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Productivity of the English National Health Service: 2016/17 Update

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No ethical approval was needed.

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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 2015/16 to 2016/17 and reports trends in output, input and productivity since 2004/05.

NHS productivity growth is measured by comparing the growth in outputs produced by the NHS to the growth in inputs used to produce them. NHS outputs include all the activities undertaken for NHS patients wherever they are treated in England, and also 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 continuously increased since the start of this series in 2004/05. Over 5.2 million more hospital patients were treated as electives, day cases or emergency admissions in 2016/17 than in 2004/05. This is equivalent to an increase of about 42%. Outpatient attendances have also increased, by approximately 131% since 2004/05, with over 60 million more contacts in 2016/17 compared to 2007/08.[1] In calculating productivity, adjustments are made for changes in quality of care. 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 has increased by 60% between 2004/05 and 2016/17, and by 3.51% between 2015/16 and 2016/17.

Increases in NHS outputs have been mirrored by increases in inputs. Between 2004/05 and 2016/17, expenditure on NHS staff increased by 57.4%. In the same period, NHS expenditure on Agency staff has evolved quite erratically, with periods of increased use followed by periods of restraint. Overall Agency staff expenditure has increased by 88.5% since 2004/05, following the first year-on- year fall in expenditure since 2011/12. Expenditure on materials and capital increased by 202.3% and 189.2% respectively between 2004/05 and 2016/17. Altogether expenditure on NHS inputs increased by 79.5% since 2004/05, and by 3% (in current terms) between 2015/16 and 2016/17. This equates to overall input growth in real terms, using the preferred direct measure of labour, of 0.64% between 2015/16 and 2016/17.

Over the last twelve years NHS productivity has increased by 16.52%. Productivity growth has been positive, with one exception, since 2009/10, with year-on-year growth averaging 1.30%. Productivity growth between 2015/16 and 2016/17 was 2.86%.

[1] Outpatient activity data in 2004/05 are not directly comparable to Outpatient activity data in 2016/17. 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
APC	Admitted Patient Care
AD	Admitted
CCG	Clinical Commissioning Group
CHD	Coronary Heart Disease
CIPS	Continuous Inpatient Spell
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
GPPS	GP Patient Survey
H&SC Act	Health & Social Care Act 2012
HCHS	Hospital and Community Health Services
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
RDNA	Regular Day and Night Attendance
SHA	Strategic Health Authority
SUS	Secondary Uses Service
TFR	Trust Financial Returns

Contents

1 Introduction

This report updates the Centre for Health Economics' time-series of National Health Service (NHS) productivity growth. The full productivity series runs from 1998/99 (Bojke et al., 2016b), but this report updates the series to account for growth between 2015/16 and 2016/17, as well as looking at the 12 year trends starting from 2004/05.

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 2015/16 and 2016/17. This latest 'link' is then attached to the chained index that reports productivity changes over the last decade. Appendix A reports the methodology followed in the construction of the output, input and productivity growth indices.

NHS output growth between two financial years is calculated by means of a Laspeyres growth index, which aggregates different types of NHS output using the previous year's cost for each specific output as weights. We adjust our output measure for quality, specifically 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 facilitate a meaningful comparison of the volume of 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 2015/16 and 2016/17. Specific details are provided about any potential data collection and coding artefacts that may compromise a genuine like-for-like comparison across these 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. The summary and concluding remarks are provided in Section 5.

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.[2] 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 2015/16 – 2016/17. 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 2015/16 and 2016/17 data
Elective	HES	RC	30-day/in-hospital survival; health outcomes waiting times	Activity described by HRG4+. Since 2014/15 we have used in-hospital survival.
Non-elective	HES	RC	30-day /in-hospital survival; health outcomes	Activity described by HRG4+. Since 2014/15 we have used in-hospital survival.
Outpatient	HES (or RC)	RC	Waiting times	Waiting time comes 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+. Since 2014/15 we have used in-hospital survival.
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

[2] 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.[3] HES is comprised of 20.6m records in 2015/16 and over 21.1m in 2016/17. We convert HES records, defined as Finished Consultant Episodes (FCEs), into Continuous Inpatient Spells (CIPS) using the official algorithm for calculating CIPS as published by NHS Digital (formerly the Health and Social Care Information Centre).[4] 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. In this report, we updated the code used to construct CIPS to reflect changes introduced by NHS Digital in the HES variable 'Admission Method (*admimeth*)'.[5] The old code only considered non-emergency transfers when determining CIPS, whilst the new code also takes into account emergency transfers from another hospital provider. The introduction of the new code for constructing CIPS has resulted in a reduction in the number of CIPS for the financial year 2015/16.

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). Research by Daidone and Street (2011) suggests that results are not sensitive to alternative methods of calculating the costs of CIPS on the basis of the first episode or the sum of all episodes. Reference Costs are reported for each HRG according to their point of delivery, indicating whether the patient was treated as 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 newly recorded (retiring) activities. In such cases we deflate (inflate) costs in order to impute missing values (Castelli et al., 2011). Between the years 2015/16 and 2016/17, 87 new HRGs were introduced, 35 were discontinued, 18 HRGs kept the same code but had a new description and 199 HRGs had a new code but the same description as existing HRGs.[6]

[3] Consistently with previous publications of this series, we continue to exclude patients categorised to HRGs which are not included in the tariff ('Zero Cost HRGs').

[4] http://www.hesonline.nhs.uk/Ease/servlet/ContentServer?siteID=1937&categoryID=1072 (last access 07/02/2019)

[5] The variable '*admimeth*', that specifies a patient's admission method, changed from a numeric to a string variable, and a new form of admission, Transfer of an admitted patient from another Hospital Provider in an emergency (category 2B) is included now as a separate category. Previously, it was not possible to distinguish emergency admissions from another hospital provider from any other type of admission as they were all captured by the generic category 'Other means (category 28)', which included all patients who arrive via the A&E department of another healthcare provider.

[6] Regarding the 18 HRGSs that kept the same code but had a new description: 14 belong to the subchapter 'GA' (Hepatobiliary and Pancreatic System Open Procedures), two to 'NZ' (Obstetric Medicine) and the other two remaining to the subchapters 'YR' (Vascular Imagining Interventions) and 'SA' (Haematological Procedures and Disorders), respectively. Regarding the HRGs with new code but with the same description: 111 belong to the subchapter 'FF' (Digestive System Open and Laparoscopic Procedures), 34 'FE' (Digestive System Endoscopic Procedures), 54 'FD' (Digestive System Disorders).

The vast majority of activity captured in HES is performed by hospital Trusts. As shown in Table 2, just over 97% of all activity was performed in Trusts in both 2015/16 and 2016/17. The proportion of activity performed by private providers is gradually increasing: in 2012/13 they provided 2.1% of all activity, increasing to 2.7% in 2015/16 and to 2.8% in 2016/17.

Table 2: Organisational coverage of HES activity, FCEs

Year	NHS Trusts	Private providers	Other[7]	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
2016/17	20,532,853	590,517	165	21,123,535

2.2.1 Elective, day case and non-elective activity

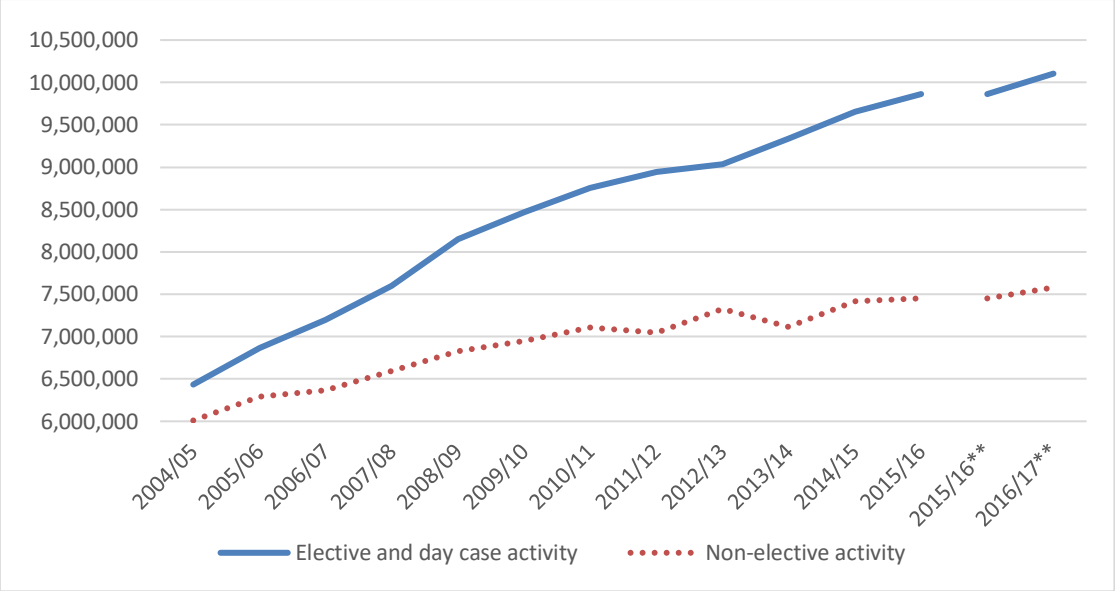
As can be seen from Table 3, elective and day case activity has increased by just over 57% over the 12 year period covered in this report, from 6.4m to 10.1m CIPS, while non-elective activity has increased by about 26%, from 6m to 7.6m CIPS. While elective activity has grown steadily, growth in non-elective activity shows a more erratic pattern, as can be also observed in Figure 1. Between 2015/16 and 2016/17 the number of elective CIPS increased by 241,194 CIPS (equivalent to a 2.4% increase), while non-elective activity increased by 129,208 CIPS (equivalent to a 1.7% increase).

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
2015/16**	9,862,566		1,590*	7,450,701	1,577
2016/17**	10,103,760		1,569*	7,579,909	1,570

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; ** Figures reflect the new CIPS methodology, following the changes in the HES variable 'admission method'.

[7] Primary Care Trusts (2012/13 only) and organisations with the org_code starting with 8 or A.



** Figures reflect the new CIPS methodology, following the changes in the HES variable 'admission method'.

Figure 1: Changes in elective and day case and non-elective activity

After cost-weighting this activity, we observe 2.45% growth in activity for electives and day cases and a growth of 3.98% for non-elective activity between 2015/16 and 2016/17. Combining both series, the total cost-weighted activity growth amounts to 3.10%.

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. 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 2-3 present average values for each of these measures over time.

[6] http://www.ons.gov.uk/ons/rel/lifetables/national-life-tables/index.html (last accessed 07/02/2019)

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
2016/17	-	99.94%	22.8	83	-	97.24%	33.3

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

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 those 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. The smaller the ratio, the bigger is the health improvement associated with the treatment.

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
2016/17	0.86	0.39	0.46	0.73

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 (Dawson et al., 2005). In this report, we also assign the above constant PROMs ratios to CIPS with error code UZ01Z. This follows from considerations that patients with a UZ01Z HRG code within the PROMs dataset are a very small and non-random sub-sample of all patients with a UZ01Z HRG code in the HES Inpatient dataset. Therefore, the average PROM ratios for UZ codes would be an unreliable estimate of the quality adjustment for all UZ codes in HES. For example, in the previous report that compared the financial years 2014/15 – 2015/16 the PROM ratios associated to UZ codes (0.339 and 0.313 respectively) were assigned to all UZ codes leading to a small overestimation of the overall quality adjusted hospital inpatient growth rates. See Table F2 in Appendix F for the corrected figures.

There is little variation in mean life expectancy for those treated in hospital over the entire period, as shown in Figure 2.

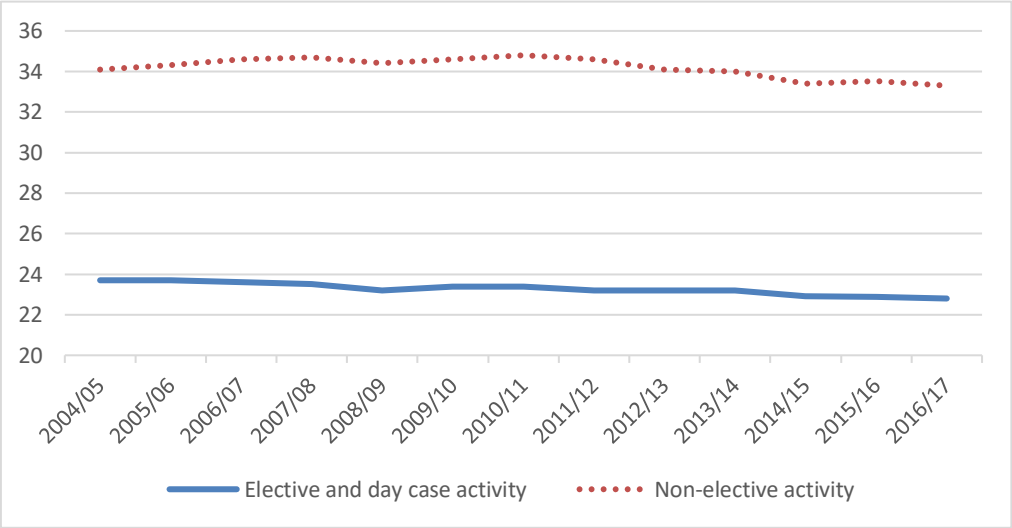


Figure 2: Mean life expectancy

A slight negative trend can be observed in recent years: this is most 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. In particular, between 2015/16 and 2016/17 the mean life expectancy decreased by 0.1 and 0.2 years for electives and non-elective patients respectively. This, however, masks sometimes large variations in life expectancy at the HRG level.

