2.78%
2012/13 - 2013/14	-0.50%	0.51%	0.60%
2013/14 - 2014/15	-1.07%	0.08%	0.11%
2014/15 - 2015/16	-3.33%	-2.33%	-2.36%

Table D4: Laspeyres growth rates for primary care - from previous reports

Years	Unadjusted Growth rate	Population adjusted growth rate	Population and quality-adjusted growth rate
2004/05-2005/06		6.59%	7.15%
2005/06-2006/07		3.50%	4.01%
2006/07-2007/08		-0.17%	-0.07%
2007/08-2008/09		2.70%	2.79%
2008/09-2009/10		0.00%	0.06%
2009/10 - 2010/11	-2.29%	NA	-3.39%
2010/11 - 2011/12	3.51%	NA	4.79%
2011/12 - 2012/13	1.54%	2.39%	2.45%
2012/13 - 2013/14	-1.01%	0.27%	0.37%
2013/14 - 2014/15	-1.07%	-0.16%	-0.14%
2014/15 - 2015/16	N/A	N/A	N/A

Source: (Bojke et al., 2017)

Table D5: Difference in growth rates between Tables 3 & 4

Years	Unadjusted Growth rate	Population adjusted growth rate	Population and quality-adjusted growth rate	Explanation for difference
2004/05-2005/06		0.32%	0.20%	QResearch FY rather than CY figures
2005/06-2006/07		-0.57%	-0.57%	
2006/07-2007/08		0.31%	0.31%	
2007/08-2008/09		1.41%	1.41%	
2008/09-2009/10		0.00%	-0.01%	
2009/10 - 2010/11	-2.75%		0.53%	2008/09 FY baseline; GPPS larger fall in contacts than GLS; Crude population adjustment
2010/11 - 2011/12	-0.40%		-0.49%	2008/09 FY baseline; Crude population adjustment
2011/12 - 2012/13	0.00%	0.33%	0.33%	2008/09 FY baseline; Crude population adjustment
2012/13 - 2013/14	0.51%	0.24%	0.23%	2008/09 FY baseline; Crude population adjustment; Include nurse contacts
2013/14 - 2014/15	0.00%	0.24%	0.25%	2008/09 FY baseline; Age & gender population adjustment

Appendix E

E.1 Deflators

We use various deflators to adjust our expenditure series, as shown in Table E1. We use the Hospital and Community Health Services (HCHS) prices index for deflating the expenditure on capital and material goods. For Primary Care expenditure, we use the HCHS pay and prices deflator, while we construct our own deflator for pharmaceutical expenditure. For labour and agency staff we originally used the HCHS pay deflator. The advent of the Electronic Staff Record data has allowed us to construct our own ESR pay deflator, which we have employed since 2011/12. The HCHS and ESR pay deflators are usually quite similar.

Table E1: Deflators

	Pay HCHS (ESR) deflator	Prices deflator	Pay and Prices deflator	Pharmaceuticals
2004/05 - 2005/06	4.7%	1.9%	3.7%	-9.9%
2005/06 - 2006/07	-1.1%	3.0%	3.7%	-3.4%
2006/07 - 2007/08	3.5%	1.8%	2.9%	-6.2%
2007/08 - 2008/09	3.0% (3.33%)	5.2%	3.9%	-5.2%
2008/09 - 2009/10	1.8% (2.38%)	-1.3%	0.6%	-3.7%
2009/10 - 2010/11	3.1% (1.19%)	2.8%	3.0%	-1.7%
2010/11 - 2011/12	0.9% (2.8%)	4.1%	2.1%	-4.4%
2011/12 - 2012/13	0.9% (0.8%)	3.1%	1.7%	-7.2%
2012/13 - 2013/14	0.7% (0.5%)	1.8%	1.1%	-1.5%
2013/14 - 2014/15	0.3% (0.5%)	1.7%	0.9%	-1.31%
2014/15 - 2015/16	0.3% (1.9%)	2.70%	1.32%	-0.07%

Appendix F

F.1 Trusts-only productivity measures

While the main body of our text focuses on a full NHS measure of productivity, we also produce estimates of Trusts-only productivity changes, and the components thereof.

As shown in Table F1, **when we look at the activity performed by Trusts only, the quality-adjusted output index rises to 3.38% mainly due to the exclusion of primary care activity.**

Similarly, we can also produce a Trusts-only input index. **As shown in Table F1, the input index is lower when taking only Trusts into account, with a mixed index suggesting growth of 2.40% and indirect index growth of 2.65%**. The larger growth observed in the NHS input index (mixed 2.59% and indirect 2.82%) is driven by the growth of the NHS England group expenditure in materials.

Table F1: Input, output and productivity growth, Trusts only

Years	Output Growth		Input growth	Productivity growth
2013/14 – 2014/15	2.86%	**Mixed**	2.27%	0.58%
		Indirect	1.46%	1.39%
2014/15 – 2015/16	3.38%	**Mixed**	2.40%	0.96%
		Indirect	2.65%	0.71%

Using this information we can produce Trust-only productivity growth figures, estimated as 0.96% for the mixed measure and at 0.71% for the indirect measure.