In 2016/17 average waiting times increased by three days compared to 2015/16, as shown in Figure 3.

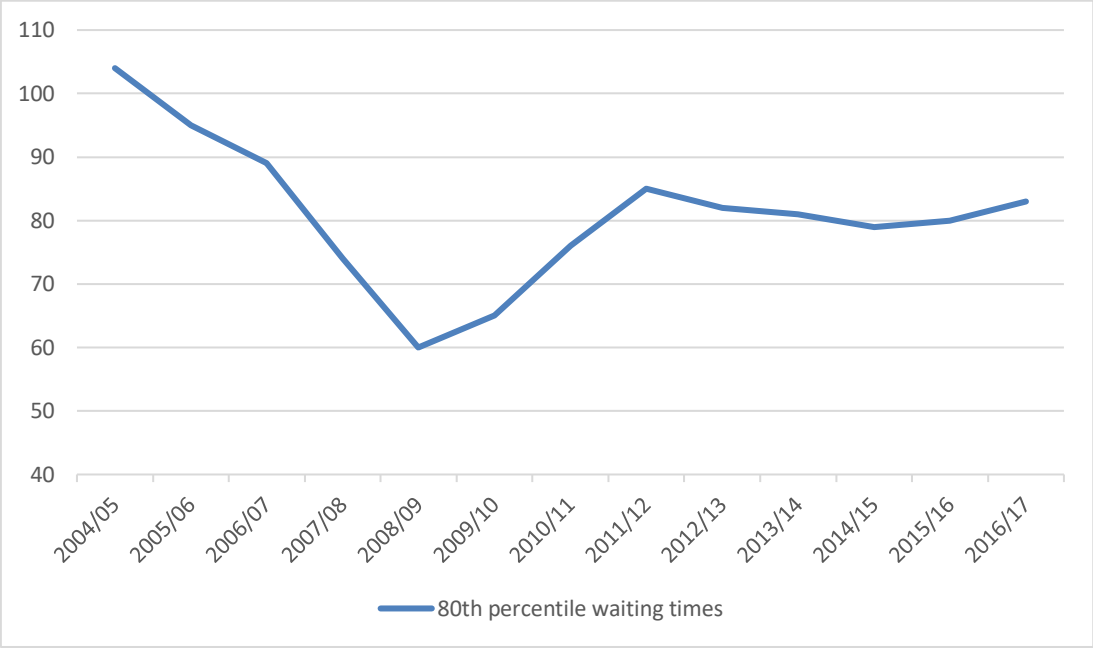


Figure 3: 80th percentile waiting times

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 3.66%.**

We find that the 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 2015/16 and 2016/17 are 2.41% and 5.32% respectively. There is a small deterioration in the quality for elective and day case activity that is driven by longer waiting times and shorter life expectancy of the patients treated (i.e. patients treated are on average older). Survival rates and PROMS show an improvement but do not compensate for the deterioration of the two other quality measures. On the other hand, the quality adjustment for non-elective activity is positive and substantial as both survival and life expectancy have improved.

2.2.3 Inpatient mental health

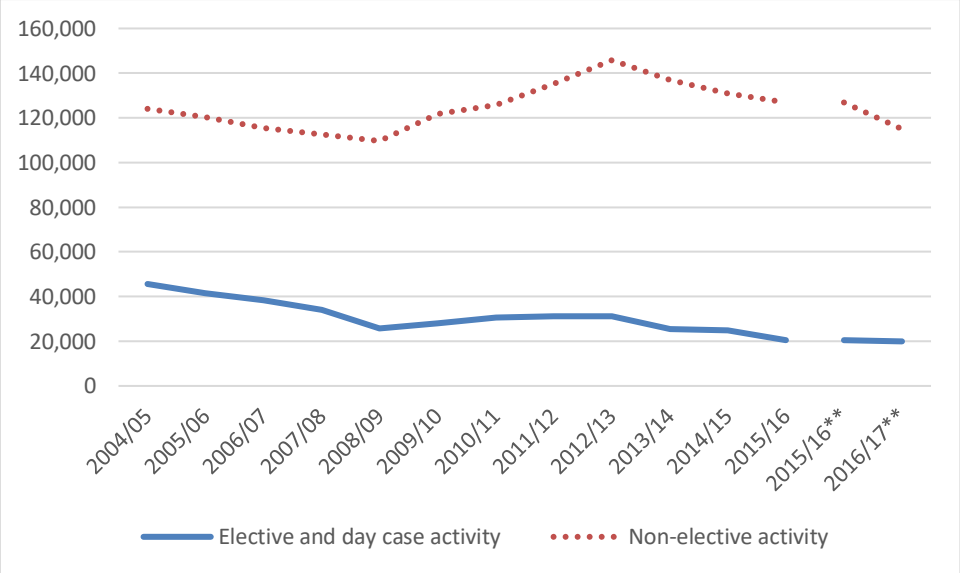
Until 2015/16 we identified mental health patients as those for which the HRG falls into the subchapter 'WD' (Treatment of Mental Health Patients by Non-Mental Health Service Providers). There were three mental health HRGs in 2015/16, but in 2016/17 those three have been discontinued and split into 15 different HRGs (9 in the 'WD' subchapter, 2 in the 'AA' subchapter (Nervous system procedures and disorders) and 4 in the 'WH' subchapter (Poisoning, Toxic Effects, Special Examinations, Screening and Other Healthcare Contacts)). In this case, we deflate current costs in order to impute prior values as previously stated.

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 four 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
2015/16	20,478	1,396	126,899	1,417
2015/16**	20,483	1,396	126,867	1,417
2016/17**	19,933	1,450	114,956	1,472

Note:** Figures reflect the new CIPS methodology, following the changes in the HES variable 'admission method'.



** Figures reflect the new CIPS methodology, following the changes in the HES variable 'admission method'.

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 an overall decline of -8.47% between 2015/16 and 2016/17. The decline is more evident for non-elective activity than for elective, with cost-weighted growth rates equal to -9.39% and – 2.69%, respectively. We conjecture that the negative growth observed in the last five 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
2016/17	-	98.91%	30.3	59	-	98.04%	25.1

[a] Previously reported figures showed the average across HRGs; from 2012/13 the figures show the 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). On average, all the quality measures have deteriorated with respect to 2015/16: MH patients show lower in-hospital survival rates, lower mean life expectancy and wait longer for treatments. **Hence, once we take quality adjustment into account, output growth from 2015/16 to 2016/17 decreases from -8.47% to -9.32% for Mental Health provided to patients admitted to hospital.**

2.2.5 *HES outpatient activity*

Outpatient activity can be derived from both the HES Outpatients Dataset and the RC data. In this section we present summary statistics for outpatient activity derived from the HES Outpatient dataset. This dataset does not include unit cost information, which we derive from the RC data. 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 definitional 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.

A further difference between HES and RC recorded activity is that HES covers activity conducted by organisation types other than Trusts. In addition, HES contains data on appointments which were attended and those which were not. Only attended appointments, representing approximately 80% of recorded data, are included in the RC series.

For the purpose of attaching unit cost data to HES outpatient activity, we 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 95% of records being matched to an associated RC code, the remaining unmatched records are 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
2016/17	112,038,760	121.74

Table 8 shows the volume and average cost of attended outpatient activity. **After cost weighting the activity, the Laspeyres growth in outpatient activity amounts to 5.37%.**

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 68 days in 2016/17. However, accounting for this has virtually no impact on the growth index which drops slightly to 5.34%.

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
2016/17		48	68

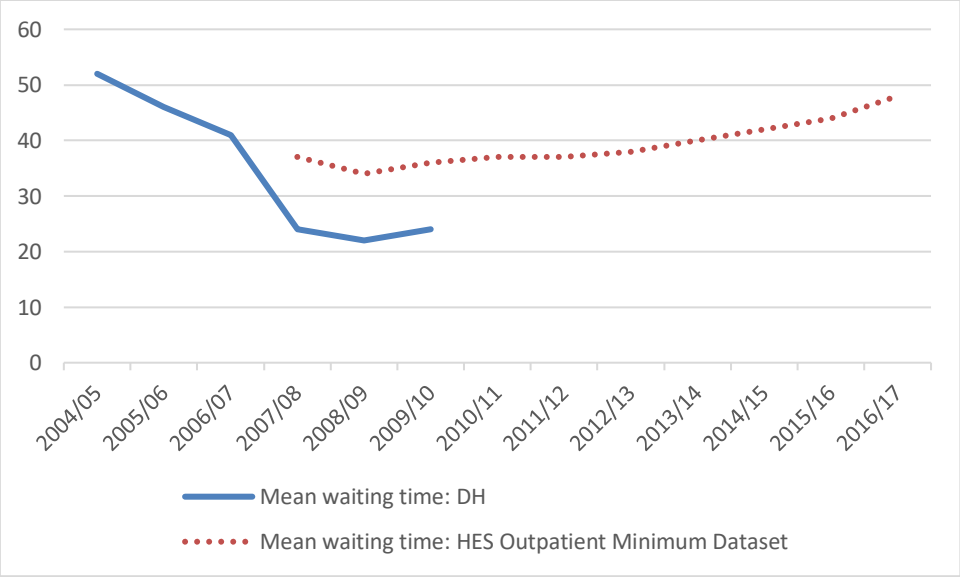


Figure 5: Trends in outpatient waiting times

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.

RC returns, in their main schedule, only cover activity undertaken by hospital Trusts, but since 2014/15 RC returns have also been 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. These validations, both mandatory and non, are carried out also by NHS Improvement, which has been commissioned to collect and report Reference Cost data since 2014/15, see Castelli et al. (2018).

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. Since 2015/16, we have revised our quality and assurance process, which now consists of four steps.

In step 1, we check whether a large change in either the total volume (>500,000 units) or the total value (>£25,000,000) of NHS activity/HRG codes as reported in the Reference Cost returns can be detected. The check compares volumes of activity, unit costs and total costs of the last two financial years in the national productivity series.

In step 2, we identify cases of NHS activity/HRG codes that do not appear to be genuine. This step might require further investigation and may lead to the identification of a sub-set of HRG/service codes related to the NHS activity/HRG codes flagged as not being genuine changes.
Limited to the HRG/service codes that have been identified as requiring further investigation, two further steps are followed, when applicable:

In step 3, we check whether any of the flagged HRG/service codes are 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). If this is not the case, then in step 4, we analyse the data in greater detail to identify the source of the large change in either volume or value of activity.

The current quality check compared the Reference Cost data for the financial years 2015/16 and 2016/17. It identified 17 types of activity/HRG codes, pertaining to three different NHS settings,

with a large change in the total volume of the activity and nine types of activity/HRG codes, pertaining to four different NHS settings, with a large change in the total volume of activity reported. Table 10 and Table 11 list NHS activity/HRG codes with a large change in volumes and a large changes in values respectively, as well as summary statistics.

Further in-depth investigation in these NHS activity/HRG codes did not identify any inaccuracies with the data reported in the Reference Costs returns and no further action/adjustments were deemed necessary for the 2016/17 update.

Table 12 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 2015/16 and 2016/17 across the different settings.

Table 10: Large changes in Volumes of Activity, 2015/16 – 2016/17

NHS setting	Service/HRG code	2016/17		2015/16		Diff in Volume
		Activity (a)	Unit Cost (£) (b)	Activity (c)	Unit Cost (£) (d)	(a) – (c)
Community Care	N02AF	30,371,780	£37	28,905,584	£38	1,466,196
Community Care	N03F	4,115,184	£55	4,666,923	£53	-551,739
Community Mental Health	MHCC99	25,563,335	£8	20,128,996	£8	5,434,339
Community Mental Health	MHCC07	17,774,673	£9	16,868,894	£10	905,779
Community Mental Health	MHCC05	10,068,969	£12	9,440,495	£12	628,474
Community Mental Health	MHCC12	17,990,955	£12	18,584,390	£11	-593,435
Community Mental Health	MHCC11	21,444,287	£8	22,068,752	£8	-624,465
Community Mental Health	MHCC20	8,953,402	£6	9,617,603	£6	-664,201
Community Mental Health	MHCC04	18,661,725	£8	19,979,242	£9	-1,317,517
Community Mental Health	MHCC03	10,388,165	£7	12,162,886	£7	-1,774,721
Community Mental Health	MHCC19	26,347,133	£5	28,345,991	£5	-1,998,858
Community Mental Health	MHCC18	28,136,002	£4	30,976,717	£4	-2,840,715
Diagnostic tests	DAPS04	246,468,097	£1	234,557,502	£1	11,910,595
Diagnostic tests	DAPS07	21,877,751	£8	20,700,717	£8	1,177,034
Diagnostic tests	DAPS05	43,200,087	£3	42,045,618	£3	1,154,469
Diagnostic tests	DAPS09	6,382,090	£3	5,250,509	£3	1,131,581
Diagnostic tests	DAPS03	44,093,504	£2	44,881,533	£2	-788,029

Table 11: Large change in the value of activity, 2015/16 – 2016/17

NHS Setting	Service / HRDG code	2016/17		2015/16		Total value of 2016/17 activity in 2016/17 costs (£)	Total value of 2016/17 activity in 2015/16 costs (£)	Diff in Value
		Activity (a)	Unit Cost (£) (b)	Activity (c)	Unit Cost (£) (d)	(e)	(f)	(f) – (e)
A&E	ASS02	5,277,120	£247	5,167,876	£236	£1,306,086,176	£1,247,724,034	-£58,362,142
A&E	VB08Z	2,869,564	£171	2,869,320	£157	£490,504,392	£449,649,020	-£40,855,372
A&E	VB11Z	1,807,819	£105	1,860,471	£91	£190,577,369	£164,094,912	-£26,482,457
Chemo/Radiotherapy & High Cost Drugs	XD31Z	166,884	£1,115	162,902	£1,392	£186,105,472	£232,325,710	£46,220,237
Chemo/Radiotherapy & High Cost Drugs	XD21Z	45,202	£439	7,982	£1,592	£19,824,446	£71,955,020	£52,130,574
Community Care	N03G	3,406,977	£75	3,712,433	£65	£255,756,466	£220,790,083	-£34,966,383
Community Care	N02AF	30,371,780	£37	28,905,584	£38	£1,121,525,866	£1,153,429,067	£31,903,201
Community Care	IC02	1,272,790	£288	945,767	£314	£367,195,260	£399,472,759	£32,277,499
Community Mental Health	CAMHSCC	1,882,991	£221	1,520,145	£242	£416,434,665	£456,399,199	£39,964,534

Table 12: Reference cost settings

Setting	2015/16			2016/17		
	Nr Cat.	Activity	Cost (£)	Nr Cat.	Activity	Cost (£)
A&E and Ambulance Services	92	37,792,911	4,454,964,482	93	38,758,786	4,818,530,379
Chemo/Radiotherapy & High Cost Drugs	340	6,283,287	3,697,193,821	342	6,789,735	4,824,078,484
Community Care	184	86,767,072	5,171,028,803	176	87,751,894	5,329,232,493
Diagnostic Tests	81	367,378,910	984,870,571	84	382,697,201	1,010,246,713
Community Mental Health	156	253,346,232	354,670,482	157	250,019,639	5,989,209,182
Outpatient	9,616	85,394,479	10,221,877,406	9,627	87,017,943	10,631,641,076
Radiology	267	10,755,438	1,048,586,605	263	11,342,904	1,074,705,162
Rehabilitation	99	2,985,717	990,145,041	96	2,893,451	959,182,247
Renal Dialysis	37	4,157,008	556,027,298	38	4,240,850	567,754,893
Specialist Services	143	5,162,337	3,402,452,724	146	5,426,763	3,456,507,951
Other	1,130	3,990,126	319,906,305	1,135	3,886,440	298,967,522

Note: A Table summarising the RC data according to broad service settings for the years 2012/13 - 2015/16 can be found in Appendix C.

2.3.2 RC outpatient activity

Outpatient activity as measured in the RC database is 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. Consultant led activity for Trusts represents about 60% of overall outpatient activity, non-consultant led just under 25%, whilst outpatient procedures are just under 15% of overall outpatient activity, increasing considerably, since 2007/08 when their share was about 3%.

Table 13: 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
2016/17			87,017,943	122

The Laspeyres output growth measure for outpatient activity, as captured by the Reference Costs data, is 2.7% for financial years 2015/16 and 2016/17.

The difference between HES and RC measures of outpatient activity growth is about 2.64%, 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 14 reports summary statistics for A&E services provided in Emergency Departments (EDs) 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 2015/16 and 2016/17, the total number of emergency department attendances declined slightly by 0.1%, with a decrease of

[9] https://digital.nhs.uk/data-and-information/data-tools-and-services/data-services/hospital-episode-statistics/hospital-episode-statistics-data-dictionary, p.15(last accessed 12/03/2019)

about 3.3% in the number of people being subsequently admitted to hospital. EDs attendances not leading to admitted hospital stay increased by just under 1.1% between 2015/16 and 2016/17.

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 6.7% between 2015/16 and 2016/17, with patients being subsequently admitted to hospital decreasing by 0.2%.

Overall, the total volume of A&E activity increased by 1.5% between 2015/16 and 2016/17. However, the number of patients subsequently being admitted to hospital as emergency cases, decreased between 2015/16 and 2016/17. This continues a similar pattern observed between 2014/15 and 2015/16. We think that it might be an indication of people presenting at A&E departments (of all types) with ambulatory care conditions, which should have been attended to in a primary care setting.

Table 14: 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
2016/17	3,966,820	238	11,039,457	152	472,913	78	4,515,570	67

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

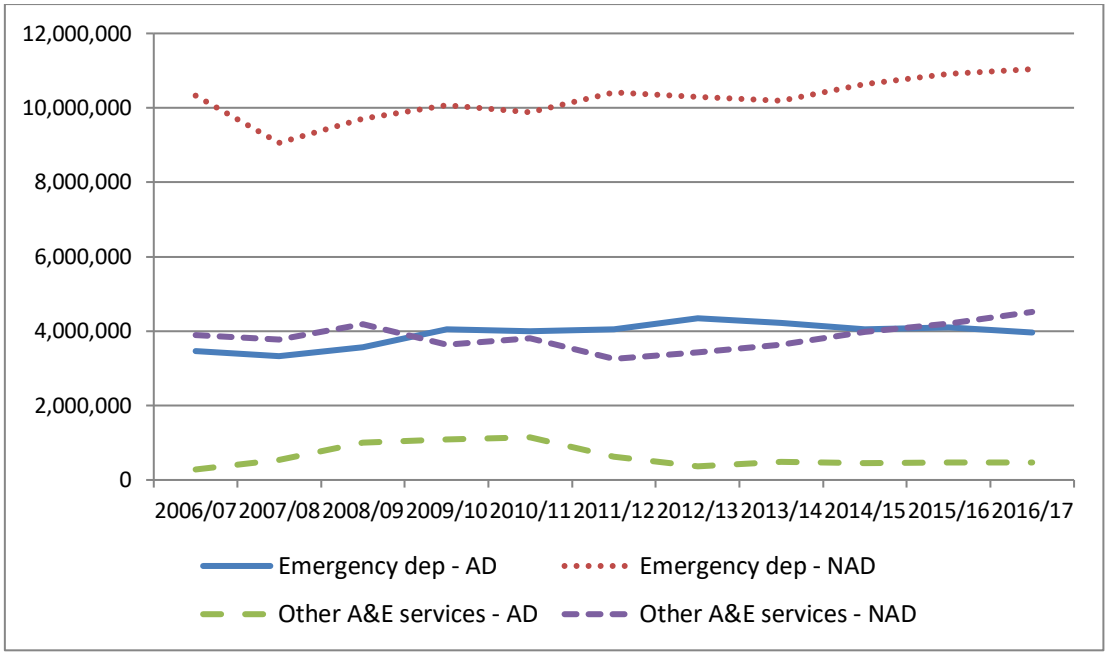


Figure 6: Trend of A&E activity across settings

Ambulance services are reported in Table 15 for the four years since this type of NHS 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 both categories 'See and treat or refer' 'See and treat and convey'. Overall activity by ambulance services continued to increase between 2015/16 and 2016/17 with a growth rate of 3.71%.

Table 15: 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
2016/17	10,238,451	7	806,804	37	2,441,651	181	5,277,120	247

The Laspeyres output growth measure for the setting 'A&E services', which includes ambulance services, increased by 2.2% between 2015/16 and 2016/17.

2.3.4 Chemotherapy, Radiotherapy & High Cost Drugs

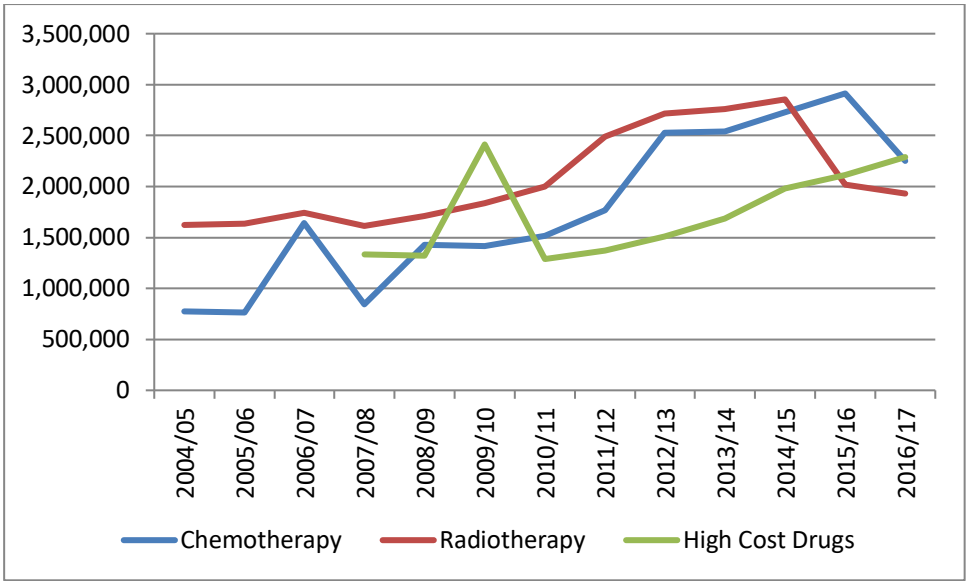
The categories used to describe Chemotherapy, Radiotherapy, and High Cost Drugs have been subject to substantial revisions over time, making it difficult to infer much from the simple counts of activity reported below in Table 16 and Figure 7. However since 2013/14 categorisation has been fairly stable for all three types of activity. High Cost Drugs had three new category added in 2016/17, whilst Radiotherapy has one less category in 2016/17 and Chemotherapy had no categorisation changes. Contrary to growth rates found between 2014/15 and 2015/16, in the most recent link, only High Cost Drugs recorded an increase in the raw volume of activity between 2015/16 and 2016/17 of about 8.2%, whilst both Chemotherapy and Radiotherapy recorded a decrease in the total volume of activity of respectively 22.7% and 4.43%. It is worth noting, however, that the average cost of Chemotherapy activity increased by 33% between 2015/16 and 2016/17.

Overall, however, the Laspeyres output growth measure for Chemotherapy, Radiotherapy & High Cost Drugs increased by 8.4% between 2015/16 and 2016/17.

Table 16: 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
2016/17	2,253,067	605	1,929,548	198	2,288,895	917

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 17 reports total volumes of Community Care activity from 2004/05 to 2016/17. With the dismantlement of Primary Care Trusts (and Personal Medical Services Pilots) in 2011/12, Community Care experienced a big drop in its recorded and reported activity for a number of years. However, we note that from 2013/14 reported activity has continuously increased. Between 2015/16 and 2016/17 Community care activity increased by 1.14%, with an associated **Laspeyres output growth index of 2.3%.**

Table 17: 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
2016/17	87,751,894	61

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.

2.3.6 Diagnostic tests, pathology and radiology

In 2014/15, Nuclear Medicine (included in the Radiology setting), underwent a complete re-categorisation exercise, increasing the level of granularity in the reporting of activity, with the total number of categories growing from 7 in 2013/14 to 139 in 2016/17.

Table 18: 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
2016/17	7,849,470	32	374,847,731	2	11,342,904	95

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 2015/16 and 2016/17, respectively by 5.1%, 4.1% and 5.46%. **The Laspeyres output growth for each broad type of test was 5.6%, 3.8% and 6.8% respectively, leading to an overall growth for these combined activities of 5.5%.**

2.3.7 Community mental health

Table 19 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 19: 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
2016/17		250,019,639	24

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. In 2016/17 activity and cost information for IAPT activity continued to be reported in a comparable manner to 2015/16 and hence, we have included this type of Community Mental Health activity in our output growth measure.

However, we have to report three separate tables summarising Community Mental Health activity: one for the years from 2011/12 to 2014/15, one for the financial years 2014/15 and 2015/16, for which we had to exclude IAPT activity, and finally one for 2015/16 and 2016/17. However, an adjustment had to be made to the Mental Health data as the accompanying report to the 2016/17 Reference Cost data states on p. 7 that 'the methodology for collecting some secure services data was changed to a combination of pathway and cluster; it is no longer viable to compare unit costs across years'. All secure mental health services have been excluded from the calculation of the Community Mental Health output growth measure for the years 2015/16 and 2016/17.

Note that 'Other Mental Health' activity underwent a re-labelling of broad category exercise back in 2014/15, which has since continued. Thus, in Table 20 the categories reported under 'Other Mental Health' activity are different from those reported in Table 21 and Table 22.

Table 20: 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 21: 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

Table 22: Care clusters and other mental health activity, 2015/16 – 2016/17

Community mental health	2015/16		2016/17	
	Volume of activity	Average cost (£)	Volume of activity	Average cost (£)
Care Clusters				
Mental Health – Care Clusters – Admitted Patient Care	5,269,507	388	5,187,204	404
Mental Health - Care Clusters - Non-Admitted Patient Care	239,684,860	9	236,183,269	9
Mental Health – Care Clusters – Initial Assessment	773,308	306	822,296	301
Adult IAPT Mental Health Care Clusters	1,038,873	275	886,645	310
Adult IAPT Mental Health Care Clusters Initial Assessments	602,437	115	726,002	127
Total volume 'Mental Health Care Clusters'	**247,368,985**	**19**	**243,805,416**	**18**
Other Mental Health *				
Children and Adolescent Mental Health Services	1,993,978	255	2,418,240	234
Drug and Alcohol Services	1,519,640	105	1,270,174	110
Mental Health Specialist Teams	2,111,275	165	2,101,077	171
Secure Mental Health Services	-	-	-	-
Specialist Mental Health Services	352,354	219	424,732	223
Total volume Other Mental Health	**5,977,247**	**183**	**6,214,223**	**187**
Total volume of Community MH activity	**253,346,232**	**23**	**250,019,639**	**24**

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

In terms of raw activity, Community Mental Health decreased by 1.3% from 2015/16 to 2016/17; the cost -weighted output growth measure, however, increased by 1.35% over the same time period, which is possibly due to the increase in the average costs associated with some of the Community Mental Health activity, as shown in Table 22**.**

2.3.8 Rehabilitation and renal dialysis

The volume of rehabilitation and renal dialysis activity over time is reported in Table 23. **The Laspeyres output growth for Rehabilitation and Renal Dialysis services were, respectively, -3.1% and 2.1% between 2015/16 and 2016/17.**

Table 23: 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
2016/17	2,893,451	332	4,240,850	134

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2.3.9 Specialist services

This NHS setting includes the following specialist services: Adult critical care, Specialist palliative care, Cystic Fibrosis and Cancer multi-disciplinary team meetings; their volumes and costs are reported in Table 24.

Table 24: 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
2016/17	2,792,536	1,082	914,564	152	11,489	9,198	1,708,174	111

The total volume of Adult Critical Care services increased by 0.5%, that of Specialist Palliative care by 6.9%, Cystic Fibrosis raw activity decreased by 3.01% and the total volume of Cancer Multi-Disciplinary Team Meetings activity increased by 12.6% between 2015/16 and 2016/17.

Taken together, the Laspeyres output growth measure for Specialist Services increased by 1% between 2015/16 and 2016/17.

2.3.10 Other Reference Cost activities

Other types of activity reported in the Reference Costs are summarised in Table 25. The categorisation of these activities has changed somewhat over the series covered in this report, with some type of activities being either discontinued or subsumed under other broader categories.

Table 25: 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	-	-
2016/17	242,322	325	3,452,571	57	191,547	125	-	-

The total volume of RDNA activity increased by 7.9%, whilst the total volume of Audiological services and of Day Care Facilities decreased respectively by -2% and -20.8% between 2015/16 and 2016/17. Hospital at Home services are now captured under Community Intermediate Care activities in the community care setting.

The Laspeyres cost-weighted output growth measure for 'Other NHS activity' decreased by 2.6% between 2015/16 and 2016/17.

2.3.11 Total Reference Cost growth

NHS activity as captured by the Reference Cost returns grew by 2.73% if we include Outpatient activity and by 2.74% if Outpatient activity is excluded from the series.

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 26.

Output for all dental services, except for those in Band 1, has continued to decrease in 2016/17**. Overall, the Laspeyres growth rate for dental activity decreased by 0.68% between 2015/16 and 2016/17.**

Data about the volume of activity for ophthalmology are published by NHS Digital on a bi-annual basis.[11]

Table 27 presents the volume of activity and cost for ophthalmic services over time. For the last two financial years, cost data for Ophthalmological services are those provided by the Association of Optometrists. The new cost data are reported in the last column of Table 27.

[10] https://digital.nhs.uk/data-and-information/publications/statistical/nhs-dental-statistics/nhs-dental-statistics-for-england-2016-17 (last accessed12/03/2019)

[11] https://digital.nhs.uk/data-and-information/publications/statistical/general-ophthalmic-services-activity-statistics/general-ophthalmic-services-activity-statistics-england-year-ending-31-march-2017 (last accessed 12/03/2019)

Table 26: Dental services

Year	Dentistry										
	Band 1		Band 2		Band 3		Urgent		Other		Total
	Volume activity	Av cost (£)	Volume activity	Av cost (£)	Volume of 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	18.8	11,251,942	51	2,129,467	223	3,693,752	19	169,831	19	1,545,498,706
2016/17	22,939,419	20	11,080,848	54	2,082,785	234	3,664,913	20	156,905	20	1,611,200,931

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

Table 27: 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
2016/17	12,995,512	28	21

Ophthalmic activity increased only slightly, 0.1%, between financial years 2015/16 and 2016/17. As the average costs have not changed since 2010/11, cost-weighted output growth measure is simply the growth in the volume of activity.

Combining activity for dental services and ophthalmology, the cost-weighted output growth is -0.53% between 2015/16 and 2016/17.

2.5 Primary care activity

Table 28 summarises the data sources for primary care consultations used since 2004/05.

Table 28: 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	

QResearch (QR) was the initial source of data used to measure primary care output (Fenty et al., 2006) and it divided primary care consultations into a subset of activity, based on location (surgery, home, phone) and type of contact (GP, practice nurse, other).

In 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, the GP Patient Survey does not ask the interviewees to state the type of contact they had or the location; thus, we assume that the distribution of contacts as observed in the 2008/09 QResearch data is unchanged for all subsequent years. This is obviously a shortcoming of our data, as the distribution of patients seen by different members of staff or in

different locations may well have changed in recent years, due to the high pressure faced by general practitioners and the introduction of new healthcare professionals roles in primary care as set out in the General Practice (GP) Forward View (2016).

The methods used to estimate consultation rates and the population growth adjustment are based on Bojke et al. (2017). Figure 8 reports the population shares for 2008/09 and 2016/17, as well as the average number of consultations, which is also computed on the population proportions of 2008/09. As for the previous years, we observe a shift in the age of population with respect to the base year (2008/09), this means that compared to 2008/09 the share of the older population is growing faster than that of the youngest people. As a consequence, we would expect an increase in the number of consultations, given that older people tend to consult the GP more often than younger ones. However, starting from 2013/14 the percentage of people interviewed who declared to have seen a GP in the last three months is slowly decreasing. This is, however, not true for nurse contacts, as the percentage of interviewed people who have seen a nurse in the previous three months has increased in the latest financial year (see Table 29).

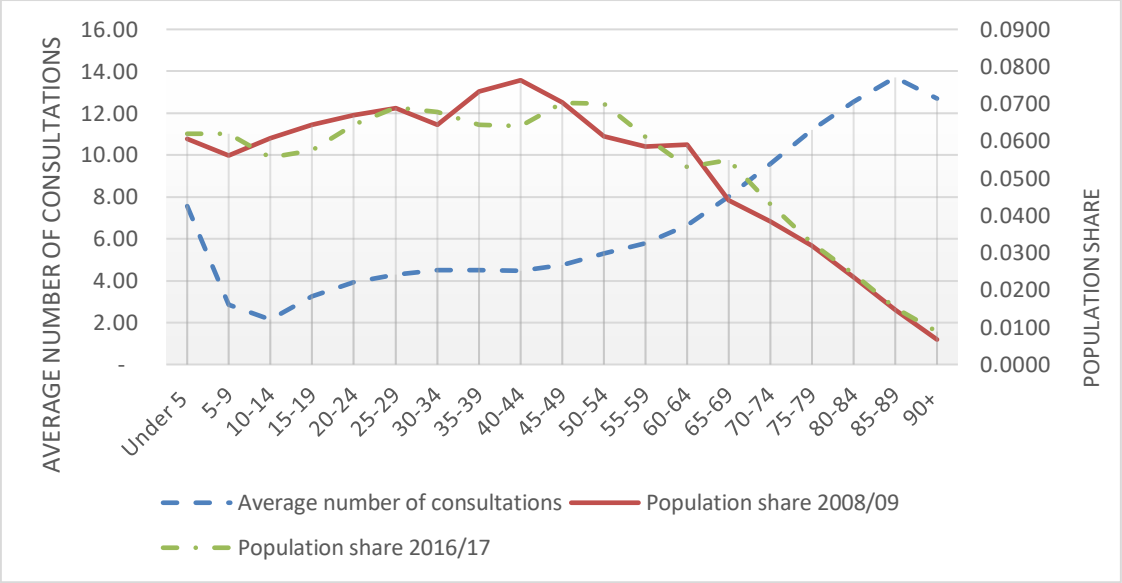

Figure 8: Population characteristics

Table 29: CHE GPPS based measure of volume of consultations

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	314,366	329,415
2014/15**	53.28%	35.86%	298,024	313,865	328,965
2015/16**	51.47%	34.81%	288,092	306,093	321,736
2016/17	50.32%	35.87%	287,569	313,792	328,841

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 had 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 numbers of primary care consultations reported in Table 29 do not constitute a consistent historic series and should not be interpreted or used as such. For the historic series, please see Appendix D in Castelli et al. (2018).

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 30.

Table 30: 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
2016/17	114	15	37	37	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.

The quality of primary care activity is measured limitedly to Coronary heart disease, Stroke and Hypertension and are accounted for using the Quality & Outcomes Framework (QOF) achievement indicators.[12] (Derbyshire et al., 2007)

The data on prevalence are taken from Annex 1 of the QOF report and data on success rates are obtained from the Clinical results tables, also in the same report.[13] As shown in Table 31 the QOF achievement for 2016/17 increased with respect to the previous financial year. As a consequence, the quality-adjusted primary care output growth between 2015/16 and 2016/17 is expected to be higher than that recorded in the previous two financial years.

[12] These are QOF CHD002 for Coronary Heart Disease, STIA003 for Stroke and HYP006 for Hypertension.

13 https://digital.nhs.uk/data-and-information/publications/statistical/quality-and-outcomes-framework-achievement-prevalence-and-exceptions-data/quality-and-outcomes-framework-qof-2016-17 (last accessed 30/01/2019).

Table 31: Quality adjustment for primary care (%)

Year	Prevalence			QOF achievement		
	CHD	Stroke	Hypertension	CHD	Stroke	Hypertension
2004/05	3.57	1.63	10.41	78.6	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	87.51	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	3.40	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	82.9
2016/17	3.15	1.75	13.83	92.43	88.06	83.36

The Laspeyres growth rates for primary care activity are reported in Table 32.

Table 32: 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%	-0.16%	-0.14%
2014/15 - 2015/16	-3.33%	-2.48%	-2.51%
2015/16 - 2016/17	-0.18%	0.86%	0.89%

Looking at the last financial year, the growth in primary care consultations, as emerged from the GP survey data, is still negative (-0.18%), but it is showing an improvement compared to previous years. Accounting for population growth has a positive impact bringing the growth in primary care consultations up to 0.86% from a two consecutive years' negative growth. Finally, adjusting for quality of care adds a further 0.03 percentage points to the growth. This is entirely due to better results in the QOF achievements for both CHD and Hypertension.

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 33 reports summary statistics about community prescribing. Drugs are categorised according to their chemical composition, with the number of categories changing over time. From the peak number of categories reported in 2004/05 (8,779 categories), the number of categories decreased, reaching an all-time low in 2013/14 (7,809 categories) before picking up again. However, some of these variations are usually due to zero counts in some years, rather than definitional changes which are in fact stable over time.

In 2016/17, the data report information on 8,147 distinct community prescribed drug items corresponding to an increase of 21 million prescriptions compared to the previous year. On the contrary, the total cost in 2016/17 decreased and it is approximately £9.2 billion, almost £100 million less than in 2015/16. These estimations are in line with those published in the 2017 Official Statistics Reports on Prescription Cost Analysis (Prescribing & Medicines Team, 2018). 780 new drug items appeared in 2016/17 for a total spending of £61 million, and 654 drug items were not prescribed in the same year corresponding to a lagged total cost of £29 million. There are no data items which appear obviously incorrect and we therefore take the data at face value.

Table 33: 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
2016/17	8,147	1,108,965,909	£9,193,912,893	8.29

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 33). Output and price indices for community prescribing are reported in Table 34. Prices have fallen year-on-year over the whole period, the drop is much higher in 2016/17 compared to 2015/16, and it is equal to about -7%.

Table 34: 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
2015/16 - 2016/17	0.9300	1.0644

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.

On the contrary, the Laspeyres output growth measure for prescriptions has continued to increase and the year-on-year growth is equal to 6.4% between 2015/16 and 2016/17.

Taking the base year as 2004/05, trends in the volume and prices of pharmaceuticals are shown in Figure 9.

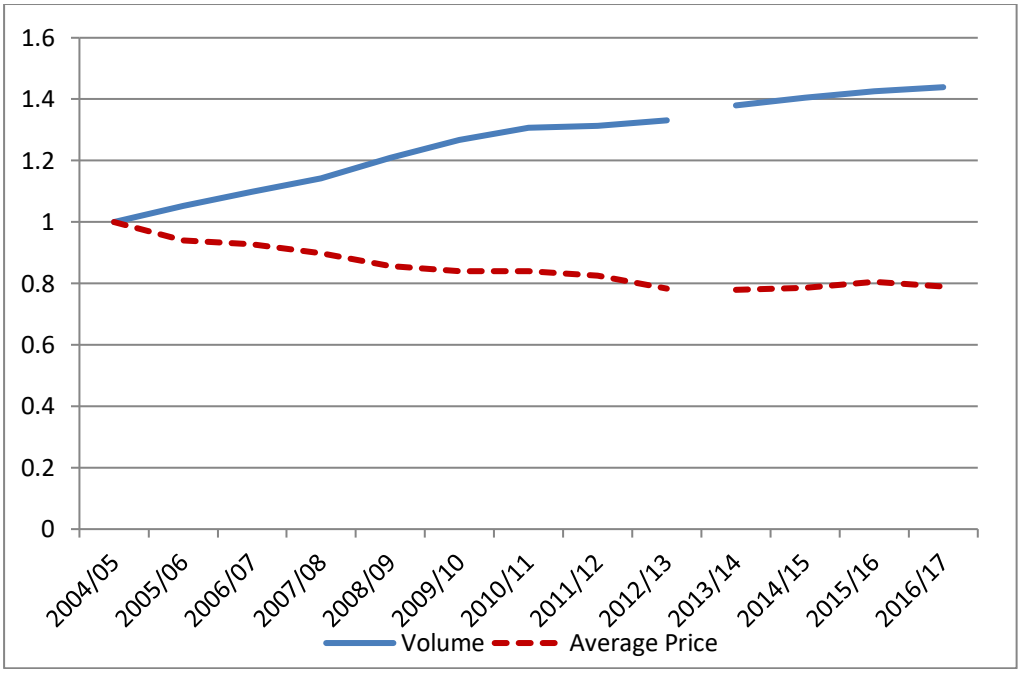

Figure 9: Price and volume changes for community prescribed pharmaceuticals

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 35, the cost-weighted output growth index increased by 3.35% between 2015/16 and 2016/17.

Re-scaling each type of cost-weighted output, where appropriate and feasible, according to changes in survival, health improvements, waiting times, and blood pressure monitoring generates the quality-adjusted index. This increased by 3.51% between 2015/16 and 2016/17. This is about 0.16% higher than the cost-weighted index, with improvements registered in some of the quality measures (survival rates, life expectancy, QOF achievements in primary care for CHD and Hypertension) and deteriorations in others (waiting times and QOF achievement in primary care for Stroke).

Table 35: 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%	2.58%*
2015/16 –2016/17	3.35%	3.51%

* The quality adjusted CW growth rate for 2014/15 – 2015/16 differs from the one reported in Castelli et al. (2018) as it has been updated to reflect a change in the methods of assigning PROMs to HES activity with UZ01 code. Please refer to Section 2.2.2 for full details.

2.7.1 Contribution by settings

Not all settings contribute equally to the output index. Figure 10 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 36.

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.

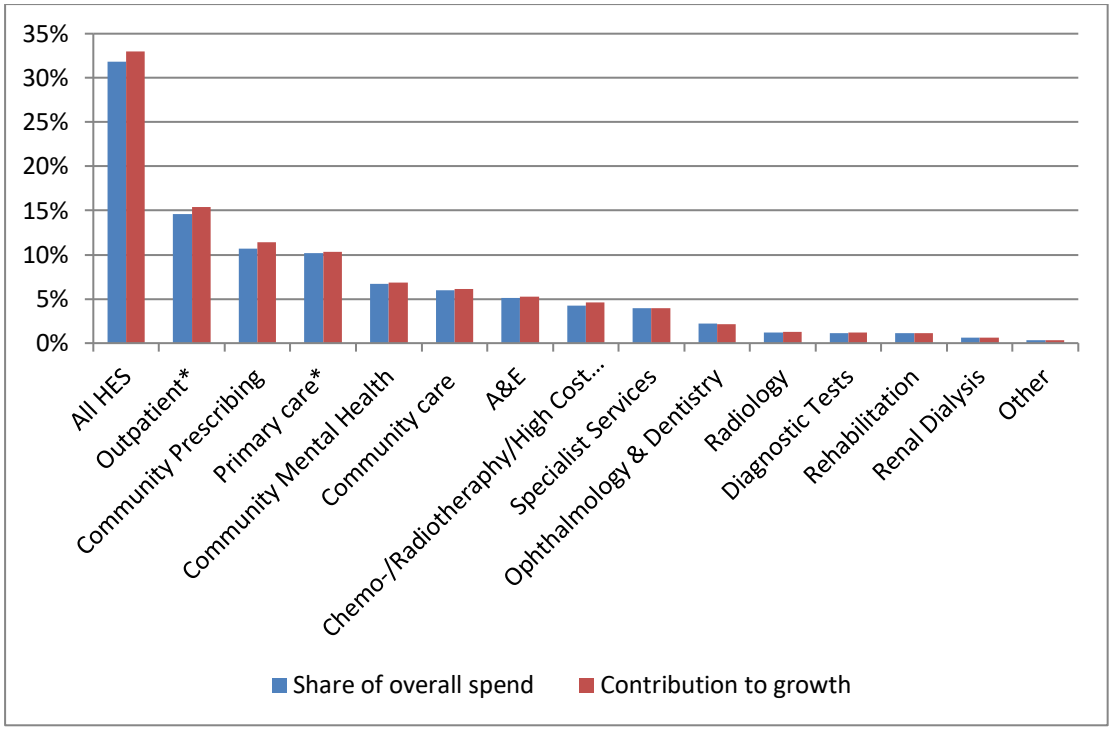

Figure 10: Contribution by setting, 2016/17

Table 36: Contribution of setting to growth, 2016/17

Setting	Growth	Setting specific growth index	Value of Activity (15/16 prices)	Share of overall spend	Contribution to growth
All HES*	3.6%	103.6%	27,638,191,417	31.83%	32.96%
Outpatient*	5.3%	105.3%	12,677,072,886	14.60%	15.38%
Community Prescribing	6.4%	106.4%	9,288,424,660	10.70%	11.39%
Primary care*	0.9%	100.9%	8,860,359,095	10.20%	10.29%
Community Mental Health	1.3%	101.3%	5,841,604,305	6.73%	6.81%
Community care	2.3%	102.3%	5,171,028,803	5.96%	6.09%
A&E	2.2%	102.2%	4,454,964,482	5.13%	5.24%
Chemo-/Radiotheraphy/High Cost Drugs	8.4%	108.4%	3,697,167,367	4.26%	4.61%
Specialist Services	1.0%	101.0%	3,402,452,724	3.92%	3.96%
Ophthalmology & Dentistry	-0.5%	99.5%	1,902,442,161	2.19%	2.18%
Radiology	6.8%	106.8%	1,048,541,345	1.21%	1.29%
Diagnostic Tests	4.2%	104.2%	984,825,204	1.13%	1.18%
Rehabilitation	-3.1%	96.9%	990,073,776	1.14%	1.10%
Renal Dialysis	2.1%	102.1%	556,027,298	0.64%	0.65%
Other	-2.6%	97.4%	319,329,769	0.37%	0.36%
Total/ NHS Output growth rate			**86,832,505,292**		**3.51%**

*All HES, Primary Care and Outpatient activity are quality adjusted. ** The contribution of each setting to growth in 2016/17 is expressed as a percentage of the total output in 2015/16. 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 use expenditure data. Labour data come 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 measuring 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 have used ESR data to calculate growth in labour inputs.[14] These data are obtained from the NHS iView database[15] which draws data directly from the ESR, and combined Payroll and Human Resources system for the NHS. The data contain the number of full time equivalent (FTEs) staff and earnings for over 580 different occupational groups. All staff employed by NHS organisations are included.[16] 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.[17]

The ESR data collection method was updated in March 2016, resulting in several developments to improve the quality of data available. A complete list of developments was published by NHS Digital in 2016 and a notice on the implemented changes is available on NHS Digital website.[18] The implications of this general change in methodology are discussed in Castelli et al. (2018).

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 contains average earnings by occupational group.[19] In our calculation we sum basic and non-basic pay to get total earnings for each staff group. As non-basic pay is not reported by FTEs, but only by headcount, we multiply non-basic pay first by an FTE/headcount ratio to get the equivalent FTE number (as advised by NHS Digital).

From November 2016, information about FTE staff and earnings by category is reported separately for ‘core’ and ‘wider’ services. Core services are made up of hospital Trusts and commissioning

[14] Up to 2006/07, we used data from the Workforce Census to count the number of staff working in the NHS.
[15] https://digital.nhs.uk/services/iview-and-iviewplus (last accessed 19/03/2019)
[16] 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))
[17] https://digital.nhs.uk/data-and-information/publications/statistical/nhs-workforce-statistics (last accessed 19/03/2019)
[18] https://digital.nhs.uk/data-and-information/areas-of-interest/workforce (last accessed 19/03/2019)
[19] In the past we had information on total earnings per month, without separation in basic/non-basic.

bodies. Wider services are made up of central support services such as NHS England. In order to be comparable with 2015/16 data, we reconstruct the total of FTE staff and wage in each category across core and wider services. For FTE staff, a sum is taken in each category. For wages, a weighted average is calculated for each staff category, where proportion of FTE staff in the relevant service act as weights. If a wage is only available for a single service type, we assume this wage also reflects the average for equivalent staff in the other service type.

Gradually more and more Clinical Commissioning Groups (CCGs) have been reporting ESR data, although for the financial year 2016/17 6 CCGs out of 210 are still not doing so (Table 37).

Table 37: Number of reporting entities by organisation type

Organisation type	2010/11	2011/12	2012/13	2013/14	2014/15	2014/15[a]	2015/16	2016/17
CCGs	n/a	n/a	9	152	202	202	201	204
CSUs	0	0	0	24	25	22	11	8
NHS England	0	0	1	1	1	1	1	1
Non-geographical staff	0	1	1	1	1	1	1	1
PCTs	147	142	132	40	26	10	0	0
SHA	10	10	10	2	0	4	0	0
NHS Trusts	248	260	260	251	249	249	240[b]	239

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.

[b] The total number of NHS Trusts for 2015/16 is 240, and not 249 as previously reported in Castelli et al. (2018).

Table 38 shows expenditure by organisational type as determined by the summed product of staff group FTEs and average earnings. The major trends of increasing expenditure from Trusts and CCGs recorded since 2014/15, continues in 2016/17. The proportional increase in expenditure on staff in CCGs has been large over the past two years. This is as expected as more CCGs have reported to the ESR dataset over time. There is also a sharp increase in non-geographic staff. However, the impact of this figure on overall staff expenditure is modest and remains within the range of expenditure on the same staff group in previous years.

Table 38: Expenditure on labour in current prices (£m)

Organisation type	2010/11 (£)	2011/12 (£)	2012/13 (£)	2013/14 (£)	2014/15 (£)	2014/15 (£)[a]	2015/16 (£)	2016/17 (£)
CCGs	0	0	7	434	535	530	619[20]	722
CSUs	0	0	0	318	306	333	261	211
NHS England	0	0	1	221	205	202	171	173
Non-geographical staff	0	157	143	76	71	16	8	57
PCTs	5,822	3,742	1,329	89	1	0.15	0	0
SHA	133	114	110	0.4	0	0.32	0	0
NHS Trusts	28,809	31,761	33,753	34,510	35,820	35,131	36,319	37,492

[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 39. Changes from 2015/16 to 2016/17 are similar to those observed in recent previous years.

[20] A rounding error in reporting expenditure of CCGs in 2015/16 was found whilst updating the NHS productivity series; this figure should have been 619 and not 618 as reported in Castelli et al. (2018).

Table 39: NHS staff numbers

	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2014/15[c]	2015/16	2016/17
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	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	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	105,565
Ambulance staff				21,149	23,084	24,489	25,056	24,908	24,566	24,757	25,381	25,028	26,008	27,451
Administration and estates staff				237,264	243,018	262,479	263,723	250,539	242,980	239,359	245,504	208,961	213,880	218,700
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	133,050
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	362,774
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	173,399
Unknown and Non-funded staff				4,327	3,595	3,462	3,351	3,055	2,652	2,423	0	3,544	3,757	4,194
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											
Total	1,040,513	1,077,977	1,069,764	1,065,754	1,096,086	1,144,150	1,239,366	1,161,102	1,136,604	1,141,811	1,044,540	986,270	1,001,467	1,025,133

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 40: 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%
2015/15 – 2016/17	3.42%	3.19%	2.36%	2.19%

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 40 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.

The growth rate for labour between 2015/16 and 2016/17 is positive, at 2.36% across the NHS overall and 2.19% within Trusts alone. These growth rates are larger than between 2014/15 and 2015/16, though not as large as growth between 2013/14 and 2014/15. Unusually, growth in expenditure is slightly larger for the NHS overall than for Trusts alone.

3.2 Expenditure data

The source of expenditure data has changed over time and by type of organisation, as summarised in Table 41. 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.[21]

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. It is therefore 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 these accounts.[22] Instead, we rely on data provided directly by the Department of Health to identify expenditure on agency staff.

[21] https://www.gov.uk/government/publications/department-of-health-annual-report-and-accounts-2016-to-2017;https://www.gov.uk/government/publications/department-of-health-annual-report-and-accounts-2015-to-2016 (last accessed 31/01/2019)

[22] http://www.parliament.uk/business/publications/written-questions-answers-statements/written-question/Commons/2014-10-22/211600/ (last accessed 31/01/2019)

Table 41: 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 the more aggregated input category. Thus, investigations into the contribution of volume and price to different inputs are more limited.[23]
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 items of expenditure designated as materials and capital in the most recent financial data are listed in Table 42 for NHS Foundation Trusts and NHS Trusts and CCGs/NHS England Group, separately. In 2016/17, the naming convention of items dealing with impairment changed.[24] For example, 'Net Impairment Property, Plant and Equipment' is a change from the previously used 'Impairment & reversals of property, plant and equipment'. In order to ensure comparability of figures, the values reported for 2015/16 in the 2016/17 accounts were compared to the year 2015/16 in the 2015/16 accounts. For a single item, 'Net Impairment Property, Plant and Equipment' there was a difference in the values reported. Therefore, to ensure comparability of figures, values for 2015/16 as reported in the 2016/17 accounts were used instead of the values reported in the 2015/16 accounts for this item of capital expenditure when calculating growth from 2015/16 to 2016/17.[25]

[23] We apply the Hospital and Community Health Services (HCHS) prices deflator for materials and capital. For labour and prescribing expenditure, we construct our own deflators using ESR and Prescription Cost Analysis data respectively. See in Table D1 in Appendix D the list of deflators. Up to 2015/16 we used a pay and prices deflator for primary care expenditure. For the 2015/16-2016/17 link, this deflator is not available. Therefore, we construct a pay and price deflator using the following formula 0.1 + 0.4*(ESR deflator) + 0.4*(HCHS). This formulation matches the one used previously by the DH to construct pay and price deflators from HSCI and a price deflator which draws in ESR data.

[24] Codes identifying different items of expenditure are unchanged.

[25] The impact is a reduction in the total value of capital expenditure in 2015/16 by £266,414 (2% of capital expenditure in 2015/16 as reported in the previous publication).

Table 42: 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 Net Impairment of Property, Plant & Equipment Net Impairment of Intangible Assets Net Impairment of Financial Assets Net Impairment for Non-Current Assets held for sale Net Impairments 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 43 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 2015/16 and 2016/17 we observe an increase in expenditure on labour by 2.29%. Expenditure on materials fell by 12.53%, following a large increase in the previous year of 34.45%. Capital expenditure fell by 6.50%, similar in magnitude to the reduction observed in the previous year.

Table 43: 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
	2016/17*	1,781,455	1,714,391	470,188

* 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 44 shows the expenditure for Labour, Materials and Capital for hospital Trusts.

In the process of calculating growth from 2015/16 to 2016/17, an error was found in calculating expenditure in earlier years. Specifically, expenditure from two Trusts were not included in the totals calculated for each category. Therefore, Table 44 presents corrected figures for Labour, Materials and Capital in 2014/15 and 2015/16. For the previously reported figures, see Castelli et al. (2018). The inclusion of additional Trusts means an increase in Labour expenditure by £554 million (1.15% of Labour expenditure in 2015/16). For the same year, Materials increase by £397 million (1.23%) and Capital by £64 million (0.51%). Due to similar increases in expenditures in 2014/15, the impact of the additional Trusts on growth between 2014/15 and 2015/16 is modest. In Castelli et al. (2018), increases of 2.87%, 9.68% and -1.4% for Labour, Materials and Capital respectively are reported. After including the previously missing Trusts, growth in nominal expenditures between 2014/15 and 2015/16 is found to be 3.34%, 10.32% and -1.2% respectively.

Note that these comparisons do not include the change to impairments discussed in the previous section, as this only effects measurement of input growth between 2015/16 and 2016/17. A second 2015/16 line, accounting for both the additional Trusts and changes to impairment, is also presented in Table 44; this is the comparator used in calculating growth from 2015/16 to 2016/17.

In current terms, after accounting for the additional Trusts and changes to impairments noted above, Labour expenditure increased by 3.55% between 2015/16 and 2016/17. We observe larger proportional increases in spend on materials and capital of 4.74% and 9.10% respectively.

Table 44: 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*[1]	47,170,735	22,125,031	12,787,098
2015/16*[2]	48,748,162	23,644,352	13,396,241
2015/16*[3]	48,748,162	23,644,352	13,129,827
2016/17*	50,479,070	24,765,135	14,324,055

* 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.
[1] Figures differ from Castelli et al. (2018) due to including expenditure from two Trusts, which were not part of previous equivalent figures.
[2] Figures differ from Castelli et al. (2018) due to including expenditure from two Trusts, which were not part of previous equivalent figures. In addition, impairment is allocated to capital instead of materials.
[3] Figure for 2015/16 used to calculate growth between 2015/16 and 2016/17. This uses information for 2015/16 from the 2016/17 accounts where a naming convention has changed and the value of 'Net impairment property plant and equipment' for 2015/16 differs between accounts published in 2015/16 and 2016/17. See also note 2.

The use of agency staff is subject to considerable year-on-year variation, as shown in figure 11. Following a sustained period of growth in expenditure on agency staff from 2011/12 to 2015/16, expenditure in 2016/17 was lower than the previous two years. This fall in expenditure may in part reflect a shift away from agency staff and towards bank staff by NHS Trusts. We do not have specific figures for bank staff spend. However, the main difference between the value of ESR spend (used in our direct measure) and Labour spend in published accounts is the inclusion of bank staff spend in accounts data. The NHS pay review body 2018 reported a pay bill per FTE increase of 2.4% for staff recorded on ESR between 2015/16 and 2016/17[26]. The growth in total FTE staff in ESR from Table 39 is 2.36%. Applying the wage growth from the pay review body report to the observed growth in FTEs ESR staff gives a growth in spend on staff of 4.8%.Table 45: Total NHS current expenditure (£000) Table 45 (below) indicates growth in staff spend of 5.4% from accounts figures which include bank staff. Therefore, the difference of 0.6% is likely to be due to increased numbers of bank staff and/or a larger increase in the unit cost of bank staff, which are not reported in the ESR data.

[26] See Table 3.6, p50.
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/720320/NHSPRB_2018_report_Web_Accessible.pdf

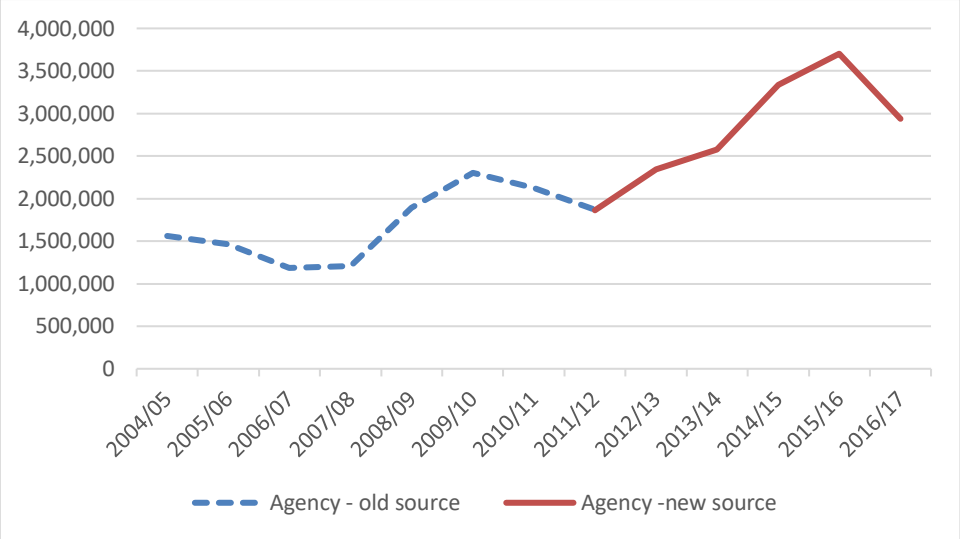

Figure 11: Trends in use of agency staff

Table 45 presents current expenditures for the whole NHS. From 2013/14 onwards, we do not include spend for DH (now DHSC) administration. This is due to the restructuring of the NHS and changes to the DH (now DHSC) responsibilities.

Table 45: Total NHS current expenditure (£000)

Year	NHS Staff	Agency	Materials	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[1]**	45,562,935	3,333,806	23,582,829	13,323,481	8,942,734	13,460,552	n/a	108,206,337
2015/16[2]**	46,787,408	3,702,409	25,604,358	13,899,138	9,288,425	13,759,292	n/a	113,041,030
2015/16[3]**				13,632,724			n/a	112,774,617
2016/17**	49,325,649	2,934,876	26,479,526	14,794,243	9,193,913	13,427,480	n/a	116,155,687

*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.

[1] Figures differ from Castelli et al. (2018) due to including expenditure from two Trusts which were not part of previous equivalent figures.

[2] Figures differ from Castelli et al. (2018) due to including expenditure from two Trusts which were not part of previous equivalent figures. In addition, impairment is allocated to capital instead of materials.

[3] Figure for 2015/16 used to calculate growth between 2015/16 and 2016/17. This uses information for 2015/16 from the 2016/17 accounts where a naming convention has changed and the value of "Net impairment property plant and equipment" for 2015/16 differs between accounts published in 2015/16 and 2016/17. See also note 2.

3.3 Input growth

Our measures of input growth are reported in Table 46. Both the mixed and indirect methods of calculating inputs are presented.

For 2015/16 – 2016/17 the mixed index suggests a growth rate of 0.64%, while the indirect index suggests an input growth rate of 1.47%. This implies that growth in Labour inputs between 2015/16 and 2016/17 is greater if using expenditure data rather than ESR data. One explanation for this difference is the inclusion of expenditure on bank staff in the indirect measure of labour inputs, which is not included in the direct measure. [27]

Table 46: 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%
2012/13 – 2013/14	0.43%	0.55%
2013/14 – 2014/15	1.94%	1.52%
2014/15 – 2015/16[§]	2.73%	3.18%
2015/16 – 2016/17	0.64%	1.47%

[§] Figures include two Trusts which were not included in the figures reported in Castelli et al. (2018).

Table 47 presents contributions to Input growth, following the same approach as discussed in Section 2.7.1 on the contribution by NHS settings to NHS Output growth. The largest contribution to growth in inputs is from labour (42.47%), followed by materials (23.56%). This table also highlights that while the reduction in spend on agency is large relative to agency spend, the contribution of this to overall input growth is small at 2.58%.

[27] The figures for 2014/15 and 2015/16 include the two Trusts that were missed out in Castelli et al. (2018). The corrected measures of input growth are higher than previously reported. Specifically, the mixed method indicates growth in inputs which is 0.14% higher at 2.73%. The indirect method indicates an increase in inputs growth by 0.36% at 3.18%.

Table 47: Contribution to Inputs Growth by type of input, 2016/17

Setting	Growth	Setting specific growth index	Value of Activity (15/16 prices)	Share of overall spend	Contribution to growth
Labour (Direct) (Labour (Indirect, excl agency staff))	2.36% (4.36%)	102.36% (104.36%)	46,787,408	41.49%	42.47% (43.30%)
Agency	-21.53%	78.47%	3,702,409	3.28%	2.58%
Materials	-0.62%	99.38%	25,604,358	22.70%	23.56%
Capital	4.29%	104.29%	13,632,724	12.09%	12.61%
Primary care	-4.43%	95.57%	13,759,292	12.20%	12.61%
Prescribing	6.44%	106.44%	9,288,425	8.24%	8.77%
Total/ NHS Input growth rate			**112,774,617**		**0.64% (1.47%)**

Table 48 presents expenditure and Laspeyres growth rates for each input type for 2013/14-14/15 to 2014/15-15/16. The patterns of Laspeyres Input Growth over time indicate a high degree of volatility in the growth of individual categories, especially for Agency spend. There is no strong pattern of growth rates over time across different types of inputs based on these three points. The deflators used for each input category are also presented. The deflators used are discussed in more detail in Appendix D.1.

Table 48: Expenditure, Deflator and Input Growth rates by type of input

Inputs		Years 2013/14-2014/15	2014/15-2015/16	2015/16-2016/17
Labour	Expenditure growth	2.10%	2.69%	5.43%
	Pay HCHS (ESR) Deflator	0.30%	0.30%	1.01%
	Laspeyres Input Growth	1.79%	2.38%	4.36%
Agency	Expenditure growth	29.27%	11.06%	-20.73%
	Pay Deflator	0.30%	0.30%	1.01%
	Laspeyres Input Growth	28.88%	10.72%	-21.53%
Materials	Expenditure growth	4.05%	8.57%	3.42%
	Price Deflator	1.70%	2.70%	3.90%
	Laspeyres Input Growth	2.28%	5.64%	-0.62%
Capital	Expenditure growth	-4.53%	4.32%	8.52%
	Price Deflator	1.70%	2.70%	3.90%
	Laspeyres Input Growth	-6.15%	1.50%	4.29%
Primary care	Expenditure growth	1.25%	2.22%	-2.48%
	Pay and Price Deflator	0.88%	1.32%	2.06%
	Laspeyres Input Growth	0.35%	0.87%	-4.50%
Prescribing	Expenditure growth	2.75%	3.87%	-1.02%
	Pharmaceutical Deflator	-1.31%	-0.07%	-7.00%
	Laspeyres Input Growth	4.10%	3.94%	6.44%

4 Productivity growth

Year-on-year productivity growth figures from 2004/05 to 2016/17 are provided in Table 49. These figures are constructed by comparing the quality-adjusted NHS output growth rate, as reported in the final column of Table 35, with the estimates of mixed and indirect input growth, as reported in Table 46.

First, let's observe the trend in the year-on-year growth of NHS output and NHS input separately, as depicted in Figure 12. Between 2015/16 and 2016/17 NHS output has increased, whilst NHS input (mixed) growth rate has decreased. This will result in a positive growth in NHS productivity, as reported in Table 49. In particular, **NHS productivity is estimated to have increased by 2.86% based on the mixed method, and 2.01% based on the indirect method.**

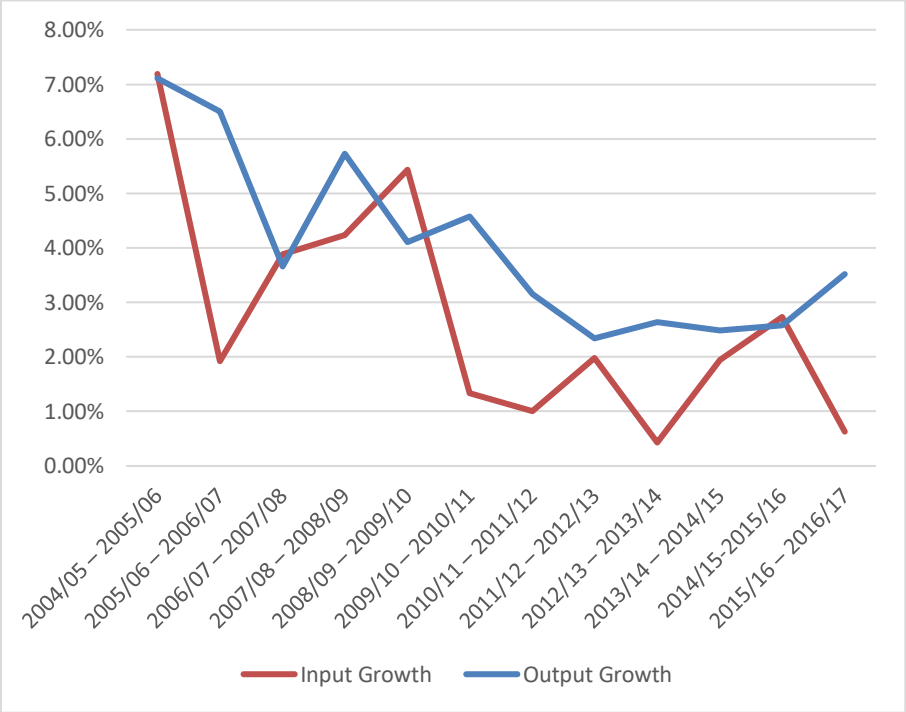

Figure 12: Input and Output growth

Table 49: 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[28]	-0.15%	-0.58%
2015/16 – 2016/17	2.86%	2.01%

Finally, Figure 13 shows the trend in the NHS Output, Input and Productivity indices from the start of the most recent time series (2004/05). NHS Outputs and Inputs have both increased since 2004/05, with NHS Outputs increasing by about 60% over the whole period, and NHS inputs by just under 38%.

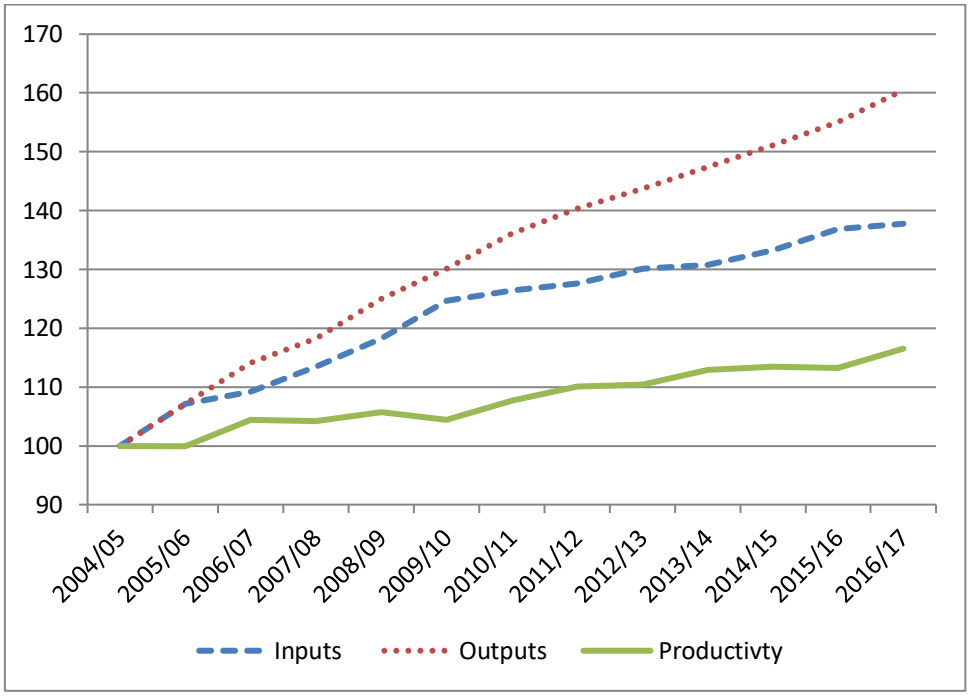

Figure 13: Trends in input, output and productivity indices

[28] The Mixed and Indirect NHS Productivity growth rates for the years 2014/15 – 2015/16 have been updated to reflect the methodological change in assigning PROMs values to activity with a UZ01 code for hospital inpatients (see Section 2.2.2) , as well as the inclusion of two missing Hospital Trusts in the input expenditure (see Section 3.2.1).

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, which is used to measure the contribution to the economy of each sector in the United Kingdom. [29][30]

The rate of NHS productivity growth since 2004/05 compares favourably with that achieved by the economy as a whole. From 2004/05 total productivity growth was 16.53% for the NHS, compared to only 6.72% in the whole economy. This is shown in the graph below, with the 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. The period between 2013/14 – 2015/16 is the only time after 2008/09 where the productivity for the whole economy grew at a faster rate than that for the NHS. Between 2015/16 and 2016/17, NHS productivity growth abandoned a period of stagnation and outpaced again the productivity for the whole economy, respectively at 2.86% vs. 0.50%.

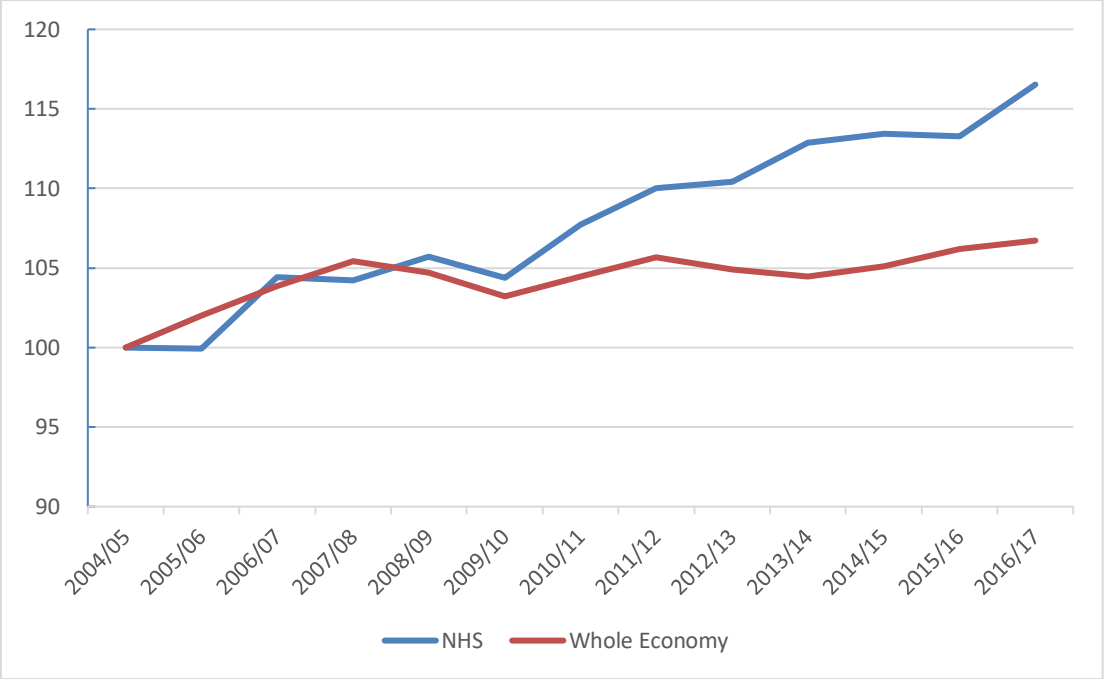

Figure 14: Comparison of productivity indices: NHS vs. Whole Economy

[29] 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 (link to National Archives – last accessed 31/01/2019)
[30] http://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/labourproductivity/datasets/labourproductivitytables110andr1 (last accessed 31/01/2019)

5 Conclusions

Total NHS productivity growth between 2015/16 and 2016/17 amounted to 2.86% according to our preferred mixed method, which corresponds to an average annual growth of 1.30% from 2004/05.

Quality adjusted output growth between 2015/16 and 2016/17 amounted to 3.51% for the NHS as a whole, which is larger than the growth recorded between 2014/15 and 2015/16. Despite the increase over the last two financial years, this remains lower than the average over the whole period (4.03 %). Positive growth is observed in most settings, with the exception of Ophthalmology & Dentistry, which is mainly due to a decrease in dental services, Rehabilitation and Other NHS activity. Growth was substantial for the second consecutive year in the settings Outpatient, amounting to 5.34%, and Community Prescribing, 6.44%. We observe also high growth in Chemo/Radiotherapy & High Cost Drugs and in Radiology, respectively equal to 8.39% and 6.77%. The former representing about 4.3% of the total value of NHS activity and the latter just over 1.2%.

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 Coronary heart disease, Stroke or Hypertension. There were improvements in most of the quality measures for hospital inpatient activity except waiting times and health status. The quality of primary care has improved between 2015/16 and 2016/17 for all three conditions monitored, due mainly to higher QOF achievements for all three conditions. Overall, however, the net effect in the quality improvement is minimal between 2015/16 and 2016/17, adding about 0.16 percentage points to the cost-weighted output index.

Our indirect measure of input growth indicates a growth of 1.47% between 2015/16 and 2016/17 and our mixed measure (using the direct measure of labour) indicates growth of 0.64%. Our usual base case measure uses the mixed method, as it is generally recommended to use direct measures of input whenever possible. However, the Department of Health and Social Care has brought to our attention that Hospital Trusts have substantially decreased their use of agency staff (as reported in Section 3.3) and increased the use of bank staff in 2016/17. Bank staff are not captured by the ESR data. This may have artificially resulted in a smaller than expected growth in the use of labour inputs, which may explain the modest growth in the mixed input growth rate compared to the indirect input growth rate between 2015/16 and 2016/17.

As in previous years, we also report a measure of Hospital Trusts only in Appendix E. NHS Trusts output growth is 3.60% and their mixed (indirect) input growth is 1.15% (2.35%) between 2015/16 and 2016/17; thus leading to productivity growth of 2.42% (1.22%) between these two years.

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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:

$$\Delta TFP = [X/Z] \tag{E1}$$

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 (Eurostat, 2001).

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:

$$X^{cq}_{(0,t)} = \frac{\sum_{j=1}^{J} x_{jt} c_{j0} \left[\frac{v_{j0} q_{jt}}{q_{j0}}\right]}{\sum_{j=1}^{J} x_{j0} c_{j0}} \tag{E2}$$

We define x_j as the number of patients who have output type *j*, where *j*=1…*J; c_{j0}* 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:

$$Z^{D}_{(0,t)} = \frac{\sum_{n=1}^{N} z_{nt} \omega_{n0}}{\sum_{n=1}^{N} z_{n0} \omega_{n0}} \tag{E3}$$

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:

$$Z^{Ind}_{(0,t)} = \frac{\sum_{n=1}^{N} \pi_{nt} E_{nt}}{\sum_{n=1}^{N} E_{n0}} = \frac{\sum_{n=1}^{N} z_{nt}\pi_{nt}\omega_{nt}}{\sum_{n=1}^{N} z_{n0}\omega_{n0}} = \frac{\sum_{n=1}^{N} z_{nt}\omega_{n0}}{\sum_{n=1}^{N} z_{n0}\omega_{n0}} = Z^{D}_{(0,t)} \quad \text{(E4)}$$

As shown, this is equivalent to using volume data, provided that deflators capture correctly 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. (E2), a chained output index takes the following form:

$$X^{cq}_{(0,T)} = \frac{\sum_{j=1}^{J} x_{jt} c_{j0} \left[\frac{v_{j0} q_{jt}}{q_{j0}}\right]}{\sum_{j=1}^{J} x_{j0} c_{j0}} \times \frac{\sum_{j=1}^{J} x_{jt+1} c_{jt} \left[\frac{v_{jt} q_{jt+1}}{q_{jt}}\right]}{\sum_{j=1}^{J} x_{jt} c_{jt}} \times \cdots \times \frac{\sum_{j=1}^{J} x_{jT} c_{jT-1} \left[\frac{v_{jT} q_{jT}}{q_{jT-1}}\right]}{\sum_{j=1}^{J} x_{jT-1} c_{jT-1}} \quad \text{(E5)}$$

This can be simplified as:

$$X^{c,q}_{(0,T)} = X^{c,q}_{(0,t)} \times X^{c,q}_{(t,t+1)} \times \cdots \times X^{c,q}_{(T-1,T)} \quad \text{(E6)}$$

where each link is represented by eq. (E2) 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, 2015/16 – 2016/17

In 2016/17, the Reference Cost data collection continues to include independent sector providers (non-NHS bodies). The availability of the total volume and unit cost of activity sub-contracted to the independent sector allowed us to keep track of the output growth in these providers. However, we only explore activity delivered by non-NHS providers as a sensitivity analysis and do not include them in the measure of NHS output and productivity growth. The total volume of activity has shown a relevant increase, as they are almost doubled with respect to 2015/16, as shown in Table B1. From this table we excluded the inpatient activity, which are covered in the national NHS output series based on the HES APC database.

Table B1: Volume and value of activity provided by non-NHS bodies, 2015/16 and 2016/17

Year	Volume of activity	Value of activity (current)	Value of activity (constant costs – base year, with correction for high and low cost outliers)
2015/16	4,487,986	169,219,627	81,813,032
2016/17	8,761,439	206,282,510	222,316,220

The increase in volume of activity is mostly due to an increase in Diagnostic tests and, in particular, it is driven by two types of tests, namely clinical biochemistry and haematology. Given the fact that the same remarkable increase is reported in the Reference Cost for NHS providers, we hypothesise that the increase might be due to an attempt at reducing the number of unnecessary hospitalisations.

In 2016/17 there are less categories with respect to 2015/16. In particular, there are not any activity registered for ambulance and rehabilitation services (as reported in Table B1), where the setting Ambulance and Emergency (A&E) just includes emergency setting activity and categories.

Table B2: Health care settings for which non-NHS bodies provided activity in 2015/16 and 2016/17

Year	Nr of Categories	
NHS settings	**2015/16**	**2016/17**
A&E Services	13	25
Chemo/Radiotherapy & High Cost Drugs	27	33
Community Care	31	38
Diagnostic Tests	7	10
Community Mental Health	11	10
Other	35	5
Outpatient	316	459
Radiology	72	95
Rehabilitation	1	0
Renal Dialysis	14	14
Specialist Services	16	16
Total	543	705

In general, as shown in Table B2, the number of categories in 2016/17 notably increased, but setting specific totals are not directly comparable across the two years. For example, the number of categories reported under Specialist Services appears to be the same in 2016/17 and in 2015/16, but the type of categories are not necessarily the same. In fact, four new categories, neuroscience adult patient, thoracic surgical adult, burns and plastic surgery and renal adult patient, were reported in 2016/17.

Similarly to the quality checks performed for the Reference Cost data for NHS Trust and NHS Foundation Trusts, we also carried out quality checks for non-NHS providers' RC data. We saw that there were no activities involved in large changes, both in terms of volume (>500,000 units) or value (> £25,000,000) among the two financial years analysed. We report the results of this check in Table B3, where the first activity registered a large change in the total value with respect to 2015/16 and this large change was driven by a large increase in the volume of activity while the current cost was dramatically lower. The last two rows in the table report the activities recording a large change in volume and, as mentioned before, they belong to the setting of' Diagnostic test'.

Table B3: Large Changes in Value and Volume, between 2015/16 and 2016/17

Setting	Activity	Volume of activity in 2015/16	Volume of activity in 2016/17	2015/16 Unit Cost (£)	2016/17 Unit Cost (£)	Difference
Community care	District nurse adult, face to face	6,995	316,027	371	45	£103,029,186
Diagnostic test	Clinical Biochemistry	2,457,197	5,118,763	1	1	£2,661,566
Diagnostic test	Haematology	438,089	1,074,410	2	2	£636,321

The growth in the total amount of activity sub-contracted to non-NHS bodies between 2015/16 and 2016/17 is given by the ratio between the value of activity in constant terms for 2016/17 and value of activity in constant terms for 2015/16 (see Table B1). Between 2015/16 and 2016/17 this is equal to 46%.

Purchases for health care services from non-NHS bodies are already accounted for in the national NHS input series (see Table 43 of this report). Table B4 summarises the value of these purchases by type of NHS Trusts for 2015/16 and 2016/17 respectively.

Table B4: Purchases of health care services from non-NHS bodies (£000), 2015/16 and 2016/17

Year	Total value of purchases of health care services from non-NHS bodies (£000)		
	NHS Trust	NHS Foundation Trusts	Total
2015/16	303,148	643,688	946,836
2016/17	321,738	754,176	1,075,914

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 measures. Table B5 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, whilst Table B6 restricts the analysis to outputs provided by NHS Trusts and non-NHS bodies only.

Table B5: NHS output, input and productivity growth rates, 2015/16 – 2016/17, NHS overall

Year		Output	Input	Productivity
			Indirect	
2015/16 – 2016/17	**NHS Overall**	3.51%	1.47%	2.01%
	NHS Overall, incl. non-NHS bodies	3.57%		2.07%
			Mixed	
	NHS Overall	3.51%	0.64%	2.86%
	NHS Overall, incl. non-NHS bodies	3.57%		2.91%

Table B6: NHS output, input and productivity growth rates, 2015/16 – 2016/17, Trusts and non-NHS bodies only

Year		Output	Input	Productivity
			Indirect	
2015/16 – 2016/17	**Trusts only**	3.60%	2.35%	1.22%
	Trusts only and non-NHS bodies	3.85%		1.47%
			Mixed	
	Trusts only	3.60%	1.15%	2.42%
	Trusts only and non-NHS bodies	3.85%		2.68%

We find that including services sub-contracted to non-NHS bodies increases the NHS productivity growth rate by 0.05 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 0.26 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

Table C2: Reference Cost settings, 2014/15 – 2015/16

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

Appendix D

D.1 Deflators

We use various deflators to adjust our expenditure series, as shown in Table D1. We apply the Hospital and Community Health Services (HCHS) prices deflator for materials and capital. For labour and prescribing expenditure, we construct our own deflators using ESR and Prescription Cost Analysis data respectively. Up to 2015/16 we used a pay and prices deflator for primary care expenditure. For the 2015/16-2016/17 link, this deflator is not available. Therefore, we construct a pay and price deflator using the following formula 0.1 + 0.4*(ESR deflator) + 0.4*(HCHS). This formulation matches the one used previously by the DH to construct pay and price deflators from HSCI and a price deflator which draws in ESR data.

Several other potential replacements for the pay and price deflator were tested and it was found that the impact of different approaches on the measures of input and productivity growth were modest. If it is assumed that the deflator was the same as the previous year, this indicates a value of 1.32% for the pay and price deflator, 0.73% for Input growth and 2.77% for productivity growth. That is, an increase in input growth by 0.09% and a decrease in productivity growth by 0.09% compared to our preferred deflator. We also considered alternative weights for the pay and price deflators, estimated by running an ordinary least squares model of pay and price deflators from recent years and including the pay deflator estimated by ESR and prices deflator from DHSC as independent variables. This approach indicated a value for the pay and price deflator of 2.17%. Applying this value of the pay and price deflator implies input growth of 0.63% and productivity growth of 2.87%. In order for productivity growth to differ from our preferred measure by 0.1%, holding all else equal, the pay and price deflator would need to take a value outside the range of 1.31% and 2.88%.

Table D1: 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%
2015/16 - 2016/17	1.0%	3.90%	2.07%	-7.00%

Appendix E

E.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 E1, when we look at the activity performed by Trusts only, the quality-adjusted output index rises to 3.60%.

Similarly, we can also produce a Trusts-only input index. As shown in Table E1, the input index is lower when taking only Trusts into account, with a mixed index suggesting growth of 1.15% and indirect index growth of 2.35%. As discussed for the main analysis, the difference between inputs growth indices produced by the mixed and indirect methods can be partially explained by an increase of use of bank staff to deal with instances of increased patient demands.

Table E1: 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*	3.31%	*Mixed*	2.59%	0.70%
		Indirect	3.12%	0.19%
2015/16 – 2016/17	3.60%	*Mixed*	1.15%	2.42%
		Indirect	2.35%	1.22%

* The figures reflect changes in both NHS outputs and NHS Inputs following the update of the methods used to assign PROM values to activity with a UZ01 code for hospital inpatients (see Section 2.2.2) , as well as the inclusion of two missing Hospital Trusts in the input expenditure (see Section 3.2.1).

Using this information we can produce Trust-only productivity growth figures for 2015/16 and 2016/17, estimated as 2.42% for the mixed measure and at 1.22% for the indirect measure.

Appendix F

F.1 Changes to PROMs code

Patient Reported Outcome Measures (PROMs) are one of the four elements that make up our quality adjustment measure. PROMs are available for four conditions: unilateral hip and knee replacement, varicose vein surgery and groin hernia repair. For conditions with PROM information we apply a value of the ratio of EQ5D values before and after treatment given by each patient. For conditions not present in PROMs data, we apply a constant value of 0.4 for non-electives and 0.8 for elective care HRGs.

The PROMs dataset is made up of elective and day case patients with a valid PROMs record and includes a variable that indicates the HRG associated with each episode of care. Some of these records have the HRG error code of UZ01Z. The PROMs-based quality-adjustment code included a cut-off of at least 100 observations per PROMs-HRG, with the aims of excluding those HRGs with a low number of records. The PROMs dataset is then mapped to the HES dataset at the HRG level. Thus, if a particular PROMs-HRG has less than 100 observations in the PROMs dataset, this HRG will not be mapped to the HES Admitted Patient Care (APC) dataset. Therefore, these HRGs will be assigned the constant average value of 0.8 when they appear in the HES APC dataset.

In the previous two financial years, the number of patient records with a UZ codes in the HES APC dataset experienced a large increase, which was also reflected in an increase of records with UZ codes in the PROMs dataset. For example, in 2015/16 the PROMs dataset had over 1,000 patient records with a UZ HRG code, whilst the number was only 87 in 2016/17. As a result, all observations with a UZ HRG code in the 2016/17 HES APC dataset were assigned the constant value 0.8 whilst those from 2015/16 were assigned the average ratio from PROMs data which was 0.31.

The problem is that patients with a UZ HRG code within the PROMs dataset are only a very small sub-sample of all patients with a UZ HRG code in the HES APC dataset and as such these four conditions cannot be considered a representative sample of all UZ codes in the HES APC dataset. Therefore, by assigning the average PROM ratios to all UZ codes, we run the risk of underestimating/overestimating the quality adjustment of these UZ codes. Following our previous example, the increase of the ratio from 0.31 to 0.8 would have had an overestimated negative impact on the overall quality adjustment of hospital inpatient activity.

We have thus decided to correct our methodology and not to assign PROMs value to CIPS with a UZ HRG code.

Further, we found an additional error in the SAS code for PROMs, which was assigning actual PROMs values also to non-elective activity for the HRGs associated with the four PROM conditions as well as to the UZ HRG code. As PROMs are only recorded for elective surgery, we have reverted to assigning them the constant value 0.4.

The two issues with the PROMs code affected our estimation of the hospital inpatient quality adjusted output growth rates for the financial years 2014/15 and 2015/16.

Table F2 shows a comparison of the published inpatient growth rates and the resulting growth rates after the corrections of the SAS code and the change in methodology. For the link 2014/15 - 2015/16 the effect is almost negligible because the UZ HRG codes in the PROMs dataset had a frequency greater than 100 in both financial years. Therefore, UZ codes passed the cut-off in both years. Those values were k =0.33906 and k =0.31290 respectively for 2014/15 and 2015/16, leading to a small

overestimation of the overall quality adjusted hospital inpatient growth rates. Please see Table F2 below for further details on the corrections for the two issues.

Table F2: Assessment of the effect of the changes in PROMS methodology on inpatient output growth

ALL HES (Including Mental Health)	Published Output Growth Figures (CHE RP 152)	1st Correction Assigning PROMS ratios only to PROMs Elective activity	2nd Correction Assigning PROMs only to Electives and assigning UZ HRG code a constant K value (0.8 (elective and day cases)/04(non-elective))
Cost-Adjusted Growth Rate	3.389%		
Quality-Adjusted Growth Rate	5.079%	5.005%	4.922%